THE

ÆTIOLOGY, PATHOLOGY

DIAGNOSIS AND TREATMENT

OF

TUMORS

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Profusely Illustrated

CLEVELAND PRESS
CHICAGO
1903

PREFACE.

In presenting this work to the medical profession I desire to state that my purpose has been to give the reader as clear a conception of the causation, origin, structure, diagnosis and treatment of tumors as possible. The importance of this subject can scarcely be over-estimated, and these pages represent all of my leisure time for the past four years.

Barring the broad divisions of tumors into benign and malignant, they have been classified according to their histological structure, as it is my opinion that tumors cannot be considered scientifically or to the best interests of the surgeon in accordance with the germ layers.

It has been my intention in treating of the different genera to so associate the local origin, histology, pathology, and general characteristics of the growth as to make the diagnosis comparatively easy, for upon a correct diagnosis will rest a proper treatment.

In the preparation of the work I have drawn from many treatises on embryology, histology, pathology and practice, and have endeavored to give proper credit for these extractions, but should I have failed in any particular instance it has been from oversight and not from intention.

One feature of the work is the new illustrations. Excepting a few drawings representing well-recognized procedures, all of the illustrations are original. The drawings of histological and histo-pathological structures have been made directly from microscopical observation. This part of the work, with few exceptions, has been done by Dr. Charles G. Willson, late instructor in Histology and Pathology in the Wisconsin College of Physicians and Surgeons. I desire to express my great appreciation of Dr. Willson's most excellent work. I am also indebted to Dr. John M. Beffel, Professor of Pathology and Director of the Mark's Laboratories in the Wisconsin College of Physicians and Surgeons, for many excellent microscopical sections.

A. H. L.

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CHAPTER I.

The subject which we approach today—that of Tumors—is one of commanding importance to both students of medicine and to practicing surgeons. Its importance is perhaps not exceeded by that of any other subject in the entire domain of surgery. It is essential that students of medicine gain a thorough, reliable, working knowledge of tumors. This knowledge they will obtain in the clinical amphitheatre, in the laboratories, and at the didactic lectures. They must know tumors as they do their most intimate friends, being familiar with their every characteristic, if they would be able to recognize them when masked and disguised in various ways and under various conditions. They must know the causes which brought them into being—know their minute and gross structure, their life history, and their surgical treatment.

As successful surgeons dealing with tumors, you must, in addition to this, be thorough anatomists, practical pathologists, must be skilled in aseptic and antiseptic surgery and in surgical technique.

To the surgeon the subject of tumors is one of the greatest importance, and one which excites in him the keenest interest. It is of importance on account of the great frequency of tumors, and also because their treatment devolves almost entirely upon the surgeon. Medicines within and salves without have little or no place here. It is of interest because of the skill, knowledge and experience required for their successful treatment. Upon this skill, knowledge and experience very often depends the subsequent beauty, happiness, comfort, health and even life of a patient. It is of interest on account of the dangers, difficulties and risks incident to their treatment. You should, then, as students, as practitioners of medicine and as surgeons give such attention to the subject as to make yourselves perfectly familiar with the work in hand.

DEFINITION. Tumors have been very variously defined, there being almost as many definitions as writers, and perhaps in the present unsettled state of our knowledge concerning their ætiology any definition which might be given would be more or less incomplete, unsatisfactory and incorrect. Here in the clinical amphitheatre, for the purpose of diagnosis and differentiation the term *tumor* will be used in its widest sense. A tumor may then be defined as an independent, more or less circumscribed, new growth.

Tumors have certain well defined characteristics

I. They have no useful function.

II. As a rule their growth is continued throughout the life of the individual, being uninfluenced by health, disease or medication.

III. Their growth is in most cases prejudicial to the life of the individual.

IV. They often produce injurious compression upon adjacent organs.

V. They are often the cause of secondary tumors in distant parts of the body.

VI. They never originate *de novo*, but always from pre-existing tissue.

VII. The tissues of which they are composed are prone to undergo degenerative changes, as fatty, colloid, hyaline, calcarious, and amyloid; or to undergo formative changes, connective tissue being converted into tissue of a higher grade, as cartilage or bone.

VIII. Tumors correspond in histological structure more or less closely to that of the tissue in which they grow; epithelial tumors springing from epithelial tissues, fibroid tumors from fibrous tissue, muscle from muscle, etc.

ÆTIOLOGY. A great many theories and opinions have been held at different times concerning the nature and causation of tumors, some authorities holding for one cause, some for another, while many believe there are various causes. It seems at the present time to be well established that all tumors are not due to one and the same cause, but that there are many causes as there are many kinds of tumors, now one cause acting and now another.

It would be an unprofitable task to even attempt to give you all of the theories and opinions which have been held at different times concerning the causation of tumors. Consequently I shall state but a few of them, and first the theories and possibilities.

The humoral pathologists held that tumors had thei origin from the extravasation of blood or lymph into the tissues, which subsequently took on organization and growth.

It has been held, and not without reason, that the primal cause of many if not all tumors lay in a circumscribed, more or less chronic inflammatory process, either of traumatic or microbic origin. Also that inflammation by bringing the tissues into a more or less embryonal condition, by producing a rapid mitosis in the cells of the part, and a diapedesis of leucocytes from the vessels, as well as a fibrinous exudate from the blood, produced a condition most favorable, and the forms and kinds of cells necessary, for the formation of any and all kinds of tumors. And in fact it cannot be questioned but what in the exudate of traumatism or inflammation, the nidus for many a tumor is formed. Again some have thought that tumors had their origin from the white blood corpuscles, as the result of a process of migration and budding; that the various protoplasmic forms, which are taken by leucocytes might easily be made to represent the various forms of tumor cells.

Others have maintained that tumors originate *de novo*. But this is simply a confession of ignorance. Virchow and others have shown the absurdity of this, in that tumor cells are but the representatives of classes of cells found either in embryonic or mature tissue from which they spring. Many have held that a dyscrasia not only produced profound nutritional changes, but also so altered the composition of the blood as to produce within it a chemical substance which was causative of some of the malignant tumors. Attempts have been made to isolate this substance, but they have been unsuccessful.

Great nutritional disturbances by lowering the vitality and the power of resistance seemingly at times favor the formation of malignant growths. Again, diet has been

regarded as a predisposing or active cause of malignant growths. The two articles against which this charge has been more especially brought are meat and tomatoes. Evidently there is no foundation in this belief as vegetarians and those who do not eat tomatoes are quite as prone to cancer as those who do.

It has been held that there is a certain antagonism between cancer and tuberculosis, that these diseases are almost never found in the same individual at the same time, and that conditions and diet which are beneficial to one are prejudicial to the other. It is claimed that while a diet containing phosphides and compounds of phosphorus is most favorable for the consumptive, it at the same time favors the production of cancer.

FACTS AND PROBABILITIES. Some tumors are congenital in origin, as the angiomata, and are apparently brought into existence by one of three exciting causes:

I. Cutaneous nerve influence.

II. Disturbances in the local circulation.

III. Mechanical causes, as those which occur at the various normal fissures and embryonic clefts of the body.

Cystic tumors which are congenital are due to imperfect or defective closure of the branchial clefts.

Dermoids are due either to errors in embryonic development, by which a portion of the skin (ectoderm) becomes included within the deeper tissues, or they are of traumatic origin. Many cystoma are due to retention of the glandular secretion.

Thoma has pointed out that some tumors, as the teratoma, are produced by the inclusion of an acardiac embryonic rudiment within the tissues of a well-formed fœtus.

The formation of fatty tumors is favored by obesity. Age plays a very important role in the production of cancer. The senescence of tissue which occurs in old age as well as the marked proliferation of epithelial cells upon the cutaneous surface and at the various apertures of the body, are predisposing causes, if not direct and actual exciting causes. Injury and irritation play very important parts in the production of sarcoma and carcinoma. It is well known

that sarcoma is liable to, and very often does, follow injuries, there apparently being no other cause; and especially is this true of injuries to periosteum and bone; while continued irritation of some part, as the tongue, by the sharp tooth, the lower lip by the stem of the pipe, the scrotum in the chimney-sweep, the pylorus in patients who have and are suffering from gastric catarrh, is extremely liable, especially in persons advanced in years, to cause carcinoma.

Two cases have recently been reported which are of interest and which have a direct bearing upon the subject. In one the tumor was due to infection, while the other was due to irritation.

Case I. Reported by Albanan and Bernard. An epithelial tumor due to the bilharzia hæmalobia.

The patient had died in Egypt of bilharziosis. At the autopsy the submucosa of the bladder was found to be much thickened, and the epithelium proliferated. Macroscopically the mucous membrane presented numerous projections which formed a distinct tumor at the fundus; microscopically this area showed a well-marked epithelial proliferation, resembling epithelioma of the bladder. In the connective tissue of the growth there were numerous eggs of the bilharzia. It is reasonable to suppose that the ova were the exciting cause of the growth.

Case II. Reported by Spitzer. A tumor caused by the irritation of caterpillar hairs.

A man 62 years old had a tumor of three months growth on the dorsum of the left foot. It was sharply defined, and covered with bluish skin, through which light yellow nodules, the size of a barley corn, could be seen. On removal of the tumor it was found to consist of a number of nodules embedded in a fibrous stroma, which were composed of epithelial and small cells, with occasional giant cells. In the center of each was an accumulation of leucocytes showing no signs of caseation, and imbedded in the leucocytic mass were some sharp cylindric hairs. It was learned on inquiry that six months previously the patient, while working in the field, had been suddenly seized with pains in the left foot. On taking off his boot he found a large hairy cater-

pillar. The foot became red and swollen; but this soon passed off, and the tumor did not make its appearance until three months later.

The hairs of the larva in question are very thin and have barbed ends. (*Year Book*, 1899.)

THE EMBRYONAL CELL THEORY.—Remak was the first to advance the theory that a growth of embryonal cells might wander to a distant part of the body and subsequently be the starting point of a tumor.

Virchow gave this theory some support and showed that some tumors might be formed in this way. Cohnheim applied the theory in a much wider sense and endeavored to show that all tumors were formed by this method. This theory is most ingenious and fascinating, and has been given quite general support. In a few words the theory is that in embryonal development more cells are formed than are found necessary for the construction of the various tissues and organs of the body, so that a certain number remain unused and dormant. These superfluous cells may be few and confined to some particular region, or there may be a great number and perhaps evenly distributed throughout the body. At some subsequent time in the history of the individual these latent cells receive a stimulus which causes them rapidly to proliferate, resulting in a tumor formation, or perhaps in a malformation.

This theory is most plausible and undoubtedly holds good for a certain number of tumors, but that it explains the causation of all tumors we do not for a moment believe. We shall have more to say concerning this subject when we come to speak of the origin of tumors in particular.

THE CELLS OF NORMAL TISSUES AND OF TUMORS. THE MORPHOLOGY OF CELLS. Man has his origin from a single parent cell which, as the result of division and repeated subdivision, is enabled to construct the tissues of the entire body. At first the cells are round, and are not to be distinguished one from the other either in form or function; but with the formation of the germ layers (the ectoderm, mesoderm and entoderm) and the construction of the different organs of the body, the cells become differentiated

and acquire different forms and distinct functions. Those cells which are formed along the same lines and possess the same characteristics, are united into one of the distinctive tissues: 1. Epithelial. 2. Supporting. 3. Muscular. 4. Nervous. The cells of the various tissues form a matrix which assists in fixing and binding the cells together into tissues.

Tumors never originate *de novo*, but always from the cells of one of these four tissues, and the characteristic of the tumor, the form of its cells, its density, the rapidity of its growth, its contour, whether it is painless or painful, whether it invades adjacent tissue or becomes encapsulated, whether it is benign or malignant, will depend almost entirely upon the tissue from which its cells have had their origin.

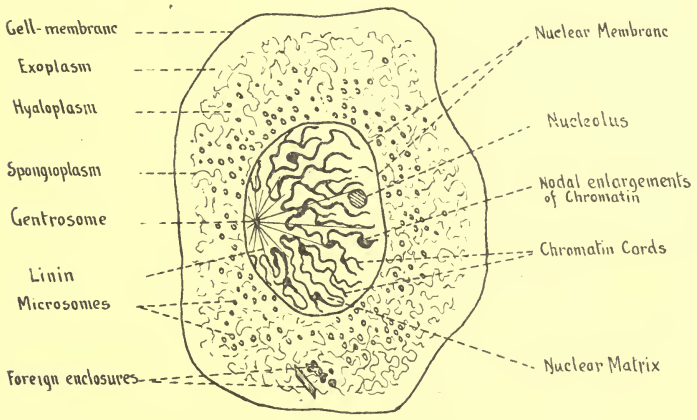


Fig. 1. Diagram of a Cell.

Epithelial and supporting tissues are found in plants as well as in animals and are called vegetative tissues. Likewise we find in plants tumors corresponding to these two forms of tissue. The muscular and nervous tissues stand on a higher level both structurally and functionally, and are found only in the animal body. Consequently tumors composed of muscular or nervous tissue are found only in animals.

THE HISTOLOGY OF CELLS. A cell is a microscopical structural element which under favorable circumstances is

able to carry on a separate existence, providing for itself nourishment, increasing its size and multiplying. It is an elementary organism and is composed of albuminous substance called protoplasm, which resembles the white of an egg, and which is common to all organisms both animal and vegetable. It represents the physical basis of life, and is the starting point of all subsequent cellular development. Protoplasm is soft, semi-fluid in consistence, insoluble in water, has an alkaline reaction, contains water and salts, and a special nitrogenous substance—plastin. If a cell be examined with a high magnifying power the protoplasm is seen to contain granules—microsomes—in varying quantity, and a net work of structure—spongioplasm—with an amor-

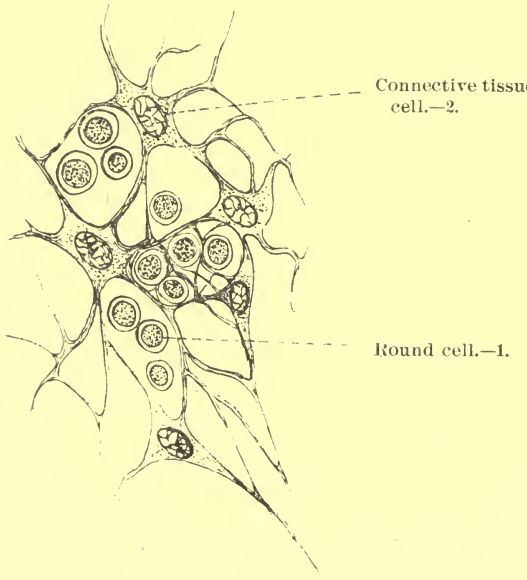


Fig. 2.

phous ground substance—hyaloplasm. (Fig. 1) The nucleus lies in the centre of the cell, has a membranous envelope, is sharply defined and vesicular in character. It consists of several protein substances: chromatin, pyrenin, linin, and amphipyrenin. The chromatin forms cords of varying calibre, which at intervals exhibits isolated enlargements.

Chromatin and linin form the nuclear network the in-

terstices of which are occupied by one or more nucleoli. The centrosome is a diminutive corpuscle within the nucleus from which fine threads extend to the chromatin cords and to the nuclear membrane. During the division of the cell the centrosome wanders from the nucleus into the protoplasm where it divides.

Many cells have no membrane, while others possess a structureless membrane which is either a transformation of the peripheral zone of the cell or a secretion of the same. There are many cells without a nucleus, some of these having lost their nuclei during the process of development. The majority of cells have but one nucleus, while a few are polynuclear, as the myeloid cells of sarcoma, and the giant cells of tubercular processes. In the latter the polynuclear condition apparently is due to the irritation of the bacilli of tuberculosis, which seemingly is capable of causing division of the nucleus without being sufficient to cause division of the cell.

The cells have a variety of forms—even the epithelial cells differing greatly in contour. They may be spherical (Fig. 2) as the embryonal cells and the leucocytes while

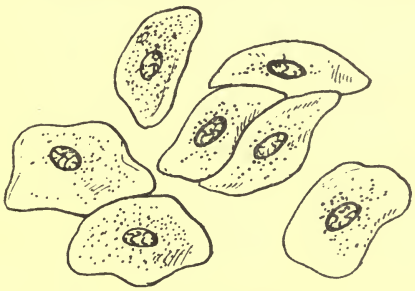
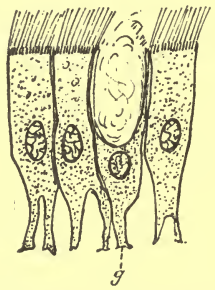


Fig. 3. Squamous Epithelium.

resting, or flattened, as the squamous cells (Fig. 3), or spindle-shaped (Fig. 2–2), as many muscular and connective tissue cells, or columnar or goblet-shaped (Fig. 4), as some of the intestinal epithelium, or polyhedral, as the liver cells.

The majority of cells are soft and plastic and yield readily to pressure, consequently their form may be influenced either by the pressure of adjacent cells or by extran-

eous pressure, as occurs with the surface epithelium; or their form may depend upon function, as is the case both with the ciliated epithelium of the fallopian tubes and respiratory tract, the cells of muscle where traction is essential and the cells in consequence become elongated, and the goblet cells of the intestinal epithelium where their form is due to the secretion into their interior and the retention of mucin; or the shape of the cells is seemingly the result of



(*g*.—Goblet cell discharging mucus.)
Fig. 4. Ciliated Columnar Epithelial Cell.

an architectural design, as in the stratified epithelium, where there is a gradual gradation from the round cell beneath to the flattened cells upon the surface. The apparent form of a cell in a microscopical specimen will often depend upon the direction of the section. A spindle cell cut crosswise will appear spherical; a squamous cell seen from the side will appear more like a spindle cell; a columnar cell seen from above will appear hexagonal.

In the structure of tumors, whether benign or malignant, we find the same cells that we do in the normal tissue, and, microscopically, from the form of the cell alone, it will often be impossible to differentiate the most malignant growth from the simplest tissue—e. g., the squamous cell of stratified epithelium (Fig. 3) is not different in form or contour from the squamous cell of an epithelioma (Fig. 5). The round cell of adenoid tissue is not to be differentiated by its form from the most malignant round-celled sarcoma. The connective tissue cells of normal tissue (Fig. 2–2) are the same as those making up the uterine fibroid or the neuroma.

In the formation of tumors, as in the production of normal tissue, the increase of tissue elements is due entirely to cell division. A cell multiplies by dividing into two, and, after remaining quiescent for a short time, enlarges and subdivides, the process being repeated almost indefinitely. Different observers have described the pro-

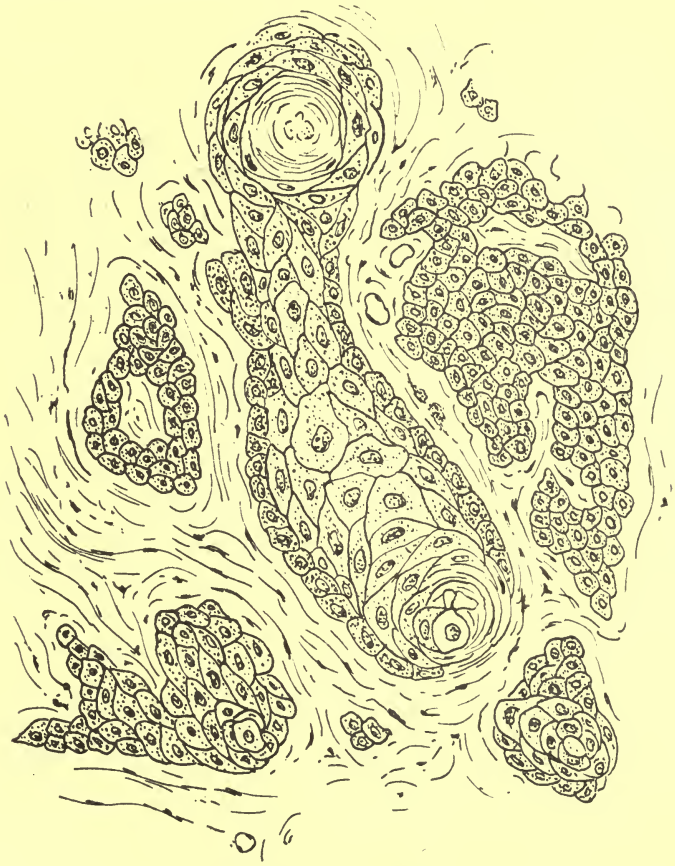


Fig. 5. Epithelioma of Finger

Showing variously shaped epithelial cells in masses and "whirls" or "pearls."

cess of cell division somewhat differently it seems, some of the details varying slightly according to the kind of a cell in which the process has been observed. It is now practically agreed that nearly all cell multiplication is due

to indirect division. This consists in a series of changes in the nucleus by which the chromatin fibers become divided into two equal parts. In the resting condition of the cell (Fig. 6–1) before any changes have occurred in the nucleus, it consists of a close mesh-work of fibrils surrounded by an envelope. The fibrils are easily stained with carmine, but the matrix in which they are enveloped does not take the carmine stain.

Fig. 6.

In the first stage looking to a division of the cell the nuclear fibrils become thickened and more distinct, (2–close skein). The fibrils now become less tortuous, the individual threads of the skein parallelling each other. (3–loose skein.)

The chromatin loops now move to the equator of the spindle preparatory to their division. (4-astor, or mother star). During the formation of the astor the chromatin loops divide and form two (daughter stars-5). Complete division of the nucleus now follows the daughter stars, assuming positions in the poles of the spindles. The process from this on is the reverse of what previously occurred. Following the two daughter stars, or skeins, is formed a

loose skein (6) then two closed skeins (7), and finally two daughter nuclei and complete division of the cell. The time consumed in cell division varies from one-half hour in man to five hours in amphibians.

CELL DIVISION. Fig. 6. Indirect Division, Mitosis, or Karyokinesis.

(1) Resting Nucleus.
(2) Close Skein.
(3) Loose Skein.
(4) Astor.
(5) Diaster, or Daughter Star.
(6) Daughter Loose Skein. (Commencing division of protoplasm).
(7) Daughter Close Skein.
(8) Daughter Nuclei—Complete division of cell.

THE ANATOMY OF TUMORS.—After studying the histology of cells and the histological appearance of tumors, it will be in order to consider their microscopical appearance and gross structure.

The form of tumors varies greatly and will depend upon their situation, the manner of their growth, the tissues of which they are composed, or the pressure of adjacent tissues or organs. In form they may be circumscribed or diffused, spherical or flat, irregular, lobulated or nodular.

In consistence tumors represent nearly every degree of hardness or softness. They may be as hard almost as stone or so soft that they seemingly are semi-fluid. In solid tumors, the consistence will depend largely upon the amount of interstitial substance present. In hard fibroids there is very little interstitial substance and comparatively few cells, while in soft fibroids there are more cells and a great quantity of interstitial tissue, which may be myxomatous, fatty, or liquid, the latter due to venous congestion; or all of the above-named interstitial tissues may be present in the same fibroid, making a very soft and succulent growth out of what otherwise would be a very hard tumor. In cystic tumors the degree of hardness will depend in part upon the thickness of their walls. Tumors having

thick walls, other things being equal, will be harder than those having thin walls. Of much greater moment, however, in the production of hardness, is the tension of the cyst wall—the degree of pressure to which the cyst's contents are subjected. Cysts with very tense walls, irrespective of thickness, are very hard. The greater the tension of the cyst wall the harder the tumor, so that it is often difficult, yes, impossible, by palpation alone, to differentiate cystic tumors with thin, tense walls from those that are solid. In fatty tumors where tension is always low the tumors are soft.

On section the shades of color in tumors vary almost as much as their consistence. They range from the pearly whiteness and glistening appearance of some fibroids to the brown or black melano-sarcoma, with the dirty-white carcinoma or blue or red angioma intervening.

In the gross structure of tumors we have three important anatomical tissues: the parenchyma, composed of cells; the stroma, or frame work, made up of connective tissue; and the intercellular or interstitial substance, which may be granular, homogeneous, finely fibrillated or fluid. The parenchyma of a tumor is of paramount importance; it is the vital growing part, that which determines the characteristics of the tumor, the manner and rapidity of its growth, whether it be circumscribed or diffused, benign or malignant. It is the part which is responsible for regional and systemic infection and the formation of metastatic tumors. The greater the proportion of parenchyma the softer the tumor will be and the more rapidly it will grow, while in malignant tumors as a rule the malignancy will be increased with an increase of the parenchyma. The parenchyma imparts to the tumor some of its most important anatomical characteristics and its clinical significance.

With every tumor there is a stroma or frame work which, though not having the clinical significance of the parenchyma, is nevertheless worthy of careful consideration. In cystic tumors the stroma makes up the major portion of the capsule. In some solid tumors, as the hard fibroids, it

constitutes the principal part of the tumor. In the hard carcinomata it forms the frame work, the partitions in which the vessels course; the partitions holding and supporting the epithelial cells. Tumors possessed of a large amount of stroma are usually hard, often irregular, and grow slowly.

The intercellular substance may be only a cement substance, as occurs in normal structure, binding the tissues together, or it may make up the major part of the tumor, as is the case in myxomatous and chondromatous tumors, and also to some considerable extent in soft fibroids. The intercellular or interstitial substance is due in part to the degeneration of tissue, or it may be the result, when liquid, of interference in the circulation or it may be natural to the tissues. Tumors possessed of a large amount of intercellular substance are usually soft. This substance seemingly has no special clinical significance and no function other than of affording a matrix for the cells or of binding the tissues together. The intercellular substance, like the stroma, plays no part in determining the question of malignancy in tumors.

Arteries and Veins.—The relative proportion of blood vessels in tumors, their size and the thickness of their walls, vary greatly. In the construction of a new growth the extension into it of the arterial system is necessary in order that the vitality of the tissues be preserved. This is effected by the formation within the new tissue of small, pointed processes of protoplasm, the base of these protoplasmic masses resting upon the nearest capillary; the processes of protoplasm becoming both canalized and in direct communication with the capillary upon which they are resting. Often the capillary is as it were projected through these canals forming the wall of the new vessel, or the capillary wall may be formed from the connective tissue cells. The separate conical masses of protoplasm become united at their points or attached to the walls of other capillaries, thus affording a continuous circuit for the circulation. The growth of a tumor will depend very largely upon its blood supply. This may be so meagre as scarcely to afford suffi-

cient nutrition to prevent the tissue falling into decay, or the blood supply may be most abundant, far greater in fact than required for nutrition, becoming to the part pathological rather than physiological.

The vessels may be possessed of normal walls or their walls may be undeveloped, having not infrequently but a single coat (endothelial) as occurs in the vessels of many fibroids and fatty tumors. In some tumors the blood vessels make up the major part of the growth, as in the angeioma, angeio-sarcoma and some sarcoma. Again there are tumors in which the vessels are not only numerous but of enormous size, being possessed of thin walls, often only an endothelial coat, or they may have no walls at all, being simply canals or caverns hollowed out of the soft, friable tissue. The veins correspond very closely with the arteries in size, number and condition of their walls, as well as their relation to adjacent structures.

In encapsulated growths the vessels first enter the base of the capsule, breaking up into numerous branches, then the stroma through which they ramify to supply the interior of the tumor. Some tumors pulsate vigorously and present a bruit on auscultation, rendering great care necessary in differentiating them from aneurism. These tumors can usually be reduced very much in size by pressure by simply forcing the blood out of the vessels. The angieo-sarcoma are often composed of a great network of vessels and after removal, incision, and the washing away of the blood and debris, there is very little remaining of what previously was an enormous growth.

LYMPHATIC VESSELS. Lymphatics are present in practically all of the epithelial and connective tissue tumors, and it probably is a histological fact that lymphatic spaces and lymphatic vessels may be found wherever there are connective tissue spaces and capillary vessels—even in the corneal tissue, where there are no capillaries, lymphatic spaces abound, and we can scarcely for a moment imagine a fibroma, lipoma or osteoma to be free of lymphatics while these vessels are so numerous in normal fibrous, fatty and osseous tissue. In benign tumors the lymphatics are of no special moment to the surgeon, but in the malignant growths they are of the greatest importance and should receive the most careful attention. In the carcinomata the cell nests are situated in the lymphatic spaces, often in direct communication with the lymphatic radicals. This intimate relationship between the cells of a carcinoma, on the one hand, and the lymphatics on the other, unquestionably explains the frequency of lymphatic involvement in this class of malignant growths. In contradistinction to the lymphatics, the blood vessels in carcinomata are often of small calibre, have their course through the stroma of the tumor, and are thus quite separate and distinct from the cell nests. The anatomical relationship of the lymphatics and the blood vessels in carcinomata explains not only the cause of the frequent lymphatic involvement and metastasis, but also the infrequency of venous infection and metastasis. In the epithelioma or skin cancer the conditions are quite changed. Here the growth springs from the stratified epithelium of the epidermis in which there are no lymphatics, and a very considerable time elapses before it penetrates the basement membrane and pushes its pegs or columns of cells down into the deeper portions of the skin Further, it does not involve the lymphatic spaces and it is not in direct communication with the lymphatic radicals as is the case in the glandular carcinomata. Consequently, in epithelioma, involvement of the lymphatic glands only occurs, if at all, after months or years of growth.

If we now study the relationship of the vessels, lymphatic and venous, in the sarcomata, to the cells, we will

readily see a great contrast between them and the vessels and cells in the carcinomata and at the same time discover the reason why metastasis in the sarcoma frequently occurs through the veins and but rarely through the lymphatics. While there are lymphatics in all of the sarcomata, the cellular growth does not take place in the lymphatic spaces, and the cells are not in communication with lymphatic radicals, consequently, there being no direct communication between the cells and the lymphatics, lymphatic infection both local and general will be rare.

The blood vessels in the sarcomata are in direct relation with the cells. They are thin-walled, often possessed of only an endothelial coat or, as is frequently the case, of no coat at all, being simply great channels or great caverns hollowed out of the tissues, the sarcomata's cells making up their walls and being in direct communication with the blood stream. There is then every reason why the cells or infecting material of a sarcoma should become detached by the blood stream and be swept away to the first capillary plexus, where they may form a metastatic growth. In malignant tumors the anatomy of the part determines the channels of infection.

Biology. The life history of any class of tumors is an ever changing picture. This is quite as true of tumors when considered singly as it is of species. Their course is influenced by a great variety of considerations, for instance, their growth depending largely upon cell division and blood supply. The rate of cell division is seemingly inherent to the growth, and changes not only with the species but also with each separate tumor and each individual and in the same tumor from day to day. While soft fibroids grow rapidly and hard fibroids slowly, there are no two that grow exactly alike for any considerable time. There are no known laws which govern absolutely mitosis in tumors. Growth, however, is greatly influenced by blood supply. A rich blood supply favors cell division and rapid growth, while a poor blood supply prevents, in part, cell division and effects slow growth.

Age also influences cell division and consequently

growth. Cell division corresponds very closely with the other processes of life, and is more active in youth than in advanced age. The rule holds good in both benign and malignant growths. The character of a tumor is also somewhat changed by age. If a tumor be malignant, its malignancy is increased by youth. Age is also a predisposing cause with certain tumors. The majority of tumors favor youth and adult age. This is true of the benign and sarcomatous tumors, while old age, with senescence of tissue, favors the development of the carcinomata.

Sex, as it affects function and habits, is a factor in the production and growth of certain tumors. Both benign and malignant neoplasms are more frequent in the female breast than in the male. This is probably on account of function. The lip, tongue, œsophagus and stomach are more frequently affected with carcinomata in man than in woman, unquestionably on account of the difference in habits. Again, the genitalia of women are much more frequently affected by malignant growths than are those of men. This is probably largely due to the various injuries and diseases from which the former suffer. Local conditions often affect very materially the growth of tumors, especially those that are malignant in character.

Irritation not only increases growth but often adds to the malignity of a tumor. This may be the irritation incident to situation, as when a tumor has its origin from the hand or foot or inside of the thigh, or that resulting from the application of a blister or the use of iodine or caustics or irritating ointments. The use of massage will usually increase cell division and consequently tumor growth. In malignant growths the irritation and inflammation incident to and following incomplete and bungling operations, with portions of the growth, bruised and torn, left within the tissues, are often sufficient not only to excite quickened growth in the portions of the tumor unremoved but also to add very materially to its malignant character.

Pregnancy and menstruation often have the most marked effect upon the growth of tumors. During pregnancy the growth of uterine fibroids may be increased or arrested,

and they have been known to undergo partial atrophy or even to disappear. Uterine fibroids usually make their appearance during menstrual life and the periods of physiological congestion of the uterus and breasts seems to favor tumor formation and growth. A most interesting case illustrating the effects of both pregnancy and menstruation recently came under my care. A girl when sixteen years of age noticed a lump the size of a small hickory nut beneath the skin of the rignt thigh. During several years this growth was noticed to become distinctly larger with each menstruation, while during the intervals it seemed to stand still or diminish in size. At the age of twenty-five the woman married. The tumor was now about the size of a hen's egg. She soon became pregnant, when the tumor took on rapid growth, and at the time of her confinement was as large as, or larger than, a croquet ball. After her confinement there was no further apparent or decided growth until she again became pregnant some five years thereafter, when the tumor again took on a most rapid growth and at the time I saw her, two weeks after the second confinement, it was larger than the largest adult head. The tumor had an apparent capsule, was shelled out of the tissue and found to be a spindle-celled sarcoma.

The increase in the size of a tumor is largely due to cell division. It may, however, be due in a measure to cystic formation or to hæmorrhage. Cell division or growth may be central or peripheral. This will depend upon the character of the tumor. Those which are circumscribed, encapsulated and benign, grow from the center. Consequently the youngest cells are centrally situated, the oldest peripherally. The growth is constantly from the center towards the circumference where the oldest cells displace the normal tissues. In the microscopical study of such a tumor the central portion should be examined, as the peripheral, the older portion, may have undergone degenerative change. Tumors which are not encapsulated, but diffused, which infiltrate adjacent tissues, instead of displacing them, are malignant. Such tumors grow from the periphery, and this portion or the youngest should be examined, micro-

scopically as the central portion may have undergone formative or degenerative changes. Occasionally a malignant tumor, especially the spindle-celled sarcoma, will have a capsule more or less perfect with which it can be shelled out from the adjacent tissue, but this is never a perfect encapsulation, for outside of the capsule within the adjacent tissues there is always a diffusion of tumor cells.

The peripheral growth and macroscopic appearance of malignant tumors is due to a variety of conditions. The growth may be fast or slow, depending upon the inherent power of cell division, the blood supply and the presence or absence of local irritation. The growth circumferentially may be regular and uniform producing a tumor spherical in appearance, or it may be most irregular and uneven resulting in a neoplasm which upon its surface will be ridged, bossed or nodular. The general appearance and course of a malignant tumor, especially a carcinoma, is dependent very much upon regional infection which may occur through the the lymphatics, producing large or small nodules in the vicinity of or upon the border of the new growth. These nodules may subsequently become attached to the new growth making it still more nodular and uneven, or they may remain separated, maintaining a distinct existence and forming new tumors in the vicinity of the old; or regional infection may occur as the result of contiguity of growth. By this means malignant growths travel considerable distances along fascial or muscular planes, blood vessels, nerves or bones, and especially serous membranes. In this manner new regions are invaded and considerable spaces spanned. Carcinoma of the pylorus not unfrequently by contiguity of growth spans the space between the stomach and liver, passing along the gastro-hepatic omentum to the liver in which it produces infection. Again, carcinoma of the pylorus may extend downwards along the gastro-colic omentum to the colon, bridging the intervening space, and becoming attached to or surround the transverse colon. Such a case recently came under my care, in which the pylorus and transverse colon were firmly united by a bridge of carcinomatous tissue. In malignant growths systemic infec-

tion or metastasis is of frequent occurrence and of great interest and importance. Metastasis as a rule occurs through the veins (Thoma), but it may also indirectly occur through the lymphatics. In metastasis the germs of infection, which may be the cells of the malignant tumor, usually become arrested in the first set of capillaries through which they have to pass after leaving the growth. A malignant tumor being situated in the area of the portal circulation, metastasis will occur in the capillaries of the liver, or the infectious material passing the first set of capillaries will go to the right heart and from there to the lungs where they may become arrested in the second set of capillaries, namely, those of the lungs; or passing even the second set, the particles will then go to the left heart and from there will be sent into the general arterial circulation where they will most likely be arrested in the capillaries of the liver, spleen or bone marrow on account of the slowness of the capillary circulation in these organs, as pointed out by Hoffman and v. Recklinghausen, Ponfick, Kunkel, Siebel and others, "on the ultimate destination of free pigment granules in the blood"; or they may become arrested in the capillaries of the brain or kidneys on account of the narrowness of the capillaries in these situations. The arrest of infectious material within the capillaries of an organ is not necessarily followed by the growth of metastatic tumors. In order that metastasis be successful the infectious material must become implanted upon a vessel wall and there find conditions suitable for its life and growth. These conditions may not prevail and it is more than probable that very many, perhaps by far the major portion of the infectious particles which gain an entrance to the circulation, never find a suitable resting place; as a consequence they perish, disintegrate and disappear from the circulation. Aside from the narrowness of capillaries and the slowness of the blood current certain tissues seemingly favor the implantation of infectious particles on account of a similarity of tissue or an affinity of nature. The sarcomata which are mesoblastic in origin seem in their metastasis to favor the connective tissues.

I have at present under my care a patient who had the

scapula removed on account of a sarcoma. At the time of the operation both axillæ were the seats of metastatic growths, and now, some eight months after operation, there is a large growth in the right iliac fossa, one in the right quadriceps extensor cruris muscle, large infiltrations in both the erector spinæ, lumbar region, and several subcutaneous metastases upon the shoulders and neck. These infiltrations have occurred at distant points, since the operation, while the cicatrix and area of operation have remained free. In such a case systemic infection has occurred though perhaps not discoverable before the time of operation. In carcinomata regional and distant, lymphatic metastasis is of very frequent occurence. Surgically speaking, the marrow of the bone is seemingly more frequently affected in the systemic metastasis of carcinomata than any of the other tissues. Carcinosis, cancerous cachexia, or the general systemic poisoning of the fluids and tissues of the body, a condition which often occurs during the later stages of a carcinoma's growth, is due to the products formed incident to that growth, as well as the result of the absorption of products resulting from the disintegration of the cancer.

CHAPTER II.

RETROGRADE CHANGES IN TUMORS.

ATROPHY. Definition: Atrophy in its freest sense can be defined as a diminution in the size of a tissue or organ. This may be due to a degenerative process, or the tissue may have undergone no pathological change, there being simply a reduction in the number or size of the cells or a lessening of the intercellular substance.

Causes: In normal tissues the causes of atrophy are various.

1. *Loss of Function.* This is always followed by more or less of atrophy, as in the uterus after the menopause and in nerves after section. Neoplasms, having no excretory ducts and being without known function, are not subject to this form of atrophy.

2. *Atrophy from Pressure.* This is of common occurrence and may be the result of undue pressure on organs, or tissues, such as the too firm application of a splint or bandage, or the pressure of a tumor upon adjacent tissue. Firm, undue and continuous pressure upon tumors will produce in them pressure atrophy.

3. *Atrophy from Disuse.* This form of atrophy is one of every day observation. The limb or muscle which for a considerable time is allowed to lie dormant and unused undergoes atrophic change. Tumors are not only without known function but they are also without use, consequently this form of atrophy will not affect them.

4. *Atrophy from Deficient Blood Supply.* This affects not only normal tissues but neoplasms as well. A proper blood supply is an absolute requisite for nutrition, normal cell division, and healthy growth, in both normal and pathological tissues. A deficient blood supply will produce in either of them atrophy or else some degenerative change. Deficient blood supply may be the result of thrombosis, embolism, or cirrhosis of tissues.

5. *Senile Atrophy.* This form, which occurs in old age, though it be in normal tissues, does not directly affect tumors.

6. *Nerve Influence and Pigmentation.* Atrophy may also be due to a disturbance or interruption of the trophic nerves. Nerve influence probably does not very materially affect neoplasmic growth. Associated with atrophy there is often an increased pigmentation of the part. This may be due to a decrease in the tissue elements, both in number and size, or to an increase of pigment in the part.

ULCERATION, SLOUGHING AND GANGRENE. These retrograde changes are often noticed in tumors and are of especial importance. Some species, especially the malignant, pedunculated and cystic, are frequently affected by them; others are seldom so affected, and some probably not at all. Probably the most frequent single cause of ulceration, sloughing or gangrene is interference with the blood supply that is normal to the part. This, in malignant growths, in which it often occurs, causes ulceration; occasionally, in ovarian cysts, as the result of a twist of the pedicle, gangrene results; and in pedunculated growths with long pedicles, as the result of traction upon or twisting, ulceration, sloughing or gangrene may follow. Interference with the blood supply, associated with pyogenic or saprophytic infection, will cause a progressive, ulcerative process resulting not infrequently in destruction of a considerable part, if not the whole, of a tumor. Mechanical or chemical injuries, irritation and pressure are also frequent causes. In surface tumors progressive retrograde changes, such as ulceration or sloughing, may be the result of a severe traumatism or the application of caustics, or from surface irritation, the latter the result perhaps of position.

