The hypodermatic injection of morphine (gr. $\frac{1}{10}$) and atropine (gr. $\frac{1}{100}$)* give the best results: other eligible preparations are the deodorized tincture of opium (gtt. i.) and paregoric (gtt. x. to xxx.).

When the violence of the vomiting has abated recourse may be had to the so-called intestinal antiseptics. Sodium salicylate (gr. i.); salol (gr. ss.); creosote (gtt. $\frac{1}{2}$–$\frac{1}{2}$); resorcin (gr. $\frac{1}{2}$), and many other drugs are commended by authors. The writer has been accustomed to rely with the most confidence on the bismuth preparations, of which the subnitrate (gr. x.) and the subgallate (gr. ij.–iij.) are the best.

I have seen good results from the aromatic sulphuric acid (gtt. iij.) given in a teaspoonful of bitter almond water.

French authors speak highly of the nitrate of silver. It may be given by the mouth (gr. $\frac{1}{12}$–$\frac{1}{8}$) or the rectum. When used by rectal injection the anus should be first washed with a solution of common salt, as otherwise even weak solutions may cause severe tenesmus. The hyperpyrexia, which is in itself an element of danger, and the attendant nervous phenomena are best treated by repeated cold sponging or the graduated bath. The use of antipyretic drugs, especially the coal-tar derivatives, cannot be too strongly condemned.

For the bath the child is gently immersed in water at 100° F. when the temperature is gradually reduced by the addition of cold water or ice to 85° F. An ice cap should be worn on the head. The immersion is continued for from ten to twenty minutes and should be repeated whenever the temperature approaches the danger line. It is inadmissable should symptoms of exhaustion or collapse be present.

Stimulants are needed in nearly all cases. It is a common mistake to delay their use too long. If not retained by the stomach they should be given hypodermically and per rectum.

Good old whiskey in gtt. x. to xxx. doses, repeated as required, fulfils every indication. It is surprising how much whiskey can be profitably taken by a child threatened with collapse.

Strychnine nitrate (gr. $\frac{1}{300}$) and atropine sulphate (gr. $\frac{1}{500}$) given hypodermically will often carry a flagging heart over a critical period.

During convalescence the child should be carefully watched, as one attack increases the liability of a recurrence. *W. J. Conklin.*

CHOLESTEATOMA is a term applied to a tumor-like mass composed of flat, cornified cells which are usually packed more or less closely together into a spherical, pearl-like, glistening body.

The first to call attention to this tumor was Cruveilhier in 1829; he applied to it the descriptive term *tumeur perlée*. The name cholesteatoma was given it in 1838 by Johannes Müller, who was the first to describe accurately its gross and histological characteristics. Virchow considered the subject very fully in 1855. Recently (1897) it has been reviewed in a masterly way by Bostroem.

Typical cholesteatomata are found chiefly, perhaps exclusively, in connection with the central nervous system and the bones of the skull. Similar pearl-like formations are found in other parts of the body, such as the middle ear, the ovary, and the testicle, but their exact origin has not yet been determined.

In the central nervous system the tumors are found chiefly at the base of the brain, on the posterior surface of the cord, and in the ventricles.

The tumor may form one compact pearl-like body, or consist of one or more pearls and irregular, soft, friable masses. The form is usually round or oval; the surface may be smooth or nodular. The tumor generally occurs singly, but Trachtenberg has reported a case in which multiple tumors were present on the surface of the brain and cord, and in the ventricles.

The size may vary from a pin-head to 5 or 6 cm. in greatest diameter.

The surface of a cholesteatoma usually presents, at least in places, a white, glistening, pearl-like appearance, the pearly lustre being limited to the surface; on section the mass is of a yellowish-white color. The consistence of these growths at the surface is fairly firm, but within it is usually soft and friable.

Microscopically the growth consists of large, flattened, folded, dried up, and cornified cells usually disposed in layers. In at least some of the cells a shrunken nucleus can be demonstrated. Between the lamellæ of cells occur cholesterine crystals to the presence of which the tumor owes its name. In sections the laminæ of cells seen from the side resemble fibrillæ.

The effect of a cholesteatoma on the adjoining brain tissue is purely mechanical. It causes pressure atrophy with increase of the neuroglia tissue.

The origin of these tumors has led to much discussion. Virchow believed that the dried-up cells came from transformed connective-tissue cells. Of late years, however, it generally has been held that the cells are of endothelial or epithelial origin. Bostroem in his monograph comes out very strongly in favor of their epithelial origin, and presents an array of facts which would seem to settle the question for all time.

According to him it is always possible to find at some point in the periphery of the tumor a relatively small, sharply limited area covered with typical epidermis. This represents the growing part of the tumor mass; the rest of it is made up almost entirely of dead, desquamated cells. The growing cells undergo cornification and in a certain layer, as in the skin, produce granules of keratohyalin. They also give rise to drops of eleidin and crystals of cholesterine.

The epidermis with an underlying connective-tissue layer derived from the pia or a choroid plexus forms a membrane which may cover a varying proportion of the cholesteatoma, but never the whole of it. The rest of the tumor is uncovered or adjoins brain tissue or pia.