Retrograde changes, either intrinsic or extraneous, in tumors, may be produced by pressure. The central growth of a tumor may produce such pressure against the skin as not only to arrest the circulation in it, but also in the superficial portions of the tumor, tending to ulceration or sloughing. Malignant tumors most frequently cause ulceration in consequence of their peripheral growth; the cells grow into

permeats, and displace the normal histological structure of the skin or mucous membrane; these cells, being poorly nourished and consequently having a low state of vitality, readily fall into decay and ulceration ensues.

CASEOUS DEGENERATION. In this process the tissues of a part are converted into a substance resembling cheese; the fibres lose their identity and the cells and nuclei either disappear or lose their power of taking stains. Under the microscope the mass is either coarsely or finely granular, and surrounded by a zone of coagulation or inflammation, the original tissues being converted into a caseous debris. Virchow explains caseation as "a finely granular degeneration of the tissues into fatty and albuminous material with subsequent inspissation." Thoma regards caseation as "a necrosis of tissue, associated with coagulation of the albumen of the cells, and of the fibrin-containing fluid, which has transuded into the caseous area from the neighborhood." Weigert maintains that a most important part of the caseous process is affected by the wandering into the caseous area of the albuminous fluids and migrating cells of the adjacent tissues, where the albuminous elements coagulate and assist very materially in completing the caseation of the tissues. Caseation in tumors occurs as the result of imperfect nutrition. This may be brought about by cirrhosis of tissue or infarction interfering with the circulation, which may be normally low, the growth being made up largely of cells, or by the pressure of cells, one against the other, this not only interfering with the circulation of the blood, but also of the tissue fluids. Caseous masses in tumors may undergo more or less absorption, in which case cicatricial tissue takes their place, or they may become softened and liquefied, producing a peruloid material, or calcified, by the deposit of lime salts.

Caseation, although occurring in a variety of tumors, is most frequent in the malignant growths.

FATTY DEGENERATION. This may be defined as a process by which the protoplasm of the cell is converted into fat. It must not be confounded with fatty infiltration, which also occurs in tumors, and is simply a deposit of fat

within the tissues without any necessary change in the cell protoplasm. Fatty degeneration may be preceded by cloudy swelling, which is a pathological process occurring in tumors as the result of an inflammatory action, in which the cells swell up and become cloudy, in consequence of the deposit in them of small, dark, albuminous granules. Fatty degeneration not only follows cloudy swelling, but is also often due to interference of the circulation and to poisons. Any process which starves the tissue and thus disturbs metabolism, may produce fatty degeneration. (Fig. 7 c.) The

Fig. 7. Mucoid Degeneration. Carcinoma Mammæ.
a. Cancer Cells.
b. Mucoid or Gelatinous degeneration of Connective Tissue.
c. Fatty Degeneration of Cancer Cells.
(From the Laboratory of the Wisconsin College of Physicians and Surgeons, Milwaukee.)

various toxins such as are engendered in infectious fevers, suppurative and septic processes, as well as those which are not of bacterial origin, as arsenic, phosphorus and alcohol, are also capable of producing fatty degeneration. The tissues, the site of fatty degeneration, are usually increased in volume and lessened in density with a reduction

of their specific gravity. The process may be progressive and result in liquefaction and complete destruction of tissue, or in mild cases, especially if the cell nucleus is preserved, the fat may be absorbed and the part return to its original condition. Macroscopically the tissue is of a light, yellowish color; microscopically the cells are somewhat enlarged and more rounded, the protoplasmic granules, and often the nuclei, disappear, and small, shining granules with dark outlines take their place. The granules may run into very considerable droplets. They are stained black by osmic acid and dissolved by alcohol. Where fat is formed in large quantity so-called margaric acid and cholesterine crystals are observed. Fatty degeneration occurs in malignant growths in fibroids and dermoids.

CALCIFICATION. This process which consists in the deposit of earthy salts, the phosphates and carbonates of calcium, or the oxolates, occurs in tissues which are necrosed or in a low state of vitality, or in which the circulation has been interfered with, causing atrophy, and also in the degenerative processes. Calcificatino may be present in tumors where the circulation is interfered with and may be followed by nutritional disturbance in the cells. A microscopical examination of the tissues in commencing calcification shows the deposit of fine refractile granules in the intercellular substance and even in the cells themselves. These grauules appear dark by transmitted, and white by direct, light. The calcified tissues represent almost every degree of hardness, being at times as firm as the hardest bone. Their color is usually white, gray and yellow. By the addition of hydrochloric acid the salts are dissolved with the production of gas; by the addition of sulphuric acid crystals of gypsum are formed. Calcification occurs occasionally in nearly all tumors. but with especial frequency in the chondroma, fibroma, myoma and sarcoma. Not unfrequently it makes up a very considerable part of the growth. Calcification must not be confounded with, or mistaken for, ossification which occurs occasionally and to a considerable extent in some of the mesoblastict umors. Ossification frequently occurs in tumors springing from bones, cartilages or periosteum.

It is the construction of new tissue by osteoblasts. The salts are more regularly deposited and are in masses between the cells. Ossification occurs in healthy tissues as a physiological process, calcification in diseased tissues as a pathological process. In calcification the lime salts are deposited not only between the cells but also in the cells that show pathological changes in their protoplasm or nuclei. Calcification is supposed to be in part the sequence of a super-saturation of the blood with lime salts. Macroscopically it is difficult or perhaps impossible to differentiate calcification from ossification, and microscopically in order to decide as to the character of the tissue, it will be necessary to detremine the degenerative change, the osteoblasts or the histological structure of bone.

HYALINE DEGENERATION. This is a process closely allied to amyloid, mucoid and colloid degeneration. In fact there seems to be no very pronounced and unchanging line separating them. Colloid degeneration may be transformed into mucoid, or the reverse process may take place, and what was formerly called hyaline degeneration of epithelial cells is now termed mucoid. Hyaline degeneration occurs in toxic conditions of the system; it follows inflammation of the arteries and injury to tissues and seems especially liable to take place in those that are necrosed when air and infection have been excluded. In neoplasms hyaline degeneration occurs in the blood vessels and in the peri-vascular and intercellular spaces. It usually does not occur in gross amount and can seldom be detected macroscopically. In tumors it is most freqnently found in the cylindromata and keloids. Hyaline matter is firmer and less translucent than mucoid, and has not the iodine reaction of amyloid. It is homogeneous or distinctly laminated, and has a decided glistening, waxy appearance. (Fig. 8). Hyaline matter takes the acid, aniline stains. It is probably formed *in loco* and does not materially affect the parenchymatous cells of he part.

AMYLOID DEGENERATION. This form of degeneration occurs occasionally in tumors, especially in those which are

malignant. It affects the stroma more frequently than the specific cells of the part. The amyloid material is seemingly formed in the tissues as it is insoluble in water and in the body fluids. V. Recklinghausen holds that the cells of the part generate the amyloid material and excrete it into the

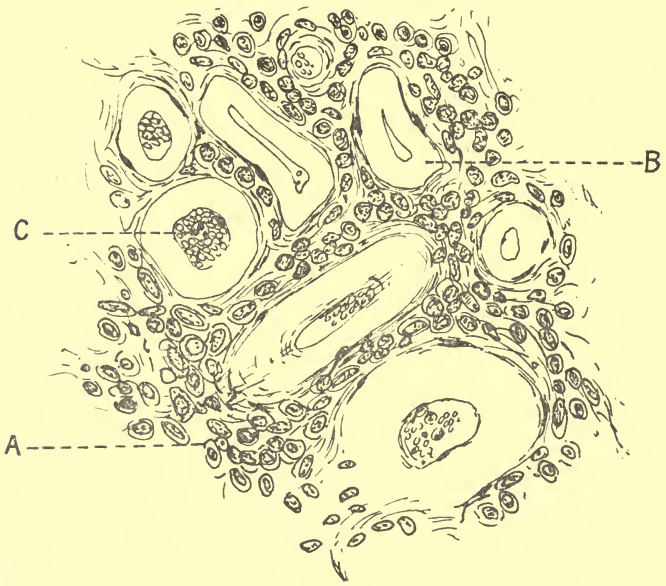


Fig. 8. Angeio Sarcoma.
a. Sarcoma Cells.
b. Hyaline Degeneration of Blood Vessel Walls.
c. Blood Corpuscles.

lymph spaces. It has some of the characteristics of starch, giving the same reactions with iodine and sulphuric acid. Starch, however, is a non-nitrogenous substance, while amyloid material contains about the same proportion of nitrogenous matter as albuminoids. The tissues in which this form of degeneration has occurred are somewhat larger in size, with an increase in the specific gravity. They are smooth and firm on section, the degree of firmness depending somewhat upon the amount and kind of tissue in which the degeneration has occurred. This degenerated tissue has some likeness to wax, being translucent, glistening and homogeneous in appearance. Occasionally when the degen-

erated material is in excess the tissues will appear mottled and lardaceous.

In gross specimens the iodine reaction is most valuable, iodine 1.0 potassium iodide 10.0 aquæ destill. 100.0. This colors the amyloid material a mahogany brown, while the normal tissue is colored a straw yellow. In a microscopic section the gentian violet reaction is valuable. It colors the amyloid material a pink, while the other tissues are colored blue. Amyloid degeneration is produced by processes which lower the general vitality and thus markedly change the metabolism of the tissues. It frequently occurs in cases of long continued suppuration, in syphilis, malaria, leukæmia, and in the cachexia from cancer. Not only does the degenerative change affect tumors, but there are amyloid tumors composed entirely of amyloid material. These are supposed to be due to a nutritional disturbance of the cells of the part. The amyloid tumor has been found to occur in the conjunctiva, larynx, and at the root of the tongue, and may attain the size of a walnut. (Leber, Rohlmann, Ziegler).

Mucoid degeneration. We understand this to be a process by which the tissues—epithelial, connective, and ground substance, are converted into mucin. The degeneration will most frequently have its origin in the epithelial cells of the part and may remain limited to them, but often it will spread out beyond these cells and include all the tissues. Mucin is a soft, gelatinous, semi-fluid, hyaline substance which is insoluble in water, though capable itself of absorbing it, and soluble in alkaline solutions, dilute caustics and lime water. It is precipitated by acetic acid, heat and alcohol, and some of the metals. Mucoid degeneration must not be mistaken for the hyper-secretion of mucin, which occurs in the epithelial cells and glands of mucous membranes which are subject to irritation and inflammation; nor the normal or physiological secretion of mucin which occurs in the goblet cells of mucous membranes and glands. In the physiological process the granular protoplasm of the cell becomes converted into a clear mass of mucus. During this process the nucleus si

compressed and the cell wall much distended. With the completion of the process the cell wall ruptures, the mucus is discharged and the protoplasm at once becomes regenerated. This process may be repeated almost indefinitely; on the other hand, in mucoid degeneration, the histological structure of the part is entirely changed, the tissues normal to the region disappearing by being converted into mucin. In mucoid degeneration of epithelial cells, their protoplasm is changed into a transparent substance which is dotted here and there with granules. If the process affects connective tissue it is converted into a mucoid, homogeneous, structureless mass, (Fig. 7 b) which is soft, elastic and easily torn. In connective tissue it is seen that the mucus lies between the cells, and the ground substance has disappeared. Mucin may be stained with hæmatoxylin or methyline blue. Mucoid degeneration frequently occurs in the sarcomata, carcinomata, fibromata, chondromata and myxomata, and may affect any one or all of the tissue elements. It renders a tumor, in whole or in part, soft, semi-fluid, variable in consistence and sometimes cystic. Mucin is not deposited, but formed within the tissues, seemingly by the conversion of proteids.

Colloid degeneration. This is a process quite like, and one not easily differentiated from, mucoid degeneration. Colloid material, in contradistinction to mucoid, does not absorb water and is not precipitated by acetic acid or alcohol. Colloid degeneration frequently occurs in goiters, thyroid growths and also in carcinomata, especially when situated in the stomach or intestine. During the process in the carcinomata the cancer cell becomes changed into a transparent homogeneous drop. This process may progress until the cells ofan entire alveolus are converted into a gelatinous substance in which nothing is to be seen of the cells excepting here and there some granular remnants of the protoplasm. On section these colloid masses are usually not visible macroscopically, but occasionally the process is carried so far that the stroma of the tumor also undergoes degenerative change, when distinct colloid material, often in the form of cysts, these having thin walls and being yellowish or

brownish in color, will be seen. These masses resembling amber beads are in appearance quite like bunches of grapes. The process is often accompanied by a serous transudation which seems to dissolve the colloid material, so that there are only compartments left containing a

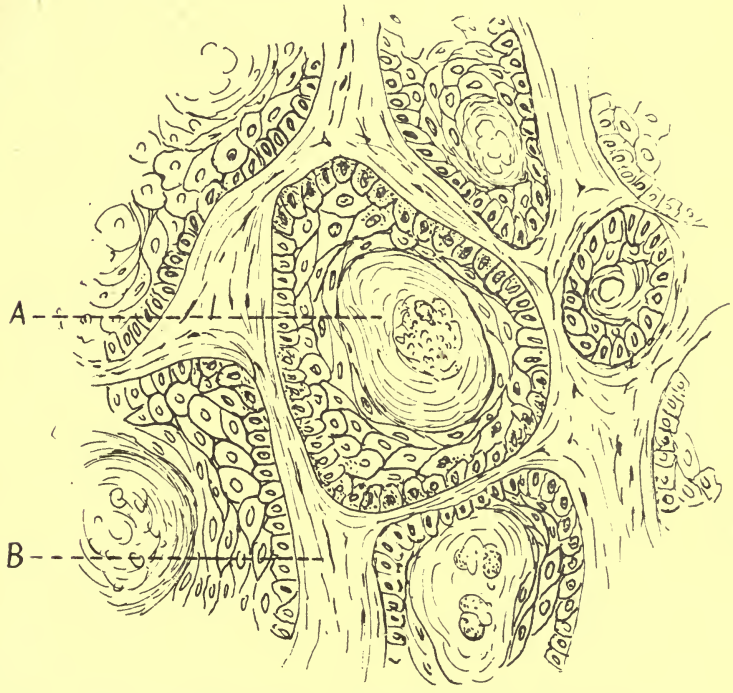


Fig. 9. a. Epithelioma. Colloid Centre of Epithelial "Nest."
b. Connective tissue Stroma,

chocolate-colored fluid. Microscopically the process is not always to be distinguished from mucoid or hyaline degeneration, and even with the aid of chemical reagents the differentiation will not always be easy. (Fig. 9). In growths of the thyroid and in carcinoma the colloid material will be found in the glandular acini, the alveoli, and the connective tissue. In the alveoli of a carcinoma the cells may be in part or entirely replaced by colloid material, or the cells and stroma may have been converted into a colloid mass leaving in places nothing of the original

tissue. In Fig. 10 the major portion of the growth, a scirrhus of the breast, had been converted into colloid material

Fig. 10. Scirrhus of the Breast.
From the Laboratory of the Wisconsin College of Physicians and Surgeons, Milwaukee.)

in which there was none of the original tissue present, and it was only at the border and in the area which still remained hard, that cell structure and stroma could be found. Colloid material seems to be formed *in loco* and apparently is due to some nutritional change or to a preceding inflammatory action.

CHAPTER III.

THE TISSUE ORIGIN AND CLINICAL COURSE OF TUMORS.

In order that the surgeon, as well as the student, may be able to make a differential diagnosis and to prognosticate the probable course, as well as to determine the likelihood of regional or systemic infection, he must know the tissues from which any given tumor has had its origin. In the early days of embryonic development, before the construction of tissues, there are to be found only round cells, alike in form and without function. But later in the life history of the embryo these round cells become differentiated and form the germ layers, the tissues and organs of the body. It has been quite customary to classify tumors embryologically as coming from one of the three germ layers, the epiblast, mesoblast or hypoblast. While the classification is somewhat restrictive and, to that extent, of benefit to the student in limiting the general area from which a tumor may have its origin, it does not, nevertheless, impart sufficient information, without qualifying terms, to make it of any considerable value. If we examine the germ layers histologically and then consider the possible origin of the various tumors from these layers, we will find that the amount of information conveyed by simply stating that a tumor comes from a certain germ layer is not great. There is also seemingly a want of uniformity among writers as to their understanding of the histological structure of the germ layers. This seeming want of agreement, or perhaps confusion, among writers is shared to some extent by embryologists and has added very materially to the embarassment of the student in this particular line of study. The parts formed from the blastodermic layers, as given by Prof.

Schafer in Quain's Elements of Anatomy, are tabulated as follows:

From the Epiblast:

"The whole of the nervous system, including not only the central organs (brain and spinal cord) but also the peripheral nerves and sympathetic.

The epithelial structures of the organs of special sense. The epidermis and its appendages, including the hair and nails.

The epithelium of all the glands opening upon the surface of the skin, including the mammary glands, and the sebaceous glands.

The muscular fibres of the sweat glands.

The epithelium of the mouth (excepting that covering the tongue and the adjacent posterior part of the floor of the mouth, which is derived from the hypoblast) and that of the glands opening into it. The enamel of the teeth.

The epithelium of the nasal passages, of the adjacent upper part of the pharynx and of all the cavities and glands opening into the nasal passages.

The epithelium of the anus and immediately adjacent part of the rectum.

The epithelium of the vagina and of the urethra.

From the Mesoblast:

The urinary and generative organs (excepting the epithelium of the urinary bladder and urethra.

All the voluntary and involuntary muscles of the body (excepting the muscular fibres of the sweat glands).

The whole of the vascular and lymphatic system, including the serous membrane and spleen.

The skeleton and all the connective tissue structures of the body.

From the Hypoblast:

The epithelium of the alimentary canal from the back of the mouth almost to the anus, and that of all the glands which open into this part of the alimentary tube.

The epithelium of the Eustachian tube and tympanum.

The epithelium of the bronchial tubes and air sacs of the lungs.

The epithelium lining the vesicles of the thyroid body.

The epithelial nests of the thymus.

The epithelium of the urinary bladder."

If we consider the germ layers minutely in accordance with the above tabulated form and for the purpose of determining the exact histological structure of each layer, we

find that in the epiblast, while the epithelial tissue perhaps predominates, there is, nevertheless, a great quantity of connective, and some muscular, tissue. In the mesoblast, while the connective and muscular tissue prevails there is at the same time a great amount of epithelial tissue, as, for instance, that in the secreting structure of the kidneys, the testicles, the ovaries, the uterus and the surface endothelium of the serous membranes. The hypoblast alone is made up almost entirely of epithelial, or one kind of tissue.

Some writers speak of tumors which have their origin from either the epiblast or hypoblast as being necessarily of epithelial structure, and, again, those coming from the mesoblast as being alone of muscular or connective tissue origin. This classification is evidently incorrect from a histological standpoint and likely to lead to error in diagnosis. A tumor having its origin from the epiblast may be a fibroid, a myoma, an adenoma, a cystoma, or the tumor may be malignant and be either a carcinoma or a sarcoma. From the mesoblast we may have practically every form and kind of tumor known, and only in the hypoblast will the tumor formations be limited to epithelial structure, and even here we may have either an adenoma, a cystoma or a carcinoma. The classification of tumors according to their supposed origin from one of the germ layers, may not only be unsatisfactory in consequence of the germ layers being made up of so many different kinds of tissue, but it may also lead to error in that it will often be impossible to determine the germ layers from which a given tumor has had its origin. Take, for instance, a tumor of the thyroid gland, the stroma and vessels come from the mesoblast, while the epithelial structure, the secreting part, comes from the hypoblast. What is such a tumor to be called—a hypo-mesoblastic tumor? Again a tumor growing in the mammary gland may contain epithelial structure from the epiblast and connective tissue from the mesoblast. Shall we call this an epi-mesoblastic tumor, and will it convey much information if we do? If a tumor grows from the back of the mouth, or from the side of the tongue, or from just within the rectum, at a point where the epiblast and hypoblast meet, or perhaps

form the sub-mucous tissue, who can say whether the tumor is epiblastic, hypoblastic or mesoblastic? It may be an epi-hypo-mesoblastic tumor, and be solid, cystic, benign or malignant. Confessedly then it will often be most difficult or even impossible, to correctly designate the germ layers from which a tumor has had its origin, and even if one were able to do this, but little information is given concerning the tissue origin, the nature or general characteristics of the growth. While then it may often be a convenience and a help to speak of tumors as coming from this or that particular germ layer, nevertheless, for purposes of study, as being more exact and imparting more information, it is probably better to adhere to the histological tissue origin of tumors. To say that a tumor is of epithelial or connective tissue origin, imparts a great deal of information as to its structure and characteristics, consequently in discussing the tissue origin of tumors, we shall rely more upon their histological than their embryological origin. A tumor coming from epithelial cells will have the characteristics of epithelial structure and may be either benign or carcinomatous, but it cannot be a sarcoma. On the other hand, a tumor having its origin from the connective tissues, either in their embryonal, fully developed, or in a state of higher development, will always be a connective tissue tumor. It may be a benign growth or a sarcoma, but it never can be a carcinoma. A carcinoma will always spring from epithelial tissue, a sarcoma from connective tissue, while a benign tumor may come from either. Histologists divide the tissues of the body into four classes—the epithelial, connective, muscular and nervous. But in so far as the tissue origin of tumors is concerned, we may simplify this classification by putting all of the tissues into two classes. This will place the nervous tissues with the epithelial because they have the same embryological origin, and the muscular tissues with the connective for the same reason. It will divide tumors in so far as their tissue origin is concerned into epithelial and connective tissue growths.

THE CLINICAL CHARACTERISTICS OF BENIGN AND MALIGNANT TUMORS. With few exceptions the growth of be-

nign neoplasms will be slow, uniform, uninterrupted and often scarcely appreciable from month to month or even from year to year. This slow growth may be an inherent characteristic of the tumor or the result of a poor blood supply, or both combined. Occasionally a benign tumor such as a soft fibroid, a chondroma or a cystoma may have a rapid growth, but these will be the rare exceptions which will not invalidate but rather help to prove the rule. Benign growths are possessed of a distinct capsule which they do not transgress, the tumor cells never passing beyond the capsule into the surrounding tissue. Benign neoplasms are freely movable and easily shelled out of their bed. This is in consequence of their perfect encapsulation and the loose connections between the capsule and the adjacent tissue. The border of a benign tumor is easily defined and readily marked off from the healthy tissue. Benign tumors have a pretty uniform density, which as a rule either equals or exceeds that of the surrounding tissue. They frequently undergo formative changes, parts of the tumor being converted into a tissue of a higher grade, a myxoma into a chondroma or osteoma, a fatty tumor into a fibroid; while occasionally they undergo degenerative change, the tissue of the tumor being converted into that of a lower grade. The growth of benign tumors being always limited by their capsule, they never cause regional or systemic infection, nor the implication of the adjacent or remote lymphatic glands. Benign tumors, if completely removed, never return. Their growth is usually painless because they do not infiltrate or destroy adjacent tissue, but simply push it one side. Benign tumors usually grow centrally or in an expansive manner, pushing the older tissues toward the periphery, where probably as the result of irritation and condensation of tissue a capsule is formed. Benign tumors in their growth do not form ptomaines or toxines or readily undergo suppurative or ulcerative change. Consequently they do not affect the health, constitution or well being of the patient, except mechanically, nor do they produce a cachexia.

Characteristics of Malignant Tumors. The general characteristics of the benign as well as the malignant growths,

should be kept well in mind by the student of order that he may be able to differentiate them at the bedside. As compared with benign growths, the malignant have a much more rapid and irregular growth, attaining perhaps in a few months a size which it would require a benign tumor as many years to reach. Their growth is not uniform nor always progressive, but, on the contrary, very variable, now fast and then again slow, or seemingly at times to stand still or even to diminish in size, causing atrophy or shrinkage of the organ or tissue from which or in which they are growing. Malignant growths are often of unequal consistence, at points hard or of semi-hardness, and then again soft and even fluctuant. If cysts are present they will be irregularly placed through the growth, of varying size, thin walled and often made to project above the surface of the growth. The cysts are often filled with blood and debris, the result of hæmorrhage and the breaking down of the softer portions of the tumor. They usually are in direct communication with one or more large blood vessels. Malignant tumors are made up very largely of cells. The cells are poorly supplied with blood and consequently in a low state of nutrition. This often results in degeneration and liquefaction of tissue with cystic formations. The blood vessels, often thin-walled or possessed of but an endothelial coat, or without coats other than the cells of the part, are as the result of violence or undue blood pressure or softening of tissue ruptured, with the result that the blood escapes into the softened tissue, changing its density and forming cysts of greater or lesser size. The cysts thus formed may be few or many. Malignant growths never have a capsule which is not transgressed by the tumor cells. The great majority are without even the semblance of a capsule, and as a result of their peripheral growth they infiltrate, perhaps destroy, the adjacent tissue. As a result of their non-encapsulation they seldom have a definite border, but shade off almost imperceptibly into the healthy tissue. In fact at their seeming border in tumors that are encapsulated, outside of the capsule there is always an intermingling of tumor cells with normal tissue, rendering recurrence almost certain after

enucleation. In consequence of this intermingling of benign and malignant cells the tumor not only becomes inseparable from, but after a time immovably fixed within, the normal tissues. It is not always an easy task, in fact it requires time and care and, it may be, repeated examinations to determine in a movable organ, like the breast, whether a growth moves with the organ or is separate from it. Pain is usually caused as the result of the growth of malignant tumors. This may be a burning, gnawing, piercing or lancinating pain, which is often severe and sometimes even excruciating. The pain is caused by the infiltration and destruction of normal tissue, the pressure upon, irritation and destruction of sensitive nerves. One of the chief characteristics and pathognomonic symptoms of malignant growths is their production of lymphatic involvement, with regional and systemic infection often added thereto. Enlargement of the proximal lymphatic glands may occur in benign growths that have undergone pyogenic or pathogenic infection, but aside from this these conditions are pathognomonic of malignancy.

Ulceration is of frequent occurrence in malignant growths. This may be the result of pressure or traumatism, but it is more often due to the infiltration of the overlying tissue with poorly nourished cells which readily fall into decay.

The Cancerous Cachexia. In some persons suffering from cancer there appears during the course of the disease a condition which has been termed the cancerous cachexia. This is usually described as characterized by loss of flesh, and strength, by anæmia, sallowness of the skin, and a careworn, haggard expression of the countenance. A state which has been observed and described by physicians for hundreds of years could scarcely be said not to exist; nevertheless it can scarcely be denied that it is more often conspicuous by its absence than by its presence, and the student who looks for a cachexia as a characteristic of cancer will more often be disappointed than otherwise. The cancerous cachexia seldom occurs until late in the disease, when ulceration, suppuration and general systemic infection has taken place.

General systemic infection is probably an indispensable condition, while ulceration and suppuration are adjuvants.

Of the cases that come under observation the condition is probably not present in one in twenty. A woman, about 66, presented herself some days ago for examination. She was plump and erect in figure, with a pink and white skin, sparkling eyes and a sunny countenance, a beautiful specimen of womanhood of her age, and still she had had a scirrhus of the left breast for the past three years. At time of examination there was destruction of the nipple by ulceration and involvement of all of the axillary glands.

The cancerous cachexia is perhaps difficult to describe as it varies much in different persons. It is not anæmia alone, nor loss of flesh, nor a careworn or sallow hue of complexion, but a peculiar combination of these conditions. Some months ago a woman, age 55, presented herself for a consultation. She was suffering from a soft, ulcerating carcinoma of the interior of the uterus. She had had severe and repeated hæmorrhages, was very anæmic, but fleshy, and in conversation at times animated, and then again listless. Her appearance was striking. There was a yellowish whiteness about her distinctly waxy, apparently œdematous skin, that was remarkable. The skin seemed almost translucent, although she was anæmic this was not anæmia, nor was there a careworn face or loss of flesh, but it was a general carcinosis, a cancerous cachexia, in a most striking and characteristic form. The patient's condition grew rapidly worse and she died at the end of two months in an asylum for the insane.

CHAPTER IV.

THE DIAGNOSIS OF TUMORS.

The correct diagnosis of a tumor may be easy, difficult or impossible according to circumstances. The rightful interpretation of a particular growth, perhaps superficially situated and easily defined, may be the task of but a moment, but not unfrequently, however, a growth, even if superficially situated and accessible to examination, will have had its general characteristics so altered by formative or degenerative change as to render a correct diagnosis most difficult. It unfortunately too often occurs that a growth deeply situated in some one of the great cavities of the body is so masked, hidden and inaccessible, and the condition of the patient so unsatisfactory for examination as to render a correct diagnosis an impossibility. It may be stated without fear of successful contradiction, that the correct diagnosis of tumors under all conditions is easily the most difficult problem in the entire domain of surgery, and not unfrequently a probably correct diagnosis is only attained after the most careful and painstaking research, reinforced by repeated examinations. In making an examination in any given case of tumor one should have some well-defined method or rule of procedure. Rules of progress, if they are practical, lighten the work, assist the memory, cultivate thought and make the examination more thorough. In having the work systematized, important points are not likely to escape observation; we not only gain the whole truth, but are also enabled to eliminate factors leading to error. If we gather all the facts our review of the case is likely to be easy, satisfactory, and lead to a correct diagnosis. On the contrary, if, in consequence of a want of system or otherwise, we gather but a portion of the facts, the review may be difficult, unsatisfactory, and perhaps lead to errors in

diagnosis. Nothing is more to be deplored in the young surgeon, and nothing more likely to bring upon him reproach and adverse criticism, and upon his patient misfortune and even disaster, than a non-systematic, careless and incomplete method of examination. He may think to complete and correct the diagnosis in the operating room, and this at times may be unavoidable, but it is seldom, if ever, done with credit to the operator or benefit to the patient. Anything short of a most systematic, thorough and painstaking seeking after the truth in one's endeavor to make a correct diagnosis in tumors is reprehensible, almost criminal, and should not be countenanced or tolerated.

In addition to making a systematic and thorough examination the surgeon should keep a record of his cases. Case taking, so frequently slighted, or perhaps entirely neglected, stands next in importance to a complete and systematic examination. If a surgeon keeps a record, this of itself will not only be an inducement but it will create almost a necessity for systematic and thorough work. Full, complete and sytematic records of a large number of cases will not only be a mine of wealth, but of inestimable value for future reference. The memory is treacherous and can scarcely be entrusted with the detail of a great variety of cases, and every case has something of value that should be preserved. Case taking results not only in an accumulation of valuable facts, but it is also a great educator. "Who can estimate how much we have lost from the fact that generations of men gifted with powers of acute and shrewd observation have passed away without leaving one record behind them.

Think not that it is the hospital physician or surgeon alone who can advance the progress of medicine. There is not a practitioner who could not aid this great work. But he can only add to it with efficiency if he has faithfulyl recorded his observations and does not trust to the general and vague impressions of an unassisted memory. Therefore on all grounds personal to yourselves and general for medical science, so engrain this habit within you that it becomes a second nature." (Coupland.) The following form

nas been found convenient for securing and preserving the records of cases:

Name			Race
Address			Birth place
Age	Sex		Family history
Father			Mother
Brothers			Sisters
Grandparents			
Mother's side			
Father's side			
Aunts			Uncles
Personal history			Habits
Diseases			
Previous tumors			
Present tumor			Duration
Location		Pain	
Rate of growth			
Possible exciting cause			
General appearance of patient			
State of nutrition			
Examination			
Condition of skin over tumor			
Size and number of veins			
Contour of tumor			
Solid	Cystic	Hard	Soft
Capsule	Movable		
Condition of glands			
Regional infection			Systemic
Ulceration			Hæmorrhage
Diagnosis			

These sheets may be bound with an intervening blank page for remarks. Upon this should be recorded anything of interest concerning the subsequent course of the tumor, nei medical and surgical treatment, the operative technic and the microscopical examinations.

The examination and study of any given case of tumor for the purpose of making a diagnosis should be conducted with the following subdivision of the subject in mind: 1st, Heredity or predisposition. A short history of the ancestry

and immediate relations should be obtained in so far as it may have a bearing upon the growth in question. 2nd, A full and complete clinical history should be obtained. 3rd, There should be a most painstaking and conscientious examination of the patient and tumor. 4th, In cases where the macroscopic appearances are not absolutely conclusive, a microscopical examination of the tumor should be made, either before or after removal.

Hereditary influences are important in the carcinomata, the granulomata and probably also in the fibromata. The examination must extend through at least three generations, as it is a well-known fact that transmission may pass over one generation to reappear in a generation later. It has seemed that hereditary influences were quite as pronounced in some cases of fibromata as in that of carcinomata or granulomata. The writer has now under his care a woman with multiple fibroids of the uterus. Her only sister underwent an abdominal hysterectomy for fibroids. Their mother died as the result of uterine fibroids. A sister of the mother has an only daughter who also has uterine fibroids. This is but one of many such cases that have come under observation.

The Clinical History:—Seemingly far too little attention is paid to this part of the subject. The Surgeon who after a few desultory questions proceeds to the examination of the tumor is very often obliged to return to the clinical history before he has half completed the physical examination. A full and satisfactory clinical history will not only aid the surgeon in his examination, but it is an absolute necessity, for a proper understanding of the case and will often make the diagnosis comparatively easy, whereas, otherwise, it might be difficult or impossible. With a complete clinical history a diagnosis may be possible without even an examination. If more time is devoted to the clinical history less will be required for the examination and the results will be better. To illustrate—one of the best diagnosticians in the city of Milwaukee will devote from one half to perhaps one hour to the history of the case, and then but a few moments to the physical exam-

ination. He obtains the history so perfectly that little else is required to establish the diagnosis. The clinical history should cover the diseases, if any, from which the patient has suffered, as well as his condition previous to the appearance of the tumor, as these may explain in a measure, his present state. The information should always be gained if the tumor is the first from which the patient has suffered. This is important as showing a possible fibroid or fatty dyscrasia or perhaps a secondary metastatic growth, the result of a primary malignant tumor which has been removed. The surgeon must also inquire as to the time when the tumor was first discovered, and when symptoms were first manifested indicating local or general disturbance. The time the patient first discovered the tumor cannot be taken as the time of origin. Patients discover tumors accidentally and the time of origin will usually have ante dated this by several months, perhaps years. But a few weeks ago the writer removed from a young girl, aged twenty, an ovarian tumor reaching to the umbilicus, which had not been detected by the patient and was only discovered by the attending physician in an examination for supposed appendicitis. The detection of a tumor by a patient will, as a rule, be antedated for months by symptoms of disturbed function, or local pain or loss in general nutrition or strength, or in all of these conditions combined. These symptoms of local or general disturbance are of importance as more nearly indicating the time of origin of the tumor. The amount of pain caused by a tumor is of importance. The production of pain during the growth of a tumor is dependent upon such a variety of circumstances that it cannot be taken as representing a great amount of diagnostic worth. Benign tumors only produce pain mechanically, that is, by pressure. This ordinarily is not great and may be entirely wanting. In benign tumors connected with sensitive nerve filaments, as the painful subcutaneous tubercle, the pain is generally severe, particularly upon pressure. Occasionally, however, the pressure of a benign tumor, especially if situated within the abdomen, will directly or indirectly cause attacks of localized inflammation, during which the pain may be severe,

even alarming. With the subsidence of the inflammation the pain disappears to return perhaps again and again. In malignant growths the pain depends upon one of two, possibly three, conditions. 1st, Mechanical pressure, which is often aggravated by attacks of localized inflammation. 2nd, Destruction of tissue, epithelial, connective, muscular, nervous. And 3rd, The products of this destruction and disintegration of tissue with the ptomaines and toxines engendered, and the pyogenic and pathogenic germs, acting upon the sensitive nerve filaments of the part. While the pain of a benign tumor is usually slight and often entirely absent, that of a malignant growth is generally severe and most always present. If the pain of a benign growth as the result of pressure, possibly infection, and attacks of inflammation, is sometimes and for short periods almost unbearable in its severity, that of a malignant growth, in its severest form, is well nigh continuous, ever boring, grinding or lancinating, and in severity the most excruciating and horrible that the human being is perhaps ever called upon to suffer. As a whole, then, the pain of a malignant growth is much more severe and continuous than it is in a benign growth.

The Location of a Tumor.—The location of a growth upon its first appearance is of pronounced importance in a diagnostic sense. If the tumor is situated upon an extremity, it will be of interest to know if it was primarily deep-seated and near or upon the bone, or just beneath the skin, or if it had its origin from the skin. If coming from the skin, it may be of epithelial or connective tissue origin, solid or cystic, benign or carcinomatous. If it had its beginning from beneath the skin it will be of connective tissue origin and, barring a possible traumatic dermoid, be either benign or sarcomatous. If the tumor is abdominal, its primal location will be of decided importance. In a female a tumor having its origin within the pelvis and to one side, is likely to be from either the ovary, broad ligament or the Fallopian tube if centrally situated from the uterus. A tumor implicating the ascending or descending colon will be at the side of the abdomen, while one of the transverse colon will be about on

a line with the umbilicus. Tumors of the stomach will usually be above this line. Tumors of the kidneys, often difficult of differentiation, come from beneath the ribs and posteriorly.

Rapidity of Growth.—Benign tumors with few exceptions grow slowly, and not all malignant tumors grow rapidly, but rapidity of growth is a strong indication of malignancy.

Fever.—Benign tumors that are not complicated with inflammation or infection—do not produce fever. Malignant tumors that are growing rapidly, irrespective of inflammation or infection, are usually attended with fever, the temperature often ranging from 100° to 102° F.

Loss of Weight and Strength.—The ovarian face and enormous abdomen of twenty years ago are seldom seen to-day. Not that the same great tumor would not produce a like condition, but the ovarian tumor is not now allowed to grow until by pressure upon the gastro-intestinal canal it so interfers with digestion and assimilation as to produce a grave condition of malnutrition. Emaciation and loss of strength are usually not incident to the growth of benign tumors, but they are common during the growth of malignant tumors, and especially the carcinomata. This is especially true of carcinomata affecting organs in contradistinction to those affecting tissues.

Loss of weight and strength during the growth of carcinomata are due to many causes. The horrible pain from which many patients suffer, with the mental anguish and loss of sleep are prominent factors. The disturbance of function, and, as a consequence, or, as an associated condition, the prevention of nutrition, are also causes. The fever which so frequently accompanies the rapidly-growing tumors, the pyogenic infection with ptomaine poisoning, each one and all act in their own way to produce a loss of flesh and strength.

Ulceration and hæmorrhage occurring during the growth of a tumor are not only of diagnostic worth, but they are also active causative factors in the loss of flesh and strength. These complications are rare in benign tumors, where ulceration seldom occurs, except as the result of a traumatism with infection. Ulceration in malignant growths is not only of

frequent occurrence, but the character of the ulcer is of diagnostic worth, being fungous and bleeding readily in the rapidly growing tumors; but hard, excavated, dormant and bloodless in those of slow growth. Barring the uterine fibroid and the villous tumor of the bladder, benign tumors seldom cause hæmorrhage; on the other hand, hæmorrhage is one of the most pronounced characteristics of malignant growths.

Possible Exciting Causes.—Malignant growths are so frequently the seeming result of continuous irritation or local injury, that these conditions, if they have been active, may be taken into account in arriving at a diagnosis. After having gained a complete anamnesis of the patient by interrogation, the surgeon is prepared for an objective examination of the case. This examination may be confined to the tumor and its immediate surroundings, or it may be extended so as to include every important organ in the body. When a diagnosis is reached, it must not be simply a name for the tumor, but should include as well the prognosis and the line of proper treatment to be pursued. Much information may be gained by a simple inspection of the tumor area. The condition of the skin should be noticed: if it is intact or ulcerated, of natural color or reddened, under tension and thinned or lax and of normal thickness. The veins are also important. Are they enlarged and increased in number or in a normal state? We also may gain valuable information concerning the size, contour and general appearance of the tumor.

The Objective Examination.—The first essential in the examination is to determine by the means at the examiner's disposal, such as palpation, percussion, auscultation, and the use, if necessary, of instruments devised as aids, if the patient really has a tumor. The patient's statement or belief, or the statement of the attending physician, are never to be taken in lieu of a personal examination. Only to-day a patient presented herself, stating that she had a tumor of the breast. Two young surgeons, after examination, advised amputation. The tumor had increased rapidly in size during the past two weeks. The axillary glands were enlarged and there was an indistinct sense of fluctuation in the tumor. A hypodermic needle disclosed pus.