Bostroem believes that these tumors arise from aberrant epidermic cells which become included in the central nervous system at the time of its formation. The aberrant cells develop in case they find proper conditions for nourishment; this happens only when they come in contact with the vascular pia or a choroid plexus. The growing part of the tumor, therefore, is always attached to one or the other.

The epidermic origin of these cells is based on their arrangement in the form of a pavement epithelium, on their producing keratohyalin and undergoing cornification, and on the formation of eleidin and of cholesterine crystals. Bostroem proposes that these tumors, in view of their origin, shall be called epidermoids.

Another point in favor of the epidermic origin of the cholesteatomata is the fact that a few of them are found containing hair. This is to be explained on the supposition that the aberrant cells in these cases consisted of cells not only from the epidermis but also from the cutis. The growing surface in these cases contains hair follicles and sebaceous glands. This class of cholesteatomata should be classed with the dermoids.

The cholesteatomata which occur in certain bones of the skull probably owe their origin also to aberrant epidermic cells which grow in the vascular marrow and derive their nourishment therefrom.

We have had at the Boston City Hospital, during the past two years, three cases of cholesteatoma of the brain.

The first consisted of a pearl the size of a pea and of several small, irregular, white, friable masses more or less embedded in the cerebellar tissue on the left side just where it joins the pons.

The second tumor was larger, measuring 3.5 cm. in diameter and 2 cm. in thickness, and was attached to the velum interpositum at the posterior end of the third ventricle.

The third tumor was still larger. It lay at the base of the brain on the right side and extended from the optic commissure out beneath the right frontal lobe. It was irregularly oval in shape, measuring 7 cm. in length and 3.5 cm. in diameter. It lay beneath the pia and had so shoved itself into, displaced, and compressed the adjoining brain tissue that it might almost have been thought to have originated within it (Fig. 1290).

The histological appearances of these three tumors agree in all respects with the description given above.

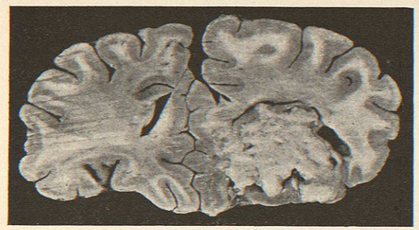

Fig. 1290.—Section of the Brain in the Third Case Mentioned Above, showing how the cholesteatoma in its anterior portion has pressed into the substance of the brain. (Original.)

For a complete bibliography up to time of publication see Bostroem: *Centralblatt Für Pathologie*, 1897, viii., 1. For multiple cholesteatomata see Trachtenberg, Virchow's *Archiv*, 1898, cliv., 274. *F. B. Mallory.*

CHOLESTERIN ($C_{26}H_{44}O$).—As its name indicates this substance was first recognized as a constituent of the bile and was regarded as a bile fat (cholestearin); but its proper designation is cholesterin (bile solid). When pure it crystallizes in white mother-of-pearl leaflets which have a fatty feel but possess no taste or odor. It has a neutral reaction, melts at 145° C., and sublimes without change in a vacuum at 360° C. According to its reactions it is probably a monovalent alcohol.

Cholesterin is insoluble in water, dilute acids, dilute and concentrated caustic alkalies, and in cold alcohol. It is soluble in hot alcohol, ether, chloroform, benzole, and in the volatile fatty oils; but dissolves with difficulty in solutions of the bile-acid salts, and is only slightly soluble in water solutions of soaps. The solution in ether is neutral, and turns the polarized ray of light to the left.

From ether solutions cholesterin crystallizes on evaporation in large, thin, transparent, rhombic plates, ($C_{26}H_{44}O + H_2O$), whose edges and corners are frequently irregularly notched, so that the plates as they lie heaped up have the appearance of being cut out in step-like forms. The formation of the plates is frequently preceded by a stage of fine needles which gradually change into blunt cones and then pass into the plate form. Cholesterin is unchanged by the action of boiling caustic alkalies. With concentrated nitric acid it yields cholesteric acid ($C_{12}H_{16}O_7$) in addition to acetic and butyric acids. Concentrated sulphuric acid gives cholesterin a red color, and breaks it up into a variety of isomeric hydrocarbons (cholesterilin). When heated with organic acids for long periods of time at 200° C. cholesterin passes into ether combinations: as for example with acetic acid it forms acetic-acid-cholesterin-ether, ($C_{26}H_{43}$-C_2H_3O,O).

When treated with a mixture of five parts concentrated sulphuric acid and one part water, cholesterin crystals take on a deep carmine red which gradually passes into violet. A weaker solution causes a violet coloration of the edges of the crystals which on the addition of water becomes lilac. Sulphuric acid containing a trace of iodine colors the crystals violet, blue, green, and red.

If cholesterin is dissolved in chloroform in a dry test tube, and acetic acid anhydride added, the addition of concentrated sulphuric acid, drop by drop, produces a rose color which quickly becomes blue and after a few minutes changes to vivid green. When only very small amounts of cholesterin are present the green color alone appears. This is one of the most reliable tests for this substance, and the presence of .05 mgm. can be shown by it. When substances containing a small amount of cholesterin are evaporated with a drop of concentrated nitric acid upon the water bath, a yellow coating is left which on the addition of ammonia becomes bright red.

Cholesterin is a constant constituent of the bile of all animals, in which it is held in solution by the bile-acid salts and the soaps. The proportion in normal human bile has not yet been ascertained. It is also found in the intestinal contents as a result of the presence of the bile. In the blood it occurs only in a very small amount, which is held in solution by the fats and soaps of the blood. The various nerve structures contain it in large proportion; more than half of the dry substance of nerve fibres consists of fat and cholesterin; the gray matter of the brain contains about one-fifth. Burchard has found traces of cholesterin in every organ and tissue of the body. It is found also in roots and seeds, especially in peas, beans, and the cereals. From its wide distribution cholesterin may be said to be a constant and essential constituent of both animal and vegetable protoplasm.

Under certain pathological conditions the cholesterin of the bile may be separated, giving rise to the formation of calculi, which consist largely or entirely of cholesterin or of cholesterin in connection with bile pigment, phosphates, carbonates, etc. An ethereal extract of the crushed calculi will yield cholesterin crystals on evaporation. The tests mentioned above may be applied to the extract.

Cholesterin is also found in old exudates and in the contents of cysts, especially in ovarian and hydrocele fluids. In these it may occur in so great an amount that the crystals may be seen with the naked eye as small shining particles. It may be found also in the fatty changes occurring in atheromatous conditions of the blood-vessels, wens, cholesteatomata, caseating tubercles, and degenerating tumors. It is a constant constituent of pus, probably arising from the fatty degeneration of the leucocytes. Cholesterin crystals are also found in echinococcus cysts, and rarely in cataractous lenses.

The origin and fate of cholesterin in both the plant and the animal organisms are unknown. It is most probably an intermediate product in the metabolism of proteids, but the physiological significance of this substance remains to be discovered. It is not excreted in normal urine. Its pathological significance is likewise obscure. Austin Flint's view that the severe nervous symptoms in icterus gravis are due to the retention of cholesterin is not supported by animal experiments. Injections of cholesterin into the blood stream of dogs produce no pathological effects. It is more probable that these symptoms are due not to cholesteræmia but to the presence of some poison not yet discovered. *Aldred Scott Warthin.*

CHOLINE.—Choline is a basic body derived from ammonium hydroxide; it is, in fact, trimethyl-oxyethel-ammopium hydroxide, and is represented by the following formula:

$$N\begin{cases}(CH_3)_3\\C_2H_4OH\\OH\end{cases}$$

It was discovered by von Babo and Hirschbrunn in the seeds of white mustard and named by them sinkaline.

The same body was isolated from the animal body in 1862 by Strecker[1] and named by him choline, since he obtained it from bile. The closely related but far more poisonous base, neurine (trimethyl-vinyl-ammonium hydroxide), was discovered about the same time; the name neurine has been frequently applied to choline, and much confusion has thus arisen. Choline may be made synthetically by the union of ethylene chlorhydrin and trimethylamine; it can also be obtained from a large number of animal and vegetable tissues. It is obtained

* The doses given in this article are for a child one year old.

with the greatest ease from the yolk of eggs and from brain by boiling these with barium hydroxide. Free choline forms a strongly alkaline syrup which dissolves fibrin; it was at one time used to dissolve the false membrane in diphtheria. With acids it forms salts which are easily soluble in water. It is easily decomposed by heat into trimethylamine and glycol.

Choline occurs in the animal body chiefly, if not exclusively, in lecithin and its compounds or as one of the decomposition products of this substance. As lecithin is found, so far as is known, in every animal and plant cell, it is evident that choline is very widely distributed; it probably plays a more important rôle in life processes than is generally recognized. The ease with which lecithin is decomposed by the simplest chemical processes makes it difficult to determine whether the choline obtained from a given organ was present as such or was split off from the lecithin during the chemical manipulations. So far it has been found with certainty in but few organs and fluids—in the brain by Gulewitsch,[2] in the semen by Gumprecht[3] and others, in the cerebro-spinal fluid and blood of cases of general paralysis of the insane by Mott and Halliburton,[4] and probably in the suprarenal gland. Nesbitt[5] has found it in the intestine of the dog after a meal rich in lecithin (eggs); Marino-Zucco and Dutto claim to have found it in the urine in cases of Addison's disease: it has been found in cultures of the comma bacillus and other micro-organisms. It can be obtained from most organs of the body after decomposition has set in.