The surgeon is held responsible, and properly so, for the result; consequently he must acquaint himself with the facts. If a tumor is present the following considerations should be borne in mind during the examination:

First.—Is the tumor encapsulated, well defined and movable, or the reverse? Much of the correct diagnosis and prognosis will depend upon the proper interpretation of these conditions.

Second.—Is the tumor solid, semi-solid or cystic? These are most important considerations, and ordinarily there should be no great difficulty in differentiating them, especially if the tumor is superficial. Nevertheless, there are perhaps no questions in diagnosis concerning which errors of judgment are more frequent. A good rule to follow when in doubt, and the conditions are practicable, is to use the hypodermic needle.

Third.—Is the tumor the site of spontaneous pain and is pain produced on pressure? Spontaneous pain in a tumor is due to irritation, inflammation or destruction of sensitive nerves or tissues. Pain on palpation will usually result either from pressure upon a sensitive nerve or from infection with inflammation.

Fourth.—What is the contour and rate of growth? It is perhaps true that the diagnosis cannot be advanced very much by an answer to these questions. Still it is well known that tumors of rapid growth are most frequently of smooth surface and are usually malignant. Irregularity of growth is also more frequently found in malignant growths than in benign. As has been already stated, it is of the utmost importance to determine whether the contour is well-defined or if it shades off imperceptibly without known limits into the adjacent tissues. An irregularity of contour may be the result of a cirrhosis of tissue or due to the fact that the tumor is growing from a peripheral point.

Fifth.—Are the proximal glands enlarged, and is there regional or systemic infection? This is one of the most important questions in a diagnostic sense that can be asked, as regional or systemic infection means malignancy, while enlargement of the proximal glands may be interpreted differently. In judging of the value of enlargement of these glands

the surgeon must bear in mind the fact that they may become enlarged during the growth of a benign tumor that has become infected by some one of the pyogenic germs.

Transparency of Tumors.—The possibility of transmitting light through tumors by ordinary means is not unfrequently taken advantage of in their diagnosis, as in hydroceles and also in some solid tumors having clear contents, as the myxomata.

Pulsating Tumors.—Apparent or real pulsation in a tumor is often of decided importance in a diagnostic sense. There are many tumors which pulsate, such as the angeiomata, the pulsating encephaloid, the vascular, soft sarcomata, the erectile tumors and pulsating tumors of bone. In all of the vascular tumors the pressure effects are marked, lessening their size and decreasing or arresting the pulsation. Their growth must be differentiated from aneurisms and from solid tumors and abscesses placed over arteries of considerable size. In aneurism the tumor or sac has an expansile character with each pulsation, and a bruit, and is affected by direct pressure as well as pressure upon the vessel above and below the tumor. In solid tumors or abscesses placed over a vessel, there is simply a lifting up with each pulsation. They are also unaffected by pressure and have no bruit. In the diagnosis of tumor a glance may at times be sufficient, but ordinarily a complete history of the case, and a careful examination, will be found necessary. It will occasionally, perhaps frequently, happen that after the first examination there will remain much of doubt and perplexity in regard to the exact conditions present, while after the second examination all will be clear and satisfactory. It is quite true that while the surgeon is by his objective examination usually able to make a diagnosis sufficient for surgical purposes, he is often unable to say, with positiveness, whether a certain tumor is benign or malignant, or to determine its exact histological structure. These are matters which must be left for microscopical study, and every tumor concerning whose character or histological structure there is the slightest doubt should be subjected to a microscopical examination. It may not often be necessary or seem advisable to do this before operation, but before or

after in nearly every case it should be done. The microscope gives information both for diagnosis and for prognosis, which is invaluable, and it cannot be obtained in any other way. For without its aid who could, *e. g.*, differentiate, macroscopically, the spindle-celled sarcoma or the fibro-sarcoma from the pure fibroma, or some of the medullary carcinomata from the round-celled sarcomata, or tell whether one of the cystoma, fibroma, myxoma, chondroma, is pure or mixed with sarcomatous cells? The proposition needs no argument, for every one recognizes the fact that it cannot be done. The daily use of the microscope is a mighty educator, assisting wonderfully in the diagnosis, not only of the present case, but the experience so gained will aid materially in the correct interpretation of those that follow. It is safe to say that the surgeon who relies entirely upon the history of the tumor, the objective examination, and the macroscopical appearance, will at least be in doubt about one-half of the time. It is true that the busy surgeon may not, and probably will not, have time to use the oven and microtome and their use can without prejudice be delegated to others, but he should have time for the daily use of the microscope, if he wishes to attain the best result in both diagnosis and prognosis.

CHAPTER V.

THE PROGNOSIS OF TUMORS.

There are some questions relating to the prognosis of tumors which are asked many times each day, both by patients and their friends, and it is of the utmost importance that they be answered correctly. A definite and exact prognosis is not always and at all times possible, but in so far as it is within our power by intelligent and careful research to determine the future of any given tumor it should be done. This course will not only be to the best interests of the patient, his future welfare and perhaps peace of mind, but it will also conserve and increase the reputation of the surgeon. Most persons are sufficiently inquisitive as to desire a name for any given tumor, even if that name does not convey to them very much information. They are desirous of knowing not only its name, but they solicitously inquire regarding the growth and ultimate effect of the tumor upon the system. These inquiries are not only made, but the patient or his friends have a right to expect that they will be answered fully and as nearly as possible correctly. In order to successfully forecast the course and probable termination of a tumor the surgeon must first have made a correct diagnosis. He must not only have determined the special character of the tumor, as to which particular genus or species the tumor belongs, but also its situation and environment.

The first and most important question to be decided, then, is as to whether the tumor is benign or malignant. While this is a question of diagnosis its correct solution is absolutely essential in making up a prognosis. As has been already

stated a tumor is either benign or malignant. There is probably no middle ground, and while histologically it is usually perfectly easy to differentiate them, clinically they often pursue a parallel or like course. It is also undoubtedly true that occasionally benign growths, as well as normal tissues, are either transformed into, or the site of, malignant tumors. The occasional conversion of benign epithelial growths situated upon cutaneous or mucous surface, as well as cicatrices and simple ulcers, into malignant tumors or ulcers, is now well known. If we are able to establish the benign character of a given growth its prognosis may be said to be good, provided its location and surroundings are not prejudicial. A benign neoplasm never produces local or systemic infection, glandular enlargement, or a poisoning of the general tissues or fluids of the body. While they are benign growths, they are not always innocent—in that they may produce most serious results and even death directly or indirectly by pressure, irritation or hæmorrhage. A perfectly benign bronchocele may produce in its growth such pressure upon the trachea as to cause bending, kinking, or even ulceration, resulting in difficult or impeded respiration, attacks of impending suffocation or even sudden and most unexpected death. A case in point occurred quite recently in this city. A young girl, with a small, hard goitre, situated principally within the left lobe, had experienced for a considerable time an increasing difficulty in respiration. She had also occasionally suffered from some comparatively mild suffocative attacks. These attacks occurred at night, but seem to have produced no special impression either upon the family or the physician. One night the attack was much more severe than usual, the girl sprang up in bed gasping for breath, clutching at her throat, and after a few seconds of terrible struggling fell back upon the bed dead. The pressure had become so severe as to produce sudden kinking of the trachea, with complete arrest of respiration. An ovarian tumor of large size may by pressure upon the gastro-intestinal canal so interfere with the normal functions of digestion and assimilation as to cause death. A benign tumor situated within the cranium or within or upon the spinal cord may by pressure or irritation cause epilepsy, insanity, paraly-

sis and even death. A sub-mucous fibroid may by pressure and irritation cause such profuse and repeated uterine hæmorrhages as to greatly exhaust the patient and perhaps directly or indirectly lead to death. The benign, villous tumor of the bladder practically always causes such repeated, severe, and at times almost continuous hæmorrhage, as to at least greatly debilitate, if it does not almost exsanguinate, the patient. A small benign tumor within the larynx is quite likely to cause severe attacks of cough and even threatened suffocation, and occasionally has even caused the death of the patient. A benign abdominal tumor may cause by pressure, or traction, obstruction of the bowels or as the result of rotation of its pedicle, alarming or fatal hæmorrhage or even death from sepsis. Not all benign tumors, then, are harmless or innocent. In their growth, however, they affect the system mechanically if at all, and, while the great majority produce no deleterious influence upon the individual, they may be so situated and circumstanced as to destroy life as quickly as the most malignant neoplasm.

The Prognosis of Malignant Tumors. — While the word benign or innocent when applied to a tumor, removes a load of doubt and fear from the mind of the patient, and brings in its stead hope, courage and cheer, the word malignant, on the contrary, sounds like a death knell. It drives away hope and brings discouragement; it drags the patient down to the very depths of gloom; it converts determination and courage into indecision and cowardice, and cheer into despair. It is quite true that with some patients the effect may be different. With them the truth once known and appreciated, they arouse themselves from a seeming state of indifference or lethargy, become possessed of courage and are prepared to do and act.

It will be of advantage to consider the natural prognosis of malignant tumors, as well as their prognosis as affected by proper treatment. While it may be stated that the natural prognosis of malignant tumors is bad and that their tendency is always downward toward death, still it must be borne in mind that their course varies much, being now almost benign and, again, most deadly. While some malignant tumors will destroy life in from three to six months, others will produce

little or no appreciable effect upon the health or seeming well-being of the patient for from fifteen to twenty years.

The malignancy of tumors is extremely variable and depends largely upon their histology, upon the genus or species to which they belong and upon their location and surroundings. It is not unlikely that in the near future, with a better understanding of the etiology of malignant neoplasms, the genera carcinoma and sarcoma, as well as the various species, may be eliminated and replaced by terms more in accordance with, or expressive of, their etiology. For the present, however, it seems desirable to retain these divisions. It is difficult to compare accurately the course and termination of the sarcomata with the carcinomata because the prognosis of the different species varies so much among themselves. The course of scarcely any two malignant tumors is parallel or alike. Still it may be stated that on the whole the sarcomata have a better prognosis, are more amenable to treatment and less malignant than the carcinomata. It is true that they frequently occur at a period of life when rapid growth and extreme malignancy is perhaps the rule; nevertheless, the system during this period is more vigorous and better able to withstand noxious influences than it is in the senescent period when carcinomata so frequently occurs. The prognosis of any given class of malignant tumors will depend very much upon their primary situation, upon the organ or tissue from which they spring, upon the importance of that organ or tissue to the life of the individual, and finally upon the readiness with which local and systemic infection occurs. The sarcomata always spring from connective tissue and are frequently found growing upon and within an extremity. The tissue and situation in these cases are both favorable, for neither the one nor the other is necessarily essential to life. It is quite true, however, that the sarcomata frequently grow in important cavities and from important organs, or in organs where dissemination readily occurs, as, for instance, the abdominal cavity, the testicle, the uterus, the kidney and the tonsil. In a general way, however, the situation of the sarcomata is more favorable than is the situation of the carcinomata. The tissues and organs from which they spring are not as a rule so

essential to the life of the individual; and, finally, local and systemic infection do not so readily occur. If we take the alimentary canal from the mouth to the anus we find that while the sarcomata do occur, their occurrence is comparatively rare, while the carcinomatous growths are not only of frequent occurrence, but are also extremely malignant. In the liver, primary carcinoma is also of frequent occurrence as compared with sarcoma. In 1885 Podrouzek (*Prag. Med. Wohnscher*, Nos. 32 and 33) stated that up to that time he had been able to find but thirteen cases of primary sarcoma of the liver recorded. In the genito-urinary system carcinoma is much more frequent and fatal than sarcoma. In the extremities growing from bone periosteum, and inter-muscular planes in or upon the inferior or superior maxillary bones, sarcomata find their seats of predilection. If we study the course of the different species of sarcoma, we will find that they are most variable. The spindle-celled sarcoma growing from between the muscles or from the periosteum in an extremity may and probably will run a perfectly benign and innocent course for years. It very seldom possesses any considerable degree of malignancy and probably more perfectly represents a growth which is upon the border line between benignity and malignancy than any other tumor. The patient with the spindle-celled sarcoma in an extremity will seldom suffer any special inconvenience inside of five or ten years, and the expectancy of life will usually be from ten to fifteen years, and often this time will be extended, the patient living twenty or twenty-five years. The course of the giant-celled sarcoma is not so favorable as that of the spindle-celled, being often primarily situated either within the interior of a bone, as the lower jaw, or at the knee. It will run its course and cause death in from two to five years. In contrast to these two, the round-celled sarcoma is one of the most fulminating and destructive of all malignant growths. When situated within the end of, or upon, a bone it is likely to destroy life in from one to two years. Situated within the abdomen or growing from some important organ it may destroy life in from three to six months. The prognosis, then, of sarcomatous growths, while in the end always bad, depends

very largely, in fact almost entirely, upon their histological structure, their situation and general characteristics.

PROGNOSIS OF CARCINOMATOUS GROWTHS.—The course of a carcinoma depends very much upon its structure, position and surroundings. While some cancers are frightfully malignant, others pursue for years at least an almost benign course. In glandular carcinomata position and histological structure play the important roles. A scirrhus carcinoma situated at the pyloric or cardiac orifice of the stomach will usually destroy life within a year; it may be within nine, or even six, months. This is largely in consequence of the position producing obstruction at an orifice of the stomach, and also to the fact that glandular infection occurs early. On the other hand, a withering scirrhus of the breast occurring at the age of fifty or sixty may never affect the health or well-being of the patient, at least it is frequently the case that it does not for ten to fifteen years, the patient finally dying of some intercurrent disease. So true is this that many surgeons question, in atrophying scirrhus of the breast in aged women, the advisability of operation. The seemingly almost benign character of withering scirrhus of the breast is due largely to its histological structure, the growth being made up of great strands of contractile connective tissue, between which are located a few cell nests. The prognos is of an atrophying scirrhus of the breast contrasts very strongly with that of an encephaloid growth of the same organ. The encephaloid is composed almost entirely of cells which do not differ materially, at least in appearance, from those of the scirrhus. There is, however, in the encephaloid but very scant connective tissue. The cells multiply with great rapidity, growth is rapid, local and systemic infection quickly occur and life is soon destroyed, not unfrequently in six months. The prognosis of the epitheliomata depends very much upon their situation. Those situated upon the skin or upon the lower lip are comparatively benign, as glandular infection as a rule only occurs after the lapse of a very considerable time, it may be six months or one or more years. When glandular infection has once occurred they run a more rapid course, but still life may be preserved for one or more years. The epitheliomata situ-

ated upon mucous membranes are much more virulent and run a more rapid course than is the case with those situated upon the skin. Contrast, for instance, an epithelioma situated upon the tongue or in the œsophagus or in the rectum with the epithelioma situated upon the cheek or lower lip. In the former, glandular infection occurs early and the course of the disease is much more rapid and malignant.

THE PROGNOSIS OF MALIGNANT GROWTHS WITH PROPER SURGICAL TREATMENT.—In accordance with our present knowledge it must be held that all malignant growths are primarily localized and confined within reasonably definite areas. It is true that they never are encapsulated in the sense in which a benign tumor is, or microscopically limited to a certain sharp and well-defined area. Nevertheless, they are at first sufficiently well localized as to admit of complete removal, providing their situation is favorable. With thorough and complete removal, going wide of the suspected area and before lymphatic infection has occurred, the prognosis should be good. In many cases, even after glandular infection has occurred, thorough removal has effected a lasting cure. It is quite true that many malignant growths are so situated within the interior of the body as to make an early diagnosis difficult, or perhaps for the time being impossible, thus delaying the proper treatment and rendering the prognosis more unfavorable than it otherwise would be, or their situation may be such that complete and thorough removal is an anatomical impossibility. The prognosis, however, of very many of the malignant tumors becomes bad, not because an early diagnosis could not have been made, but because there has been no intelligent and earnest attempt made to arrive at a correct diagnosis. The physician in the case is unfortunately too often imbued with a spirit of procrastination, indecision or indifference, a combination of mental traits which is, to say the least, most unfortunate for the physician, while for the poor patient entrusted to his care becomes often the cause indirectly of a fatal result. How frequently a patient comes to the surgeon with a malignant growth, in whose case three, six or nine months have been spent, watching, waiting, and, if the growth was external, in the application of caustics or ointments. This time is

almost as valuable to the patient as life itself. The time so wasted never can be recalled, and its loss works an irreparable injury to the patient and means, almost inevitably, a hopeless prognosis. In an early diagnosis and an early operation lies the patient's only safety.

With the surgeon it is often a serious question just how much of the information which he acquires by his examination of a tumor should be imparted to the patient. There is no question but the family, or some member of it, should be acquainted with the facts concerning the character, probable cause, and final termination of the growth, but the patient, under ordinary circumstances, had better not be told the truth. Many will not ask, and very few will care to know, that they have a malignant growth. It would be a great cruelty and an act of inhumanity to take from the patient every ray of hope, unless for business or other considerations it is best that he or she should know the truth. Nevertheless, it seems at times necessary to put the very worst phase of the case squarely before patients in order to bring them to a realization of their danger. But recently a young woman came to me for an opinion concerning a growth in one of her breasts. The tumor was very hard and as large as an egg. It was adherent to and incorporated with the skin. The nipple was retracted and the axillary glands implicated. She had first noticed the growth about a year before, but had steadfastly refused to have any operative interference, and stated before the examination that she would not under any consideration have an operation performed. She had been told that the growth was an innocent one. With these facts before me and after examination, I told her at once that the growth was malignant and that unless she had it at once removed it would cost her her life, if, in fact, the day for operation was not already past. She was an intelligent, nervous person and fairly shrieked with mental anguish at my words. She tried to stop her ears to shut out the unwelcome news. She asked how could I say such things to her—that I was cruel—but her bravado about not having an operation was gone in a moment and she made the greatest possible haste to get out of the office and off to a hospital for

the purpose of having an operation performed. In such a case the truth, though unwelcome, is of the greatest service, and is the greatest kindness the surgeon can render the patient.

CHAPTER VI.

THE TREATMENT OF TUMORS.

The rational treatment of tumors will depend largely upon their character and location. It is a cardinal rule in surgery that all malignant growths which are primary should be removed at the earliest possible moment, provided the situation makes this course possible. The surgeon in removing them should go wide of the tumor into the healthy tissue, for the simple reason that the tumor cells always infiltrate a zone of tissue outside of the microscopic limits of the growth. Benign tumors which either at the time of examination, or prospectively in the near future, are causing or will cause serious functional disturbance or become unsightly in appearance should be removed.

If the reverse conditions obtain, then and in that event the tumor may frequently be allowed to take its usual course. In the great majority of cases excision or incision with enucleation, or incision, and exposure of the tumor followed by ligation of the pedicle, will be found most applicable. In the operative treatment of tumors, whether benign or malignant, every justifiable and intelligent effort should be made to remove the tumor entirely. If a portion be left and the tumor is malignant, recurrence is certain, and probably with increased malignancy. If the tumor is benign and a portion be left recurrence is likely.

The treatment of tumors may be considered under the following heads: 1st, Medical; 2d, Surgical; and, 3d, Treatment by subcutaneous injections.

The time was when nearly every physician and surgeon

was hunting the pharmacopœia for some drug with which to cure tumors. A great many remedies have been brought forward at different times and by different men, with an honest intent and for the most laudable of purposes, viz., the cure of tumors, and especially malignant tumors. But all of these remedies have met the same fate, they have proven, after a short trial, worthless or even worse. One might sometimes feel like asking himself whether the motive power which has propelled some of these remedies into such prominence hadn't been engendered by a commercial spirit. While this may possibly be the case with a very few, it certainly is not true of many. Mercury was one of the remedies to be first recommended, and up to the present time it is most frequently used. Formerly there was no attempt made, and even now it is not always possible, to separate the granulomata from the true tumor; consequently the use of mercury has often seemed beneficial or even curative in the treatment of tumors. Mineral waters containing iodine as well as preparations of potash have been recommended and used with apparent benefit. With many physicians and surgeons arsenic has been prescribed with confidence both before and after operation, and its use continued for long periods of time. Probably much or most of its reputation has been derived from its use in enlargements of the lymphatic glands either benign or sarcomatous. It may be of benefit also by invigorating the system.

One of the most popular and long-lived remedies with the laity has been a decoction of red clover. The writer has not unfrequently met with patients suffering from a carcinomatous growth who would not submit to operative measures until they had taken this decoction of red clover for some months. Chian turpentine has been highly recommended. The preparation of conium maculatum received the endorsement of Störk in 1761 and was used more or less extensively for more than a hundred years, enjoying considerable repute. Animal charcoal, and the various narcotics, have been thought at times to have more or less controlling influence upon the growth of

tumors. Perhaps no vaunted cancer cure of recent or even remote times has created such a burst of apparent popular acclaim as did condurango, which was brought prominently forward by Dr. Bliss, of Washington, in 1871 and 1872. Testimonials of its marvellous curative effect upon cancers were numerous from men of both high and low degree. But its utter worthlessness was soon apparent, and, like many other highly extolled remedies, it soon disappeared from use. While the essential cause of cancer is still unknown, yet a better knowledge of pathology and bacteriology has led workers in this particular field to look or hope for a curative agent, if one is ever to be found for malignant growths, in other directions.

Surgical Treatment. — The subject of the surgical treatment of tumors may be primarily subdivided into the radical and palliative treatment. By the term radical, as here used, is meant an operation which results in the complete removal of a tumor, whether that tumor be benign or malignant. While radical operations are nearly always possible in benign growths, they are not always, perhaps not generally, possible in malignant tumors. An operation may be ever so extensive and seemingly thorough, but unless it gets at the root of the trouble, unless it eradicates the disease, it cannot be called radical. Radical operations instituted for the cure of tumors will usually require more or less extensive incisions and dissections. There is no doubt that human nature instinctively shrinks from the use of the knife. The mere use of the word in the presence of sensitive persons, will send cold shivers down their spines. They associate with its use all that is disagreeable, repugnant, and horrible, and this seemingly natural, or from experience or observation acquired, dread of the knife drives many a patient into the hands of quacks and charlatans. The surgeon in his consultations, and while recommending operative measures for the cure of tumors, should keep as far away as possible from actions or statements which are disagreeable to the patient. The surgeon

who strides up and down his consultation room, declaring at the same time that he must "use the knife," is the one who will use it the least frequently. This fear, and even abhorrence, of the use of the knife by patients has been nursed and encouraged by quacks who are always picturing to the public its disadvantages and horrors, and in contrast lauding their own "painless" as well as "bloodless" methods of cure. Much of this opposition may be overcome, or perhaps not be engendered, by striking the word "knife" entirely out of the surgeon's vocabulary—at least so far as the patient is concerned.

Patients, however, if necessary, must be made to understand that the surgeon's methods, those by which he, at least in malignant tumors, goes wide of the growth into the surrounding tissues, are the only ones that are radical or which can insure promise of a permanent cure.

The use of the knife, while the usual and undoubtedly the best, is not the only means of dealing with tumors radically. In the case of the angeiomata, if large, and especially if situated upon the face, and more especially, if about the eye or mouth, may be dealt with radically by the use of multiple ligatures, and if they are properly applied, this method is very often to be preferred to the knife, especially in infants and young children who bear the loss of blood badly.

Some tumors may be treated radically by the use of pastes and caustics. This form of treatment is particularly applicable to the epitheliomatous growths of the skin. There are many skillful surgeons and dermatologists who favor the treatment by pastes, in skin cancers of the face, to the use of the knife. They hold that the pastes require less loss of time, inconvenience and pain than does the cutting operation; also that the scarring is less and the results quite as good. I well remember hearing Kaposi discuss this subject some ten years ago. He claimed that his method of treatment of epitheliomatous tumors of the face, by curettment, and then the application of the stick of nitrate of silver, afforded just as many cures as did Billroth's treatment with the knife. I

accepted this statement, at the time, with some degree of incredulity and have not since been able to persuade myself of its absolute correctness. I am quite ready to believe that the surgeon who is perfectly familiar with, and has had experience in, the use of pastes, can accomplish very much in surface carcinomata; but I also believe that the use of the pastes should be confined entirely to this class of individuals, just as cutting operations are supposedly confined to men of skill and experience in their particular line of work. While the use of pastes in the treatment of surface cancer by intelligent men can, perhaps, be recommended, their use by those who have not been properly educated in medicine, by quacks, is to be greatly regretted. This whole method has been, and is, in disrepute in consequence of the practice of unskilled, ignorant, and unscrupulous persons. These persons, knowing or caring nothing for the value or sacredness of human life, and having little or no knowledge in the use of remedies which they are applying, or of the course and complications of malignant growths, attempt to cure, by the application of pastes, tumors of all kinds situated upon or beneath the skin. They treat a primary epithelioma of the lip with paste, usually with no other effect than to aggravate its growth, and then when secondary involvement of the submaxillary and cervical glands has occurred, a paste is applied to these regions as well. The result of this outrageous treatment is not the removal of the glands, because that would be quite impossible by such means, even in the hands of the most intelligent and skilled surgeons. It means simply the formation of a great, disgusting, sloughing wound, with a most offensive and free discharge; the cause of untold pain, the aggravation of the disease, and also a very marked lowering of the patient's vitality and the formation of a wound which becomes infected and never heals. Such a case is represented by Fig. 11. A German, aged 73, with a good family and personal history, noticed three years ago a small nodule upon the lower lip near the left angle of his mouth. No particular attention was paid to this for some

months, when he picked a crust off and after that it seemed to grow more rapidly. In November, 1898, the small growth was removed by the application of a plaster. The wound did not heal and the growth recurred and grew faster than before. In the spring of 1899 a second plaster was applied, in July the third, and in September the fourth. The wound during these ten months never healed, the growth was never entirely

FIG. 11.

removed, but recurred and grew more rapidly after each application of the plaster. During the middle of the summer of 1899 the submaxillary and cervical glands had become involved and a plaster was applied to this region, with no result other than the creation of a wound that became infected, and constantly increased in size so that when the patient presented himself it was a horribly offensive and rapidly growing fungous mass. Fig. 12 shows the patient three months after

operative measures had been undertaken for his relief. The lower lip was completely excised and a flap slid in from the neck and cheek. The fungous mass upon and below the jaw was surrounded by incisions, and as much cut away as possible. The soft masses were then followed up with a sharp curette, which was used vigorously, and following this the Paquelin cautery was most thoroughly applied. It is difficult to imagine what must be the condition of one's conscience, or the state of one's feelings, after having applied plaster after

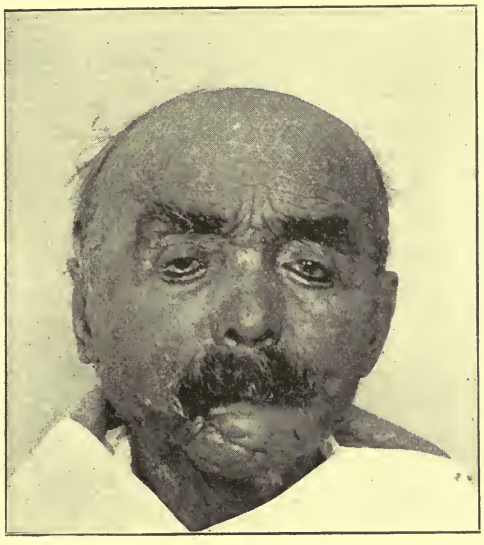


FIG. 12

plaster to a growth which was primarily easily curable by operative means, but which as the direct result of the application of the plaster and the necessary delay, had not only become incurable, but had caused the patient to become almost an outcast, in consequence of the loathsomeness of his disease, with practically no place that he could call his home or where he might lay his head. The application of pastes, by ignorant and irresponsible persons, is not confined to the lip or face, but they are applied to tumors of the breast, be-

nign and malignant, and over the axillæ in cases of implication of the axillary glands. Of course with educated surgeons the use of pastes will not only be confined to suitable cases, but they will also be properly used. With the uneducated, however, the prospective fee seems to be the only incentive which directs and controls their application, and with them their use is almost a crime. Some tumors can occasionally be treated successfully and radically by electrolysis, as keloids, nævi and tumors of the thyroid gland. The thermo-cautery is also occasionally used with gratifying results in the radical treatment of tumors.

Treatment by Subcutaneous Injection.—*Sarcomata.* In the treatment of sarcomatous tumors nearly every surgeon at some stage of the disease prescribes arsenic, either before or after operation, or in inoperable cases. The drug should be used for a very considerable time, at least for months, and be pushed until its full physiological effects are produced. Arsenic is not only given by the mouth but it is also injected subcutaneously, it may be directly into the tumor. Occasionally during its administration the most gratifying results are obtained. Tumors of considerable size may cease to grow, diminish in size, or even disappear. This is probably more frequently the case in lympho-sarcoma, than in the other forms of sarcomatous growth. It is even possible that in some of these cases the surgeon has had to deal with a lymphadenitis—simple in character—rather than with a lympho-sarcoma. The writer's experience in the use of arsenic in sarcomatous growths has not been so fortunate as that of some other surgeons; although he has used arsenic in nearly every case under his care for the last twenty years he has yet to see the first decided benefit from its use. Notwithstanding the fact that its use is only rarely of signal benefit, it is nevertheless to be recommended both before and after operation, and especially in inoperable cases.

The Subcutaneous Injection of Cultures of the Streptococcus of Erysipelas, and of the Toxines of

THESE CULTURES.—It is now several years since surgeons recognized and appreciated the fact that sarcomatous growths had occasionally disappeared following an attack of erysipelas. With their increasing knowledge of bacteriology, it was not long before they endeavored to make use of these facts and to apply them in the treatment of sarcomatous tumors. Fehleisen was the first to recommend the subcutaneous injection of cultures of the streptococcus of erysipelas. Some successes were obtained as the result of these injections. Many of the patients, however, contracted erysipelas and a few died. As a result the treatment was practically discontinued—at least for a time. It was, however, revived in this country by Coley, of New York, who also at first injected the living pure cultures, and afterward for the purpose of avoiding the attacks of erysipelas he injected the toxines of the streptococcus of erysipelas. He subsequently added the toxines of the bacillus prodigiosus. The injections are only made in inoperable cases. One drop of the fluid containing the toxines ("Coley's mixture") is injected directly into the growth, and its effect watched. When the patient's condition has again become normal, the second injection is given and then the third, and in this way the injections are continued from time to time as the patient's condition will permit. The amount given can usually be increased one or more drops with each injection, depending upon the severity of the reaction. The patient will not unfrequently have a chill within a half hour after the injection and his temperature will often rise to 102° or even 104° F. The fever continues, though in a lesser degree, for several days. The chill and rise of temperature naturally weakens and may even prostrate the patient for the time being. Coley, although finding the greatest benefit from this treatment in sarcomatous growths and especially in those made up of spindle cells, does not confine its use to this class of cases. He uses it in all inoperable malignant growths. He has recently reported upon the results of this treatment in thirty-five cases, twenty-four of these were sarcoma, eight carci-

noma, and three were carcinoma or sarcoma. In five cases of sarcoma there is reasonable hope of permanent cure and in many of the others there was marked improvement. All the cases were inoperable. While it has come within the writer's observation to see an inoperable sarcoma disappear as the result of an attack of erysipelas, he nevertheless has, up to the present time, failed to observe any improvement in inoperable malignant tumors as the result of the use of the Coley mixture.

In the treatment of the carcinomata not only have the combined toxines been used, but a variety of other substances have been injected as well. Adamkiewicz injected a substance which he calls cancroin. This is a toxic product obtained in solution from cancerous tissue, by allowing small pieces to become softened in distilled water. The mass is then rubbed up in a mortar and filtered. This fluid is alkaline and is neutralized with citric acid. A twenty-five per cent. watery solution is then saturated with carbolic acid and is diluted with an equal quantity of water. He has solutions of various strength and injects them into the vicinity of the growth. Adamkiewicz does not regard the injection of cancroin as curative, but considers it of benefit in this class of cases. Pyoktanin, first recommended by Mosetig Moorhof, has been extensively used. Injections are made with solutions varying in strength from 1 to 1000, to 1 to 300, and as much as six grammes of the stronger solution have been injected at one time without ill effect. Mosetig Moorhof's idea was to destroy by the injections the nuclei of the proliferating cells and thus to arrest the growth. Although no cures have been effected many cases have seemingly been benefited by the treatment. Formalin has also been extensively used of late in inoperable cases. But the results following its use have shown no improvement over former methods. On the whole it may be said that the treatment of malignant growths by subcutaneous injections is most discouraging and leaves practically everything to be desired. We trust that the near

future has something better in store for us. At the present time, however, no one is justified in resorting primarily to subcutaneous injection for the cure of malignant growths in lieu of radical measures. The treatment is only to be tolerated in inoperable cases and as a last resort. Even then, at least in the writer's experience, it is likely to cause annoyance, pain, debility, loss of sleep, perhaps chills, and high fever, without producing one particle of relief as compensation in return.

THE TECHNIC OF TREATMENT.—It is of the utmost importance that wounds made in the removal of tumors heal by first intention. It is quite possible that this desideratum in its entirety may never be attained. But if one is ever to approximate the desired end, he will be obliged to not only practice surgical cleanliness with intelligence, but also exercise great care, constant watchfulness, and eternal vigilance. The surgeon must also have a clear knowledge of bacteriology, and of the laws governing sepsis, antisepsis and asepsis. Without going into the details of surgical bacteriology it may be stated that the germs with which the surgeon has always to contend in his wound treatment, are the staphylococci, the streptococci, and a few bacilli. Of the latter especial mention should be made of the Bacillus Coli Communis and the Bacillus Pyocyaneus. These, then, are the pyogenic, or pus-producing germs, which so often cause infection and suppuration.

Without germs wound infection and suppuration does not occur. It is true that there are other germs which produce infection and suppuration, but they occur so comparatively rarely that they may be left out of consideration in the primary treatment of wounds. These pyogenic germs are omnipresent and thrive in countless numbers in the dust of the street. They are carried with every gust of wind through the air and lodge upon every exposed object. The drier the air, the more severe the wind, the greater will be the diffusion of dust and consequently of bacteria. The dust-laden air of

cities contains a much greater proportion of bacteria than does the air in the country. The air of the sea and of mountain heights is comparatively free. The same may be said of the atmosphere following a rain, and of that containing much moisture. These germs are found, not only in the air, but also in water, in clothing, upon every exposed object and especially upon the surface of the skin and beneath the superficial epidermis. Upon the skin they find conditions most favorable for life and growth, namely, heat, moisture and nourishment. Upon the hands, which are especially exposed to infection, they occur in great numbers, and particularly at the borders of, and beneath, the nails. The hairy portions of the body are also favorite sites for their existence and growth.

The questions for the surgeon to meet and answer are: 1. How can he so prepare the operating room, in which the floors, walls and every article of furniture is covered with visible or invisible dust containing millions of micro-organisms, so as not to infect his wounds? 2. How can he prepare his instruments, dressings, sponge-cloths and ligatures as to render them aseptic? 3. How shall he prepare his patient so that infection from the patient's skin or auto-intoxication will not occur? and, 4. How shall he prepare himself, his hands, so as not to infect the wound he is about to make?

Wound infection unquestionably most frequently occurs: 1. From the hands of the surgeon or from those of his assistants; 2. from improper preparation of the patient; and 3, from the sutures, ligatures or sponges.

The technic of preparation requires a consideration of the terms sepsis, antisepsis and asepsis. The word sepsis has been translated somewhat freely, and at different times made to express various meanings. At first it was synonymous with putrefaction, but now by common consent it is intended to express that condition of a wound caused by pyogenic infection and resulting in pus formation. A septic wound, then, is one into which the pyogenic germs have entered and pro-

duced inflammation and suppuration. This was the usual condition of wounds before the days of Lister, and would be the condition to-day, were it not for the stringent measures taken to prevent infection.

The term asepsis represents a condition which is the very antithesis of sepsis. It means a state of absolute freedom from pus-producing germs. There probably are, however, no wounds perfectly free from these germs. It is a well-known fact that the manifestations of sepsis do not depend entirely upon the mere presence of germs, but as well upon their number and virulence, and the condition of the cells and fluids of the individual. A person in robust health is able to dispose of, or destroy, a goodly number of germs and thus prevent infection, and it is only when the number of these organisms, or their virulence, is increased or the cells and fluids of the body weakened, that they gain the mastery and wound infection occurs.

An aseptic wound, then, is one into which the pyogenic germs have not entered in sufficient numbers to cause infection and suppuration.

By the term antiseptic it is intended to express conditions which are opposed to germ growth and life. The antiseptics are remedies which oppose, inhibit or destroy germs.

Methods of Sterilization.—Before considering the various preparations necessary, previous to an operation, it will be well to review briefly the methods of sterilization. These may be divided into mechanical, thermal and chemical. In the preparation of the operating room, the patient and the surgeon's hands, and the hands of his assistants, mechanical sterilization is indispensable. By the vigorous use of the brush, with soap and warm water, countless numbers of bacteria may be gotten rid of, if not destroyed, and the surfaces rendered fairly aseptic.

The Use of Heat.—The instruments may be rendered perfectly aseptic by the use of heat as applied in boiling water. The ligatures and sutures are sterilized in boiling water, by

steam, or by the use of heat and chemicals. The dressings, towels, sheets and gowns are disinfected by steam, and the water to be used by boiling.

The Use of Chemicals.—There are many chemical agents of great value as adjuncts to the mechanical methods of sterilization—some of these, it is true, may be used quite alone, as disinfectants, such as the bichloride of mercury and carbolic acid which are distinctly germicidal in their action. Many of the chemicals in daily use as antiseptics only inhibit the growth of bacteria. They are all, however, of value, either as principals, or adjuncts in some of the various methods of sterilization.

The Preparation of the Operating Room.—In a well regulated and modern hospital the surgeon has only to think of his personal preparation and the preparation of his assistants. But as some operations—not from choice, but from necessity—have to be made in private houses, it is well to consider the preparation of the room in which the operation is to be done. A room of good size should be selected and one having an excellent amount of light. If possible on the day preceding the operation, all hangings and superfluous furniture should be removed. That portion of the room in which the operating table is to stand should be free from carpet or rugs. The walls and the floor are then thoroughly swept and the room well aired, after which it is closed for two or three hours to allow the dust to settle. Then the walls, the woodwork and floor are thoroughly gone over with a cloth wrung out of a solution of bichloride of mercury or carbolic acid. The room may then be closed for the night. On the morning of the operation any places especially exposed are again wiped off with a damp cloth. The floor and any remaining pieces of furniture are covered with sterilized sheets. A clean, narrow table is provided for the operation, and covered with a folded blanket, over this is a sterilized sheet, then a piece of rubber sheeting and then a second sterilized sheet with which to cover the patient. Two small accessory tables are

provided and covered with sterilized towels. These are for the basins, dressings, instruments and ligatures. The instruments are prepared by boiling in a 1 per cent. solution of sodium carbonate for not less than fifteen to twenty minutes. The surgeon will ordinarily bring his ligatures and sutures prepared. The gauze for sponge cloths and dressings, the absorbent cotton and bandages may be procured from a reliable house ready prepared, or they may be prepared in a sterilizer in the operating room with the towels, sheets and gowns. Plenty of sterilized hot and cold water should be at hand, in covered aseptic pitchers or pails. The paraphernalia will also include from four to six new tin or granite basins, these having been rendered aseptic by scouring, scrubbing and boiling, are placed bottom up on one of the small tables until wanted. These arrangements are completed as the patient is being anæsthetized. Ordinarily, of course, the preparation of the room and its belongings will be in the hands of a trained and skilled nurse who will need few if any instructions from the surgeon. While the writer recognizes the fact that some operations must be done in private houses, and that the antiseptic and aseptic measures taken need not be as stringent in order to secure success as would be necessary in a hospital, and has seen a room prepared so clean and white, with sheets spread and pinned here and there and tables covered with sterilized towels, and basins shining from scouring and scrubbing, and the air so soft and fragrant on account of the materials fresh and steaming from the atomizer, and solutions warm in basins, that it was a real pleasure to do work in them, still he believes that house surgery is a mistake and that it is only to be favored in cases of great emergency or prime necessity. He regrets very much that there are so-called "house surgeons" who turn to account the whims and prejudices of patients, and make a practice of operating in houses. The house with its restricted surgical appliances and limited assistants is certainly not the place in which to meet unexpected complications or grave conditions which may weigh heavily in

the balance against the patient. The best interests of all will be conserved by having these patients cared for in modern hospitals.