Choline was for some time regarded as inert physiologically; more recently it has been shown to be a poison of considerable power. Thus Brieger[6] found that 0.5 gm. per kilogram is fatal to rabbits. Many of the statements concerning the physiological action of choline are to be received with great caution, for most of the older and some of the more recent experiments were evidently made with preparations mixed with the very poisonous base neurine. In frogs choline is said to produce general paralysis from a curare-like action upon the terminations of the motor nerves. Injected into mammals choline causes salivation, diarrhœa, and very characteristic changes in the circulation; the latter have been studied with especial care by Mott and Halliburton. The heart is slowed from a stimulation of the endings of the cardio-inhibitory nerves; the blood pressure falls greatly. Mott and Halliburton have shown that the fall of blood pressure is due largely to a dilatation of the peripheral vessels, especially those of the intestinal area; the slowing of the heart may account in part for the fall of blood pressure. These changes in the circulation are very transient. Atropine is an effective antidote to choline.

Choline has attracted most attention from the toxicological standpoint on account of its close chemical connection with the highly poisonous substances neurine and muscarine. By the loss of one molecule of water it is converted into neurine, while on oxidation it yields a very poisonous compound isomeric with muscarine, the poisonous principle of many mushrooms. Neurine, which is found in decomposing meat, brains, mushrooms, etc., is always accompanied by choline, and it is very probable that the former is derived from the latter. The transformation of choline into neurine can be easily accomplished by chemical processes, but the conditions under which this change takes place in the animal body are obscure. Micro-organisms, however, seem to bring about this conversion: thus Schmidt[7] found that when choline was mixed with hay infusion or decomposing blood and allowed to stand a few days a substance having the chemical and physiological properties of neurine, and probably identical with it, was formed. Nesbitt has obtained a substance which he considers to be neurine from the intestine of a dog after feeding the yolk of eggs; he thinks this body is derived from the choline formed by the decomposition of the lecithin. The conversion of choline into neurine by putrefaction may explain the production of poisons in foods; perhaps the choline itself, which has an action similar to but less powerful than neurine and muscarine, may be partly responsible for some of the symptoms observed in cases of poisoning with decomposing meat or mushrooms.

Attention was called above to the fact that Mott and Halliburton have found choline in the cerebro-spinal fluid and blood in cases of general paralysis of the insane. They are inclined to think it possible that this substance is responsible for the low blood pressure which is found in the later stages of this disease. I have been led to believe from investigations of my own that there are substances in the brain, and also in the suprarenals, which yield choline on decomposition and which have a more marked toxic action than choline. I have not been able to determine the exact nature of these substances, but it seems possible that some of the effects ascribed by Mott and Halliburton to choline may be due to such antecedent substances.

Reid Hunt.

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[3] Gumprecht: Centralbl. f. allg. Path. u. path. Anat., ix., p. 583.
[4] Mott and Halliburton: Phil. Trans., cxci., p. 211.
[5] Nesbitt: Journ. exp. Med., iv., p. 1.
[6] Brieger: Ueber Ptomaine, i., p. 39.
[7] Schmidt: Archiv d. Pharmacie, ccxxix., p. 481.

CHONDROMA.—(*χόνδρος*, cartilage.) Definition.—A chondroma is a histoid or connective-tissue tumor of which the essential constituent parts correspond to some one or more of the several varieties of cartilage, these cartilaginous elements differing to a greater or a less degree from the normal, and having associated with them other sorts of tissues. The term now includes those cartilaginous new growths which arise from structures containing cartilage normally, formerly called "ecchondroses"; as well as those which develop in regions where normally no cartilage is present, formerly known as "enchondromata." This form of tumor occurs ordinarily in the shape of sharply circumscribed, rounded, or knobbed growths, sometimes multiple, which may reach a very considerable size, and may develop in almost any part of the body, more commonly about the bones, and in certain glands.

Varieties.—Several varieties of chondroma may be recognized, the distinction between them being based upon the character of the cartilage present, and also upon the nature of the tissue or tissues associated with the cartilage in the tumor. Every sort of cartilage present in the body is represented in chondromata, and other forms may occur for which no analogue exists in normal structures. Thus, a chondroma may be found to consist of hyaline, fibro-, or elastic cartilage, or to contain cells distinctly cartilaginous in appearance and embedded in a soft, semi-gelatinous, mucoid substance. The complex forms of chondroma produced by the association of cartilage with other varieties of new growth include: chondro-lipoma, chondro-myxoma, chondro-fibroma, chondro-angioma, chondro-endothelioma, chondro-myxosarcoma, and osteo-chondroma.

Structure.—A simple chondroma is composed of small masses of cartilage embedded in a fibrous connective-tissue stroma. The consistence of the tumor and the appearance of the surface of section are determined by the character of the cartilage and by the nature and the degree of development of the stroma. Chondromata made up of hyaline, fibrous, or elastic cartilage usually have a firm consistence, while those in which the cartilaginous elements present a mucoid intercellular substance are soft and resemble myxomata. A chondroma in which the fibrous connective-tissue stroma is very abundant may present the macroscopic characteristics of a fibroma; such a chondroma best illustrates the tendency which this kind of tumor possesses toward an alveolar type of structure, the appearance of the cut surface suggesting that the growth is composed of a great number of small tumors separated from one another by septa of connective tissue. In some instances large masses of cartilage are found detached from the main body of the tumor;

these give to the tumor its rough, knobby feel. It is probable that these separated masses have assumed their position as the result of the development of the stroma, and that they are not the product of several centres of growth. The cartilage cells of the chondroma may resemble normal cartilage cells, consisting of cell, nucleus, and capsule; not infrequently, however, they are without a capsule, and differ from the normal in number and in size. At times, along with cartilage cells of the ordinary form there are stellate cells, and elements which correspond to the round and the spindle-shaped cells of connective tissue. The cells vary much in shape and in size; in the hyaline chondromata they usually are round and large; in the fibrous form they are often small and irregularly shaped. When the intercellular substance is soft and similar to mucus, the cells are frequently spindle-shaped, with long anastomosing processes. Virchow has observed amœboid movements in such cartilage cells, and is disposed to regard them as a cause of malignity. Most chondromata upon boiling yield chondrin; this is not true of those which have a soft intercellular substance, such forms yielding an albuminous or a mucin-containing material. In some instances, the stroma of the tumor is composed of embryonic connective-tissue cells, and the cartilaginous elements consist of small scattered groups of cells; such tumors often occur in the testicle, and are termed chondro-sarcomata.

The blood-vessels of the chondroma, which lie in the stroma, may be very abundant, especially in rapidly growing tumors, and not infrequently are embryonic in character. Neither lymph vessels nor nerves have been demonstrated in this form of tumor.

Chondromata are often separated from adjoining structures by a connective-tissue capsule. In chondromata which develop in the centre of bones such an enclosing capsule is composed of bone, formed probably from the enveloping periosteum; this capsule is complete usually in the early stages of the growth only, subsequent development causing it to be broken through.

Certain structural properties of the chondroma are characteristic of its place of origin. The chondroma arising from bone usually contains hyaline cartilage, more rarely fibrous, and sometimes mucous, the malignant chondromata of bone ordinarily being of the latter sort. The chondromata of the soft parts usually present fibro-cartilage, more rarely hyaline; they seldom are simple, being commonly associated with either myxoma or sarcoma. Chondromata arising in these parts have also a tendency to ossification and to calcification. In a chondro-endothelioma of the ear, von Dembowski found the cartilaginous elements of the tumor to arise by metaplasia from the hyperplastic endothelium of the widely dilated and cavernous blood-vessels of the growth; the endothelial cells became separated into clumps by a hyaline intercellular substance, subsequently underwent further isolation, and finally passed from a polygonal to a round form, and developed capsules.

Locus; Mode of Growth.—Chondromata may develop from any one of the connective tissues. The most common seat of origin is bone. Here the chondroma may consist of a circumscribed hyperplasia of cartilage, or occur as a new growth of the medullary canal of the long bones. In the former instance the tumor has but little tendency to growth, and is, except from its possible position, benign; it may become pedunculated, or even break off and thus form one of the foreign bodies found in joints. The tumor may also arise from the fibrous connective tissue of the periosteum; the capacity of the latter structure to form cartilage is shown by the production of it after fracture. Lücke has found that the development of cartilage from connective tissue takes place through the agency of groups of indifferent cells in the tissue, which secrete an intercellular substance. Virchow describes a more direct transition; he assumes that the fibrous tissue becomes more dense and undergoes a form of sclerosis, that the cells increase in size, and that in this way takes place a direct transformation into hyaline cartilage. The other forms of chondromata of bone are either peripheral or central in their position. The peripheral forms constitute large, rough, knobby tumors, which may surround the bone, and from pressure cause it to atrophy, the soft parts being pushed to one side; they usually possess a bony capsule. Such chondromata are most commonly found upon the pelvis near the symphysis, upon the scapula, and upon the upper jaw; they occur in the later years of life. The chondromata which develop in the medullary portion of bone, known as central chondromata, occur most commonly in the phalanges of the fingers and the toes; they are often multiple, especially in children, and give rise to protuberances known to the older writers under the name of spina ventosa. These tumors have a partial or a complete bony capsule, although this is sometimes absent, or is represented merely by fragments of a thin osseous plate. They appear during the period of life in which the skeleton is growing most actively. The long bones of the upper extremity are also often the seat of these tumors.

Of the soft parts, certain glands are the most frequent locus of primary chondromata. This form of tumor is found in the parotid gland, in the testicle, more rarely in the submaxillary gland, in the breast, and in the ovary. It sometimes occurs in the lachrymal gland and in the kidney; the chondromata of the kidney are possibly analogous to those tumors of this organ which contain striated muscle fibres, and are of embryonic origin. Primary cartilaginous tumors have also been observed in the thyroid gland, in the skin, and in the lungs. Birch-Hirschfeld has observed a large chondroma originating from the cartilage of the trachea of an old man, which produced a fatal stenosis of the trachea.