PREPARATION OF THE PATIENT.—This should commence at least two days before the time set for the operation. At this time the patient is given a brisk cathartic and on the following day sent to the hospital, where the cathartic is repeated. On the morning of the day of operation an enema is administered. The food during the twenty-four hours preceding the operation should be simple and easily digested. In the writer's clinic where the hours are from 9 to 11 the patients receive no food on the morning of the operation, unless very weak. In this case a cup of hot broth is given early in the morning. At the time of operation there should be no undigested food, and as little material as possible, in the gastro-intestinal canal. Unquestionably much of the nausea, vomiting, restlessness, general discomfort and fever, arising after operations, comes from an imperfect cleansing of the alimentary canal. The loss of strength and lowered vitality succeeding an operation, the disturbance or arrest of function, the necessary inactivity of the bowels, favors putrefactive processes in any organic and undigested material which may be present in the alimentary canal at the time of operation. During the occurrence of these putrefactive processes ptomaines are formed in great quantities, and being absorbed, cause nausea, vomiting, restlessness, fever, and, it may be, severe delirium. A marked case in point occurred in the writer's experience a few years ago. A girl, aged 20, having an endometritis, painful and excessive menstruation, retroversion of the uterus and a tumor of the left ovary, entered the Presbyterian Hospital on a Sunday for the purpose of having an operation performed on Monday. She was prepared as usual for a curettment and laparotomy. Several small doses of salts were given on Sunday and an enema on Monday morning. The bowels moved as it was thought satisfactorily. Her habit had been invariably one of decided con-

stipation. On Monday morning after being anæsthetized she was curretted and then the abdomen opened, the tumor removed and the uterus fixed to the abdominal wall in closing the wound. The operation was without incident. The patient, however, passed a restless night, suffering severely from gas and nausea. On Tuesday morning her temperature was 100° F. She passed a most uncomfortable day, being very restless and suffering greatly from tympanitis, constant nausea and frequent vomiting. The second night she complained of great abdominal pain, was extremely restless, very tympanitic and vomited almost constantly. Temperature Wednesday morning 104° F., pulse 120. The patient was put in position in the bed and the uterus washed out. There was, however, no indication of infection. She was then transferred to the operating room, lightly anæsthetized and the wound opened. The peritoneal cavity seemed normal and without sign of inflammation or sepsis. The wound was closed and the patient put to bed. After recovery from the anæsthetic five grains of calomel were given in grain doses every half hour. This was followed by small doses of citrate of magnesia. At the same time enemata of soap and water, or glycerine and water, were administered at frequent intervals. It was but a few hours before she commenced to have some horribly offensive stools. These occurred at short intervals for thirty-six hours. During this time she not only passed an enormous quantity of fæcal matter, but also berries which she had eaten one and two days before the operation. When the bowels had moved satisfactorily her vomiting, fever and restlessness disappeared and she made a good recovery.

It is evident that this patient was suffering from ptomaine poisoning, the result of a very imperfect clearing out of the intestinal canal before operation.

Many cases similar in character, but of lesser degree, have come under my observation during the past few years. A few cases of auto-intoxication following operations have been reported. In some of these the patients not only suffered

from nausea, vomiting, restlessness, pain and fever, but were violently delirious. This unfortunate, distressing and often dangerous condition, could be entirely avoided by careful attention to the bowels before operation.

To return to the preparation of the patient. On the afternoon or evening before the operation the patient is given a thorough bath with warm water and soap, and then put to bed in clean clothes.

The part to be operated upon is now attended to by shaving—if hairy—scrubbing thoroughly, and washing with alcohol and bichloride solution. A large dressing is applied consisting of either simple gauze or wet bichloride gauze. Many surgeons are now using the soap poultice, made by saturating some gauze with liquid soap and water. This macerates the superficial layers of epidermis, rendering their removal more easy upon the following day. At the time of the operation and as the patient is coming under the influence of the anæsthetic, the dressings are removed and a wide area scrubbed with a sterilized brush, warm water and soap until it is red. This scrubbing must be vigorous. The part is then washed in succession with sterilized water, alcohol, and the bichloride solution. Towels wrung out of this solution are then placed about the area to be operated.

Preparation of the Operator and his Assistants.—There is no doubt but that the surgeon or his assistants frequently infect the wounds they make. At times this may be accidental or perhaps unavoidable. With surgeons who are not operating very much, it often occurs from carelessness, indifference or perhaps from a failure to correctly grasp the requirements of aseptic work. It is too often thought that a mere scrubbing of the hands and a brushing of the nails is all that is necessary in order to secure asepsis. How often is the occasional operator or assistant after preparing his hands seen to touch unconsciously articles of furniture or parts of his clothing or person which have in no way been sterilized. The surgeon in order to obtain the best possible results, must not only

be in excellent health, but he must also maintain a reasonably aseptic condition of his hands and a state of great bodily cleanliness.

There is no doubt but that it is much more difficult for some surgeons to do aseptic work and to attain primary wound-healing without disturbance than it is for others. While great attention has been paid to the preparation of the hands, but little or none has been devoted to the cleanliness of the body, the condition of the clothing or the state of the health. It is impossible or unwise to divorce these conditions from that of the hands. The morning bath and a frequent change of underwear, will not only assist in maintaining the vigor, and preserving the health, but will also very materially aid towards keeping the surgeon in an aseptic condition.

Before entering the operating room the street shoes and outer clothing should be put off, and in their place duck pants, a long white gown with short sleeves and white canvas shoes, with thick rubber soles, put on. This attire not only adds to the ease and comfort of the surgeon, but it also assists very much in maintaining him and the operating room in an aseptic condition. Pants and shoes worn day after day in an operating room, where they are spattered, splashed, and perhaps soaked with blood or pus are not in a condition helpful to asepsis. If for no other reason than that of ordinary cleanliness, decency and precept they should be changed before entering the operating room for materials aseptic in character. It is scarcely to be gainsaid that naso-pharyngeal catarrh, decayed teeth, foul tongue and gastro-intestinal disturbance, when occurring in the surgeon are each and all prejudicial to aseptic results. The distance from the mouth or nose to the wound is often not great, and is frequently traversed by pyogenic germs. With constipation, and other gastro-intestinal disturbance, the surgeon may not only form within himself ptomaines sufficient to produce auto-intoxication, as shown by Brieger, Bouchard, Berymann, Salmi and others, but probably also by excretions and emanations

from the skin and disturbances of the breath to poison his patient. A regular and healthy condition of the gastro-intestinal canal is of prime importance in the surgeon.

Preparation of the Hands.—In all the antiseptic technic pertaining to modern surgery the preparation of the hands is the most difficult if not the most important. While perfect asepsis is unquestionably an unknown quantity and not essential to success, reasonable asepsis is necessary in order to prevent infection of the wound. A smooth skin surface is easily rendered aseptic, while the hands with their numerous irregularities, clefts, grooves and areas beneath the nails, present a problem for asepsis most complex. The hands even of persons not engaged in the practice of medicine, are not only always exposed to infection, but also constantly contaminated, while the surgeon's hands, in his operative work in pyogenic cases and in the treatment of septic wounds, are occasionally simply steeped in the most virulent infectious material. It is scarcely necessary to state that the surgeon who contaminates his hands the least with septic operations and in the dressing of septic wounds, will have the least difficulty in rendering them aseptic. The habit of some operators to solicit and make a practice of doing post-mortem work cannot be too strongly condemned. The principles of asepsis, the modern operating room with its tiled floor and walls, scrubbed, scoured and douched, its polished tables and basins, the patient fresh from the bath, and in as nearly an aseptic condition as water, soap, brush and bichloride can make him, have nothing in common either with the stench and filth of the morgue or its cadaver reeking with ptomaines and germs of every kind—pyogenic, pathogenic, saphrophytic—and they should be at once and forever divorced.

Methods of Hand Sterilization.—The fact of there being so many methods is very good proof that none are quite satisfactory. Still the results of any method will depend very much upon the manner and thoroughness of its application. That there is a great difference in the application of aseptic

and antiseptic principles by different surgeons, even when endeavoring to follow the same technic is made apparent by a visit to different clinics. In one the work being systematized and done with thoroughness, precision and in order, is followed by the best results, while in another there is carelessness in preparation with confusion and disorder, and as the result many breaks occur in the aseptic chain. Not all of failure, therefore, can be charged to the method of sterilization, but very much must be placed to the manner of its application. The method of Fürbringer, more or less modified, is in favor with very many surgeons. As applied at St. Joseph's Hospital it is as follows: The hands and forearms are first thoroughly scrubbed with a sterilized brush and liquid soap, in warm, running water. The nails, which are kept short, are then carefully cleaned at their borders and beneath the ends with a sterilized nail file. Following this the arms, hands, and especially the fingers are again thoroughly scrubbed, allowing plenty of warm, running water to pass over them during the process. They are then carefully wiped with a sterilized towel, rubbing well between the fingers and at the borders of and beneath the nails. The hands are now washed in alcohol and then in a solution of bichloride, 1 to 2000. During the latter the solution is rubbed in well with a piece of gauze, especially between the fingers and about the nails. During the course of the operation the hands are frequently rinsed in sterilized water and then in a solution of bichloride. This method will probably give as many satisfactory results as any practised at the present time. With surgeons, however, who operate very much it may cause redness, irritation and roughness of the skin. In this condition satisfactory disinfection is impossible. This redness and irritation is often induced or favored by the use of strong soft soap. It is seemingly less irritating to the skin, and in consequence a direct advantage, to occasionally change the method of sterilization. In such a case the Schatz-Kelly method may be used, which is practically as follows: After

scrubbing the hands and arms as before they are soaked in a saturated solution of permanganate of potassium at a temperature of 110° F. until they become very dark in color. The hands and arms are then washed in a saturated solution of oxalic acid also at a temperature of 110° F. until the discoloration has entirely disappeared. They are then first washed in normal salt solution, and then in bichloride of mercury solution. This method leaves the hands quite white and soft.

A process suggested by Mr. Ranschenbery, of New York, is as follows: The hands and arms are first washed as in the other methods. Then a scant tablespoonful of chlorinated lime is moistened with enough warm water to make a thick paste. This paste is rubbed thoroughly into the hands and arms, a piece of carbonate of soda about an inch square and half an inch thick is crushed in the hand and rubbed into the paste until the latter becomes smooth. The process requires from three to five minutes. The hands are then rinsed in sterile water and washed in an aqua ammonia solution of the strength of 1 per cent. It is stated that the bacteriological tests made after the use of this process have been most satisfactory. This method was put in use in the Presbyterian Hospital, Milwaukee, some three years ago. Some of the assistants, however, claimed that it irritated their hands very much and its use was in consequence discontinued.

The above probably represents the best methods of hand sterilization in vogue at the present time, and although they are reasonably satisfactory in practice they are far from being perfect. If the surgeon after practising any one of the above methods will take a reasonably strong magnifying glass and attentively examine the areas at the borders of and beneath the nails, he will not be surprised that infection occasionally occurs, but on the contrary, that asepsis is ever attained. For at these points there are frequently great heaps of epidermis and debris, which have not been removed by the cleansing, and which look very uncleanly, and often are septic. In consequence of the difficulties and imperfections of hand sterili-

zation many surgeons have resorted to the use of gloves, both rubber and cotton. The writer's first observation of the use of rubber gloves was in Vienna in 1888, at which time Dr. Von Eiselberg, then second assistant to Billroth, was using them in septic work. The white cotton glove was introduced by Mikulicz. These gloves can be perfectly sterilized either by boiling or by steam, and if thin and of good fit they scarcely interfere at all with the manipulations of the operator. The rubber gloves are reasonably durable and as long as they remain free from perforations or tears they are an absolute guaranty against infection of the wound by the hands. The slight extra expense and increase of technic incurred by their use should count as nothing when compared with the additional safeguard against infection secured to the patient. In the experience of many surgeons wound infection has been reduced very materially by the use of gloves. To guard against infection in case of possible perforation or tear the hands should be prepared with the same care as though the gloves were not to be used.

While so very much attention has been paid to the sterilization of the hands very little consideration has been given to a possible infection from the head. Until recently the unkempt beard and long hair have been allowed to pass without a protest. They certainly contain much of septic material which may, during the exertion and perspiration incident to an operation, gain access to the wound. In the interests of asepsis both hair and beard should be short. Since the anti-and aseptic era, and especially during the past few years, there has been considerable discussion as to the possible infectiousness of the breath, the general consensus of opinion, however, having been that it was not infectious. The investigations of Miller, Flugge, Neisser, Mijulla and others have shown that the breath often is infectious. In the nose, mouth and pharynx conditions are present favorable for the lodgment and growth of bacteria, namely: Warmth, moisture and nutrient material. Within these cavities, even in individuals in the best of

health, are usually found a variety of germs, pyogenic, pathogenic and saprophytic. Among the germs most frequently present are the streptococcus pyogenes, staphylococcus pyogenes aureus, albus and citreus, the bacillus of tuberculosis, of typhoid fever and diphtheria, and the pneumococcus of Weichselbaum. In addition to the above there are not only saprophytic but also non-pathogenic germs to be found. Investigation seems to show that in ordinary respiration with the mouth closed these germs do not contaminate the expired air to any extent. But in conversation, and especially in forcible speaking, coughing or sneezing great numbers are propelled outwards with the visible and invisible particles of moisture in the breath. In a very considerable number of experiments made in St. Joseph's Hospital it was found that plate culture media were readily infected by the breath of persons speaking over them, and also that the germs could readily be projected through two thicknesses of gauze by forcible speaking or coughing. There seemingly is scarcely a doubt but that wounds can be infected by the breath, and especially if surgeon or assistants carry on much conversation while stooping over the wound.

The mode of dress adopted in the writer's clinic is shown in Fig. 12. In the preparation the operator and his assistants divest themselves of their shoes and outer clothing and put on sterilized pants, gowns and canvas shoes, the latter having rubber soles. The hands and arms are then prepared and a pair of sterilized rubber gloves put on. The gown is now changed for a fresh one, and the nurse taking a piece of sterilized gauze of triple thickness, and in size about 12x36 inches, cuts a longitudinal slit in the center from 8 to 10 inches long for the nose and eyes. The gauze is applied to the face, as shown in the figure, the ends being tied at the back and top of the head. Excepting the window for the nose and eyes, the gauze covers the entire face and head, protecting the wound from the expired air, covering the hair and gathering up any moisture which may occur about the forehead or tem-

FIG. 12

ples during the operation. The dress is aseptic, light, cool, comfortable and a thing of pleasure and security in which to work.

The Closure of Wounds.—The method and the material used in closing a wound may represent the difference between an aseptic and a septic wound, between a wound healing in seven or ten days without irritation, inflammation or pain, and one which will heal only after long-continued suppuration, accompanied perhaps with widespread inflammation, severe pain, high fever, loss of strength, and the formation of a great quantity of granulation tissue. When healed, it may represent the difference between a simple linear cicatrix, beautifully white and hardly observable, and as strong perhaps as the original tissue, and one which is broad, elevated and unsightly, and which will readily yield to any undue pressure. It will undoubtedly be conceded that what is desired in the approximation of a wound is to place the tissues as nearly as possible in their original relationship and to maintain them there without infection or irritation until a perfect and strong union has been accomplished.

This can only be effected by sutures which are not too readily absorbed and which will not cause, if buried, irritation in the tissues either immediately or remotely.

The discussion which follows will be confined very largely to the methods and materials used in the closure of wounds in tiers. It is quite true that many wounds can be closed and perhaps most advantageously by through and through sutures. This may often be the case after having opened the abdomen in the linea alba, and, if so, the only question then would be the material to be used. In the closure of wounds by sutures the important question at once arises, shall we use absorbable or non-absorbable material?

In selecting an absorbable material the following questions present themselves: How long will a given material remain in a wound without being absorbed? and again how long is it necessary to maintain tissues in approximation in

order to effect a firm union? In tissues upon which there is little strain and which readily unite, seven to ten days of approximation may be quite sufficient to afford a fair union. In the approximation of the peritoneum a few hours may be sufficient; in the approximation of the skin at least one week will be necessary; and in the approximation of fascia, from ten to twenty-one days will be ordinarily required to effect a firm union. Cat-gut and kangaroo tendon, which are the absorbable materials in general use, are put upon the market, the former in three and the latter in two, sizes. The small cat-gut or kangaroo tendon if properly prepared is quite sufficient in tissues which become readily and quickly united and upon which there is no undue strain. The medium or large-sized cat-gut or kangaroo tendon would be required in uniting tissues on which there is considerable strain or which do not readily unite. The medium-sized cat-gut when used as a suture material upon the surface, or within the vagina, if chromicized, will not be absorbed sooner than seven to fourteen days. If buried within the tissues it will be much more quickly absorbed. The larger strands of cat-gut or tendon of course will retain their hold upon the tissues for a much longer time. The great objection to the use of the large strands of cat-gut or tendon is the difficulty, or often impossibility, of their perfect sterilization. This fact is attested by the great variety of methods in use at the present time for the purpose of sterilization, almost every hospital and every surgeon having a method peculiar to the hospital or surgeon, which method is not found effectual in other hospitals and by other surgeons. While some excellent surgeons may affirm that they use the larger strands of cat-gut or tendon with perfect impunity and without subsequent infection, others, perhaps equally reputable as surgeons, perhaps possessed of, and putting in daily use, as perfect a technic as the former, will affirm with one accord that the larger strands of cat-gut and tendon cannot be so sterilized as to be used without frequently infecting the wound. To such an extent has this been the experi-

ence of some surgeons who are in the daily habit of using the smaller strands of cat-gut, and use them with perfect confidence in their aseptic condition, and without subsequent bad results, that they have wholly discarded the use of the larger strands of both cat-gut and tendon for buried sutures, and this has only been done after some most unfortunate experiences of wound infection directly traceable to the use of these materials. It has occasionally happened after the closure of a wound with the large sized cat-gut or tendon, to have the healing process go on kindly for several days and then at once and without assignable cause to have a severe suppurative inflammation become established. This may perhaps at times occur through the circulation, auto-infection, or be the delayed result of infection occurring at time of operation; but the more probable explanation is that the outer layers of the sutures were rendered aseptic by the sterilizing process to which they had been subjected, while the center of the strands remained in a septic condition. After the sutures had been for some days in the wound the outer layer would become absorbed or macerated thus exposing the infected center of the strand to the wound secretion, producing infection and establishing a suppurative inflammation. If, then, for suture material, the smaller strands of cat-gut or tendon are too quickly absorbed, and the larger strands cannot at all times be rendered absolutely aseptic, we must seek for some other material for uniting tissues which require a buried suture to hold them in apposition for more than a few days. This brings us to the subject of non-absorbable materials for sutures.

Those in general use are silk, silk-worm-gut, silver wire, annealed iron wire and horse hair. In making selection of a non-absorbable suture material the advantages and disadvantages of each must be carefully considered, and, first, the certainty of sterilization. A non-absorbable buried suture must be aseptic. Silk-worm-gut, wire and horse hair are more easily sterilized than silk.

Then the least amount of irritation possible must be engendered by the buried suture. Silk-worm-gut, wire or horse hair are less irritating to the tissues in buried sutures than silk. Again, buried silk becomes permeated with the fluids and possible micro-organisms of the part, thus increasing the liability of its acting as a foreign material in the part, causing irritation, possible infection and later the discharge of the suture. While many surgeons use buried silk sutures, either with satisfaction to themselves, or because they have no substitute, probably the great majority are disposed to avoid their use as far as possible, and for what would seem to be most excellent reasons. For instance, you have just closed a wound in tiers with buried silk. For some reason, known or unknown, avoidable or not, the result perhaps of a faulty technic or imperfectly sterilized silk, it matters not how, but the wound has become infected at the time of operation or before its closure, and after a few days acute suppuration becomes established. Now, before you can arrest that suppurative process and render the wound surfaces reasonably aseptic and place them in such a condition that they will take on reparative action, you must absolutely remove or have discharged through the wound's secretions every suture of silk you have buried. Your silk here not only immeasurably complicates the process, retards the healing, aggravates the inflammation, increases the suppuration, pain and general discomfort, but it is also instrumental in causing the formation of a large amount of granulation tissue which renders the cicatrix more or less soft, distensible, and one which will easily give way if it be placed under much strain, as somewhere upon the anterior abdominal wall. Again, buried silk in a wound which heals kindly, aseptically and without irritation or inflammation, may at some subsequent time (this may be months or may be years) cause irritation, the formation of granulation tissue, perhaps become infected and come to the surface, much to the annoyance of the surgeon, but far more to the annoyance, inconvenience and disappointment of the patient.

This has frequently happened in the writer's practice and he is quite sure that it occurs in the practice of other surgeons. Silk-worm-gut, silver wire and annealed iron wire, if allowed to remain indefinitely within the tissues may also cause irritation, the formation of granulation tissue and become extruded. Horse hair is too fragile for ordinary use. The ideal suture material, then, would seem to be one which was non-absorbable, which would not become permeated with the fluids and possible micro-organisms of the part, which would not cause irritation, which could be easily introduced, and so introduced that when firm union had become established and the suture material of no further use, it could be easily extracted from the tissues.

In 1895 the writer published an article that appeared in THE CLINICAL REVIEW in which he advocated the use of Cushing's right-angle, continuous suture in intestinal work. Since then the use of the Cushing suture has been so greatly extended that now it practically excludes all other methods of suture in superficial and deep wounds implicating skin and fascia. Where muscles have been divided the medium-sized chromicized cat-gut suture is to be used. For uniting peritoneum, fascia and skin the right-angle, continuous, silk-worm-gut suture is used (Fig. 13). Entering the needle through the cutaneous surface at about a point where the first stitch would be inserted, it is carried down through the tissues and through the fascia; crossing the wound in the fascia, it is made to pick up about one-eighth of an inch of the fascia upon its under surface and very near its border. The needle is then carried directly across the wound and again made to pick up about one-eighth of an inch of the fascia upon its under surface and near the border, and thus forward and backward until the entire rent in the fascia has been covered, when the needle is brought out of the wound through the tissues and through the skin. A forceps is then applied to each end of the silk-worm gut. The cutaneous wound is united in a like manner, entering the needle perhaps one-fourth of an inch from one ex-

tremity of the wound it is carried through the skin and across the wound and is made to pick up perhaps one-eighth of an inch in extent of the under surface of the skin very near its border. The needle should get a good hold on the under surface of the corium, and then is made to traverse the wound forward and backward until the entire extent has been covered, when it is brought out through the skin as before. By drawing these threads tightly, first the fascia and then the skin is evenly, strongly and beautifully approximated in as near their normal relationship as it is possible to place them. The fascia and skin sutures can then be tied at their respective ends over a bit of gauze, or an additional suture may at times to advantage be inserted and tied, and then the two ends of the threads passing through the fascia and skin are tied to this. The advantages of the continuous suture are, first, that the sutures can be rapidly placed and the wound sooner approximated than by any other method of union in layers. Again, it takes less material to approximate the wound and there consequently is less suture material to cause irritation. The tissues are more evenly and beautifully approximated and the cicatrix is smaller and much less of a blemish; the sutures remain in the tissues one, two or three weeks without causing irritation, inflammation or disturbance of any kind, and at the end of this time, when the parts are firmly united, the sutures are readily removed. This ends absolutely and forever the liability of any suture material coming to the surface and causing annoyance. But what is perhaps of greater importance is the fact that in case you have by faulty technic, or otherwise, infected the wound at time of operation, your suture material will not add to or aggravate the infection, and the infection will not be maintained or increased in consequence of this material remaining in the wound; and in the event or in case you desire to remove the sutures this can be done without loss of time or disturbance or complication of any kind, or causing undue pain.

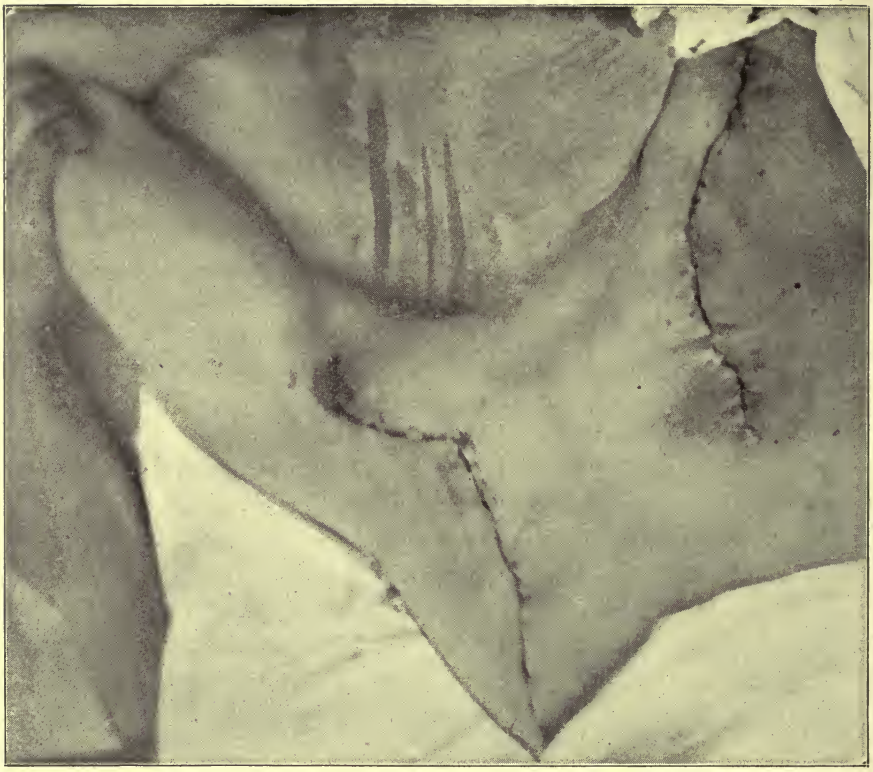


FIG. 14

Represents the wounds caused by the removal of the breasts closed by continuous silk-worm-gut suture. Photograph taken ten days after operation.

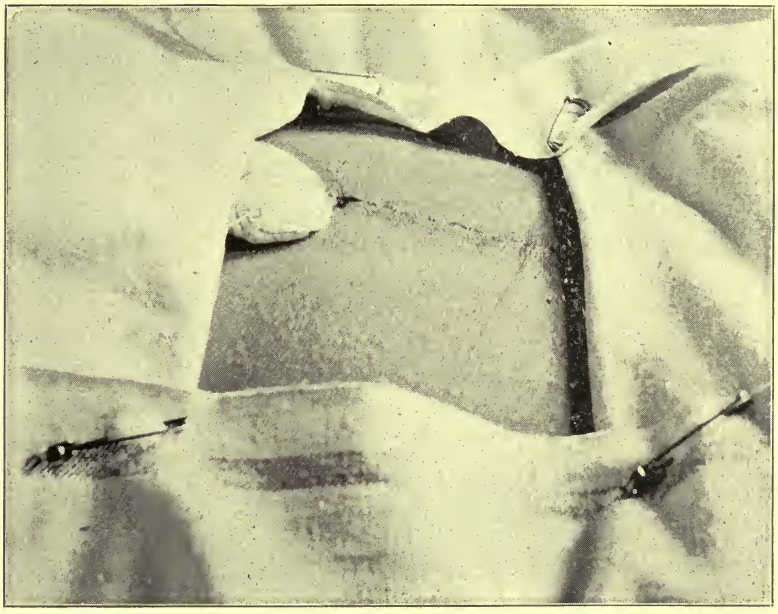


FIG. 15.

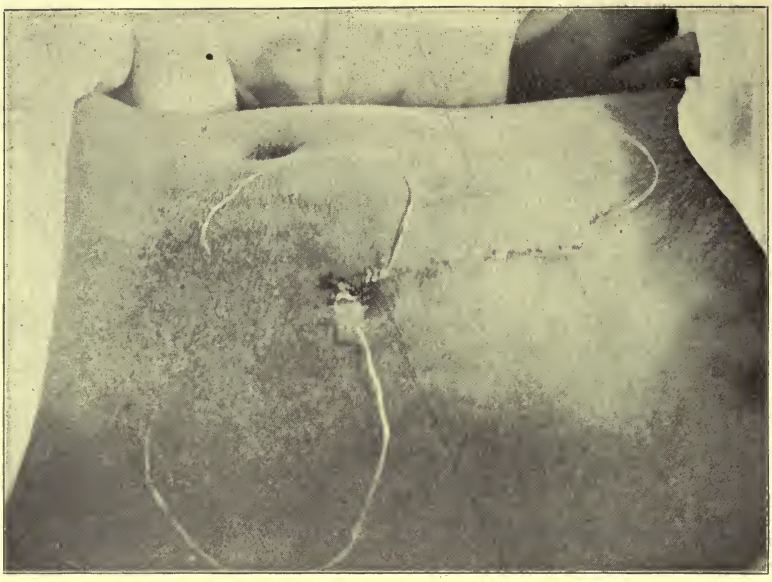


FIG. 16.

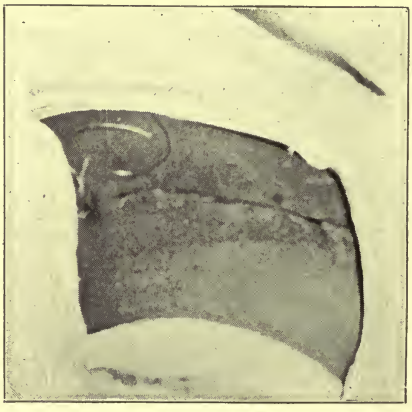


FIG. 17.

Figs. 15, 16 and 17 represent laparotomy wounds closed by the continuous suture. In these cases the peritoneum was also united by the continuous silk-worm-gut suture. Photographs taken two weeks after operations

CHAPTER VII.

THE CLASSIFICATION OF TUMORS.

For more than one hundred years physicians, surgeons, pathologists and chemists have endeavored to find some basis, etiological or structural, upon which to build a correct classification of tumors. They have, however, up to the present time succeeded only in part. A brief historical review of the efforts made and the work done, in this direction, showing at the same time, the gradual progress in knowledge, should be of interest.

Since the time of Hippocrates physicians have held the most divergent views concerning the cause, growth, structure, character, blood supply, the relation of the individual, and proper classification of tumors. Much of this contention has been due to a want of knowledge regarding the intimate structure and causation of tumors, as well as a lack of some limitation to the use of the word "tumor."

As the earlier writers had little or no knowledge of the anatomy or pathology of tumors they could not classify them according to structure, consequently were obliged to group them in accordance with their external appearance. In consequence of there being no restriction placed upon the use of the word "tumor," it was by usage made to include such conditions as effusions and extravasations, phlegmons and œdema, carbuncle, anthrax, furuncle and hydrocele; in fact almost every swelling and enlargement, circumscribed or diffuse, inflammatory or not, concerning which there was any doubt about the diagnosis. The only seeming exception to the rule was an abscess when the diagnosis was perfectly clear. With the acquisition of some knowledge in pathology and anatomy

there was a successful attempt made to restrict the application of the term tumor. At this time all of the inflammatory swellings were excluded. Physicians very early recognized the fact that there was a great difference in tumors, in the course they pursued, the rapidity of their growth, their affects upon the system, and their general characteristics. They came to know that one set of tumors did not materially influence the individual either in his health, constitution or length of life. These tumors were termed *benign*—or *inflammatio benigna*. They also knew that another class in its growth did affect the health and well-being of the patient and soon lead to his death. This group was called *malignant*—or *inflammatio maligna*. This is probably the only classification of tumors, made at an early date, which has remained until the present time. Although there was little or nothing known at this time concerning the etiology of tumors there was very much of theory and conjecture. In consequence of the different and varying views of writers there came a great number of classifications of tumors. (The writer desires to acknowledge his indebtedness to the great work of Virchow on tumors, published in 1863, in making up much of the historical matter which follows.)

Guilelm Harvey, writing in 1651, classed all tumors as parasitic in origin. He held that while at least so far as our observation extends all tumors live upon the body, they were nevertheless quite as capable of carrying on an existence entirely separate from the body. A great many physicians, even as late as 1825, held that all cystic tumors had their origin in entozoa. This idea became especially prominent after some knowledge had been gained of the course and nature of the echinococcus and cysticercus. At this time many physicians believed that even the solid tumors were of this nature. The one thing remaining was the discovery of the parasite. It was also during the fore part of this century that the view was held by many that all tumors were either the result of inflammation or irritation. Broussais held that tumors were

nothing more than a form of inflammatory induration, consequently he favored eliminating the word tumor entirely from medical phraseology. Carl Wenzel, writing in 1815, was also of the opinion that tumors were nothing more or less than inflammatory products. John Nep Rust, in considering the etiology of tumors, opposed very strongly the idea that they could have any other than a constitutional origin. He classed cysts, nævi, warts, hydrocele and retention cysts as constitutional affections. Following this tumors were divided and grouped in two classes; first, according to certain characteristics, as their appearance, form, color, consistence, rapidity of growth and gross appearance on section; and in the second case, according to their vital relations to the body, and to the changes occurring in each as a result of the association. The first classification was known as the anatomical and the second as the physiological. The grouping of tumors according to form and appearance gave the names knot, tubercle, polyp, fungus, ganglion, cauliflower, condyloma, keloid and molluscum. The hard bunch or punctated point with radiating vessels like the feet of a crab gave the name carcinoma.

Z. B. Schuster, writing in 1851, made an excellent classification of tumors according to regions, as tumors of the head, thorax and abdomen. Tumors were also classified in accordance with their likeness to known things. A cyst with a watery contents or containing a fluid not unlike water, was called a hygroma. Tumors were called meliceris when their contents had the consistence or appearance of honey. They were called colloid when their contents was like jelly or gelatinous material. Again a tumor was called an atheroma when its contents was of a soft, greasy, granular character. It was, however, quite impossible to make any considerable advance in the classification of tumors so long as their relations to the body, their anatomy, histology and growth were not known or understood. The first distinct advance made was when the fact became partially known that the tissues in tumors were not unlike those of which the normal body was

composed. That a tumor might be made up of fat, which would be like normal fat, or of connective or glandular tissue like normal connective or glandular tissue. That a growth from the superficial portion of the skin might resemble in structure and be not unlike normal epidermis. John Abernethy, writing in 1809, was perhaps the first to give expression and authority to the idea of this likeness. He spoke with confidence, not only of the likeness of certain tumors to particular tissues of the body, but also of the close resemblance of some tumors to particular glands, as, for instance, the mammary gland. John Müller, a pioneer worker and thinker, held that there was nothing to be found in tumors which did not exist normally in the body, either as mature or embryonal tissue. He thought that all tumors should be most carefully examined and then placed in one of the two great classes, the benign or malignant. It was not, however, until the labors Bichat had laid the foundation for an understanding of anatomy and pathology, and that of Haller and John Hunter had made some progress in embryology, that the great work of Döllinger in evolution and that of Schwann and Johannes Müller in histology made possible a classification of tumors on a scientific basis. Before this much at least had been confusion and chaos. Now it seemed possible to group tumors according to their anatomical or histological structure. Dupuytren was probably the first to take advantage of this knowledge of anatomy and histology in the classification of tumors. He made two great classes, in one he placed all tumors which had a likeness in structure to some particular part of the body. In the other he placed the tumors which from their growth and structure were unlike any portion of the body. The first were called accidental tumors, and the second tumors *sui generis*. Laennec, on account of the likeness of some tumors in appearance and consistence to brain tissue, called them encephaloid. Munoir, on account of the appearance of a medullary sarcoma held it to be an excessive growth of nerve tissue and classed it as a nerve tumor. A tumor which was very hard was called

a scirrhus; one less hard a steatoma. It was very largely due to the work of Laennec, Bichat, Dupuytren and Cruveilhier that the knowledge of tumors was so much advanced, and their likeness or identity to the tissues of the body made more clear.

J. F. Lobstein divided tumors into two great classes. In the one he placed all tumors which were like or resembled the tissues of the body. To this class he gave the name homœoplastic. In the other class he placed all tumors which differed both in appearance and structure from the tissues of the body. To this class he gave the name heteroplastic. Lobstein also made a second classification. Believing, as he did, with the humoral pathologists, that the nature of a tumor depended very largely upon the character of the nutrient material furnished it, he called those tumors whose tissues resembled the tissues of the body and which he had formerly called homœoplastic and which were wont to pursue a benign course because nourished with favorable material, euplastic. Again, the growths which differed in structure from the tissues of the body and which he had called heteroplastic and which were likely to pursue an unfavorable course because nourished with improper material he called kakoplastic.

The circulation of the blood in tumors is a matter concerning which there has been much conjecture, some strife and no little speculation. It was thought for a very considerable time that the circulation in tumors was entirely separate from that of the body. That the tumor had within itself a separate and distinct circulatory apparatus. Kluge, Hasse and others held that tumors should be classified according to their circulation. That in one class the circulation was situated upon the periphery, while in another which, however, pursued a less favorable course, it was situated centrally. Shroeder Vanderkolk thought that the circulation in tumors was entirely distinctive. He divided tumors into two classes. In one of these the arteries which came from the general arterial system broke up into capillaries upon reaching the surface of the

tumor, the blood being then collected into veins and returned into the general venous circulation. These tumors, he thought, were of the nature of hypertrophies. In the second class the blood was carried to the tumor as before in arteries, which broke up into capillaries upon its surface, but the blood was returned through arteries instead of veins—the circulation resembling that in the liver, there being, however, two sets of capillaries and arteries instead of two sets of veins. Vanderkolk found that he was often unable to inject a tumor through the veins while it was possible to inject it through the arteries. This fact, he thought, supported his view. The temporary or permanent closure of the veins might, however, be due to the pressure of the tumor upon their compressible walls or be the result of the tumor having grown into the veins and in consequence obliterated them.

It was about this time that the profession came to devote itself to the consideration of the chemical aspect of tumors. There was an effort made to extract by chemical analysis the important element, the vital principle, the etiological factor of tumors. This was perhaps especially true in France where such chemists as Thénard, Vauquelin, Lassaigne and others devoted much time in their effort to elucidate the subject. It was finally concluded that the malignant growths contained more albumen than the benign, while the latter held more lime and fat. The fat was thought to be in both a fluid and crystalline state. Even so great a pathologist as Carl Rokitansky said that in albumen man should seek and would find the active principle and chief cause of the worst cases of tumors. Virchow, in his work on tumors, 1863, says that the tumors were cooked, extracted and maltreated in man's endeavor to find some chemical substance vital to them. But the work of course was without any special result—nothing of importance being found.

Following the abandonment of the chemical study of tumors, physicians and pathologists took up with great enthusiasm their microscopical study. The microscopist was

expected to find some typical cell or substance which would not only afford a basis for classification, but also be the specific element or substance causative of tumors. The microscopist was equal to the occasion, for it was not long before he had a typical cell for cancer, sarcoma and tubercle. Lebert was especially emphatic and positive in his opinion, that in every tumor, as in every plant and animal, there was something specific and distinctive, something which separated one tumor from another as clearly as one animal was separated from another. Virchow, writing in 1847, opposed this view that there was anything specific in the structure of tumors. In his work published in 1863 he says: "We are now in position to say that there are no specific tissue elements in tumors. That we must hold fast to the idea that whatever the construction of a tumor it is always a part of the body out of which it has grown, and not unlike some part of it in structure." Virchow divided tumors primarily into two great classes. In the first class he placed all tumors which corresponded in structure with the tissue from which they grew. This class of tumors he called homologous. Thus a cartilagenous tumor growing from a rib was homologous because at a previous time, if not at the present, the rib also had been composed of cartilage. In the second class he placed all tumors which in structure did not correspond to the tissue from which they sprung, either at the present or at any previous time. These tumors he called heterologous. Thus a cartilagenous tumor growing in the testicle was heterologous. The homologous growths were classed as hypertrophies because they conformed to the normal tissue of the body. They were also benign, while the heterologous growths were usually malignant.

At this time there was also an attempt made to classify tumors according to their supposed cause. The active causative conditions were supposed to be three in number. The first was the local cause, "*locus minosis resistentiæ.*" This cause was supposed to be active in producing a tumor in some

particular region. This might be the result of a lessened local resistance in the tissues, or to an over-action of the exciting or specific elements at that particular point. The second was the predisposing cause. This was an active condition, local or general, which affected the growth of a tumor at some particular region. The third was the constitutional condition or dyscrasia, or diathesis, a something within the blood which, aided by the local and predisposing conditions, effected the production of a tumor.

Virchow, in his work on tumors, made a further classification. In the first class he placed all tumors which were of simple structure and composed throughout of a single tissue. To this class he gave the name histioide. These tumors may be composed of fibrous tissue, mature cells, such as cylindrical or squamous cells or of embryonal tissue. The growth may be benign or malignant. In his second class the structure is more complex. Instead of a single tissue there is a combination of tissues. Often with a typical arrangement of structure it may be closely resembling an organ. To this class he gave the name organoid. The third class is still more complicated in structure, there being not simply one organ, but many organs, they all resembling more or less perfectly the appearance of a body. To this class he gave the name teratoid. While these three groups comprised the great majority of tumors they did not include them all. There were mixed or combination forms not included. Such were retention cysts when complicated by a serous or hæmorrhagic exudate, or cysts in which secondary cysts had grown. To this class he gave the name combination tumors.

The broad division of tumors into benign and malignant, without restriction to cause, will probably always remain. This distinction is the first which presents itself to the mind of the patient, and one of the first and most important which the surgeon must consider in his differential diagnosis and prognosis. The classification of tumors by Virchow in 1863, according to the tissues from which they spring, remains,

with some few exceptions, to the present day. So long at least as we have not an etiological basis upon which to build a classification we must consider tumors in accordance with their histological structure.