The chondroma has a marked tendency to occur as a multiple tumor; cases have existed in which all of the fingers of an individual were at the same time the seat of this form of new growth. In general, however, the tumors are limited to that portion of the body in which they originate; they do not tend to produce metastases. When metastasis does take place, it is usually when the chondroma is complex, and has associated with it osteoma or sarcoma. When metastasis of simple chondroma occurs, it is usually in consequence of the breaking through of the tumor into a vein, by means of which tumor elements capable of development are carried as emboli to more or less remote parts of the body. The most frequent locus of secondary chondroma is the lung; Birch-Hirschfeld has observed a secondary nodule upon the endocardium of the right ventricle of the heart. In Weber's classical case, a man of twenty-five years died with chondromata scattered over his entire body; the largest of these was seated upon the ilium; others were upon the scapula, upon the clavicle, and upon the ribs. At the autopsy, numerous emboli were found in the branches of the pulmonary artery, some of which were of recent origin, while others presented a distinct growth of the embolus into and around the vessel. Upon examination, the emboli were all found to be of the same nature as the tumors upon the skeleton. The source of the emboli was a large tumor growing into the left iliac vein. Paget has reported a case very similar to this. The lymph nodes are seldom involved. In one case a metastatic nodule has been observed in the spleen. Metastases in the liver are also very rare. The exemption of the lymphatic system is probably due to the compactness of the chondroma, and the large size of its cells, together with the fact that the tumor does not stand in very close relation with the lymph spaces. The chondromata which arise from normal cartilage, in so far as the production of metastases is concerned, seem to be wholly benign, and the differentiation of these from other chondromata under the name of "ecchondroses," as was done by Virchow, is of some clinical significance.

The rate of growth of chondromata is in general slow, but steadily progressive; in some instances periods of rapid growth alternate with intervals of repose. The complex forms, especially the osteo-chondromata, tend to

grow more rapidly than do the simple forms. Notwithstanding its slow rate of growth, the chondroma may attain a very large size, even that of a man's head.

In the course of development of a chondroma, the soft parts are crowded aside; tendons may make deep indentations in the tumor, and even run through it in canals made by the bridging over of such indentations. In the chondromata of the ends of the bones the articular cartilages play no part in the development of the tumor, but are overgrown and covered by the new growth.

Retrograde metamorphoses are especially characteristic of the growth and the development of the chondroma; the comparatively small blood supply of the tumor and the difficulty of nourishing the circumscribed masses of newly formed cartilage adequately explain this. Calcification is frequent; it may occur in the form of scattered islets of calcareous material, or of hard lamellæ, the latter being easily mistaken for bone. In the process of calcification, calcareous material is deposited first in the cell capsule, then in the cells, and finally in the intercellular substance. Ossification takes place about as frequently as calcification, and occurs not only in chondromata of bones, but also in those of the soft parts. The process is characterized by the formation of spicules and septa of bone which intervene between groups of cartilage cells. Very often there takes place the formation of isolated osseous plates, or of a spongy bone with well-marked Haversian canals. In chondromata which develop from bone, the new growth may contain remains of the old bone enclosed in the newly formed cartilaginous tissue.

Myxomatous softening, with associated cyst formation, is frequent in chondromata. If this metamorphosis takes place throughout the whole extent of the tumor, there are formed, between the trabeculæ of the stroma, cysts of varying size, with yellow or gray contents. The process is characterized by a fatty degeneration of the cartilage cells, which thereby become filled with fat drops and are changed into granular corpuscles. The intercellular substance undergoes softening, with the formation of a mucoid substance, and from the blood-vessels take place hemorrhages which give to the softened mass a dark-brown color. In some rare cases, the skin over a chondroma becomes ulcerated, and a fistulous opening develops into one of these cysts of softening.

The teratomata, or mixed tumors, especially those of the sacrum, frequently contain cartilage in association with other tissues; these tumors constitute a distinct group.

The osteo-chondroma, described by Virchow, is a form of complex chondroma in which ossification takes place chiefly by the deposition of lime salts in the intercellular substance. The cartilage cells of this tumor are similar to those which occur in the course of the ossification of the long bones; the cells generally possess no capsule, and are distinguished from connective-tissue cells by their shape. This form of chondroma is most often found upon the long bones, where it produces very large masses. The growth is usually surrounded by a bony capsule formed from the periosteum. Softening in this variety is not common.

As to recurrence of chondromata after removal, it may be said of this class of tumors in general that they do not tend to return. This is true especially of chondromata of the soft parts, and of those of the phalanges; it is not the case with chondromata of certain other regions, notably the bones of the pelvis. Virchow reports one instance in which the tumor was removed seven times at intervals of from six months to two years.

Etiology.—The beginning of the growth of a chondroma is often traceable to a very early period of life; in some instances, especially those in which the growth arises from bone, the tumor is congenital. Chondromata of the soft parts usually develop later in life.

Trauma is often alleged to be a cause for the occurrence of a chondroma either in the soft parts or in bone. The form of injury most frequently regarded as standing in a causal relation to the development of chondromata is fracture of a long bone; tumor formation in such a case may be looked upon as due to some irregularity in the reparative process which follows the injury.

For the occurrence of chondromata of the bones, irregularity of development is the probably correct explanation. In favor of this point of view may be considered the fact of the multiple character of these tumors, and their appearance in that period of life in which the skeleton is growing most actively. Cohnheim's theory of the formation of tumors, which asserts that new growths arise from vestigial embryonic tissue, seems to find confirmation in the case of the chondroma. Virchow found that remains of embryonic cartilaginous tissue are often enclosed in the medulla of the long bones, and it is probable that such remains are the immediate antecedents of many chondromata of the bones. The cause of the persistence of this embryonic tissue may be a disturbance of blood supply, or an excessive growth of the primary cartilage. A form of chondroma which arises in the spheno-occipital synchondrosis is by some authorities believed to develop from surviving embryonic cells of the chorda dorsalis. Irregularity in the post-fœtal development of bones, as in rachitis, is also held to stand in relation to the occurrence of chondromata; under these circumstances, islands of cartilage remain in the bone, from which tumor formation may proceed in childhood or later life.

For the occurrence of chondromata of the soft parts, misplaced embryonic cartilaginous elements are probably responsible. Thus, primary chondroma of the lungs may proceed from detached portions of the primary cartilage of the respiratory tract, and chondroma of the breast from that of the ribs. The chondromata of the thyroid gland and of the parotid gland may arise from the cartilage of the branchial clefts. The same is probably true of certain cartilaginous tumors of the skin. The simple chondromata of the testicle and of the ovary may arise from islands of cartilage detached from the primary cartilage of the notochord. The occurrence of the cartilage-containing mixed tumors in the various organs may rightly be referred either to a detaching of parts of an adjacent cartilaginous Anlage, or to a heteroplastic development of mesenchymal cells.

Diagnosis.—A firm, hard tumor seated upon cartilage or upon bone should always suggest chondroma. In some instances, the early stages in the development of a chondroma may resemble an osteitis, or a periosteitis. Chondroma is differentiated from fibroma by its hardness except when the latter is calcified, and from other tumors, including osteoma, by its rough, uneven surface. The central chondromata of bones may often be recognized by the parchment-like feel of their bony capsules. The chondromata of the soft parts are usually easily to be diagnosed from their firm consistence, uneven surface, and slow growth.

George Burgess Magrath.

CHONDRO-SARCOMA. See *Sarcoma*.

CHORDEE (Chorda venerea) manifests itself in more or less persistent erections, during which the penis is curved like a bow or bent at an angle. Near the centre of the concave side of the bow and at the interior of the angle, palpation reveals hardening of the tissues. This hardening may be circumscribed or diffuse. The patients compare their sensations during chordee to the feeling of a tense string or a red-hot wire drawn through the penis or urethra.

Chordee is due to cavernitis, either of the penis or of the urethra, or of both, in hyperacute gonorrhœa; it may also be produced by the use of excessively strong injections, by an injury to the urethral mucosa, by the use of a sharp-pointed syringe, or by the unskilful introduction of instruments, during the acute stage of urethritis. It may, futhermore, be due to infarction of urethral crypts and glands, with or without consequent peri-urethral or cavernous abscess. In some cases induration continues without either of these terminations for years, and may then become an impediment to copulation on account of deflection of the penis during erection.

In chordee the penis is bent in the direction of the infiltration that causes it, because the infiltrated part does not take part in the general turgescence of erection. The intense pain produced by such erections may drive the patient to desperate measures, such as placing the organ upon a hard surface and striking it a violent blow "to break the cord." Some patients have sought relief by coitus. The results of such violence may be urethral rupture, fatal hemorrhage, urinary extravasation, and consequent death from urinary infection, laceration of the corpora cavernosa, and gangrene of the penis. Even in those cases in which neither a stricture nor any one of the results just enumerated occurs, the part of the penis in front of the injury may thenceforward be cut off from sufficient blood supply to enable it to participate in erection.

Treatment.—In the acute stage, rest in bed under light covering, a low diet, purgatives, camphor or its monobromate, with or without opium, may be prescribed with advantage; locally, hot sitz-baths, hot or cold compresses—whichever the patient finds most soothing—and leeches to the perineum, are indicated. In hyperacute cases, the infiltrated tissues may be punctured with fine needles, as a last resort, if the other treatment does not suffice. If an abscess forms it must be opened early to prevent its breaking through into the urethra. In chronic cases, where the infiltration has become solid and gives but little or no pain during the deflected erection, galvanism may be used to stimulate absorption of the infiltrated material. If it is employed the negative pole should be applied to the infiltrated tissues and the positive to the opposite side of the penis. At first a low amperage should be used for several minutes, but afterward the séances should gradually be lengthened until they reach a term of from twenty to twenty-five minutes each.

Ferd. C. Valentine.