In the building of the human body there are four reasonably distinct and separate tissues—the connective, muscular, nervous, and epithelial. Whatever else may be outside of or beyond, as possible predisposing or etiological factors, all tumors have their origin in and are composed of one or more of these tissues. The tissue in one tumor may be a little younger and in another a little older, or it may have undergone degenerative or formative changes, or the contents of a tumor may be abnormal to the part, as is the case with dermoids. Still the tissue of the tumor itself will primarily always have corresponded to the tissue from which it springs.

The classification or consideration of tumors in regions and according to structure is often of the greatest assistance to the student and surgeon in making a differential diagnosis. Excepting dermoids and errors of development, if the student considers the histology of a part he can tell very accurately the kind of tumors which are likely to or may occur in any particular region. If we study the infra-maxillary region where tumors so frequently develop we will find that in consequence of the histological structure of the tissue, both superficial and deep, the following growths may occur: From the epidermis, an epithelioma; from the epidermis and papillæ, papilloma; from the fibrous tissue, a fibroma, a sarcoma or a molluscum fibrosum; from the glands, adenoma, carcinoma and retention cysts. In the connective tissue and fascia beneath the skin may occur lipomata, fibromata or sarcomata; and from the nerves, neuromata. From the vessels in this region, arterial, venous and lymphatic, there may occur not only the various forms of angeiomata, which here are often congenital, but also lymphatic cysts and endothelial tumors. From the muscles there may occur myoma, and from both the periosteum and bone, fibroma, sarcoma and osteoma. From the

parotid and sub-maxillary glands may come retention and gland cysts, adenoma, carcinoma, fibroma and sarcoma. The lymphatic glands may be the site of various affections, forming or simulating tumors. Such as lympho-sarcoma, lymph-adenoma, and tubercular lymphangitis.

While this method of classification is advantageous in diagnosis and in differentiation it seemingly is not desirable for purposes of study.

In these lectures as a basis for classification we shall adopt the enumeration of tissues into connective, muscular, nervous and epithelial. We shall consider dermoids and cysts separate from this classification on account of their peculiarity of origin.

Connective Tissue Tumors.—In arranging this group of tumors we shall follow the histologist rather than the embryologist and shall make it include practically all those which have their origin from connective tissue, whether this tissue be what is ordinarily considered as embryonal, fully formed, or connective tissue in a state of higher development. It will include the following tumors with their various species:

1. Lipomata,
2. Fibromata,
3. Osteomata,
4. Chondromata,
5. Odontomata,
6. Myxomata,
7. Gliomata,
8. Angeiomata,
9. Lymph Angeiomata,
10. Myelomata,
11. Sarcomata.

While the myomata and according to many, the neuromata, might also be considered under this head, we have thought it best for the purposes of study to make separate groups for these two genera. It must be understood that the tumors of this group—and for that matter of any group—are not always pure tumors, that a lipoma is not composed entirely of fat, nor a fibroma always of fibrous tissue, nor an osteoma or chondroma entirely of osseous or cartilaginous tissue, nor a sarcoma wholly of cells; but that these several

tissues in their respective tumors predominate. In fatty tumors there is to be found a quantity of fully formed connective tissue, in fibroma often muscle, cartilage, or bone, in chondroma frequently osseous tissue and in sarcoma always connective tissue. In consequence of this fact it is not always easy to determine to which genus a particular tumor belongs, for tumors are not always classified according to the tissue which predominates, but rather in accordance with the grade or importance of that tissue. As muscle and bone are tissues

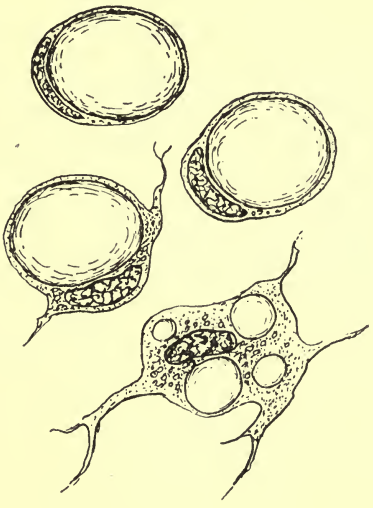


FIG. 18.

a. Connective tissue cell in which there are fat drops.
b. Connective tissue cell filled with fat.

of greater importance than normal connective tissue and represent stages of higher development, they should be given the greater consideration in naming a tumor when both are present. When a tumor contains elements of malignancy hese, though perhaps small in proportion to the benign elements, should be given the greater prominence because of their greater importance. It is not infrequently the case that two or more of the elements of a tumor are so nearly

equal in quantity or character as to require compound names to express their histology or character, as myo-fibroma or osteo-chondro-sarcoma.

Lipomata or Fatty Tumors.—A lipoma is composed of tissue identical with normal fat and consequently in histological structure is made up of round bullet-like cells, each having a membrane, a nucleus and a small amount of protoplasm. (Fig. 18.) The cells are primarily connective tissue cells which

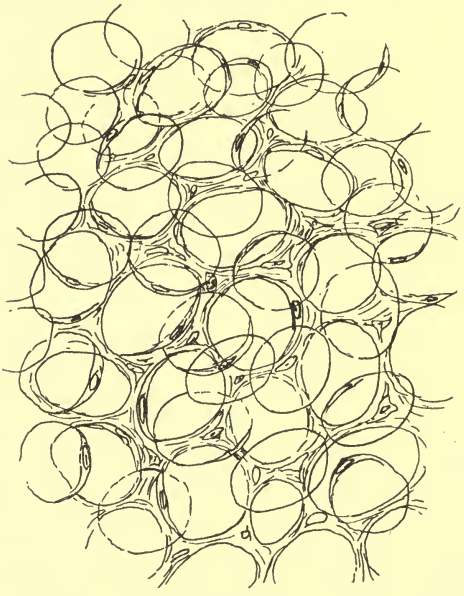


FIG. 19.
Adipose tissue.

have become filled with fat. If the quantity of fat is small it may be distributed through the cell as large or small drops; when the quantity is large the separate drops run together making a large fluid mass which fills and distends the cell, thus forcing the nucleus and protoplasm against the wall of the cell. Fat cells are highly refractive and under the microscope glisten strongly. They lie directly one upon the other, being collected into bunches or lobules which are surrounded by connective tissue. (Fig. 19.) In this connective tissue

the vessels ramify. The surface of a lipoma is nearly always uneven and nodular owing to the formation of the lobules, although occasionally it is as smooth as a tense cyst. (Fig. 20.) A lipoma is surrounded by a thin connective tissue capsule which sends partitions through the tumor, supporting it, forming the framework and at the same time separating the

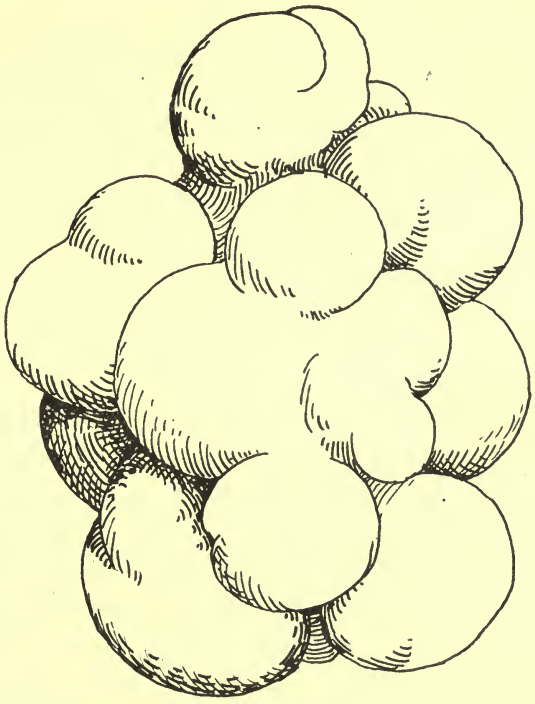


FIG. 20.

Fatty tumor showing the lobules.

above-mentioned lobules. The amount of this connective tissue varies very much, at times it forms a very considerable part of the tumor, making it firm and hard—*lipoma fibrosum.* Again, the amount of connective tissue may be small, the tumor being composed very largely or almost entirely of fat—*lipoma molle.* The capsule of the tumor is formed by the condensation of the connective tissue in the immediate vicinity

of the tumor, and by the formation of new connective tissue, both being the result largely of the irritation incident to pressure. Many lipomata are more or less diffused in consequence of the capsule being deficient. Virchow states that the lobules are the result of the proliferation of a single cell. The superficial portion of a subcutaneous lipoma is usually connected to the skin by many strong strands of connective tissue. These strands by dragging upon the skin cause the dimpling which occurs when the tumor is forced in different directions. The connective tissue of fatty tumors is liable to various changes, both formative and degenerative. The tumor may in part be converted into bone or become calcified, or undergo a myxomatous change, or the cell membranes, apparently in consequence of defective nutrition—as may occur in disturbances of the circulation—may be destroyed, setting the fat free and producing a veritable cyst of each lobule, or of many lobules. A more serious disturbance of the circulation may occur with or without infection and lead to ulceration, gangrene, or abscess. There are not only disturbances of the circulation, but the number and size of the blood vessels which go to the capsule and permeate the interlobular connective tissue are also subject to great change. Ordinarily the amount of blood going to a lipoma is not great, the vessels being few in number and small in caliber, but occasionally the vessels are so increased in number and size as to entirely dominate the other elements and produce a very vascular growth, *lipoma telangiectaticum.* This is especially liable to occur in congenital lipomata.

Seats of Predilection.—Fatty tumors follow very closely in their situation the normal fat layers, such as the subcutaneous, subserous, and submucous. While they are most frequently found in one or the other of these layers, they may occur not only wherever fat is physiologically present, but also in tissues where fat never is found except as the result of a pathological process. Those tissues and organs in which lipomata occasionally occur, as heterotopic tumors, are the

muscles, periosteum, scrotum, labia majora, kidneys and brain. It should be remembered that lipomata are not only

FIG. 21.

Lipoma of neck and scalp.
(Taken from a patient in the writer's experience.)

connective tissue tumors, but also are little more than accummulations of fat within connective tissue cells, and, consequently, may occur wherever connective tissue is present.

Lipomata in Subcutaneous Tissue.—As this is the most favored site for normal fat, so it is the most frequent seat for fatty tumors. (Fig. 21.) These may be single and small, perhaps not larger than a walnut, or very large, weighing perhaps ten, twenty or even one hundred pounds, or they may be multiple and even symmetrical. When situated upon the neck or trunk they are most frequently upon the posterior surface, when upon the extremities they are very frequently upon the flexor surfaces. Lipomata, while usually single, are more often multiple than any other class of tumor. There may be ten, twenty or even more upon the same individual. In a case recently under observation there were twenty-six lipomata upon the right arm and forearm, twenty-four upon the left, and more than two hundred upon the trunk and lower extremities. These tumors were of various sizes ranging from that of a hickory nut to that of a large apple. Subcutaneous lipomata are seldom found upon the head or beneath the surfaces covered with hair or where the overlying skin is thick or tense. Unless they have undergone inflammatory change they are loosely attached to the surrounding tissues and consequently freely movable. They may be sessile or pedunculated, and on account of their loose attachments may occasionally travel considerable distances from their original site. Von Lloyd removed a fatty tumor from the perineum that had made its appearance in the groin ten years previously, and Lyford removed one from below the knee that had first been noticed upon the abdominal wall. Very small lipomata occur in single or multiple form upon the eyelids. These are the xanthoma of some writers. In size they correspond to a pin's head or a kernel of wheat. In form they are irregular, with a flat surface; in color, yellowish, and in consistence soft. According to Stengel they not only represent an embryonal state of adipose tissue, but a tissue which is often infiltrated with round cells. This yellow color is derived from the coloring matter of the blood. Lipomata not infrequently occur in connection with the mammary gland.

In that situation a growth of adipose tissue may completely envelop the breast, being more or less diffused, or it may be encapsulated and lie external to the gland. It may produce a tumor of enormous size. The so-called hypertrophies of the breast often belong to this class. Robert and Amusat amputated two lipomatous breasts in a young girl, aged 21. The right breast weighed 30½ pounds and the left 20½ pounds. The girl, after the operation, weighed only 101 pounds. Lipomata also occasionally occur in the palm of the hand in close relationship with the flexor tendons, on the fingers, and in the sole of the foot.

Subserous and Subsynovial Lipomata.—Every surgeon is familiar with the cushion of fat upon which the peritoneum rests. This may be the site of lipomata, large or small, more or less circumscribed or diffused, lobulated or smooth, movable or quite fixed. Occasionally a subperitoneal lipoma will during its growth force its way through the overlying abdominal muscles and appear as a subcutaneous tumor. Lipomata are also of occasional occurrence behind the peritoneum. In this situation they frequently dip down between the muscular planes, or may be situated around the kidney or within its capsule. They are most frequently associated with the kidney in chronic inflammatory affections of that organ, in which case they may form large tumors. Terillon removed a subserous lipoma weighing 57 pounds and Homans removed two large post peritoneal lipomata. A small, smooth, soft, freely movable lipoma is frequently found in the hernial region surrounding a partially or completely obliterated hernial sac. The writer in his operative work in these regions has frequently found small, pear-shaped, fatty tumors with slender pedicles which had formed around the slender process of the peritoneum as a nucleus. These slender processes of peritoneum often contain strands of omentum, or small quantities of fluid, or they may even in exceptional cases contain a knuckle of intestine. They should always be incised with caution. In the gastro-intestinal canal the subperitoneal

lipomata occur most frequently upon the colon. The appendices epiploica occasionally become enlarged into tumors of considerable size. The writer removed a subserous lipoma of the transverse colon as large as a fœtal head. The patient had noticed the tumor for many months and it finally by its weight came to produce symptoms of intestinal obstruction. Lipomata of large size have been removed from both the omentum and mesentery. Meredith removed successfully a lipoma from the omentum weighing 15½ pounds, Forster saw one that weighed 53 pounds, Waldeyer described a lipomyxoma of the mesentery that weighed 63 pounds.

Subpleural Lipomata.—Fatty tumors having their origin beneath the pleura are of rare occurrence. v. Langanbeck removed a subpleural lipoma from the anterior mediastinum, the patient succumbing to an attack of erysipelas. Gussenbauer removed one successfully which was projecting at the second intercostal space.

Lipomata of the Brain and Cerebral Meninges.—Although lipomata situated within the cranial cavity are of comparatively rare occurrence, they are, nevertheless, of great interest. Meckel describes a lipoma the size of a hazel-nut situated on the under surface of the brain adjacent to the optic nerve; Klob saw a lipoma the size of a bean situated between the pons and cerebellum; Cruveilhier found a small fatty tumor in the region of the medulla oblongata; Sangalli describes a myxolipoma on the pons in an epileptic patient.

The above-mentioned growths had their seats in the pia mater.

In 227 cases of brain tumors tabulated by Ernst von Bergmann five were fibro-lipomata. Tauber saw a fatty tumor in the tubercula quadrigemina on the right side, Chiari found two lipomata the size of a pea under the arachnoid; Wichselbaum describes one as occurring in the posterior lobe of the hypophysis in a soldier, 22 years old. Virchow, Rokitansky, Wallman, Hacker and others, have recorded cases of fatty tumors situated upon the surface of the brain. With very

few exceptions the lipomata which have been found within the cranial cavity have been situated upon the membranes, usually upon the pia mater. Wherever connective tissue is present there one may have a lipoma, and even in some portions of the brain adipose tissue is physiological to the part, as, for instance, in the raphé of the corpus callosum and in the fornix.

Lipomata of the Meninges of the Cord.—Lipomata of pure or mixed composition are of occasional occurrence in the spinal canal. They usually have their origin either from the pia, or the meshes of the arachnoid. Gowers figures a myolipoma of considerable size growing from the arachnoid; Ziegler states that lipomata are frequently observed in the epidural space. Johnson describes a case of congenital fatty tumor which had the appearance of a spina bifida. The tumor had its origin from within the spinal canal, but outside of the dura; it projected outwards through a defect in the bony wall of the spinal canal. Inside the dura there was also a fatty tumor which had produced injurious pressure upon the cord. In cases of spina bifida, the same as in hernia, there is a marked tendency to the formation of lipomata around the sacks; especially if these be more or less obliterated. In congenital tumors situated over the spine, and having the characteristics of lipomata, the surgeon must bear in mind the great probability of a concealed spina bifida.

Subsynovial Lipomata.—Fat is normal in the deeper meshes of most synovial membranes. It affords the nucleus around which the subsynovial lipomata are usually formed. It is probably also true that they may have their origin from the subsynovial adipose tissue, and gradually, as the result of the growth and pressure, force their way into the joint, producing a polypoid growth. Subsynovial lipomata are usually the sequence of a chronic arthritis and occur very often in chronic rheumatoid arthritis. As a result of the inflammatory process the tissues proliferate, the capsule becomes thickened, the synovial folds and fringes become elongated, thick-

ened, increased in number, and, finally, fat is deposited within them in considerable quantities producing small pedunculated tumors which are sometimes present in great numbers. This condition was first described by John Muller as aborescent lipoma. In consequence of the joint motions and of traction upon the tumors, their pedicles may become more or less elongated or even ruptured, the result being loose bodies in the joint. This condition is most frequent at the knee and shoulder and may require surgical intervention.

Submucous Lipomata.—These tumors are usually small and occur less frequently than the subserous. They are distributed over a wide extent of surface, and may be either sessile or pedunculated. Virchow has found lipomata in both the stomach and jejunum. Turner saw a submucous fatty tumor in the large intestine; Sangalli narrates a case in which he found in the colon decendens two quite large polypoid lipomata. These tumors had produced invagination and prolapse of the bowel. Lipomata have been observed beneath the mucous membrane of the lower lip, on the floor of the mouth, at the lower end of the esophagus, in the conjunctiva, pharynx, larynx, and bronchi. Usually in these situations they are not large and seldom produce serious disturbances.

Intermuscular Lipomata.—The connective tissue planes situated between the muscles often contain adipose tissue and occasionally are the site of fatty tumors. These tumors seemingly are quite liable to sarcomatous change.

Intramuscular Lipomata.—It should be kept in mind that fatty tumors are not always confined to the tissues in which fat is a normal ingredient. Fat is not a physiological ingredient of muscle and still intramuscular lipomata have been observed many times—a fibro-lipoma has been observed in the substance of the heart. According to Sutton intramuscular lipomata have been seen in the biceps, deltoid, complexus, the cardiac septum, and the rectus abdominis. Lipomata have frequently been observed in the oral cavity. Partsch tabulated twenty cases of lipomata of the mouth. In

twelve of these the tumors were situated either within the muscles of the tongue or beneath its mucous membrane, seven were upon the lips, and one grew from the gums. Rydygier figures a lipoma of the tongue which seems an inch or more in diameter. In lingual lipomata it is often difficult to determine accurately whether they primarily were intramuscular or submucous. This is in consequence of their growth forcing them out of the muscle and making them project strongly against the mucous membrane, often as pedunculated growths.

Periosteal Lipomata.—The periosteum does not normally contain fat, but periosteal lipomata have been found having connections with the following bones: the scapula, innominate bone, clavicle, humerus, radius, ulna, femur, tibia, fibula, cervical vertebræ and frontal bone. Periosteal lipomata have frequently been mistaken for sarcomata and the diagnosis will always be difficult on account of their situation beneath the fascia. These tumors are often not pure but contain muscular elements.

Lipomata of the Scrotum and Labia Majora.—Fatty tumors of large size have occasionally been observed growing from the scrotum. They have their origin either in the dartos or the tunica vaginalis. They also have been observed in the labia majora where their origin presumably is from the areolar tissue of the labia which resembles in structure the dartos. According to some writers these latter tumors come from the subcutaneous adipose tissue.

Lipomata of the Kidney.—A very few small lipomata have been found in the cortical substance of the kidney.

In the scrotum, labia majora, kidney, heart, and in muscle adipose tissue is not physiological to the parts.

The Causation of Lipomata.—Nearly half a century ago Virchow held that irritation and injury played a very important part in the causation of tumors. That this is true of lipomata there can be but little doubt. The very frequent occurrence of fatty tumors at places which have been subjected to irritation, injury, or chronic inflammation is seem-

ingly well established. This would appear to explain the frequent occurrence of lipomata in the knee and shoulder joints in cases of chronic rheumatoid arthritis, in and around the breast in cases of chronic mastitis, and about the kidney when that organ is the seat of chronic inflammation. It has long been held that the chronic irritation of the suspenders was the causative condition of many of the lipomata occurring upon the back. The very frequent occurrence of lipomata around hernial sacks or the sacks of spina bifida could well be charged to the irritation or injury incident to these structures. The production of lipomata is closely related to the formation of normal adipose tissue, as with very few exceptions they both occur in the same tissue layers and are identical in histological structure. Thoma says that the tendency in individuals to obesity favors the production of lipomata. Virchow and Langerhans believe that persons who daily consume considerable quantities of beer or wine are especially liable to the formation of lipomata. They state that in these persons the appendicis epiploicæ are nearly always enlarged into tumor-like processes. Age has some influence as nearly all lipomata occur at or near adult age. If, as seems probable, obesity favors the formation of lipomata, the loss of fat, even to emaciation, does not effect their disappearance or materially influence their growth. Fatty tumors are also occasionally congenital, especially the form rich in blood vessels known as lipoma telangiectaticum. There seems to be a growing belief among some pathologists that multiple lipomata, and especially those which are symmetrical, are not only connected with sensitive nerve filaments, but that these nerves in some way are causative of the tumor formations. In many cases lipomata have been known to occur in the area of distribution of some sensitive nerve following a neuralgia, in some of these cases the neuralgia has disappeared after the removal of the tumor. This may be another form of local irritation. It seems at the present time at least probable that not only irritation, whether at one point or at many, but also

injury, disturbances of the circulation—such as occurs in chronic inflammation—and disturbances in constructive metabolism play very important parts in the causation of lipomata.

Diagnosis.—The diagnosis of fatty tumors which are situated subcutaneously is ordinarily easy. A lipoma is a typical benign tumor and consequently never causes metastasis. It is of slow growth, painless, irregular or nodular in form, usually completely encapsulated and consequently freely movable, soft and even semi-fluctuant in feel. The subcutaneous portion of a fatty tumor is connected with the skin by numerous strands of connective tissue, consequently when the tumor is moved in different directions these strands drag upon the skin, producing dimpling. Although an irregular or lobular outline, and dimpling of the skin on moving the tumor in different directions, are two of the cardinal symptoms of lipomata, it would seem best not to depend too implicitly upon their presence or absence in making a diagnosis, for they may both be absent. A man came recently to consult the writer regarding a subcutaneous tumor about the size of a small cocoanut which was situated over the tuberosity of ischium and rami of ischium and pubes. The growth had only inconvenienced the patient on account of its location and size. The tumor wall was as smooth and tense as any cyst and freely movable without dragging upon or dimpling the skin. Upon incising the skin the tumor was seen to have not only the loosest connective tissue connections to it, but to be perfectly smooth having a dense fibrous capsule. On incision the tumor was found to be simply a lipoma with a dense wall. The tumor had been diagnosed as a cyst on account of its smooth surface and the feeling of fluctuation it imparted.

Treatment.—Lipomata being benign tumors, their removal is not always a necessity. They may be removed for a cosmetic effect and should be removed if on account of their location they are likely to be inconvenient, or their size, present or prospective, is liable to produce injurious pressure.

Under ordinary conditions their removal is desirable if this can be done with reasonable safety, on account of their steady growth. If they are multiple and very numerous it will ordinarily be unwise to attempt their removal. In the operative technic of a subcutaneous lipoma a free incision should be made through the skin and superficial fascia directly over the tumor. The tumor can now be shelled out with the fingers with more or less ease, aiding the process by a few strokes of the knife where necessary. If the strands of connective tissue binding the tumor to the skin are numerous and strong the knife must be used more vigorously. After the removal of a subcutaneous lipoma, a very considerable cavity is left which only becomes obliterated by natural processes after some days. As a septic inflammation is readily established in the surrounding loose connective tissue, it is well to drain this cavity for a few days with a small wick of iodoform gauze. The technic essential in the removal of fatty tumors situated beneath the serous, synovial, and mucous surfaces will depend entirely upon their special situation, the anatomy of the part and the structures involved. The lipomata situated at the base of the brain, within the substance of the heart or kidney are usually small and frequently without decided symptoms, They are inoperable tumors. Those situated within the spinal canal may be shelled out after doing a laminectomy. Subserous tumors growing from the anterior abdominal surface and either producing pressure externally or projecting into the abdominal cavity as sessile or pedunculated growths, may present difficulties in diagnosis but are not likely to require in their removal a difficult or complicated operative technic. Pedunculated tumors situated within the abdominal cavity, whether coming from the abdominal wall or from beneath the serosa of the large intestine, will only require in their removal that the pedicle be ligated, incised, and the peritoneum closed over the stump. Large sessile tumors situated upon the colon may perhaps in exceptional cases be enucleated after incising the peritoneum, but under ordinary

PLATE I.

Fatty Tumor of the Shoulder. Twelve years' growth.

circumstances they will require resection of the bowel. This was necessary in one of the writer's cases.

Submucous Lipomata.—These tumors if situated within the gastro-intestinal canal are usually possessed of a long stalk. The great difficulty will lie with the diagnosis. If in the stomach they are likely to produce a dragging pain, disturbances of digestion, vomiting, hæmorrhage, emaciation, and a feeling as though some foreign substance, or something alive were in the stomach. With this there is likely to be a severe train of nervous symptoms. If situated in the intestinal canal there is likely to be a dragging pain, occasionally blood in the stools, constipation alternating with diarrhœa, with occasional symptoms of obstruction, and it may be invagination. If the diagnosis could be established or the symptoms should require operative measures, the stomach or bowel after being rendered as nearly aseptic as possible should be opened and the tumor removed.

Lipomata may also be situated either in the naso-pharynx or antrum of Highmore. In these situations if the tumor was of any considerable size, neither the diagnosis nor the operative technic would present any special difficulty. Subsynovial lipomata when having the character of loose bodies and producing disturbance in joints should be removed. This is effected by freely opening the joint under antiseptic precautions. Intra and inter-muscular lipomata, if accessible and causing disturbance, should be enucleated.

CHAPTER VIII.

FIBROID TUMORS.

Fibromata.—A fibroid tumor is composed of fibrous or connective tissue, with more or less of elastic tissue blood vessels, nerves and lymphatics. Wherever connective tissue is present in the tissues or organs of the body, there a fibroma may occur. If the formation of connective tissue from the blastodermic layer is traced it will be seen that it comes from both the epiblast and mesoblast. The often-repeated statement that connective tissue tumors have their origin from the mesoblast alone is entirely erroneous, as the entire nervous system, as well as the muscles of the sweat glands (both connective tissue structures), have their origin from the epiblast.

The connective tissue group from which the fibromata come, assumes a great variety of forms and stages of development. In the embryonal stage it is a soft, gelatinous, plastic mass, made up of stellate cells and a non-differentiated intercellular substance. (Fig. 22.) The cells are nucleated, flattened, protoplasmic bodies from which intercommunicating projections extend into the intercellular substance. The intercellular substance makes up a considerable part of the whole. Waldeyer has described a vacuolated plasma cell as occurring in connective tissue which has some part in the formation of the blood-vessels. Aside from these two forms of cells there are round wandering cells, nucleated masses of protoplasm which are either leucocytes from the blood-vessels, or lymph cells from the lymphatics. The subcutaneous connective tissue represents a stage of development higher than the embryonal tissue. (Fig. 23.) In

this the stellate cells have in part lost their prolongations and become spindle-shaped, while the wandering and plasma cells remain as before. The intercellular substance has, however, undergone the principal change. In embryonal tissue this substance is a soft, homogeneous mass practically without fibers or structure; in subcutaneous tissue it is a coarse mesh-work of interlacing fibers and bundles. Embryologists are not agreed as to the manner of this change, some holding that the non-differentiated, intercellular matrix of embryonal tissue is converted into the intercellular fibers of connective tissue,

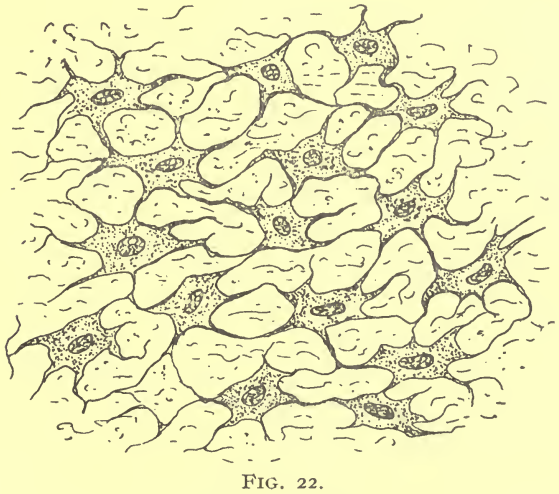


FIG. 22.
Embryonal Tissue.

while others believe that these intercellular fibers are the product of the stellate cells.

Fibrous tissue differs from connective tissue in the scarcity of its cells and in the compactness or density of its intercellular fibers. Fibrous tissue forms a dense mesh-work in fascia, while in tendon and aponeuroses the fibers are longitudinally arranged but densely packed. Fibroid tumors represent, in their growth, not only every grade of development

of connective tissue, from the embryonal to the fibrous, but many mixed forms as well.

A fibroid may be very soft, being composed of a loose mesh-work of interlacing fibers rich in stellate and spindle cells, containing a considerable quantity of fluid, *fibroma molle*, or very hard and composed of dense, wavy masses of white fibrous tissue in which there is no fluid and but few cells,

FIG. 23.
Subcutaneous Areolar Tissue.

fibroma durum. (Flg. 24.) The soft fibroids grow much more rapidly than the hard on account of their increased blood supply and by reason of the fluid they contain. Fibroid tumors usually have a poor blood supply, the vessels within the tumor being few and small. Occasionally, however, the blood supply is very rich, the vessels and even blood spaces being both numerous and large. This condition obtains sometimes to such an extent that the characteristics of growth are entirely changed, making a neoplasm that is very vascular; one that

grows rapidly and bleeds easily. The tumor assumes the type then of an angeio-fibroma or *fibroma telangeiectaticum*. Occasionally a vascular fibroma, instead of assuming the form of a nævus, takes the type of a cavernous angeioma in which the tumor is traversed by blood spaces or caverns of considerable size. In these growths the tumor is like spongy or erectile tissue, the caverns being lined with endothelial cells—cavernous angeio-fibroma. These vascular fibromata are found more frequently in the nose and naso-pharynx, than elsewhere.

MIXED FORMS.

Fibro-lipomata.—In various situations, especially in the breast, in the submucous and subcutaneous tissues, fibromata are frequently associated with more or less fat. If the adipose tissue makes up a considerable part of the growth it will be softer than a pure fibroid and rather lobulated than nodular.

Fibro-osteomata.—The occurrence of bone within the fibromata, and especially within those which have their origin from the periosteum, is of comparative frequent occurrence. This is especially true of the mixed fibroids.

Fibro-myomata.—In many of the uterine tumors, both white fibrous and muscular tissue are present in the same microscopic section. A fibro-myoma is not often to be differentiated, clinically or macroscopically, from a pure fibroid.

Fibro-adenomata.—These tumors occur with especial frequency in the mammary gland and ovary, but they may occur wherever there is a combination of fibrous tissue and glandular structure. The fibro-adenomata are softer and grow much more rapidly than the pure fibromata.

Fibro-sarcomata.—Unfortunately this is one of the most frequent of the mixed forms. Occasionally it may be difficult, even with a microscope, to differentiate a spindle-celled sarcoma from a fibroma rich in cells. The fibro-sarcomata are reasonably soft, often cystic tumors, which grow with con-

siderable rapidity and present the indications of mild malignancy. They occur frequently in the naso-pharynx, kidney, testicle, beneath the skin and from the intermuscular planes.

Fibro-myxomata.—A transformation of fibrous into myxomatous tissue is especially likely to occur in the soft fibroids when situated subcutaneously, or beneath a mucous membrane.

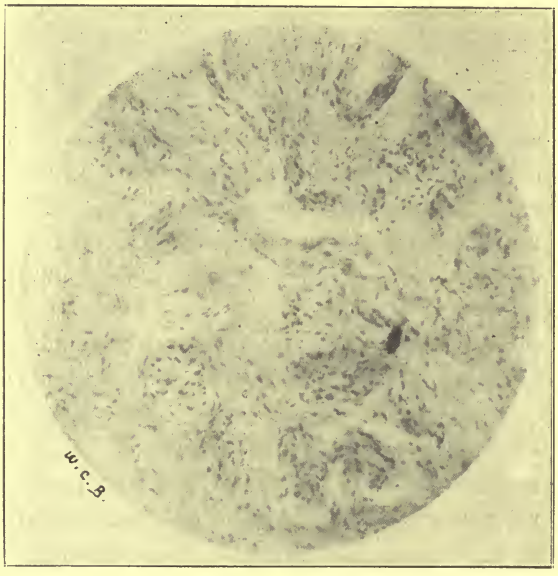


FIG. 24.
Fibroma.

RETROGRADE CHANGES. — Retrograde or degenerative changes also occur in fibroid tumors. One of the most frequent is calcification, which occurs in tissues that have already undergone some other degenerative change. The lime salts are deposited irregularly either upon the surface of the tumor or in its interior.

Fatty Degeneration.—This process takes place within the cells, and may be carried so far as to produce one or more

cysts. Ulceration, suppuration, and gangrene also occur in fibroids, but in rare instances.

Seats of Predilection.—Although fibroid tumors may be formed wherever connective tissue is present, there are certain structures and organs in which they most frequently occur. These are the skin and subcutaneous tissue, the mucous and synovial membranes, the periosteum, fascia and bone, mammary glands, uterus, ovary, vulva, kidneys and nerves. They are frequent in the nasal cavities, the naso-pharynx and in the antrum of Highmore.

Fibromata of the Skin.—Elephantiasis, which many of the German pathologists include under this head, is a process more or less diffuse, affecting especially the skin and subcutaneous tissues of the external genitals and lower extremities. In exceptionable cases the increase of tissue may be confined to some particular part, as the penis, scrotum, labia majora or the lower extremities. In typical cases affecting the legs and feet the limbs become so greatly enlarged as to resemble those of an elephant, hence the name. If the process implicate the penis, it becomes enormously enlarged. If the labia are affected great tumors are formed, while in the scrotum, growths weighing more than one hundred pounds have occurred. In its pathology the disease consists in an enormous thickening of the skin and subcutaneous tissue, due to an increase of the connective tissue of those parts.

ÆTIOLOGY.—Congenital cases occur and are thought to be due either to a defect in the lymphatic vessels, producing obstruction in the circulation, or to a specific disease. The most typical cases are the acquired, which occur in the tropical or subtropical countries. These are due to the entrance into the lymphatic circulation of a parasite—the *filaria sanguinis hominis*. The parasite, and its large hemispherical ova, inhabits the lymphatic vessels which they obstruct and cause to become acutely inflamed. More circumscribed and less severe cases of elephantiasis occur in the lower limbs as the result of repeated attacks of lymphangitis due to pyogenic

infection. Anything which interferes with, or obstructs the lymphatic circulation, is likely to cause throughout the area of disturbance a hyperplasia of the connective tissue of the skin and subcutaneous tissue producing great thickening, induration and œdema. Elephantiasis represents an enormous new growth of connective tissue due to specific causes. The process, however, is so diffuse that the majority of pathologists at the present time do not classify it with fibroid tumors.

Moles.—These are small, flat, hairy, pigmented, congenital, fibrous growths situated in the superficial portions of the skin and occasionally extending into the subcutaneous tissue. The skin is ordinarily but slightly thickened and the mole shows but scant disposition to enlarge, although occasionally very considerable growth has taken place. The tendency, however, of moles to take on malignant action is pronounced, and when this occurs the secondary growths, whether sarcomatous or carcinomatous, are not only pigmented but show great malignancy. Soldan has found some nerve fibers in these growths, and the belief with some is that they have their origin from the connective tissue of the cutaneous nerves. In consequence of their marked tendency to undergo malignant change they should be excised.

Fibromata of the Skin.—As these tumors occur they may be single or multiple, circumscribed or more or less diffused, sessile or pedunculated. When multiple there may be but a few or many hundred, scattered over the neck, shoulders and back. In fact in some cases their number is almost beyond calculation. They have their origin in the corium or papillary layer and are consequently primarily imbedded within the substance of the skin and hardly observable. Later they become projected from the surface as more or less pedunculated growths. The most frequent form of skin fibromata is that which on account of its softness has been called *molluscum fibrosum.* These are soft, white, pedunculated, painless growths which vary in size from a pin's head to that of a

walnut. They are aggregations of cellular and fine fibrous tissue, which show but slight vascularity, and no disposition to return if removed. The molluscum fibrosum is frequently seen at the mouth of fistulæ especially following gastrostomy, and in some cases where drainage has been established for an appendiceal abscess. They occur in these situations as aggregations of pedunculated, soft, white growths of the size of a kernel of wheat or even smaller and probably have their origin in the irritation of discharge. Following the teaching of v. Recklinghausen it is now generally conceded that these growths have their origin in the connective tissue of the cutaneous nerves. Weichselbaum suggests the probability of their springing also from the connective tissue of the vessels and the ducts of the glands.

Elephantiasis of the Face.—A class of most interesting fibrous growths having their origin in the skin of the face and often reaching considerable size, have been described by E. S. Mark, P. V. Bruns, Kulenkampff, Trendelenberg and others. They may be situated upon the cheek, nose, eyelids or lips. The skin in the parts affected though remaining soft and white becomes very much thickened and forms great folds, which may, and usually do, transform the appearance of the individual.

Rhinophyma.—This is a disease of comparative frequent occurrence upon the continent of Europe, though rare in this country, in which the cutaneous tissues of the nose become enormously hypertrophied. The process is an extremely chronic one, the nose only reaching any considerable size after years of growth. Trendelenberg records a case in which the growth had reached such proportions that it hung over the chin and weighed on removal five pounds. Pathologically, there is an increase of tissue which may be confined to the connective tissue, or all the structures of the part may be hypertrophied, connective tissue, sebaceous follicles and blood vessels. In appearance the nose is red, very nodular, and to the touch quite hard.

ÆTIOLOGY.—The disease is occasionally congenital in so far that small patches of thickened skin, which subsequently enlarge into typical growths, are observable at birth. The disease may be hereditary in that one or more members in each family, during successive generations, have been affected. It may be syphilitic in origin or due to a chronic inflammatory process which implicates and obstructs the circulation in the lymphatic vessels, resulting in an enormous growth of connective tissue. The process is aggravated, if not induced, by the liberal use of spirituous liquors. With some patients and in its milder forms it is the terminal stage of a rosacea (a *seborrhœa hypertrophica*).

TREATMENT.—If the process is of syphilitic origin an antisyphilitic treatment should be adopted. When due to an inflammatory obstruction of the lymphatic circulation and the process not far advanced, the subcutaneous injection of a two per cent. solution of carbolic acid is often of the greatest advantage. Should the process be due to a seborrhœa in the first stages, the treatment with alkaline baths, followed by lotions or ointments containing sulphur, resorcin, salicylic acid or mercury will be indicated. When great hypertrophy exists, whether confined to the nose or implicating other portions of the face, nothing short of surgical measures will avail. When the nose is the part affected the redundant tissue is sliced off layer by layer until the nose again assumes its proper form. The raw area remaining may be covered by skin-grafting or allowed to form a new cutaneous covering from the sebaceous and hair follicles which have been cut across in the operation, these acting as islets for the formation of new epidermis.

Keloids.—These are fibrous growths of the skin which ordinarily occur in scar tissue. They have been divided by Warren into true and false. The typical true keloid is usually situated over the surface of the sternum, develops independently of cicatricial tissue, and its surface is covered by the papillary layer of the skin. False keloids develop in scar tissue and are deficient in the papillary layer of the skin as a

covering. (Fig. 25.) It is quite probable that all keloids are false in that they develop from scars, many of the scars perhaps having been insignificant and soon forgotten. It should be remembered that the scar tissue in which a keloid develops is not necessarily that occurring from the healing of an incised or traumatic wound, but may be caused by the healing of a suppurative process in a sebaceous or hair follicle, or in a burn.

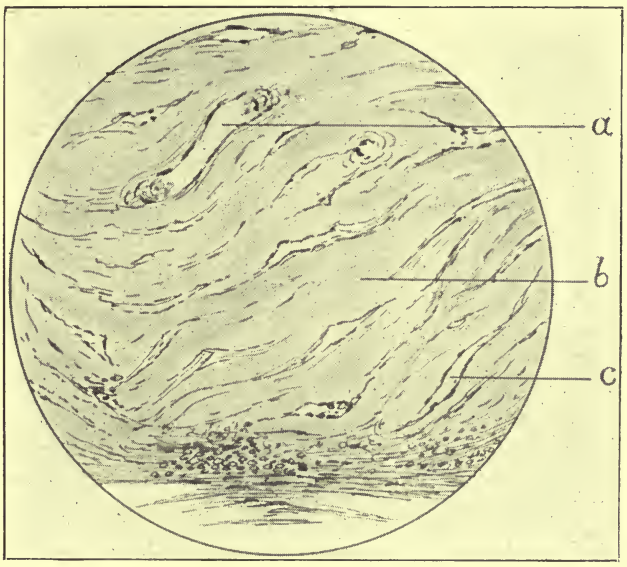


FIG. 25.—Keloid.

a—Blood vessel.
b—Dense hyaline fibrous bands.
c—Juice canals or spaces.

In its pathology a keloid is made up of dense, fibrous tissue, the fibers running parallel with the surface of the skin. In cases where there has been but a minute scar, as point of origin, the growth will be beneath a skin quite normal in its histology. Should the growth develop in a cicatrix of considerable size it will then be without a normal skin covering.

Keloids may be single or multiple. They show a certain

predilection for the negro race and are then very often multiple. When growing in a cicatrix this becomes swollen, elevated, enlarged in every direction, red in color, and the site of a burning or itching pain which is very annoying. A keloid is always more or less uneven, angular, nodular or stellate. In appearance it has been likened to a crab. Its irregular or stellate form is often due to the fact that it does not develop simply in the line of a linear cicatrix, but grows out laterally into the wounds cut by the sutures and into the stitch openings. So far as the writer's experience goes keloids only develop in recent cicatrices and in those which have healed by a suppurative process. They usually cease to grow after a few months or perhaps a year, seldom attaining any very considerable size. Fig. 26 represents a keloid which grew in a scar upon the shoulder following the removal of a benign growth and which attained the size of an adult fist. Keloids though showing a marked disposition to return after removal, especially if the subsequent wound suppurates, are not at all malignant in that they show no disposition to destroy life or produce metastatic deposits in different parts of the body.

CAUSE.—Keloids, although fibroid growths, represent in their causation something entirely different from the ordinary fibroid tumor, in that they probably only occur in cicatrical tissue which has formed during a suppurative process. It would seem, then, that the difference was represented by the infection, the germs or ptomaines becoming included within the tissue of the cicatrix, causing irritation and subsequent growth.

TREATMENT.—For the relief of the burning, itching and pain nothing perhaps acts better than the benzoated oxide of zinc ointment, to which has been added one-half drachm of glycerine, five drops of carbolic acid and four grains of extract of belladonna to the ounce. If the hyperæmia is excessive repeated scarifications and the administration of ergot have been found useful. In cases not far advanced the writer has

seen signal service accrue from the administration of thyroid extract. Operative measures for the cure of keloids have been most unsatisfactory on account of the very frequent recurrence of the growths. Unquestionably in the operative

FIG. 26 —Keloid.

technic great care should be exercised to remove not only all of the growth but also something of healthy tissue surrounding it, and to so do the work and adjust the surface that primary union will occur. In closing the skin wound it is best to use a buried, continuous, silkworm-gut suture as this will make but two small openings in the skin. With complete

removal, going outside of the previously infected area, and perfect asepsis, recurrence should not occur. Multiple, electrolytic punctures repeated at short intervals have been found very advantageous with some physicians.

Painful Subcutaneous and Submucous Tubercles.—These are small, hard, pea-shaped bodies which grow either beneath the cutaneous or mucous surfaces. Their most frequent situations are upon the forearms, the hands, and about the knees. They seemingly have a predilection for the neighborhood of joints. They are usually single, occur in adults, and most frequently in women.

A woman aged 30, of nervous temperament and poorly nourished, presented herself, complaining of more or less constant pain at a particular spot upon the posterior surface, some two or more inches from the external sphincter of the rectum. The pain was almost unbearable when hardened fæces came to rest upon or pass over the painful spot. Examination disclosed a small, exquisitely painful, pea-shaped tumor situated upon the posterior wall just beneath the mucous membrane of the rectum. The growth had all of the clinical symptoms, and, after removal, the microscopical appearance, of a painful subcutaneous tubercle. Its removal was followed by a complete cessation of the pain.

A man, aged 41, of apparently good physique, complained of a most sensitive kernel two inches above and slightly external to the right patella. Just beneath the skin was a pea-shaped body quite smooth, freely movable, very hard, and the site of the most atrocious pain upon touching or handling. The skin itself was free from inflammation or undue sensitiveness. The tumor, however, was so sensitive that even the occasional pressure of the clothing upon the overlying skin caused severe pain. Following the removal of the growth, which was done under local anæsthesia, the pain ceased.

Under the microscope these growths represent a dense meshwork of interlacing fibres. They are unquestionably

PLATE II.

A keloid growth, the result of an accidental burn.

directly connected with sensitive nerve filaments, as many surgeons have been able to trace nerve fibres directly into the tumors.

The diagnosis will rest upon the clinical manifestation. They are small, hard, smooth, freely movable, pea-shaped growths situated directly beneath the skin or mucous membrane. Their most characteristic symptom is their extreme sensitiveness upon pressure and also the fact that they are the site of much spontaneous pain. They often occasion spasm of the muscles in their immediate vicinity.

TREATMENT.—All subcutaneous or submucous painful tubercles should be promptly removed on account of the pain they cause.

Fibroids or Desmoid Tumors of the Abdominal Wall.—Tumors of all kinds situated in the abdominal wall are rare, but of those which occur fibroids compose nearly ninety per cent. According to the statistics of Guerrin more than ninety per cent. of these fibroids occur in women who have borne children. They most frequently have their origin from the abdominal fascia near the crest of the ilium, Poupart's ligament or that inclosing the recti muscles. John Mueller introduced the term desmoid, applying it to tumors which have their origin in the abdominal wall and which are made up of bundles of dense fibrous tissue.

DIAGNOSIS.—These tumors present certain marked characteristics which serve to separate them distinctly from the pure fibromata. They are situated in the abdominal wall. They are seldom completely encapsulated, often infiltrate the adjacent structures and especially if enucleated frequently recur. They have been thought to be fibro-sarcomata, and there is little doubt but what they are often mixed tumors containing sarcomatous elements. They often follow an injury, reach a very considerable size and may project either into the abdominal cavity simulating an abdominal tumor, or outwards beneath the skin, giving the appearance of a subcutaneous growth. The following is a case in point:

In October, 1898, Mrs. L., aged 23, the mother of one child, was injured by the handle bar of a bicycle coming in forcible contact with her abdominal wall just above and to the right of the navel. She was stunned and partially unconscious for a considerable time. The point of contact of the handle bar with her abdomen became discolored, swollen and remained as a very sensitive point which was never entirely

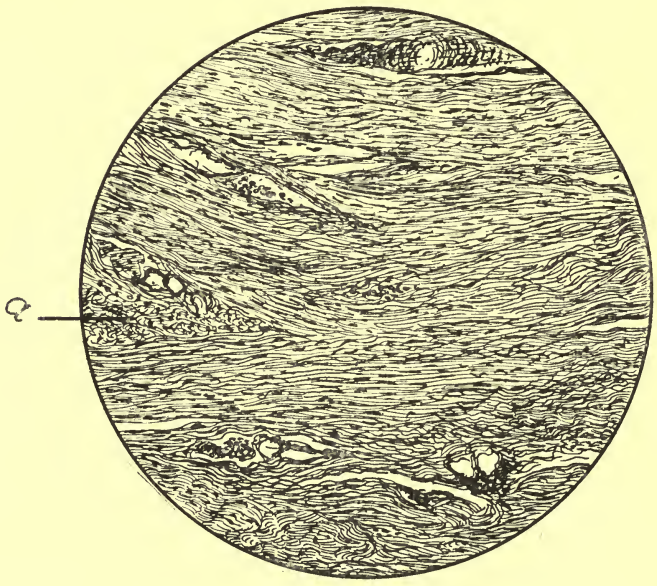


FIG. 27.

Dense Fibroma of Abdominal Wall. Fibroma Durum.
a. Connective tissue fibres cut across.

free from pain. Eight months thereafter she presented herself with a somewhat painful, hard, smooth, not well circumscribed nor freely movable growth situated in the abdominal wall at the site of the injury. In the operation for the removal of the growth it was found necessary to resect three inches of the right rectus with a corresponding portion of the peritoneum. The growth had no well-defined limits. (Fig. 27 represents a microscopical section of the growth.)

TREATMENT.—The treatment of desmoid tumors is that of thorough removal, not by enucleation, but by cutting outside of the apparent border of the growth into healthy tissue. Enucleation is not always even possible on account of the non-encapsulation of the growth, and if practiced recurrence is extremely liable to occur. If the defect in the abdominal wall caused by the removal of the tumor is large, rendering the apposition of the parts difficult, the defect should be remedied by splitting one or more of the abdominal muscles and sliding them into the wound to fill the gap.

Fibromata of the Mammary Gland.—Not unfrequently at or about the age of puberty a circumscribed or diffused hypertrophy of the peri-tubular fibrous tissue in the breast takes place, resulting in pronounced or even great enlargement. Much the same condition may be the result of a chronic mastitis in which as the sequence of the inflammatory process the interacinous and tubular connective tissue is greatly increased. In chronic mastitis this process is often confined to a single quadrant or even a small area of the breast producing a hard, more or less circumscribed induration or only one or more irregular, hard, indurated nodules. Fibromata of the mammary gland are not of frequent occurrence. According to Gross, they comprise about eight per cent. of all mammary tumors. It has been taught by Billroth that their origin was in the immature connective tissue which surrounds the acini or tubes. (Fig. 28.) If the growth of connective tissue which goes to make up a fibroid lies entirely between the acini or tubes, then and in that case the tumor will not contain glandular structure, but will be a pure fibroma. If, on the contrary, the tissue primarily implicated is that which surrounds the acini or tubes, then and in that case the growth will contain more or less of glandular tissue. These growths have been called by many writers adeno-fibroma. Senn, in his work on tumors, holds that a fibroid which includes anything of glandular structure is an adeno-fibroma. Virchow, Gross, Raunier, Lannelongue and others describe them as

fibroids. The essential idea of a tumor is that it is a new growth. If fibrous tissue in its proliferation simply surrounds and includes something of glandular structure, this of itself should not make the growth an adeno-fibroma any more than a sarcoma starting from the periosteum of the femur and growing around the bone would make the tumor an osteo-sarcoma. If in the latter case we have a new bone formation within the tumor, and in the former new glandular tissue,

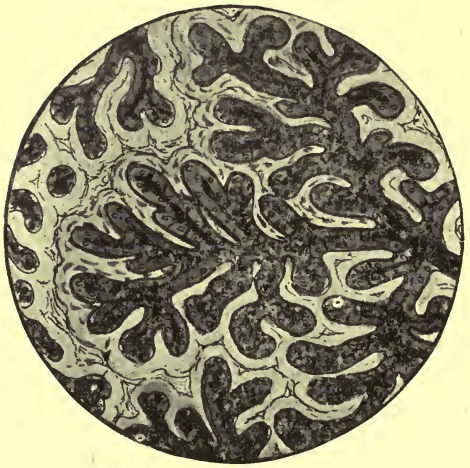


FIG. 28.
a.—Immature Connective Tissue of Breast.

then the former would be an osteo-sarcoma and the latter an adeno-fibroma. Fibroid growths in the mammary glands are not confined to women, but may occur in men as well.

A young man of twenty-four years presented himself with a tumor as large as a hen's egg in the right breast. This had been of gradual growth for five years, was the site of considerable pain, and had followed an injury. The growth was hard and of uniform consistence, somewhat uneven on the surface, freely movable within the structure of the gland, not sensitive to the touch and of slow growth. On removal, macroscopically, and on microscopic section, it was seen to be a pure fibroma.

Fibroids of the breast may be single or multiple and are quite frequently in part cystic, being hard and dense at one point while soft and more or less fluctuant at an other. This cystic condition is frequently the result of inclusions of acini or ducts within the growth, which subsequently as the result of pressure have become occluded or shut off from the main portion of the gland, and have afterwards dilated from the accumulation of their own secretion or the growth from dragging upon an acinus or duct may effect dilatation. Cysts may also be formed by myxomatous or fatty degeneration and absorption of the changed structure.

DIAGNOSIS.—According to Gross fibroids of the breast are most frequent about the eighteenth year of age. The cystic varieties seemingly occur slightly later in life than the solid. They have been seen as early as the twelfth and as late as the fifty-sixth year of life. Fibromata of the breast with very few exceptions make their appearance during the menstrual life of the individual. Their growth is also more rapid during the period of menstruation and pregnancy, than during the intervals. Gross states that a fibroid increasing in diameter one and a quarter inches in six months is the most rapid growth that he has seen. In cystic fibromata rich in vessels a bloody discharge from the nipple is quite frequent. The growths are hard, freely movable within and separate from the breast, not becoming adherent to the skin nor causing glandular enlargement or affecting the constitution of the patient. The only treatment worthy of consideration is that of removal.

TREATMENT.—In the removal of a fibroid of the breast the gland should be spared as much as possible. In multiple fibroids of the mammary gland, of which the writer has seen numerous examples, it is questionable if it be not best, as in multiple myomata of the uterus, to remove the entire organ, for the reason that additional growths, not then observable, are likely to occur. Enucleation of the growth may be prac-

ticed when possible, but it is not always practicable on account of the close adhesion of the surrounding structures. When enucleation is not possible excision should be practiced; simply going sufficiently wide of the growth to insure its complete removal. After a pure fibroid has been removed it is not very unusual, in a few months, to discover a new growth in perhaps the immediate vicinity of the cicatrix. This is due, not to recurrence, but to the growth of a previously existing, unobserved, fibrous node. There are sometimes many of these, of varying size, in the same breast.

Fibromata of the Parotid.—Not only innocent, but also malignant and especially mixed growths, are of frequent occurrence in this region.

The fibroid occurs in middle life as a hard, painless, slowly-growing, somewhat irregular, distinctly circumscribed and consequently freely movable tumor, situated primarily either in front of, or just below, the ear. In its growth it may interfere with the motions of the jaw by projecting forwards over or beneath the ramus, or grow downwards into the neck interfering with respiration or deglutition. Occasionally a fibroid in this situation will produce such pressure upon the facial nerve or cervical blood vessels as to cause serious functional disturbance. Their growth is, however, ordinarily so slow that many years are required before they reach any considerable size or can produce functional disturbance. The so-called parotid tumor is of frequent occurrence and of much interest. It is usually described as a mixed growth, being made up of fibrous tissue, cartilage, myxomatous and occasionally glandular tissue. It is primarily a pure fibroid, which by subsequent formative or degenerative change has been converted into a mixed growth. These neoplasms also occasionally contain sarcomatous elements and then present the characteristics of mild malignancy.

Diagnosis.—Fibroids of the parotid must be differentiated from malignant growths, which infiltrate the gland;

from adenomata, which are softer, of more rapid growth and often cystic; from retention cysts due to obstruction of a duct or acinus; from angeioma or lymph-angeioma which present the characteristics of tumors made up largely of vessels

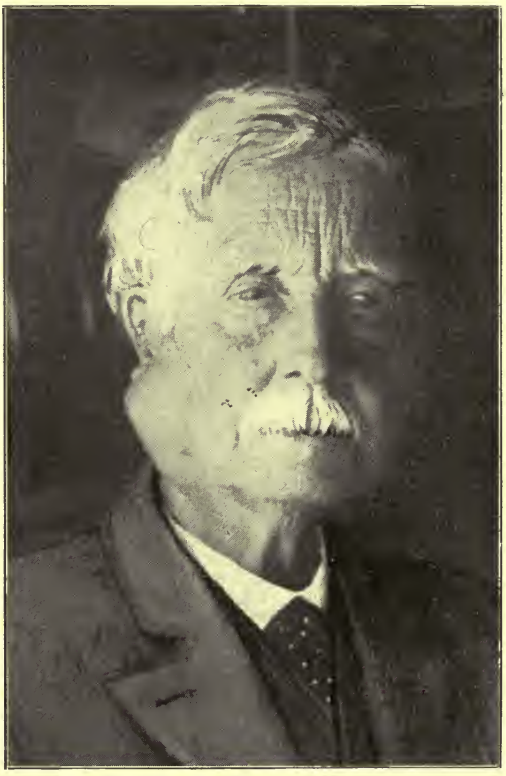


FIG. 29.
Fibroid of the Parotid in a man aged 71, St. Joseph's Hospital, Milwaukee.

either arterial, venous, or lymphatic. These vessel tumors often pulsate, feel soft, compressible, and frequently are semi-translucent or of a bluish color, and occasionally become a part of the skin. Fibroids of the parotid must also be differentiated from the endotheliomata of this region, which are

soft, cellular, often cystic tumors of more rapid growth and, being without a capsule, present the characteristics of malignancy. They should also be differentiated from tubercular glands which so often are situated in the lower portion of the parotid. Fig. 29 represents a fibroid in a man aged seventy-one which has been slowly growing for more than twenty years. It had caused no pain, was hard, freely movable, of uniform consistence, and upon the surface somewhat irregular. The only treatment worthy of consideration is that of removal. Being encapsulated growths they ordinarily are easily shelled out of the gland. There are some anatomical points, however, worthy of consideration. These growths are in close relationship with the facial nerve, which usually lies beneath the tumor and close to its capsule or directly over the tumor. The transverse facial artery often crosses the surface, while large growths press upon the temporo-maxillary vein and external carotid artery. The incision should be long and parallel to the facial nerve, while the greatest care should be exercised to avoid injury to the nerve and its branches. In the enucleation, by keeping close to the capsule, injury to the gland or important adjacent structures can usually be avoided. If the growth sends prolongations beneath the ramus or deeply into the neck, these must be followed up and enucleated. Usually the task is not a very difficult one.

Fibroid Growths in the Larynx.—Their most frequent situation is within the vocal cords. In size they vary usually from that of a millet seed to that of a hazel-nut. Von Ziemssen reports a case in which a fibroid springing from the upper border of the cricoid cartilage almost filled the supra-glottic larynx. These tumors are usually sessile and while, as a rule, single, they may be multiple. Drs. Throsher Bristowe and Gordon Buck have each reported a case of diffuse fibroid situated within the larynx. In each case the growth was beneath the mucous membrane projecting from both sides of the larynx and extending from the cricoid cartilage to the vocal cords. In

all the cases there were marked symptoms of laryngeal stenosis and in one this condition cost the patient her life.

ETIOLOGY.—Laryngeal catarrh and straining of the voice are supposed to be etiological factors in the production of laryngeal fibroids.

DIAGNOSIS.—Any growth within the larynx will cause irritation, increase of secretion, cough, a change of voice, often aphonia, dyspnœa and even stridor, with more or less discomfort and even pronounced pain. Fibroids here, as elsewhere, occur in middle life, show little disposition to ulcerate, remain distinctly localized, and do not cause infiltration or disturbance of any of the overlying tissues. An exact diagnosis will usually be possible by a consideration of the history, aided by a laryngoscopic examination.

TREATMENT.—A fibroid growth situated within the larynx should be removed without delay. The method of procedure will depend upon the characteristics which the growth presents. A growth that is pedunculated and accessible may be removed either with the forceps or the snare. If the growth is sessile and not easily reached through the mouth a thyrotomy may be done. This will render the growth easily accessible.

Fibromata of the Nasal Cavities and of the Naso-Pharynx.—The frequency of fibroid growths in these cavities require that they receive careful consideration. During the past ten or fifteen years physicians have manifested increased interest, not only in the new growths of this region, but also in the diseases as well. The fibroids occurring here have their origin in the connective tissue of the mucosa or in the periosteum, and will usually make their appearance in young adult life, although they have been known to occur as early as the thirteenth, or as late as the sixty-eighth year. The conditions which seem to favor their growth in these cavities are the high normal vascularity; frequent and excessive changes in the blood supply and the frequency of colds with their attendant disturbances of circulation. The prevalence of catarrh and of

injury, either accidental or caused by instrumentation, are presumably pronounced causative factors. In attachment they are usually sessile, varying in size from that of a buck-shot—being very small, hardly observable and seemingly an insignificant growth —to one which not only completely fills the nasal cavities or naso-pharynx, but may distend the cavities until the face is deformed and distorted. Although nasal fibromata may be situated anywhere within the nasal cavities they most frequently arise from the upper portion, or roof, of the nose.

Symptoms.—At first there may be an entire absence of symptoms or they may simulate those of a nasal catarrh, with its muco-purulent discharge, perhaps occasionally streaked slightly with blood, with a feeling of slight discomfort, or dull pain, in the nose. The amount of blood lost will depend upon the increased hyperæmia of the parts and may be such, both in frequency and amount, as to become serious, perhaps alarming. The pain is often slight, insignificant, and even wanting, when the growth is small. When large and producing serious pressure upon adjacent structures it may be productive of a sense of great tension or a feeling of burning, aching pain. A growth of any considerable size will produce symptoms of nasal obstruction. These symptoms at first will be confined to the nostril implicated, but later if the growth becomes large, both nostrils may be occluded. If the tumor is situated low down in the nose, it may expand and partially protrude from the corresponding nostril. If situated at, or near, the roof, it will either expend its force against the nasal bones, flattening the ridge, or against the ethmoid or sphenoid sinuses, or against the corresponding orbital cavity, displacing the eye and producing an exophthalmos.

Naso-Pharyngeal Fibromata.—Fibroid tumors are more frequently situated in the naso-pharynx than in any other portion of the upper respiratory tract. They may spring from any portion of the pharyngeal aponeurosis, or from the periosteum covering any one of the various bones which go to

make up the pharyngeal walls. Their most frequent origin is above, from the roof of the pharynx, and either from the periosteum covering the basilar process of the occipital bone or from that covering the body of the sphenoid. Posterior they have their origin from the periosteum covering the bodies of the upper vertebræ. Laterally they come from the periosteum covering the internal pterygoid processes and in front from the posterior border of the vomer. In their growth they either project downwards into the pharynx or downwards and forwards into the pharynx and nose. If large they are likely to produce serious pressure upon the adjacent structures or even marked deformity. Growing downwards into the pharynx they may depress the soft and hard palate, forcing them strongly into the oral cavity, or projecting forward into the nasal cavities, pushing the vomer to one side and broadening and flattening the bridge of the nose. The pressure of these growths may not only produce a displacement of bone or deformity of structure, but it may also effect destruction of tissue.

Symptoms.—Repeated attacks of epistaxis which come on without apparent cause, or after physical exertion, is indicative of a neoplasm in this region. There may also be symptoms of catarrh with a muco-purulent discharge, a sense of fullness in the naso-pharynx, and some interference with, or stenosis of one or both nostrils. This may result in a nasal-tone of the voice with more or less difficulty in respiration when the mouth is closed. These fibroids are usually very hard and of slow growth.

Pathology.—Fibroids in this situation are usually very hard, of slow growth and made up of dense fibrous tissue, in which there are but a few small blood vessels. Occasionally, however, they are quite soft, the fibrous tissue being loose and interwoven like subcutaneous tissue, and in its meshes holding many large blood vessels or blood spaces. The more vascular the tumor the more severe will have been the epis-

taxis and the greater will be the amount of blood lost during any subsequent operative procedure for its removal.

Diagnosis of Nasal and Naso-Pharyngeal Fibromata.—A fibroid situated in the nose or naso-pharynx possesses the same characteristics of growth, hardness, color and form which are peculiar to fibroids in other portions of the body. They also produce pressure effects upon one or both nostrils, upon the bones of the nose and orbit and upon the hard and soft palate, which are characteristic of new growths in these cavities. The frequent and sometimes alarming hæmorrhages which occur in vascular fibromata are usually distinctive of this kind of tumor. The correct diagnosis can usually be readily determined by inspection or palpation and a consideration of the history. Their hardness, white appearance, nodular or uneven contour and slow growth are generally sufficient for diagnostic purposes.

Prognosis.—Although these are innocent growths, they may on account of their position produce injurious pressure upon adjacent structures or invade important cavities. In a case operated by Shrady the growth had sent a prolongation through the foramen lacerum medium. Occasionally they spontaneously disappear through sloughing or retrogressive change. In the very vascular growths, even without operation, hæmorrhage is always a serious and sometimes a fatal complication. The mortality following operation upon nasal and naso-pharyngeal fibromata has been very great. Lincoln collected fifty-eight cases operated upon, resulting in ten deaths and eighteen recurrences. The death rate is much higher than it should be with a good operative technique, while the recurrences indicate that the growths were either not completely removed or that they were not pure fibromata. The operative mortality of hard fibroids situated within the nasal cavities, should be almost nothing, while that of fibroids growing from the vault of the naso-pharynx and especially if they are extremely vascular, is always likely to be high. The chief danger will be hæmorrhage and shock.

TREATMENT. — Small, pedunculated fibroids situated within the nasal cavities can be removed with the cold snare, the galvano-cautery wire or the polypus forceps. If large and their base inaccessible, it is better, primarily, to do an osteo-plastic resection of the nose. The modified operation of Boeckel answers well in these cases. (Figs. 30 and 31.) It is done as follows: If it is desired to expose the right nasal cavity an incision is made from the left lachrymal sac directly

FIG. 30.

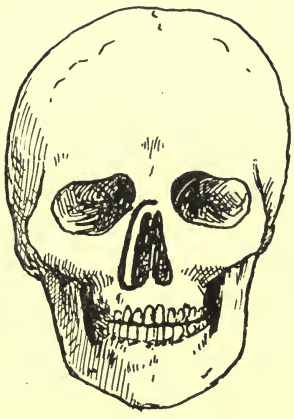


FIG. 31.

across the bridge of the nose to a corresponding position on the right side, and then, while keeping one-half inch outside of the nasal furrow, carried down the side of the nostril which it opens. The incision should go to the bone. A second incision separates the columna from the upper lip. The bones in the line of the first incision are divided with a sharp chisel. The septum is then cut through and the whole body of the nose easily turned over upon the cheek of the opposite side.

If additional room is necessary it has been suggested to resect the vomer and turbinated bones. This is, however, seldom necessary and should, if possible, be avoided as it not only leaves a very large nasal cavity, but also affects the voice and renders the patient liable to catarrhal changes lower down. In the osteoplastic resection of the nose a matter of the first consideration is to prevent the entry of blood into the windpipe, either by plugging the posterior nares, or by the dependent positions of the head. The Boeckel operation, without resecting the vomer or turbinated bones, exposes the nasal cavity and renders easily accessible any growth situated therein. The growth having been removed the parts are turned back in position and united with a few sutures of silkworm-gut. Strong union readily occurs and the resulting scar is hardly observable. The one objection to the operation is the resulting hæmorrhage which is sometimes severe. This may be in part avoided by commencing the first incision upon the left side of the nose just internal to the angular artery. Upon the right side both the angular and facial arteries are cut across. In the osteoplastic operations upon the nose and face it is ordinarily worse than useless to stop in the operation and attempt to seize the bleeding vessel as the wounds do not gap, thereby rendering access to the vessels difficult, and every part seems to bleed with equal vigor. An assistant should closely follow the knife with compression gauze sponge and, if necessary, a second assistant can compress the facial artery as it crosses the inferior maxillary bone. The sharp chisel should quickly follow the knife, wherever bone underlies the superficial incision, and when once the nose has been displaced to the opposite cheek, the hæmorrhage can easily be controlled by compression and forceps. Following the exposure of a fibroid it should be seized with a volcellum or toothed forceps, and excised with shears or Paquelin knife; being careful not only to remove all of the growth but also the area of periosteum from which it has had its origin. If the growth has been entirely removed the hæmorrhage can ordi-

narily be easily controlled, even in the vascular growths, by compression with gauze sponge. During the operation there may be more or less doubt about the exact nature of the growth—whether it is a pure fibroma or one mixed with more or less of sarcomatous elements. For this reason the injunction to remove the periosteum and, if necessary, the portion of bone from which the tumor has grown, should be rigidly adhered to.

Fibromata in the Deep Naso-Pharynx.—Fibrous tumors in the naso-pharynx present conditions far more serious than do those situated within the nose. Their pressure effects and their prognosis are more serious; their operative technique more complicated and their operative mortality much higher. If the tumor is pedunculated, not too large and its base accessible, it may be removed by the cold snare, the galvano-cautery wire, or the polypus forceps. Unfortunately many of these growths are sessile and so situated that they cannot be successfully removed by any of the means mentioned. Boeckel's osteoplastic resection of the nose, does not give sufficient access to the posterior nares and pharynx, to be available. Resection of the superior maxillary bone has been practiced, but an operation so serious and extensive is seldom, if ever, necessary, for the removal of a benign growth in this situation. Von Langenbeck's osteoplastic resection of a portion of the upper jaw, is representative of a class of operations which have been much in favor for the removal of a tumor in this region (Figs. 32, 33). The operation is done as follows: Make a curved incision commencing at the ala of the nose and carried backward and upwards, to a point beneath the prominence of the malar bone, until it reaches the middle of the zygoma. A second incision, commencing just below the inner canthus of the eye, is extended outwards immediately below the border of the orbit until it meets the first incision. These incisions are carried down to the bone. At the outer angle of the incision a metacarpal saw is passed to the outer wall of the nasal cavity under the zygoma and through the pterygo-maxillary fissure. A finger in the mouth conducts the end of

the saw. The malar portion of the zygoma is cut across, and the floor of the orbit. The saw is then withdrawn and introduced through the pterygo-maxillary fissure, when the walls of the antrum are divided, following the lower of the two external incisions. With an elevator, or strong-bone forceps, the mass is torn out of position and turned directly inward over the eye of the opposite side. After removal of the growth the resected portion of the jaw is turned back in place,

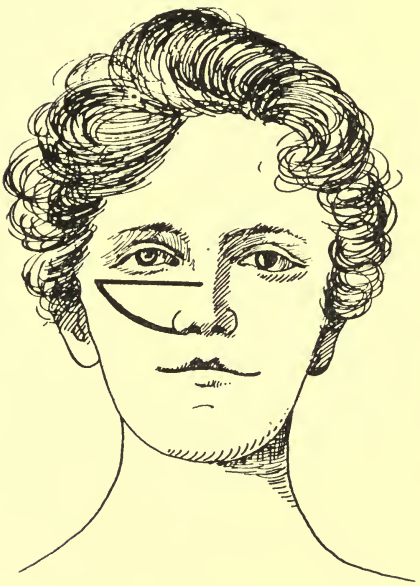


FIG. 32.

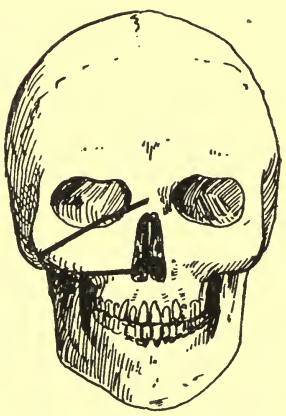


FIG. 33.

and easily held by a few sutures through the soft parts. In the two or three cases in which the writer has done this operation he has been impressed not only with the seeming difficulties, but also and especially with the great amount of blood lost. To meet these conditions the following operation was planned and in a number of cases executed with marked success. In weakly children and in debilitated or anæmic adults, as a first step the facial artery is exposed, through a short incision as it crosses the inferior maxillary bone, and tied with catgut.

The operation is then carried out as follows: Commencing an incision just below the inner canthus of the eye, it is carried outwards along the margin of the orbit, below the infra-orbital foramen to the frontal process of the malar bone. (Figs. 34, 35.)

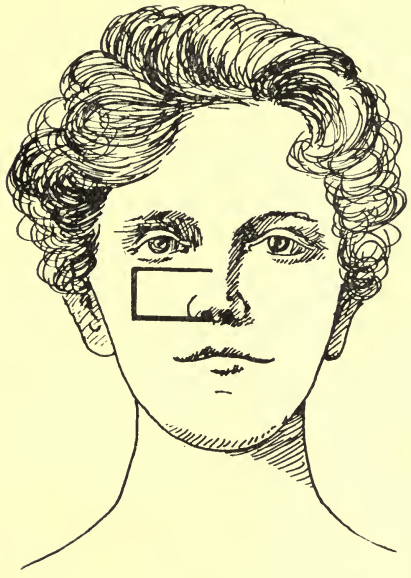


FIG. 34.

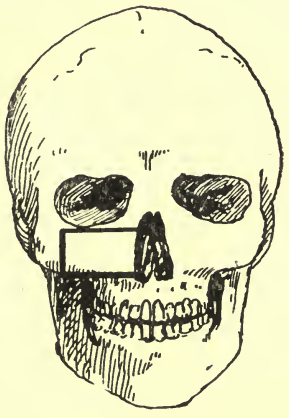


FIG. 35.

A second incision commencing at the ala of the nose is carried directly outwards, parallel with, and as far as, the first. The two outer ends of these incisions are united by a third perpendicular one. All incisions are carried down to the bone. The malar bone corresponding to the perpendicular incision is now divided either with a saw or a pair of bone forceps. The superior maxillary bone corresponding to the two horizontal incisions is divided with a bone chisel. Applying an elevator to the cut portion of the malar bone the entire mass is easily turned over upon the opposite cheek. Usually a portion of the posterior wall of the antrum is left behind with the pterygoid plates of the sphenoid and the vertical plates of the palate bone. A bone chisel is again applied in the lines of

the horizontal incision and these structures cut through and removed. After removal of the tumor the skin flap, with its attached bone, is turned back in position and held by a few silk-worm-gut sutures. This operation gives a splendid view of the naso-pharynx and renders accessible any tumor situated therein.

Incisions have been made through the soft, or the soft and hard, palate for the purpose of gaining access to tumors situated in the naso-pharynx. Manne was probably the first

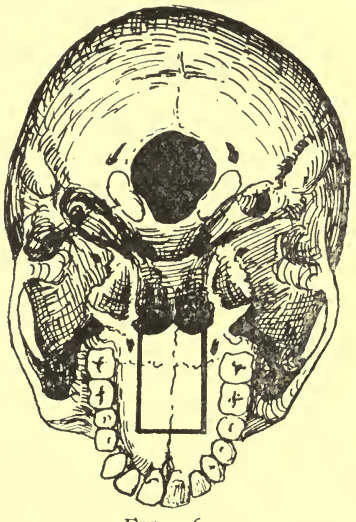


FIG. 36.

to make use of this route. He divided the uvula and soft palate in the median line. Subsequently Levret for the same purpose divided the soft palate laterally. Nelaton, Botrel, Richard and Sedillot extended the incision into the hard palate. Sedillot's operation is done as follows: (Fig. 36.) Make an incision in the median line through the soft palate and the mucous membrane and periosteum of the hard palate as far forward as the palato-maxillary suture, by means of the periosteal elevator, separate the soft tissues from the bone both upon the oral and nasal surfaces and resect a portion of the

horizontal plate of the palate bone. The tumor having been removed, the soft parts are united by suture.

Fibromata of the Periosteum and of Bone.—Fibromata in the Antrum of Highmore.—Fibroids in this position constitute about six per cent. of all tumors. They may have their origin either from the fibrous tissue of the mucosa or from the periosteum. They usually occur in adult life and produce no special symptoms until the effects of pressure become manifest. These primarily are a sense of heat, fullness, tension, with some pain in the corresponding side of the bone. If the growth reaches a size sufficient to distend the cavity the pain may be very much increased owing to the pressure producing absorption or necroses of tissue. Should this occur infection is also likely to take place in the adjacent tissues, producing in the skin of the cheek and subcutaneous tissues all of the symptoms of an inflammation. If the growth reaches a considerable size it will expand the antrum in every direction. The cheek is forced outwards and becomes prominent, the orbital cavity is encroached upon and the eye pressed upwards and outwards. The wall of the nose is forced inwards producing stenosis, more or less complete, of the corresponding nostril. The hard and soft palate may be forcibly depressed into the mouth, while the external wall of the antrum is carried outwards, encroaching upon the zygomatic fossa; the extent and direction of the displacements depending, of course, upon the extent and manner of the growth.

Diagnosis.—Of 307 cases, tabulated by Weber, 133 were carcinomata, 84 sarcomata, 32 osteomata, 20 cysts, 17 fibromata, and 13 miscellaneous growths. Fibroids of the antrum present the same characteristics as do fibroids in other portions of the body. They are of slow growth, hard, white and often nodular, occur in adult life, primarily produce little or no pain, do not affect the general health or cause metastasis. They can be differentiated from abscess by the failure of symptoms of infection and inflammation; from sarcoma by

the slowness of their growth and the absence of indication of metastasis; from carcinoma by their occurring in early or middle life, and not implicating the lymphatics or producing anæmia or interfering with the well-being of the patient. It will probably be impossible to differentiate fibroids in the antrum from cysts, without the aid of sight or touch. The fact that two-thirds of all tumors situated within the antrum are malignant should be kept in mind when considering the diagnosis and treatment.

TREATMENT.—Fibroids of the antrum should be removed as soon as a diagnosis can be made. This will usually be possible only when the growth is producing pressure upon and displacement of the walls of the antrum. The antrum can be easily opened through the incisions represented in Figs. 34 and 35.

Fibroid of the Gums. Fibrous Epulis.—These growths are quite frequent and have their origin either from the fibrous tissue of the gums or from the periosteum covering the alveolar process. They appear as outgrowths of the gums and occur at the sides of, or between, two or more teeth as hard, slow-growing, non-sensitive, pinkish, seldom ulcerating growths which loosen the adjacent teeth. Their hardness, slow growth, painlessness and usual freedom from ulceration, and small blood supply, will differentiate them from the sarcomatous epulis.

TREATMENT.—The loose teeth should be extracted and an incision made to the bone about the growth, but well into the gums and the part cut away. The removal of the alveolar border of the bone is not necessary in this growth.

Fibroids of the Vulva.—About two per cent. of all tumors situated in the vulva are fibromata. They occur as pedunculated growths having their origin from the skin, or as sessile growths arising from the fascia or periosteum. They present the same characteristics as fibroids in general and in this situation seldom reach any considerable size. They have

a scant blood supply, consequently their growth is slow. They should be removed by enucleation.

Fibroids of the Ovary.—Ovarian fibromata may be unilateral or bilateral, small or large. They are of rare occurrence. Senn describes two cases of ovarian fibroids; in the one the tumor weighed ten pounds and the other twenty pounds. In both of Senn's cases there was marked abdominal ascites. He holds that this condition in the absence of other known causes should be considered indicative of a fibroid of the ovary. Dr. L. H. Laidley recently reported a case of fibroid of the ovary as large as two fists. In this case the tumor was quite immovable on account of adhesions to the abdominal wall and to the intestines. There was also a quantity of ascitic fluid in the abdominal cavity.

Diagnosis.—An ovarian fibroid will be a pedunculated, and, unless adherent, extremely movable tumor, with a smooth or more likely irregular, and somewhat nodular, surface. There is usually more or less soreness and pain in the side owing to the injury which the very movable growth has inflicted upon the peritoneum, causing a traumatic hyperæmia and resulting ascitis. The ascitis if pronounced will render the diagnosis more difficult. It may be impossible to differentiate an ovarian fibroid from either an ovarian cyst with tense walls and gelatinous contents, or from a pedunculated, uterine myoma. The differentiation, however, will be of little moment, for the treatment will be the same.

An ovarian fibroid of sufficient size to cause disturbance and recognition should be removed. This will ordinarily be accomplished without difficulty on account of the pedunculated character of the growth.

Fibroids of the Uterus.—Aside from the serous and mucous membranes the uterus is composed of bundles of unstriped, muscular fibers bound together by bands of connective tissue. Either of these tissues may furnish the matrix and be the site of a new growth. Until quite recently the hard, white, and often multiple tumors of the uterus were classed

as fibroids. This was probably not entirely due to the fact that they presented the macroscopic appearance of fibrous growths, but also because on section they often were extremely hard, creaking under the knife, very white, and even under the microscope presented the appearance of fibrous tissue. Some of them undoubtedly were pure fibroids, with their wavy bands of white fibrous tissue sparsely intermingled with roundish cells and nuclei. A closer microscopic study of these growths has disclosed the fact that the great majority are, at least in part, made up of quite long, spindle cells with elongated nuclei. In the same section one portion may present the character of white fibrous tissue, while another will be characteristic of smooth muscular tissue. There is little doubt that in nearly all of these growths there is some muscular tissue, while in the great majority, it predominates, and in many it makes up practically the entire tumor. The majority of these growths are probably fibromyomata with the muscular tissue in excess. The entire subject will be taken up anew under the head of myomata.