CHORDOMA.—The term used by Ribbert to designate a small tumor found occasionally in the median line of the clivus, near the union of the sphenoid and occipital bones; a tumor to which Virchow had previously given the name of *ecchondrosis physalifera spheno-occipitalis*. The growth, to the naked eye, has a colloid or gelatinous appearance, and is usually about the size of a small cherry. It arises out of the spheno-occipital synchondrosis, and either occupies the space between the bone and the dura mater which may not be perceptibly elevated, or it may break through the dura into the arachnoid and pia. In longitudinal sections of the clivus the tumor is found to lie in a small cavity which involves only the superficial portion of the bone or it may extend into the medullary portion. In young individuals whose synchondrosial cartilages are still present earlier stages of the tumor may be found. In these cases there is present beneath the dura, which is usually not elevated, a small round or flattened mass of tumor tissue lying in the cartilage from which it is sharply though irregularly outlined. No evidence of transition between the tissue of the new growth and that of the neighboring structures is ever observed.

The tissue of the tumor when examined in the fresh state is found to consist of large bladder-like cells resembling plant cells. These are easily isolated by teasing in normal salt solution. They contain numerous vacuoles of varying size which may so fill up the body of the cell that the protoplasm appears to be pushed in a narrow ring to the cell periphery. Few of the cells are free from vacuoles. The protoplasm is clear and contains fine shining granules. The small round nuclei appear bright and clear. The gelatinous portions of the growth break up in water. In hardened preparations the vacuoles appear still more prominent, but are oval or flattened rather than round. The protoplasm appears in less amount, but the small round nuclei are brought out very distinctly. These lie either at the edge of the vacuoles, or when the cells are seen from above they appear to be in the centre of the vacuole. Between the cells lies a homogeneous hyaline intercellular substance varying in amount in different portions of the growth. No blood-vessels have been found.

Virchow regarded the growth as a chondroma developing from the remains of the spheno-occipital cartilage, the cells of the cartilage having undergone a peculiar bladder-like degeneration. But the character of the tissue as well as the relations of the tumor makes it very probable that it represents remains of the tissue of the chorda which have taken on proliferative activity.

Aldred Scott Warthin.

CHOREA.—(Synonyms: Sydenham's Disease; St. Vitus' Dance; Danse de St. Guy, de St. Wilh; Myotyrbie [Dartigues]; periodical jactitation [R. Watt]; Chorée, Veitstanz, Veitsdands, Vit-Tánez; Plasawicy scelotirbe; Corea; Folie musculaire [Bouillaud].)

The literature of chorea is extremely voluminous, and its history dates back to the middle ages, when it existed chiefly in its epidemic form. Hecker[1] and others detail the incidents of the various religious pilgrimages to the shrines of St. John and St. Vitus, and the imitative features of the outbreak of psychical excitement with convulsions and jactitations are of the greatest interest. In many respects this form of trouble, apart from its general character, differs but little from that in which attacks of hysterical chorea major are witnessed to-day.[2] Puccinatti and other writers have undertaken to fix the identity of sporadic and endemic chorea, and to some extent they have succeeded; but when we consider the probable pathology of the disease from the standpoint of modern investigation, it must be admitted that the psychical element is by no means an important one. During the last twenty-five or thirty years, thanks to Kirke, Ogle, Dickinson, Dowse, Jackson, Eisenlohr, and Elischer, the relations of the disease to affections of the heart, to embolism, and to rheumatism have been made very clear, and within a comparatively short space of time the organic variety known as post-hemiplegic chorea, or hemichorea, has been fully described by Mitchell, Charcot, Hoffman, Jackson, and others.

Chorea is a disease which manifests itself in an exceedingly irregular manner as to the parts affected, and the degree of violence of expression, and as to its association with or dependence upon other things. The affection is characterized by a peculiar disorderly and nearly constant recurrence of muscular contractions of an involuntary character, which are not (except in hysterical cases) at all rhythmical. It has been divided into *general chorea*, or *chorea major*, and *partial chorea*, or *chorea minor*, and the manner in which it is associated with other pathological conditions still further demands a series of qualifying terms, such as *hysterical*, *saturnine*, *procursive*, *habit*, *senile*, *rheumatismal*, *dental*, *enteric*, *hereditary*, or *Huntington's electric* (of Dubini or Bergeron), the *chorea of insanity*, the *chorea of pregnancy*.

Symptoms.—Chorea may follow some other affection—one of the ordinary diseases of childhood, for instance—or it may be the sequel of an attack of acute rheumatism; or again, it may have no basis except a general reduction of vital power with anæmia and its belongings. In such cases the development of the malady is slow and insidious, and the child for a long time presents simply those evidences of neural malnutrition which are so common. It is peevish and capricious, and restless in the extreme. Its petty exhibitions of temper render it a nuisance, and it receives its full allowance of punishment. The same caprice of disposition is found in eating—it prefers improper food, and at best eats but little. It is listless and dull at school, sleep is disturbed, and frightful dreams produce night terrors and nocturnal incontinence. Its pale face makes more conspicuous the dark spots under the eyes, and its foul breath and dry teeth betoken a derangement of digestion. After a while it begins to shrug one shoulder or the other, and twitches its hands, or fumbles the seam of the trousers, or opens its mouth with a sort of gasping movement, or twitches its lips, or corrugates its brow, or spasmodically closes its eyes; or does something else that may be regarded as