While we have only indicated the principal sites of fibroid growths, it must not be forgotten that they occur in nearly every organ and tissue of the body, as the brain, heart, spleen, bladder, kidney, testis, thyroid gland, eye, and lung. Fibroids frequently are not pure, but combine with other tissues as in the subcutaneous tissue with fat—fibro-lipoma; about joints or bone with cartilage or osseus tissue—a fibro-chondroma or osteoma; in the breast with glandular tissue—fibro-adenoma; in the uterus with muscular tissue—fibro-myoma; and unfortunately very often with sarcomatous cells—fibro-sarcoma. It might also be said with perhaps equal correctness that a scirrhus of the breast is a fibro-carcinoma.

Etiology of Fibroids.—Fibrous or connective tissue is not only the most widely distributed of any of the tissues of the body, but it is the one most readily affected by extraneous influences. Anything which increases the blood supply to a part for any considerable time, or which acts as an irritant,

will produce a proliferation of the connective tissue. In chronic interstitial hepatitis due to alcoholism, syphilis or phosphorus poisoning, there is, as the result of an irritant circulating in the blood, a destruction of the acini and an enormous growth of the interstitial connective tissue. The same condition prevails in a chronic interstitial nephritis, where as the result of an irritant, as alcohol, lead or uric acid in the blood, there is either primarily or secondarily, destruction of the tubules and an enormous increase of the connective tissue. The same holds good of every part or organ of the body. If a more or less continuous irritation or chronic inflammation is established in a part, the connective tissue will proliferate. If a person receive an injury to some particular part or a succession of injuries, perhaps slight in character, or a low grade of repeated infections, not sufficiently severe to excite suppuration, there will occur at those points an increase of blood supply with proliferation of connective tissue. Upon the palms of the hands and the soles of the feet of laborers there occurs, as the result of pretty constant friction and pressure, not only an enormous increase of the epithelial tissues, but also of the deeper connective tissue layers. In elephantiasis as the result of obstruction and irritation of the lymphatics there is an enormous increase of subcutaneous connective tissue throughout the affected area. This latter condition very often leads to the formation of very large fibroids in the scrotum and labia. While the processes thus far spoken of seldom lead to the formation of fibroid tumors, they, nevertheless, illustrate very clearly the fact that the production of connective tissue is very often the result of irritation, traumatism or inflammation.

Fibroid Tumors Due Apparently to Irritation or Inflammation.—The fibroid epulis seemingly has its cause in the irritation of a decayed or loose tooth. *Molluscum fibrosum* occurring on the surface of the skin is, at least very frequently, the result of local irritation. This fact is strongly emphasized by the frequent occurrence of these growths at the site of

fistulæ, where they are due to the irritation of the discharges. Keloids occur in an irritated or inflamed cicatrix. Injury or catarrh in the nasal cavities or in the naso-pharynx is very often the forerunner and seemingly the active cause of fibroids. Laryngologists hold that laryngeal fibroids usually occur in persons who have strained their throat in singing or speaking. Fibroids of the mammary gland have usually been preceded by inflammatory attacks either acute or chronic.

Fibroids are often hereditary, occurring in many members of the same and successive families. They are also occasionally congenital. Fibroid of the abdominal wall so often follows childbirth or traumatism that it is impossible to escape the conviction that injury or excessive strain of the abdominal wall are not seldom causative factors in their production. Age is a predisposing cause, as the majority of fibroids occur in men in adult life; and in women, when in the breasts, uterus and ovaries, during menstrual life.

Nothing of a general nature remains to be said regarding treatment which has not been considered under the various subdivisions of fibroids previously discussed in the text.

CHAPTER IX.

OSTEOMATA OR BONY TUMORS.

Formation of Bone.—Before taking up the consideration of bony tumors, and for the purpose of their better understanding, it is thought best to devote some space to the consideration of the processes taking place in the normal development of bone. These processes vary somewhat, the variations depending upon the tissue in which the bones are formed. In the development of the bones of the skeleton, excepting those of the head and face, ossification is preceded by calcification, the latter taking place in preformed cartilages, which are solid and in form correspond to that of the future bone.

The first change noticeable in a cartilage which is about to be replaced by bone is at the points of primary ossification situated within the diaphysis and epiphysis. At these points the cartilaginous cells which up to this time had been deposited irregularly throughout the cartilaginous matrix, come to rearrange themselves in rows parallel with the long axis of the future bone. At the same time they, as well as the cartilaginous lacunæ in which they are placed, increase in size while the rows of cells become more widely separated in consequence of the growth of the cartilaginous matrix which is placed between the cells. This matrix also at this time becomes calcified by the deposit of calcareous salts.

Coincident with these processes in the interior of the cartilage important changes are also taking place upon its exterior, preparatory to the replacement of the cartilaginous shaft by true bone. These changes take place primarily

within or from the periosteum and are the result of its special functions.

We will digress for a moment for the purpose of considering the structure and functions of the periosteum. This membrane is composed of two layers, the external being made up of dense fibrous tissue while the internal layer is composed of an areolar tissue, blood vessels, lymphatics and numerous round and spindle cells. The periosteum has three important functions: First, that of protection, affording, as it does, a firm, fibrous covering, primarily for the cartilage and later for the bone; second, the formation of bone through the action of its cells or osteoblasts; and third, the formation of marrow, as it is the genetic layer from which the primary bone marrow is produced.

At the same time that calcification is taking place in the primary centers of ossification the internal layer of the periosteum, the osteogenetic layer, is also undergoing important changes. Its internal layer becomes thickened, more vascular, while its round and spindle cells proliferate vigorously. Some of these cells, though of connective tissue origin, become the osteoblasts or bone-forming cells and by arranging themselves in successive layers upon the internal surface of the periosteum, are enabled to lay down successive layers of circumferential bone lamellæ.

At the same time the osteogenetic layer of the periosteum produces a soft, plastic tissue, made up of a fine connective tissue reticulum, rich in capillaries and venules, in the meshes of which great numbers of soft, plastic cells are placed.

Many of these cells are the future osteoblasts and osteoclasts which subsequently are active in the formation of, and the absorption of, bone. This soft, gelatinous mass, the primary marrow of bone, makes its way by absorption through numerous columns into the interior of the cartilage towards the calcifying centers. It opens up the numerous enlarged lacunæ in its path, converting them also into medullary cavities and filling them with bone marrow.

The osteoblasts within the marrow apply themselves in successive layers to the sides of these spaces and thus in place of the absorbed cartilage and on the interior of the enlarged lacunæ, successive layers of bone are deposited, forming bone lamellæ and Haversian systems. Almost coincident with this process and as an extension of it, the center of the bone becomes hollowed out by the action of the osteoclasts, producing the medullary canal. This canal at the time of its formation is also filled with marrow, the cells of which, as before, apply themselves in successive layers upon its internal surface, producing the internal circumferential bony lamellæ. The difference between the compact and cancellated bone depends upon the formation of few or many lamellæ by the bone corpuscles. These bone corpuscles become imbedded within the bone which they form, producing the bone cells in the bone lamellæ.

Intra-Membranous Formation of Bone.—This is the process by which the bones of the cranium, and most of those of the face, are formed. There is here no cartilage out of which, as a matrix, the bone is produced, but simply a membrane, the fibres of which primarily calcify, while upon these fibres granular connective tissue cells, called osteoblasts, arrange themselves in successive layers and produce bone.

It should be borne in mind, as we shall endeavor to show later, that this method of intra-membranous production of bone can and does occur in nearly every organ and tissue of the body; in fact at almost every place where connective tissue is present bony tumors may and do occur, the connective tissue cells taking on the action and function of osteoblasts.

It must not be forgotten that bone belongs to the connective tissue group and is little more than normal connective tissue with lime salts deposited in regular order. The process of ossification must be differentiated from calcification; ossification is a systematic and developmental process, the lime salts being laid down in regular order, and towards a fixed end, while calcification is often as it were an accidental

process, or very often a degenerative change, the salts being distributed promiscuously.

Frequency of Osteomata.—Osteomata when compared with other connective tissue tumors are of unfrequent occurrence. They may be single, but are quite often multiple and occasionally occur in large numbers as symmetrical or congenital growths. The osteomata have been variously classed according to their structure.

Virchow divided them into three classes: In the first were the ivory-like growths, or osteomata durum. These are situated upon the vault of the cranium within the external auditory meatus or upon the walls of the frontal sinus or antrum of Highmore. They are characterized by their extreme density, slow growth and small size. In the ivory-like exostoses the density is very much greater than in compact bone, there being within them few if any canals or cavities. They possess the density and hardness even of ivory. The majority of bony growths, however, about the cranium do not possess this extreme density, but have the characteristics of compact bone, and these grow more rapidly and may reach a very considerable size.

The second class of osteomata were those made up of tissue corresponding to that of spongy bone, the osteomata spongiosum. These are not composed entirely of spongy bone, but have a thin shell of compact bone upon their exterior. They are capped with cartilage, and occur most frequently at the epiphyseal extremity of the long bones. A third class or subdivision were those composed of a thin shell of compact bone upon the exterior, while within this there was cannellated bone and in the interior a medullary cavity filled with marrow, osteomata myeloides or medullary osteomata.

The osteomata as well as some other pathological growths of bone are also grouped according to their form. The immense, diffuse thickening which occurs in the bones of the skull is spoken of as leontiasis ossium. This condition has

been compared to, and corresponds closely with, elephantiasis of the lower extremities.

A more or less extended thickening of a long bone is spoken of as a hyperplasia or hyperostosis. If the bone is merely increased in density without any great increase in size it is spoken of as an osteo-sclerosis. Circumscribed new growths within the interior of bone are called endostoses, while the same kind of growths upon the exterior are known as exostoses. Small, more or less sharp spiculæ of bony outgrowths are known as osteophytes.

Bony tumors may be sessile or pedunculated and have a smooth, even, regular surface or one which is rough, warty and nodular.

Leontiasis Ossium.—This condition, although not strictly an osteoma, is nevertheless a growth of bone of such interest that it may be briefly considered at this time. The name was given by Virchow to an enormous overgrowth of the bones of the skull or face sufficient to produce in the individual affected some general likeness to the lion. One bone or a part of a bone may alone be implicated, or all or nearly all the bones of the skull or face affected. The process may commence at one point as an infective inflammation and spread from there over the bones of the face and head, producing enormous thickening, great deformity and often such pressure within the adjacent orbital cavities as to cause interference with or destruction of sight; such thickening of the bones of the nose as to interfere with the sense of smell, and interrupt nasal respiration; such enlargement of the jaw as to make mastication difficult or even impossible and, what is of greater importance, such thickening and ingrowth of the bones of the cranium as to lessen very materially the cavity and produce serious, perhaps fatal, compression of the brain.

One of the most interesting, and at the same time remarkable, cases on record is that of young Forcade, whose father was a surgeon of note in his time. In 1734, when the boy was twelve years old, the right lachrymal sac became inflamed,

suppurated, and was opened. The sac continued to suppurate for a long time, and during this process it was noticed that the nasal process of the right superior maxillary bone began to take on a very considerable growth. This spread over the left side and implicated the nasal bones. In three years these bones had taken on such growth as to compress the cartilages of the nose and render respiration except through the mouth impossible. The enormous new production of bone implicated the inferior maxillary, which threw out here and there great processes. The bones of the orbit were greatly thickened and the patient became very weak, exophthalmus occurred from a filling of the orbital cavities with bone; the patient was near-sighted, spoke with difficulty, suffered from dyspnœa, became blind and while having a head and face which were monstrous, died from consumption at the age of forty-five. The macerated skull weighed eight and one-half pounds, and the lower jaw more than three pounds.

A second case of interest, and especially as bearing upon the ætiology, is recorded by W. Gruber, of Prag, and occurred in 1847. A young girl, aged ten, having previously enjoyed excellent health, was seized with severe headache, mild delirium and occasional epileptic seizures. This attack lasted some weeks and was followed by erysipelas, which spread over the head and face. Like attacks occurred at short intervals, each being followed by erysipelas. When sixteen years of age, and after repeated attacks of erysipelas, the bones of the face and head were noticed to take on rapid growth. Hearing and the sense of smell were lost. Severe and continued pain occurred in the head, and she died at the age of seventeen after an attack of erysipelas. The bones of the head were at this time enormously enlarged.

A number of similar cases, although of lesser extent, are on record.

Osteomata of the Head.—Osteomata of the vault of the cranium may be sessile or pedunculated and situated either upon the outside or inside of the skull or project from both

surfaces. (Fig. 37.) They may be hard, ivory-like in consistency and seemingly without Haversian canals, cavities or blood vessels, or made up of ordinary compact or cancellated bone. They may be single or multiple and dotted over almost the entire surface, or symmetrical. They are of slow growth and seldom attain any great size. Upon their surface they are smooth or irregular, and when growing from the outside of the skull they may produce no symptoms and are scarcely noticeable unless they reach considerable size or are situated upon the forehead, when they may be very unsightly.

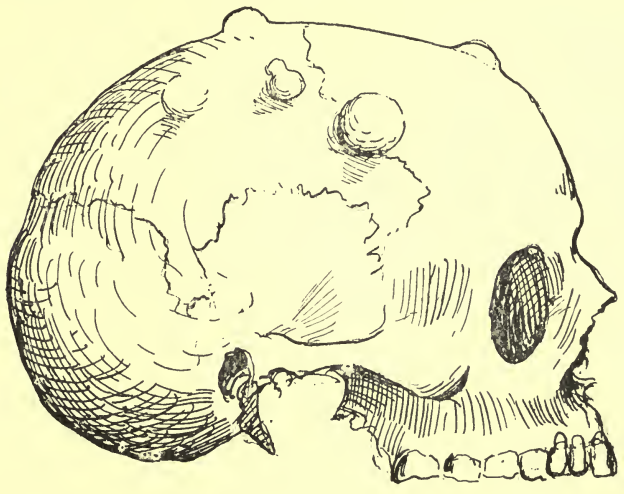


FIG. 37.
Osteomata of the vault of the cranium.

A case has recently been under the writer's observation in which there existed upon the forehead of a young girl a sessile growth of sufficient size as to cause a marked disfigurement of the features.

When these growths are situated upon the internal surface of the cranium, and especially if large or their surface warty, they may produce serious pressure upon, or irritation of, the brain and its membranes. Fig. 38 represents bony outgrowths from the orbital plate of the frontal bone. These

were discovered by Dr. C. Willson, of Milwaukee, in a post-mortem examination of the body of a woman who had suffered for several years with symptoms indicating meningeal and cerebral irritation and who died in a comatose condition.

Diagnosis will rest upon their extreme hardness, their connection with the underlying bone, and their slow growth. When situated within the cranial cavity and producing irritation of,

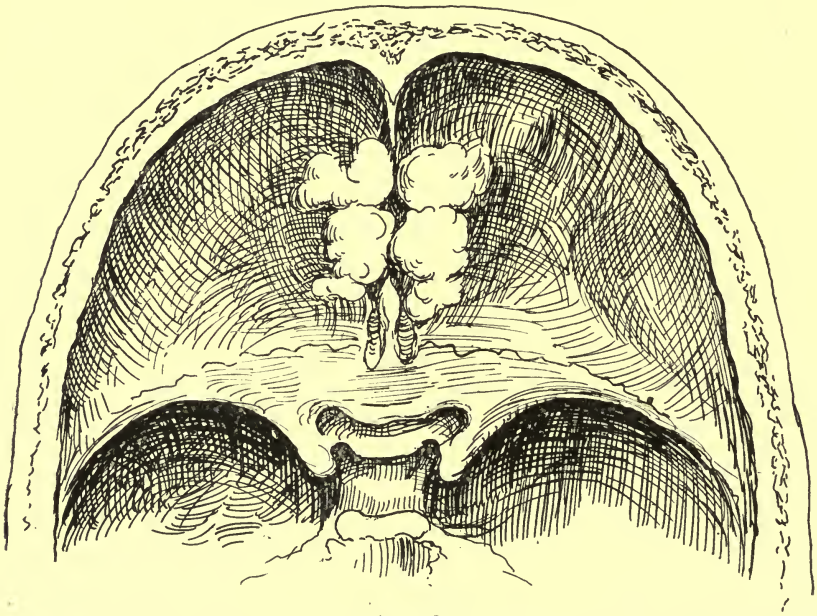


FIG. 38.
Ivory-like Osteomata growing from the orbital plates of the frontal bone.

or pressure upon, the brain or meninges, their nature may be suspected if there are like growths upon the exterior, or if the patient shows a general disposition towards the building of bony tumors.

TREATMENT.—The external osteomata, if unsightly or producing deformity, should be removed. This may be accomplished, when the growth is pedunculated, by making a short incision so as to completely expose the base, which is then

chiseled or sawed off. If the growth is sessile, only so much should be removed as will relieve the deformity. It is necessary that the work be done aseptically, as an infective inflammation may implicate not only the diplœ but also the meninges, and even cause renewed and excessive new growth of bone.

Osteomata of the Frontal Sinus.—Bornhaupt and Tich have collected seventy-eight cases of osteomata situated in the frontal sinus. These growths usually occur at or about puberty and are situated either upon the anterior or posterior wall of the sinus. They may reach a very considerable size and either project the anterior wall of the sinus forward, producing a diffuse or more or less circumscribed enlargement, or the posterior wall backwards, compressing the brain or making pressure upon the orbital plate of the frontal bone, displacing the eye downwards, forwards and outwards. They may be single or multiple and situated either in the median line or at either side. They may be complicated with dropsy or empyema of the sinus; and produce very pronounced swelling with bulging of the anterior wall. When empyema is present, the soft tissues overlying the sinus will be œdematous. Occasionally when complicated with empyema destruction of the pedicle of the growth through necrosis takes place and the tumor lies loose within the sinus as a sequestrum. Pyogenic infection is quite likely to take place in the sinus in connection with new growths on account of the direct communication with the nasal cavities.

Diagnosis.—The diagnosis of osteomata in the frontal sinus will depend upon their very slow, usually painless, growth, the projecting of the anterior wall of the sinus forward, the displacement of the eye, the deformity of the nose, and also, occasionally, upon the compression or irritation of the brain or its membranes, as well as upon the fact that they usually occur at puberty and unless complicated by infection are not attended with the symptoms of inflammation. They must be differentiated from bony growths, situated upon the external

table of the skull, which are more nodular and irregular and occur at the outer extremity of the supra-orbital arch. They also are more circumscribed, with a better defined base, and seem to rise directly out of the bone. They must be differentiated from dropsy and empyema. In both of these the process is more acute and the swelling more diffuse, while in the latter there will be pain, fever and œdema of the overlying structures. They also must be differentiated from sarcomatous growths which occasionally occur in the frontal sinus.

The sarcomata grow more rapidly, produce a more diffuse swelling, are painful, destroy the bone, affect the health, produce metastases and may cause pronounced nasal hæmorrhages.

Prognosis.—Osteomata of the frontal sinus are of very slow and usually of painless growth, and while they may reach some considerable size and produce serious pressure upon the brain or upon the nasal or orbital cavities, these grave pressure effects are not the rule. The prognosis following operative measures has been extremely bad.

Treatment.—When we take into consideration that these growths are removed largely on account of the cosmetic effects, the results of operative treatment in the past have been most unsatisfactory. Chepault collected fifteen cases which had been operated upon before 1894, with ten deaths, and it is affirmed that in Berlin more than thirty-three per cent. of the cases operated have died. This high mortality is largely due to meningeal infection. The cases when they come to operation are often complicated with fistula or empyema and at the time of operation the meninges may be exposed and subsequent infection occur. Infection may also take place through faulty technic or through the infundibulum from the nose. Unless the tumor is producing unfavorable pressure effects, or much deformity, operation is contra-indicated. Before an operation is undertaken the nasal cavities should be thoroughly cleansed and the upper portions packed

with iodoform gauze. The sinus may be opened over the growth by making a straight or curvi-linear incision through the scalp and then opening the sinus by either an osteoplastic resection of the bone or by the use of the trephine. If there are no contra-indications it is much better to replace that portion of bone removed from the wall of the sinus as this will prevent subsequent deformity. The growth should be chiseled or sawn off from its attachments without exposing the meninges, the work throughout being done in a thoroughly aseptic manner. If the tumor has been separated from its base, it will only be necessary to extract it as a sequestrum from the sinus. Should the sinus be in a suppurative condition at the time of operation, tubular drainage will be required, otherwise only a few strands of catgut need be used.

Osteomata of the Superior Maxillary Bone.—As compared with many of the bones of the skeleton, osteomata of the superior maxillary bone are of frequent occurence. They are composed either of compact or cancellated bone and are situated upon the exterior as exostoses, within the bone as endostoses, or have their origin from the antrum of Highmore. They may be single or multiple and even symmetrical. The osteomata of the upper jaw occuring in V. Bergmann's clinic were classified by Brahn with the following result: In thirteen cases they were symmetrical, while in sixty-one they were confined to one side; in point of origin the growths were in fourteen cases situated upon the outer surface of the bone, in four on the frontal process, in eight they grew from the wall of the antrum, in five from the alveolar border, in three from the orbital plate and in one case from the roof of the mouth.

When originating from the external surface they often produce unsightly deformity or serious pressure upon the skin; when from the orbital plate they sometimes interfere with the movements of the eye, or even with sight; and when occurring upon the alveolar border may produce serious disturbance with mastication. When growing from the inner wall of the antrum

they have reached a size sufficient not only to fill the cavity but also to expand its walls. The expansion may be into the orbital cavity, displacing the eye, interfering with vision, or even causing rupture of the eye-ball. The pressure can be principally upon the vessels or the nerves entering the orbit, causing severe pain or great disturbance in the circulation. They may project into the nasal cavities, interfering with respiration and the sense of smell; or into the mouth, interfering with mastication, deglutition, respiration and even causing dislocation of the lower jaw. In exceptional cases the growths have projected backwards and upwards against the base of the skull, producing pain, dizziness, vomiting and even loss of consciousness. By projecting forwards they may expand the wall, pressing upon the skin and finally causing ulceration. These growths are, upon their surface, often uneven, warty or grooved, and show here and there openings for the transmission of blood-vessels. Their growth while usually slow, is often increased by traumatism, inflammation or pregnancy. As in the frontal sinus, so in the antrum of Highmore, osteomata may, as the result of pyogenic infection, become separated from their attachments and lie loose in the antrum as sequestra.

Diagnosis.—They are to be differentiated from empyema and especially from malignant tumors. Primarily their diagnosis will be difficult or impossible; on the contrary, when the walls of the antrum have become displaced or direct inspection can be made, the diagnosis will be more easy by noting their extremely slow growth, hardness, immobility and connection with the bone. Empyema is always associated with fever, is an acute process and produces œdema of the overlying structure. An ossifying sarcoma or a carcinoma may present difficulties in diagnosis; but the malignant tumors are much more rapid in their growth. They destroy the bone, cause more pain, produce cachexia, loss of flesh, anæmia, loss of strength, metastases and frequently occur late in life.

PROGNOSIS.—This is ordinarily good, but it must not, however, be forgotten that severe pressure effects may be produced upon important adjacent structures, or that pyogenic infection, erysipelas and even suppurative meningitis may follow operative procedures.

TREATMENT.—There is no other treatment than that of removal. This may be done by opening the antrum in accordance with Fig. 34 and separating the pedicle with cutting forceps or a sharp chisel. The anterior wall of the antrum with the soft tissues is then replaced and held in position with sutures, while the cavity is drained for a few days.

Osteomata of the Inferior Maxillary Bone.—Echert collected nineteen cases, the majority of which were of compact bone. They occurred in young people and were usually situated upon the body of the jaw and had their origin either from the compact bone or from the alveolar border.

In one case the tumor was attached to the condyloid process and had produced dislocation of the jaw. They may have their origin from the external table and project outwards, or from the internal table and grow into the mouth, or even from the center of the bone producing an endostosis. While they may reach the size of a walnut or even larger, they seldom attain any great dimensions and often, after a time, seemingly cease to grow.

The diagnosis is easy on account of their exposed position. They are well-circumscribed, painless, very hard, nodular, slowly-growing tumors which occur in young adult life. In their ætiology they often seem to be the direct result of an inflammation of the periosteum or bone, or the result of an injury. When occurring upon the alveolar border of the jaw, they usually are preceded by the irritation and inflammation incident to a bad tooth. Heredity is also a seeming factor in their production.

TREATMENT.—If unsightly or causing functional disturbance or pain, they should be removed. If projecting within the mouth a short incision through the mucosa and periosteum, exposing the base, will be sufficient, when they can be

chiseled away or cut off with a metacarpal saw. If situated externally and projecting beneath the skin a cutaneous incision will be required. There should be an effort made not only to remove all of the new growth, but also a thin shell of the bone from which they have grown. By this means a recurrence is likely to be avoided.

Osteomata in External Auditory Meatus.—These tumors are not of frequent occurrence. The ivory exostosis predominates in this situation, although the cancellated form may also occur. They are usually of small size with a sessile base, although the pedunculated form may occur. The small pedunculated growth is said to be always situated upon the upper wall of the meatus near the tympanic ring, while the cancellated growths are found more frequently in the outer third of the meatus.

The most frequent points for these osteomata are where the osseous meatus joins with the different portions of the temporal, as at the mastoid behind the glenoid fossa in front, and where the tympanic joins with the petrous portion of the temporal. They may be single or multiple, and even symmetrical. Their frequent occurrence at these points was thought by Virchow to be due to the irritation incident to, or occurring at the points of, osseous development. They produce no special symptoms unless their size is sufficient to close, in part or wholly, the external meatus, when deafness, a feeling of fullness and ringing in the ear will occur.

They are diagnosed by their density, slow growth and usual freedom from inflammation and pain. They may complicate an inflammation or even suppuration; and when the latter can, and often do, produce obstruction to the discharge of pus.

TREATMENT.—If small and not producing symptoms, they may be left alone, but if comparatively large and producing symptoms such as fullness, tinnitus aurium, pain, deafness or interference with the discharge of pus from the ear, they should be removed. If small and distinctly pedunculated they may be fractured at the base or cut off with a small

chisel. If large or sessile they should be exposed by an incision placed behind the auricle, when it and the cartilaginous meatus are dissected off and drawn downwards and forwards. The periosteum covering the osteoma should then be incised and deflected, when the growth can be cut away by the use of the chisel and mallet, or by burrs in a surgical engine. The soft parts may then be replaced and held by a few stitches. The meatus should be plugged with iodoform gauze, which will prevent bleeding, maintain asepsis and cause the periosteum to reapply itself to the bone. Care must be exercised in the removal of these growths not to do injury to important adjacent structures and to maintain complete asepsis.

Osteomata of the Scapula.—Of seventy-two tumors of the scapula collected by V. Langenhagen, eight were osteomata. The osteomata of the scapula are usually of the cancellated variety. They may be single or multiple. In a number of cases reported they have been multiple, and the result seemingly of a constitutional predisposition. They may have their origin from either table or any portion of the scapula. A few cases have been reported of multiple osteomata springing from the inner table and in their growth becoming attached to the ribs. These growths being usually accessible to examination their diagnosis is readily made. If unsightly or causing functional disturbance or pain, their removal by operative means, including a portion of the scapula, is most satisfactory.

Osteomata of the Long Bones.—These bony outgrowths with few exceptions have their origin from the epiphyseal cartilages, and consist almost wholly of cancellated bone. They may and usually do continue to grow so long as there is an increase of the epiphyseal cartilages. With the replacement of these cartilages by bone in the fully developed skeleton, the growth of the tumor may cease. Osteomata of the long bones are most frequently situated upon the lower end of the femur, upper end of the humerus and tibia and upon the ends of the phalanges. The osteomata or exostoses upon the

ends of the long bones sometimes occur in great numbers. D. J. Hamilton speaks of a case under the care of Mr. Joseph Bell where almost every bone of the body had one or more of these outgrowths attached to it.

A case related by Ebert is of interest also in an ætiological sense: A boy of ten, previously well, fell into the water one cold November day, and suffered in consequence an attack of acute articular rheumatism. During the attack there occurred upon the ribs and at the ends of the long bones numerous outgrowths of bone. The boy made a good recovery, but subsequently had a second attack of rheumatism during which so many new exostoses made their appearance that sixty-five could be counted. He finally died as the result of endo- and peri-cardial complications.

At the autopsy the ends of all the long bones were not only found covered with bony outgrowths but also the ribs, scapula and bones of the pelvis.

Many such cases or similar ones of multiple exostoses have been observed.

Fig. 39 shows an osteoma upon the lower end of the femur, in a young man, coming under the writer's experience, and Fig. 40, a most irregular one, also in the writer's experience, upon the shaft of the humerus.

Osteomata or exostoses are of frequent occurrence upon the ends of the metatarso-phalangeal bones. At these points they produce hard, nodular growths which surround the plantar surfaces of all or nearly all the metatarso-phalangeal joints of one or even both feet. Pressure upon these irregular masses of bone in walking produces not only great callous masses upon the soles of the feet but also great pain, rendering walking most tedious and often impossible.

The diagnosis of the osteomata situated upon the ends of the long bones is made without difficulty as they are accessible to examination and are very slowly-growing, hard, painless, pedunculated growths. Those at the metatarso-phalangeal joints are very nodular and irregular. In causation they

often represent single or combined effects of numerous traumatisms, chronic inflammation or rheumatism. Those upon the feet are the result of the injury and irritation produced by the shoe in walking, the condition occasionally being supplemented by a rheumatic or gouty state.

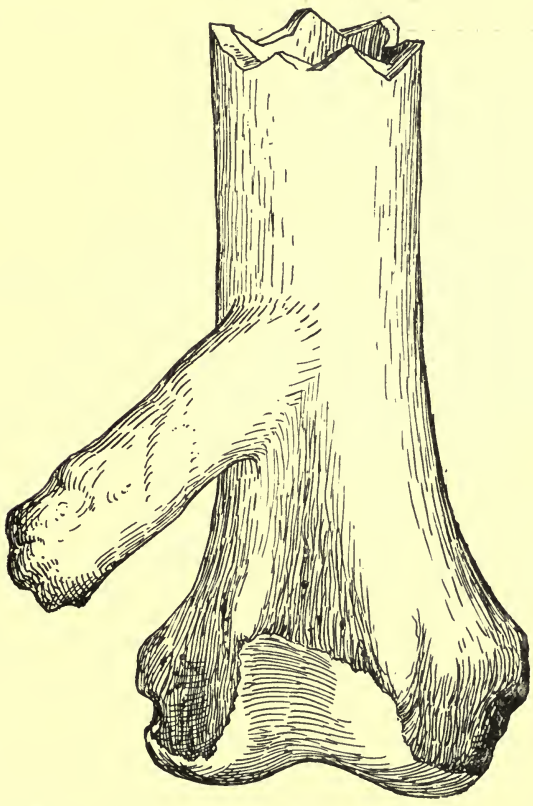


FIG. 39.

TREATMENT.—The osteomata situated upon the femur, humerus or tibia, if producing disturbance by pressure upon the muscle, fascia, blood vessels or nerves, should be removed. This may be done by exposing the base of the growth by a free incision and then chiseling it off. In the treatment of the exaggerated forms of exostosis at the metatarso-phalan-

geal joints, the writer, in some very severe cases, has met with brilliant success by resecting the joints implicated, be this one or even many. In a few of the worst cases I have resected all of the metatarso-phalangeal joints of both feet, and thereby enabled patients to walk with ease, rapidity, comfort and without aid, who previously were stubbing around slowly, painfully and with difficulty by the aid of crutch or cane.

FIG. 40

Subungual Osteomata.—These occur beneath the nail of the big toe, as small, slowly-growing, painful tumors which lift up and loosen the nail and cause considerable pain and distress in walking in consequence of the pressure of the shoe. Their true nature is frequently not recognized, they being mistaken for disease of the nail or an inflammatory condition of the matrix, with which conditions they are occasionally asso-

ciated. By cutting away the loosened portion of the nail the character of the growth is usually readily established.

In the treatment the terminal phalanx may be removed, or perhaps as preferable to this evulse the nail and then cut away the growth and gouge its base thoroughly out.

Heteroplastic Osteomata.—Osteomata occur in connective tissue entirely separate from bone, periosteum or cartilage. They occur quite frequently in or upon the membranes of the brain and spinal cord and less frequently within the brain substance itself. In the cerebral meninges they are situated upon the dura or pia or within the arachnoid. In the meshes of the latter membrane they occur most frequently, and especially upon its anterior convex surface, as thin, very smooth, oblong plates of compact bone. While they may be single they are not unfrequently multiple and occur even in considerable numbers. Upon the surface of the dura they have been seen five or six centimeters in length and have occurred most frequently, when in the dura, in the region of the longitudinal sinus. They also occur beneath the pia. In the spinal membranes they are not so frequent as in the cerebral, but do occur and especially in the lumbar and sacral regions of the cord.

A case of considerable interest occurred in the writer's clinic a year and a half ago. The history was as follows: A lad, then of fourteen years, suffered a serious accidental blow upon the left side of the head some three years previously, which slightly lacerated the scalp and dazed the boy's intellect for one-half hour, after which he rapidly recovered. One year after the accident the boy experienced an epileptic attack, and these attacks had recurred with increasing severity and frequency up to the time when he came under observation. At this time a small, somewhat tender cicatrix was present upon the left side of the head over the arm-center. There was also seemingly a slight depression in the bone at this place. The first sensation preceding an attack, as well as the first muscular contraction, had pretty uniformly oc-

curred in the right arm, which was slightly weaker than the left. The cicatrix was first excised and then the trephine applied to the bone. Nothing, however, abnormal was to be seen. The trephine opening was then enlarged, and a flap of the dura turned down, when, clinging within the arachnoid, was seen a plate of bone, white as milk and smooth as glass. This plate of bone on extraction measured two centimeters in length, was one-fourth centimeter thick and a little more than a half centimeter wide. After its extraction the dura was stitched in place and, without replacement of the bone in the trephine opening, the scalp wound closed. The boy made a good recovery, and up to the time of writing has had no return of the convulsions. It is at least fair to presume that the sequence of events in this case were, first, a traumatism; second, a chronic inflammation within the delicate structures of the arachnoid resulting in the formation of the plate of bone; and, third, epilepsy.

Dr. Chas. Wilson, of Milwaukee, informs the writer that he, while making an examination of the brain in a case where a woman had died suddenly after manifesting cerebral symtoms for a considerable time, found in the longitudinal fissure, a smooth, thin plate of bone, six centimeters long by one centimeter wide.

Osteomata in the Brain.—Simms observed an osteomata in the frontal lobe of a girl who had died at the age of ten. She had been blind for a considerable time and had suffered great motor disturbances in the extremities. Virchow found an osteoma in the cerebrum not far from its surface. It was quite loose, about the size of a cherry, of uneven surface and surrounded by a vascular connective tissue capsule. The tumor corresponded in character to that of a long bone, being of compact substance upon the exterior and having within a cavity filled with marrow.

Albers describes a case in which one-half of the cerebrum was converted into bone. Many other cases in which bony

tumors have occurred within the brain are recorded in medical literature.

It has generally been held by pathologists that these growths of bone occurring within the brain or upon the membranes are the result either of a traumatism or a localized chronic inflammation.

DIAGNOSIS.—While they may produce focal symptoms suggesting the advisability of operative procedures, there are no means by which we can know or even conjecture that the disturbing cause is an osteoma.

In a great many reported cases of osteoma situated within the substance of the brain or upon the membranes the symptoms have either been severe or the condition resulted in the early death of the patient.

TREATMENT.—If superficially situated and presenting focal symptoms they might be successfully removed with a hope of ultimate improvement, provided the adjacent brain tissue was not seriously deranged. An osteoma favorably situated upon the membranes of the brain or cord and producing focal symptoms can be removed with good prospects of success.

Plates of bone have quite frequently been found within or upon the costal pleura in cases of chronic pleurisy.

Osteomata of the Lungs.—These growths though of unfrequent occurrence may be either single of multiple, small or large. They are usually composed of spongy bone and often contain large and small vessels, bronchi, and even lung tissue. An osteoma of the lung of remarkable size has been reported by Post, of Nurnberg. It was discovered in the apex of the left lung of a woman who had died at the age of seventy-four, and was larger than a man's fist. The surface of the growth was very uneven and composed of compact bone, while within it was made up of cancellated bone through which ran many vessels and bronchi and in which there was some lung tissue.

Aside from this large growth there were many small ones the size of walnuts, scattered through the lung tissue.

The symptomatology of tumors of the lung is not definite or complete, and especially in benign growths the true nature of the case may not occur either to physician or surgeon. The symptoms will relate primarily to an irritation and localized inflammation of the lung and an interference with respiration. There will be a harassing cough caused by irritation, and pain, the result both of pressure and traumatic inflammation in the pleura and adjacent structures. The growth in interfering with respiration is likely to produce oppression with cough and expectoration. There may be interference with the circulation causing lividity of the face and swelling of the upper extremity. Pressure upon the pneumogastric or recurrent laryngeal nerve may cause paralysis of the vocal cords or aphonia. More or less of inflammation will occur about the growth, causing the symptoms of a reactive pneumonia. Physically, depending upon the size and the amount of injury inflicted upon the adjacent structures, there will be dullness from consolidation, bronchial breathing, mucous rales or absence of respiration over some certain area.

Their course is very slow but gradually progressive.

The diagnosis will have to rest upon the above-mentioned symptoms, but at best will be only one of conjecture.

TREATMENT.—Osteomata of the lungs are at present beyond surgical treatment.

Osteomata of the Eye.—They are found most frequently as thin or thick plates upon the posterior, free surface of the choroid. They can have their origin either in pre-formed cartilage or in the fibrous tissue of the part which has the same characteristics as that of the arachnoid.

Dr. J. A. Bach, of Milwaukee, informs the writer that osteomata of the choroid are of frequent occurrence. He has removed more than one-half dozen eyes in which there were shells of true bone within the choroid. These shells were

usually about one-eighth of an inch in thickness and in circumference extended more than half way around the eye. The condition is due primarily to a deep-seated injury which is followed by a low grade of chronic inflammation within the uveal tract (iris, ciliary body and choroid). This inflammation results in the formation of bone. New growths also composed of bone have been found within the crystalline lens.

Osteomata in Tendons and Muscles.—Of all the heteroplastic osteomata these are among the most frequent and most widely distributed. They may have their origin from the periosteum at the site of the attachment of a tendon or from the exuberant callus of a recent fracture and grow into the tendon and muscle, but are more frequently in their origin entirely separated from periosteum and bone. They often occur in the adductor muscles of the thigh in men who ride horse-back; in the deltoid muscles of young soldiers who are being exercised daily in the manual of arms, and less frequently in other persons in the triceps, biceps, and in the muscles given off from the pelvis, the gastrocnemius, iliac muscles and vastus externus and internus.

Rogers found in a man of thirty a great part of the muscles of the neck, breast, back and those about the trochanters, made up in part or wholly of bone. The scapula had many bony outgrowths upon it and was fixed to the ribs. These conditions find their origin in frequent traumatisms, more or less constant irritation and chronic inflammation of the muscles. A form of progressive ossifying inflammation of muscle, myositis ossificans progressivæ, has been observed in young persons without assignable cause. In this condition the muscles of the breast and neck are most frequently affected. The muscles are first swollen, presenting the indications of inflammation and later become converted into fibrous tissue and then into bone. Various deformities and pseudo-ankyloses from contraction of the muscles affected occur. The muscles of respiration may become implicated and the patient finally succumb.

TREATMENT.—Osteomata in muscles and tendons which are not causing annoyance may be left alone. If causing irritation or pain or disturbance of function they should be removed by dissecting them out of the muscle or tendon in which they are placed.

Heteroplastic osteoma occur in the testicle, parotid gland and in the skin.

ÆTIOLOGY OF OSTEOMATA.—The production of new bone as in leontiasis ossium and in osteosclerosis is at least often the result of an inflammatory process due to pyogenic infection. The production of bone in muscle and tendon is usually the result of a previous chronic inflammation, perhaps of indefinite cause, or is due to the irritation of successive traumatisms. The effects of irritation and injury in the production of bone are well exemplified in the formation of the exuberant callus, after a fracture, where the broken bones are not well immobilized; also in the production of quantities of new bone in the building of a new socket around the dislocated head of a femur or humerus. The irritation of a decayed tooth often causes not only the formation of a fibrous epulis, but also an osteoma. The plates of bone formed in the arachnoid are at least often, perhaps always, the sequence of a traumatism or chronic inflammation. Virchow states that he frequently has found plates of bone within the pleura in cases of chronic pleurisy. The exostoses occurring at the metatarso-phalangeal joints are always more or less directly due to the irritation and injury incident to walking. The exostoses occurring at the epiphyseal extremities of the long bones are, as a rule, the result of irritation or injury. A very great many cases are on record of multiple osteomata making their appearance immediately following one or more attacks of rheumatism. Sometimes the formation of an osteoma seems due to the local manifestation of a general predisposition. This is especially true in cases where multiple osteomata are congenital. It is stated upon very competent authority that the osteomata

which so frequently occur within the choroid are always due to a previous traumatism which is followed by a low grade of chronic inflammation.

Heredity.—A predisposition seems also to be transmissible. Lloyds records the case of a boy aged six who had a great number of exostoses upon the extremities, very many of these being symmetrical. The boy's father, as well as four of the father's cousins, had also suffered from exostoses on many of the long bones. Stanley narrates a case where the grandfather and two uncles suffered from numerous osteomata.

The majority of writers restrict the term osteomata to growths which are produced as the result of some influence other than traumatism, irritation, inflammation, rheumatism and syphilis. It seems to the writer if this could be done in every case there would be little or almost nothing left to be represented by the term osteoma. A growth of new bone which is circumscribed and well-defined, which endures and becomes permanent, is just as much an osteoma, although coming from a traumatism, as is a sarcoma or a carcinoma which at least often have the same exciting cause.

The sequence of events in the production of many osteomata is as follows: First in a connective tissue group either a traumatism, or repeated traumatisms, a more or less continuous irritation, or a low grade of chronic inflammation with a return of the tissues to their embryonal state, and then a rapid proliferation of the cells of the part. Some of these connective tissue cells either immediately or remotely take on the function of osteoblasts and the new tissue, whether homologous or heterologous, is converted into bone.

That metaplasia does occur, that is, the conversion of one genus into another in a connective tissue group, is attested by most pathologists. In some of the cases cited where there have been very large heteroplastic osteomata formed, any other solution of the mode of their production seems improbable.

Degenerative Change.—Osteomata probably less frequently than any other class of tumors undergo degenerative change. They occasionally, however, do undergo a fatty metamorphosis and become softened and even cystic.

Mixed Forms.—Osteomata are not alwas pure, but frequently combine with other tissue elements either benign or malignant, producing mixed tumors such as osteo-chondroma, -myxoma, -fibroma and -sarcoma.

CHAPTER X.

CHONDROMATA OR CARTILAGINOUS TUMORS.

Cartilage, like the other members of the connective tissue group, has its origin from the mesoblast. It is a tissue which is easily cut, yet dense, firm, elastic and in color milk-white, pearly or yellowish. In its histology cartilage is composed of cells and a matrix. The cells are small, round or irregular masses of protoplasm, which have a nucleus and often contain fat. They are much larger than the ordinary connective tissue cells and are irregularly arranged and situated in hollow spaces known as lacunæ, which they nearly fill.

In a lacuna there may be a single cell, or several; the latter the result of subdivision. The cells when situated singly are usually spherical; when two or more occupy a cavity they are more or less flattened where they come in juxtaposition, or the cells may be stellated with many prolongations. The lacunæ usually have a distinct lining membrane and are surrounded by the cartilaginous matrix which seems to be the product of the cell secretion. That portion of the matrix lying next the lacunæ is generally differentiated and often forms a striated capsule. It is the portion last produced and it may remain as a permanent portion of the cartilage or be subsequently absorbed.

The ground substance of cartilage may be without apparent structure or have an admixture of fibrous or elastic tissue; consequently according to the characteristics of the matrix three kinds of cartilage are described; First, hyaline; second, fibrous; and third, elastic cartilage.

Hyaline cartilage (Fig. 41) is of a pearly-bluish color, transparent, or semi-transparent and apparently homogeneous. This amorphous condition is, however, only apparent, for when it is artificially digested or when examined by polarized light it is seen to be made up of a mass of bundles which have been so intimately blended and closely united by cement substances as to give the appearance of a structureless mass.

Hyaline cartilage is of very wide distribution; it is the

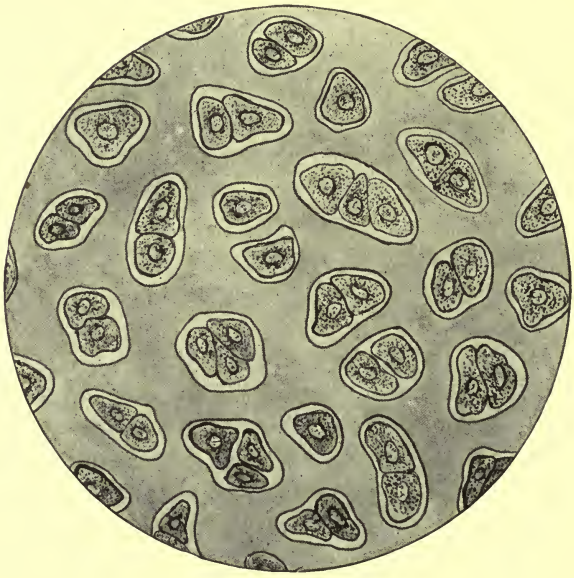


FIG. 41.
Hyaline cartilage.

cartilage of the respiratory organs, of the nose and of the costal and articular cartilages, and in the embryo it makes up the entire skeleton with the exception of the cartilaginous structure of the head and face. This cartilage is very firm, flexible, elastic and yields chrondrin on boiling.

Hyaline cartilage is very liable with age to undergo degenerative change by the deposit within it of calcareous salts, which first occur as minute granules and later as husks or

shells enclosing the cell structure. A transformation in part into fibrous tissue is also of frequent occurrence.

Elastic cartilage (Fig. 42) can be distinguished by its faint or at times pronounced yellowish color and by its matrix. The cartilage cells and their arrangement is the same as in hyaline cartilage, that is, one or more round or flattened cells occurring in a lacuna and surrounded by a thin layer of hyaline cartilage. Between these cell groups or lacunæ the

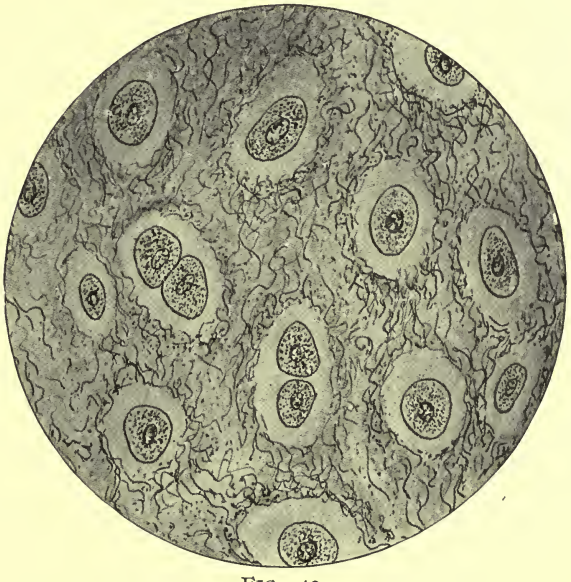


FIG. 42,
Elastic cartilage.

matrix is penetrated by a net-work of elastic fibers. Elastic cartilage has only a limited area of distribution, occurring in the cartilage of the external ear, in the epiglottis, in the cartilages of Wrisberg and Santorini and in the anterior angle of the arytenoid cartilages.

Fibro-cartilage (Fig. 43) has a matrix made up largely of bundles of fibrous tissue. Surrounding the cells, however, there is a thin layer of hyaline cartilage. This form has also

a limited area of distribution, but occurs at the pubic symphysis, at the inferior maxillary and sterno-clavicular articulations.

Perichondrium.—The free surface of a cartilage is covered by a dense, fibrous tissue known as the perichondrium. This consists of two layers, an outer composed of dense, fibro-elastic tissue, and an inner, much looser layer, between the fibers of which there are numbers of connective tissue cells.

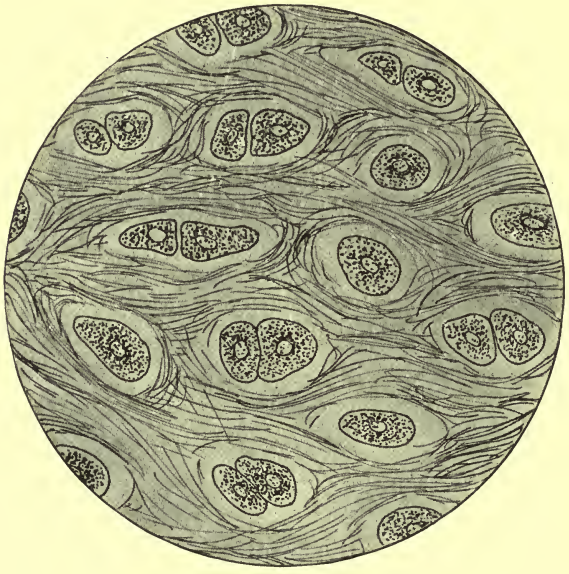


FIG. 43.
Fibro-cartilage.

The perichondrium corresponds in character and function to the periosteum of bone and is its chondrogenetic layer.

In the development of cartilage, after the formation of the perichondrium, the connective tissue cells of this membrane arrange themselves in rows parallel to the surface. These cells are at first spindle-shaped, but later gradually assume a spherical form and take on the function of cartilage cells. They secrete the matrix which surrounds them and although at first occurring in rows, they later recede from the surface,

and as the inter-cellular matrix increases they lose their regularity and become quite irregularly situated within the ground substance.

It is quite likely that both the elastic and fibro-cartilage are primarily hyaline or amorphous in character as the layer of cartilage immediately surrounding the lacunæ is always of the hyaline character.

Chondromata, or cartilaginous tumors, have been divided by Bland Sutton into three species: first, the chondromata proper which are found at the epiphyseal lines of the long bones, especially at the epiphyses of the long bones of the hands; second, ecchondroses which occur as outgrowths along the edges of the articular cartilages of the joints and of the cartilages of the nose and larynx; and, third, the loose cartilages of joints.

Stengel classifies cartilaginous tumors into two groups; the first are the ecchondroses, or ecchondromata, which are outgrowths from bones or cartilages; and, second, chondromata which are independent cartilaginous tumors and may have their origin in the interior of bones or fibrous tissue.

Cartilaginous tumors may occur as outgrowths from bone, epiphyseal or articular cartilages, from the synchondroses or from cartilages situated elsewhere in the body, and are then homologous; or they may occur as outgrowths from the periosteum, from synovial fringes, from muscle, tendon, fascia or gland and are then heterologous.

Paget and Virchow both found long cartilaginous growths in the interior of blood and lymphatic vessels. In one case the tumor had its origin in an ecchondroma of the head of the fibula, and in the other in a cartilaginous tumor of the testicle. Cartilaginous neoplasms also occur in, and as a part of, other tumor formations.

The cartilaginous tumor may develop from a single center, primarily a single cell or from many separate and distinct centers or cells. All cartilaginous tumors of any considerable size are composed of lobules, each lobule representing a sepa-

rate center of development. The fact that they have their origin from many centers and are composed of many separate lobules accounts in a large measure for their irregular, nodular, lobulated surface.

The lobules or islets are often not more than a line or a line and a half in diameter and are separated by connective tissue partitions. In the larger growths these connective tissue partitions and the blood vessels come from the capsule which is a vascular membrane, the perichondrium, and the result largely of irritation and pressure incident to the tumors growth. In small tumors there may be no such partitions, they receiving their nourishment from the investing membrane by imbibition.

Chondromata are innocent growths which occur in the great majority of instances in young adult life before the completion of the individual's growth. They are slowly-growing, very nodular, elastic, painless tumors which usually have a sessile base and only rarely reach a large size. As small outgrowths from epiphyseal or articular cartilages they are frequent; as large growths producing disturbance of function or marked deformity, they are rare.

TOPOGRAPHY.—The epiphyseal ends of the long bones.

At the epiphyseal extremities of the long bones, having their origin from the epiphyseal cartilages, chondromata are of frequent occurrence. They have their origin from the epiphyses during the stage of active growth of the epiphyseal cartilages and consequently before they have undergone complete ossification or the individual has completed his growth. Of all the long bones, the phalanges of the hands and feet, but especially of the hands, are most frequently implicated. In these situations the growths are frequently multiple, one-half dozen, or even a dozen or more occurring upon each hand. While in this situation they may reach the size of a walnut or even a hen's egg and partially incapacitate the individual. They are, however, usually small, irregular out-

growths, few in number, which produce no special deformity or inconvenience.

Articular Cartilages and Synovial Membranes.—As outgrowths from the articular cartilages, chondromata are of frequent occurrence in rheumatoid arthritis. In this disease thickenings, or more or less massive outgrowths, occur at the borders of the cartilages, often producing overhanging masses of every shape and form, and which interfere very much with the motions of the joints and cause even great deformity.

Floating Cartilages in Joints.—Although these cartilaginous bodies may occur in any of the articulations, they are most frequently observed in the knee-joints. Their occurrence may be due to an outgrowth at the border of the articular cartilage which subsequently becomes detached and set free within the joint cavity or they may be the result of an injury, a portion of the articular cartilage having become separated from its base in consequence of a traumatism. They are also due to the organization of blood-clots and inflammatory exudates, but are unquestionably most frequently caused by inflammatory processes chronic in character and often the result of repeated traumatisms which occur in the synovial membrane.

As a result of repeated traumatism or a more or less constant irritation, a chronic inflammatory process becomes established in the synovial membrane and its villous processes, resulting in the multiplication, elongation, conversion into cartilage and final separation as loose bodies within the joint cavity. There may be one or many of these loose bodies within the joint. They are of every conceivable shape, usually quite irregular and in size they vary from that of a half pea to that of the last phalanx of the thumb. They may be quite loose within the joint, but especially when coming from the villous processes they are liable to be attached by a long, slim, delicate pedicle.

Although the great majority of these loose bodies come from the synovial fringes, they can, nevertheless, take origin

from the fibrous tissue of the capsule, in which occasionally large plates and irregular masses of cartilaginous tissues are produced.

A most interesting case of chondromata in and about the knee-joint has been reported by Reichel. (Fig. 44) The report is

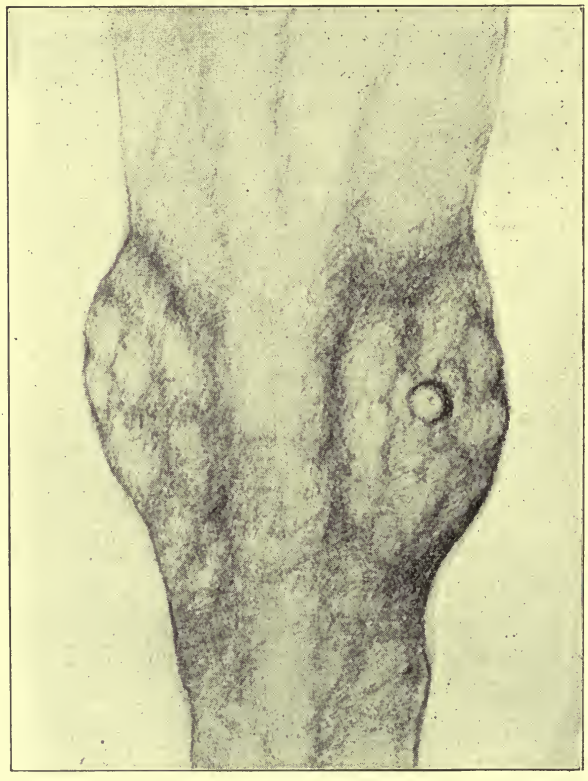


FIG. 44.
Chondroma of the knee.

in substance as follows: A man thirty-six years of age, a mason by trade, had noticed, three years before he came under observation, a swelling of his left knee. This however did not seriously interfere with his occupation until one day when cross-

ing a railroad track, as the result of some mis-step, he felt a sudden, sharp, severe pain in the knee, so severe in fact as to almost immediately incapacitate him.

The knee became very much swollen and after various local applications and rest in bed the pain was to some extent relieved, but the swelling continued to increase until finally an incision was made into the joint resulting in the discharge of a large quantity of blood and pus and a handful or more of loose, cartilaginous bodies. The wound healed quickly and the man was again able to resume work for a short time. Succeeding this there was a recurrence of the pain and swelling and when he was placed under the care of Reichel although he was well-nourished and walked without much difficulty, the joint was greatly swollen, the swelling corresponding very closely to the area of the synovial membrane. This swelling was hard, irregular and in the form of a tumor, while over it were numerous, somewhat loose, small, hard, movable bodies. Upon a careful examination it was seen that the enlargement was due to two quite separate growths, placed one upon each side of the patella. Upon the inner side of the knee, immovably fixed to the bone, was a tumor nine centimeters long by eight wide and having the thickness of a man's hand. This growth had a hard, irregular, nodular surface and had the consistency of cartilage. When the knee-joint was moved, grating, rubbing and rasping within the joint were plainly heard. On the outer side of the patella, and extending upwards some eight or nine centimeters, was a growth having a nodular surface and more or less covered by hard, loose bodies and which corresponded in size very closely to the growth upon the internal surface of the knee.

The circumference of the thigh at the place of greatest swelling was forty-four centimeters. Notwithstanding the fact that considerable muscular atrophy had taken place, upon the sound side at the same situation the circumference was thirty-nine and one-half centimeters.

Upon incision the entire synovial membrane to the bor-

ders of the cartilage was covered with a thick mass of cartilaginous outgrowths in size varying from that of a pin's head to that of a pea. Beneath the quadriceps in an extension of the synovial membrane, great plates of cartilage were present. Posteriorly in the popliteal bursa there was a growth of cartilage as large as a hen's egg.

A microscopical examination was made by Professor Nanweich which showed that the process began primarily in the synovial fringes by an increase in their number and size. Subsequent to this cartilage cells made their appearance in such numbers as to convert them into cartilaginous processes. These became pressed together and fused more or less into cartilaginous masses.

The knee was resected and the man made a good recovery.

As to the cause of the condition there had been no known traumatism or previous inflammation. The condition did not correspond to one of rheumatoid arthritis and was thought possibly to be the result of some unknown infection.

Remak, who is supported in his theory by so many writers, claims that all new growths come from pre-existing embryonal cells of the same genus which have lain dormant within the system until excited to new development. This theory would seem to fail if the microscopical findings of Nanweich are correct.

Through some influence the normal connective tissue of the fringes took on active growth, increasing in size and number, and following this the cells of this new growth were converted into cartilaginous cells. It would seem that in this case there was a direct conversion of the new connective tissue cells into cartilage cells which then went on multiplying and producing new cartilage. The assertion by Senn that connective tissue can no more produce cartilage than it can produce epithelial cells, seems overstated.

Cartilage is a connective tissue belonging to the same family as normal connective tissues, while epithelial cells belong to an entirely different group. While there is every

reason to believe that the different members of the same group of tissues may be, and frequently are, changed from the one into the other (as cartilage into bone, or fibrous tissue into cartilage, or cartilage into myxomatous tissue, or connective tissue into adipose tissue), or that some genera may undergo degenerative change, may be converted into tissues of lesser importance, there is absolutely no proof or reason to believe that a member of one group can be converted into that of another. In fact we have every reason to believe, and even to know, that the tissues of one kind, as the different genera of the connective tissue group, are not and cannot be converted into epithelial tissue or the reverse.

If a chondroma is always, even when heterologous, due to sequestered chondroblasts, or a fibroma to fibroblasts, or an osteoma to osteoblasts, or a neuroma to neuroblasts, which have wandered into abnormal regions or tissues where they may subsequently as the result of irritation produce tumors, why should they not be capable of microscopic demonstration before the advent of the growth into tumors?

It would seem that if the embryonal cells of the different groups of tissue were so in the habit of wandering into adjacent tissues we would sometimes find that epithelial cells had wandered out of their normal habitations and become sequestered and lie dormant in connective tissue areas and produce, as the result of irritation, epithelial tumors in this abnormal position. I am not aware that any such condition has ever been observed. If the epithelial cells or nerve cells never wander into abnormal situations, why should the chondroblasts, the osteoblasts or fibroblasts undertake these excursions. The theory of Remak and Cohnheim is pleasing and probably explains the production of some growths, but it is at best only a theory which at least has not been, and probably cannot be, proven.

Diagnosis:—Loose cartilaginous growths in the knee-joint are usually easily diagnosed. The history will show an injury or injuries, or a more or less chronic inflammation of

the synovial membrane with an increase of the fluid and an enlargement of the joint. The loose bodies can be felt at different times and in different portions of the joint cavity, first making their appearance on one side of the patella then disappearing perhaps to reappear upon the same side or upon the opposite side.

It is often the case that they cannot be felt, especially if single, for days at a time, when they unexpectedly reappear.

Another and pronounced characteristic of loose cartilages in the knee-joint is caused by one of these small bodies becoming caught between the articulating surfaces, during walking or movements of the limb. At such times the joint is said to be locked, and is for the time being immovably fixed; the fixation being attended with sudden and excruciating pain and only relieved by the gradual movements of the limb, whereby the floating body is displaced from between the bones. These attacks may be attended with such severe pain that the patient is unable to take a step after the locking and falls to the floor from the shock and the pain. Each fresh attack as the result of the traumatism is associated with an acute exacerbation of the synovitis and with this there is an increase of lameness, pain, swelling and the amount of secretion within the joint. The condition where there are many loose bodies within the knee-joint may become so severe from the frequent locking and the acute exacerbations as to disable the person almost entirely from following an occupation which requires considerable standing or walking.

This state should be differentiated, in the knee-joint, from displacement of the semilunar cartilages, which also occasionally occurs as the result of an injury, and which produces the same locking of the joint as occurs where loose bodies are present. In displacement of these cartilages they are simply turned upon their edge and are never present as loose bodies. The condition always follows an injury, or a sprain, and a vacuity can usually be felt at the site of the displacement.

TREATMENT.—Where loose cartilaginous bodies within a joint are causing any disturbance with motion, or creating pain or inflammation, they should be removed. This must be done under strict antiseptic precautions and through a reasonably long incision at the side of the patella. The joint being opened the loose bodies are fished out with a pair of forceps or the finger. It is ordinarily quite useless to attempt to fix these bodies, previous to opening the joint, by thrusting into them a sharp needle, for the reason that the attempt usually fails on account of their extreme density, mobility and the inability to hold them in one position; also because there are ordinarily a number of these bodies within the same joint.

In any event, after opening the joint it should be thoroughly explored with the finger for the purpose of detecting and subsequently removing any and all of the loose cartilages that may be present.

It is quite unnecessary in these cases to drain the joint but it should be immobilized until the wound is thoroughly healed and the resulting inflammation due to the traumatism has disappeared.

Chondromata taking origin from the inter-vertebral cartilages.—These cartilaginous outgrowths are of unfrequent occurrence and usually small, and when projecting forward into the neck, thorax or abdomen generally produce no great disturbance. Their position, however, is a most important one, as they are in close relationship to very important structures, and if irregular or reaching any considerablesize, they may bring about serious disturbance by irritation or compression of important structures. If in their growth they project backwards in the spinal canal they are likely to produce primarily symptoms of irritation of the spinal nerves or membranes with pain and muscular spasm, or even pressure upon the spinal cord with paresis or paralysis.

As a matter of diagnosis it would be impossible often to differentiate the chondromata from other tumors which take their origin from or within the canal. The history of the case

and an examination of the patient may enable the surgeon to differentiate chondromata from tubercular, syphilitic and secondary, malignant growths.

Previous primary malignant growths in other portions of the body, either carcinoma or sarcoma, would be strong presumptive evidence of metastasis. Chondromata here as elsewhere are characterized by their extreme chronicity, and should there be other cartilaginous growths even in distant portions of the body, this of itself would, at least, be presumptive evidence that the growth in the spine was of the same character.

In tumors of the spine which grow into the spinal canal, *pain*, which is severe, constant, increasing in severity, and increased by motion, is one of the most characteristic symptoms. The pain, which is constant and very severe, has acute exacerbations and at times is simply terrible in character. It is caused by the pressure of the growth upon the sensitive nerves as they leave the intra-vertebral foramina. The pain usually extends along the area of distribution of the nerves implicated and is not only increased by motion of the spine, but also often by local pressure. These areas are also usually hyperæsthetic, but they may alternate with areas which are anæsthetic.

With pressure of the growth upon motor nerves, muscle spasm and, later, paresis, or even paralysis with atrophy of the muscles implicated, may occur. The symptoms of pain, and perhaps spasm, may exist for a very considerable time before those of paresis or paralysis make their appearance. The latter are indicative of serious pressure upon the cord itself. In tumors of sufficient size to produce serious pressure upon the cord in the cervical or dorsal region, there will be disturbance of motion and finally complete paralysis of one side or both, depending upon the position of the growth and its size. With this there will be wasting of the muscles and an increase of the reflexes. If the pressure of the tumor only produces paralysis on one side there is likely to be crossed anæsthesia. In tumors pressing upon the lumbar portion of

the cord, paralysis of the rectum and bladder occur with loss of the reflexes; and often irregular paralysis and loss of sensation.

TREATMENT.—Cartilaginous tumors growing into the spinal canal and producing serious pressure symptoms, should be subjected to surgical operation. It is quite immaterial in what portion of the spine they are situated as they can be made accessible by resecting, under antiseptic precautions, the spinous processes and laminæ and then displacing the membranes or cord to one side, when they may be removed by chisel or gouge.

Synarthrodial Joints.—In several of these joints chondromata occasionally occur. This is especially true in the pelvis at the symphysis pubes and at the sacro-iliac articulations. In these situations chondromata may grow inwards and if reaching any considerable size can produce serious pressure upon adjacent structures. In women, especially in pregnancy or parturition, they may produce complications which are at once alarming and perhaps almost impossible to overcome. Surgical access to and removal of growths causing disturbance and having their origin from the internal surface of the symphysis pubes would not necessarily be difficult, while exposure of and removal of those growing from the internal surface of the sacro-iliac joint might be extremely difficult or impossible.

A number of cases of chondromata having their origin from the occipito-sphenoidal articulation have been reported by Virchow and others. These growths usually project inwards and in some instances have reached a size sufficient to produce serious and even fatal compression upon the brain and its membranes. It is hardly necessary to state that in this situation operative procedures are impossible.

Costal Cartilages.—Upon these structures, especially in elderly people, chondromata are of quite frequent occurrence. They may be single but are quite likely to be multiple and to range in size from a small excresence to that of a

hen's egg. In rickets, the beaded enlargements at the costo-chondral articulations are frequent and due to the proliferation of the cartilage cells and an increase of the medullary tissue. The same condition prevails in many of the long bones where there is an overgrowth of the epiphyseal cartilages and a thickening of the bone. This condition also obtains in the bones of the skull.

Chondromata of the Maxillary Bones.—Outgrowths of cartilage from these bones cannot be said to be frequent. They occur seemingly more often from the lower jaw than from the upper. Weber found in 267 cases of chondromata only eight situated upon the lower jaw.

Helferick narrates a case of chondroma of the upper jaw situated near the middle line in front and having originated from the alveolar border. The growth caused very considerable pain, the loss of the incisor teeth, and in nine months it reached such a size as to project from the mouth. It was nodular in form and of sufficient size not only to fill out and distend the oral opening but also extended upwards to the orbital plates of the superior maxillary bone. It was covered with mucous membrane and here and there showed points of ulceration.

It seems characteristic of some of the chondromata situated in the superior maxillary to produce, after reaching considerable size, such pressure upon the base of the skull as to cause ulceration of soft parts or even destruction of bone. They may also project through some of the fissures or foramina at the base of the skull and thus enter the cranial cavity and there produce serious irritation or even fatal compression of the brain.

Gurlt, in 136 cases of chondromata, found only seven taking origin from the maxillary bones. Berger in his examinations of the upper jaw met with ten cases in which they took origin from the alveolar process, seven originating from the front surface and four from the antrum and three from the nasal processes.

Chondromata of the inferior maxillary can have their origin either from the exterior or the interior of the bone. They are usually irregular upon their surface, sometimes of very considerable size and occasionally include in their growth nearly the entire extent of the inferior maxillary bone. They are ordinarily composed of hyaline cartilage although occasionally of fibro-cartilage. In the jaws their appearance is often preceded for a considerable time by severe pain in the teeth. The chondromata in these situations where they have their origin from the exterior or interior of the bones appear as hard, elastic, nodular tumors having usually a sessile base, occurring in young people and requiring from five to ten or even twenty years to reach any considerable size. They may in exceptional cases attain excessive growth and produce serious irritation or even such compression as to lead to a fatal result.

DIAGNOSIS.—Their diagnosis ordinarily should be easy, as in the great majority of cases the growth will be exposed and accessible to direct examination. If situated within the antrum of Highmore they may present simply the indications of a new growth. It would be difficult to distinguish between a chondroma, an osteoma or a fibroma, but as the treatment would be the same an error in diagnosis would not be very material.

From sarcoma or carcinoma in the same situation chondromata can ordinarily be differentiated on account of the slowness of their growth and from the fact that they have the characteristics of benign growths.

TREATMENT.—Chondromata here, as elsewhere, if unsightly or producing functional disturbance or likely to lead to serious consequences, should be removed. The large chondromata primarily situated within the antrum of Highmore, but subsequently reaching such a size as to be no longer confined by the walls of the antrum and becoming spread out against the base of the cranium implicating important structures and invading the fissures and foramina, require extensive operative

procedures for their removal, and even then some portion of the growth, if situated in an inaccessible position, may be left behind and continue to grow, giving the impression of a malignant recurrence. Aside from this possibility, which should be kept in mind, the directions already given for the excision of osteomata in these situations will apply equally as well to the chondromata.

Clavicle and Scapula.—Chondromata occur on these bones and occasionally reach considerable size. With the clavicle the ends of the bone are most frequently affected, and in the scapula the acromion and coracoid processes and the posterior surface of the bone are the situations from which cartilaginous tumors most frequently have their origin. From the body of the scapula chondromata have occasionally reached an enormous size.

Diagnosis.—The correct interpretation of cartilaginous tumors taking origin from one of these bones would scarcely be a very difficult matter in consequence of their accessibility.

Treatment.—Their treatment ordinarily will be confined to *removal.* The bones being superficial the base of the growth is exposed and then chiseled away, removing also a portion of the bone from which it has grown. If the tumor has had its origin from the body of the scapula it will ordinarily be necessary to remove the portion of the body to which the growth is attached.

Chondromata of the Ear.—These tumors, while made up of elastic cartilage, present the usual characteristics of chondromata in other situations. They seldom reach any very considerable size and are of rare occurrence. The most pronounced case which has come into the writer's notice, was that of a young man aged twenty-five who had primarily noticed a small growth upon the posterior surface of the right auricle some eight years previously. (Fig. 45.) The tumor had had its origin at about the middle of the posterior surface of the auricle. Its growth had been painless and slow, but continuous, and had finally come to involve nearly the entire

cartilaginous structure of the ear. It produced some inconvenience on account of its weight and prominence, and a most unsightly appearance. The tumor was hard, elastic, somewhat nodular, semi-translucent and covered by a normal integument which had not changed in appearance or apparent vascularity. In its removal, which was done with scissors and with the greatest ease and dispatch, the auricle was simply

FIG. 45.
Chondromata of the ear.

cut through quite close to its attachment to the head. The two skin surfaces were then united with interrupted sutures over the exposed cut surface of the cartilage. The healing was without incident and there has been no return of the growth.

Chondromata of the Thyroid and Cricoid Cartilages and Trachea.—Cartilaginous growths when having their origin from these structures are usually of small size and are situated

upon the borders of the internal surfaces of the cartilages. They may be single or multiple.

Frorilp describes a case in which there were three cartilaginous growths upon the internal surface of the larynx.

In the trachea they sometimes occur in considerable numbers as polypoid or irregular warty outgrowths. They may have their origin from the internal surface or from either border. Occurring in these situations they will cause irritation, spasmodic cough, catarrh and, it may be, difficulty of respiration with hoarseness.

DIAGNOSIS.—They will present symptoms incident to new growths, but few indications, except upon direct inspection, or palpation, characteristic of cartilaginous tumors.

TREATMENT.—If situated within the larynx, upon the cricoid or upper part of the trachea, they can be exposed by direct incision and then removed. If situated lower down it will be necessary to use the laryngeal mirror after a tracheotomy, when their removal can be effected by cutting forceps or the galvano-cautery wire.

Chondromata of the Nasal Cartilages.—These are extremely rare growths and when occurring they seldom reach any considerable size or cause pronounced disturbance or deformity.

Heterologous Chondromata.—Unquestionably the most frequent site of heterologous chondromata is in the synovial membrane of the joints—a subject which has already been considered. Another frequent situation is in the parotid and submaxillary glands. Sutton figures a chondroma of the submaxillary as large as, or even larger than, an adult head. Virchow found one as large as a man's fist. They have their origin either from the connective tissue within the gland or probably more frequently from its capsule or the connective tissue in the immediate vicinity.

When taking origin outside of the gland they often in their development project into and include some portion of the glandular structure. In the formation of cartilage

from connective tissue, Virchow sees primarily only an irritation; following this there is an inflammation by which the tissues are converted into a mass of embryonal cells. These cells lie in very close relationship to each other without marked intercellular substance. At a later period an intercellular homogeneous substance makes its appearance and the tissue becomes converted into hyaline cartilage.

The breast, testicle and ovaries are also occasionally sites of chondromatous growths. They also occur, though rarely, in the eye.

Hagg found a cystic chondroma in the testicle, weighing four and a half pounds, in a young man of thirty years of age who had received a severe injury to the testicle by being thrown upon the pommel of his saddle.

Demarquay removed a cystic chondromatous testicle weighing two pounds from a patient who had received a kick from a horse on this part, some fifteen months previously.

Chondromata of the Lungs.—Chondromata when occurring in the lungs are usually situated at the root of the lung. They have no direct connection with a bronchus as a point of origin but occur in the adjacent connective tissue and grow around a bronchus or blood-vessel.

Cartilaginous tumors also occasionally occur in the subcutaneous connective tissue or in fascia. They are also occasionally found upon or within the cerebrum, upon its membranes, or the membranes of the spinal cord.

MIXED TUMORS.

Quite frequently in making the microscopical examination of supposed cartilaginous growths tissue elements representing two or more of the connective tissue genera are found. These admixtures of tissue represent benign or malignant structures. If the former, the most frequent concombination is the osteo-chondroma, in which a portion of the growth has undergone ossification. This condition represents a stage of higher development, and is especially frequent

in chondroma which are in direct relation to bone or periosteum. Another frequently occurring mixed tumor is the fibro-chondroma, in which a considerable portion of the growth is composed of fibrous tissue. This combination is more especially found where the primary growth has had its origin from fibrous tissue. Not unfrequently cartilaginous cells will contain fat and occasionally a portion of a cartilaginous tumor is made up of normal adipose tissue. The usual cartilaginous tumor is nourished, as before stated, either from the surface by imbibition or in cases where the tumor is made up of islets or separate small growths, by small blood vessels which course through the connective tissue interspaces. In all ordinary conditions their supply of blood is small; occasionally, however, the number and size of blood-vessels going to the tumor is not only large but makes up a very considerable part of the growth. This condition produces a tumor which is soft, grows rapidly, pulsates, produces serious pressure symptoms and may lead to alarming hæmorrhage.

There is also a mild tendency in this class of tumors towards malignancy.

When the chondromata occur in glands, as the parotid, submaxillary, breast, ovaries or testicle and there is at the same time an increased growth of glandular tissue, the tumor is an adeno-chondroma. As previously stated, the inclusion of a portion of gland tissue within a new growth does not constitute an adenoma, but a new growth of gland tissue as well as cartilage, very properly receives the name of adeno-chondroma.

Another form of mixed tumor is the myxo-chondroma. This represents a benign neoplasm of slow growth and of much softer consistence than the ordinary cartilaginous tumor. A very considerable number of cases, however, have been reported in which so-called myxo-chondromata have caused metastases and even recurred after removal.

It is difficult not to believe, although this may have been impossible of demonstration, that in many of these cases

there were sarcomatous elements. It is probable that pure chondromata as well as myxo-chondromata are capable of producing metastases in consequence of some of the cells becoming detached, gaining an entrance to the circulation and being carried away to some favorable site where the tissues manifest affinity for the cells and they become arrested and take on subsequent growth. The most important of these mixed tumors is the chondro-sarcoma. This, of course, means malignancy, and this is manifested by greater vascularity, more rapid growth and often by the production of metastatic deposits in distant organs, especially in the lungs. They may also implicate and cause enlargement of the nearest chain of lymphatic glands.

In their growth, aside from their pressure effects, they may interfere with the health and well being of the patient. They not unfrequently soften and undergo cystic degeneration and present all of the indications of malignancy.

Thoma says that in pure chondromata of glands, metastases may occur of cartilaginous cells into distant organs producing secondary growths and thus simulating the characteristics of carcinomata.

Degenerative Process. — This occurs in cartilaginous tumors probably with less frequency than it does in other neoplastic growths. It is the sequence of change in metabolism, local ischæmia, imperfect nutrition, local infection, general systemic disturbance, systemic infectious diseases and poisons.

Myxomatous Degeneration.—This degenerative process, as well as myxomatous changes already described, occurs in cartilaginous tumors. The process primarily affects the intercellular tissue, setting free the cells and occasionally leading to metastasis, in consequence of these cells having gained an entrance to the blood or lymphatic circulation. Metastasis also occurs in fatty metamorphosis and in these cases it is not indicative of malignancy.

Fatty Degeneration.—This degenerative process is of fre-

quent occurrence and may reach such a degree and cause such softening and liquefaction as to produce a cyst or cysts of considerable size. Within these cysts hæmorrhage is likely to occur, in consequence of loss of support or destruction of blood vessels. This results in filling the cystic cavities with blood.

Calcification is frequently met with in chondromata. This does not change the character of the growth but increases its hardness, lessens its elasticity and causes it to assume a condition more like true bone, from which it cannot be differentiated except by microscopic examination.

ÆTIOLOGY.—The apparent factors predisposing to or causing the production of chondromata do not differ from those which we have already considered in the articles on osteoma and fibroma. Acute or chronic inflammation, continued irritation or one or more traumatisms produce disturbance of circulation and nutrition with a more or less perfect return of the tissue to its embryonal state and with this a more or less rapid proliferation of the cells implicated. With or following this there is an increase of circulation in the part, and the formation of new tissue.

An unstable condition of the tissues and a want of equilibrium predispose to and are often followed by tangent processes in various directions, such as altered function, changed circulation, production of new tissue and formation of new growths.

There is but little doubt but that special or specific infection of tissue by special or specific micro-organisms, may produce new growths, as we frequently see following syphilitic and tubercular infections with the production of the granulomata. While these may not be, and probably are not all of the principal factors leading or predisposing to the production of benign neoplasms, one can scarcely study the subject or give attention to his clinical experience, or read the cases narrated, without coming to the conclusion that they often have a very

pronounced and marked influence in the production of this class of growths.

Youth is also an important factor, as nearly all cases occur during childhood or young adult life—that is, during the growing period. In some cases heredity seems to play an important role, as chondromata have been observed in three successive generations.

DIAGNOSIS.—Barring some few exceptions, the fact that chondromata occur in well-defined localities aids the diagnosis very materially. First, they are found in connection with or in close proximity to bones or joints, growing from the epiphyseal and articular cartilages, from the synovial membranes, from the interior of bone and from the periosteum. They also originate in muscle, fascia, or tendon which has been subjected to repeated injuries or more or less constant irritation, as in the adductor of the thigh in persons who ride very much on horseback and in the deltoid in young soldiers.

In glandular tissues they are seldom found outside of the parotid and submaxillary glands and in the testicle and ovary. It is quite true that they may occur wherever fibrous or connective tissue is present, but they most frequently occur in the above-named situations. They have their development in youth and are hard, but not so hard as bone; elastic, uneven, or nodular, slowly growing, painless tumors, which are immovably connected with the tissues from which they spring.

If there is an admixture of fibrous or connective tissue, and this admixture occurs in any considerable amount, the tumor will be softer, less elastic and of more rapid growth. If a portion of the tumor is converted into bone it will be increased in hardness, lessened in elasticity and its growth less rapid.

In adenomatous admixtures the rate of growth is much more rapid while at the same time the tumor becomes much softer and even cystic. The combination with sarcomatous elements produces a more rapid growth. This condition is frequently the sequence of an injury, the growth is softer,

even in places cystic or pseudo-cystic, while other portions represent the characteristic hardness of cartilage. In these cases metastasis is likely to occur.

PROGNOSIS.—Chondromata are benign tumors not infecting adjacent tissues or ordinarily producing metastases. They will not interfere ordinarily, except perchance by pressure, with the health, comfort or well being of the patient.

TREATMENT. — Many of the small chondromata, and especially those situated upon the phalanges of the hands, may be left undisturbed, as they usually cease to grow after a short time and seldom reach any very considerable size. If, however, they are causing unsightliness or inconvenience, or are likely to cause these conditions, they should be removed. This may be accomplished by exposing the base after rendering the part bloodless and then cutting the growth away with gouge or small bone forceps.

Chondromata occurring elsewhere in the body and which have a reasonably rapid growth, or which are causing or are likely to cause disturbance by pressure or become unsightly, should be removed, providing this does not bring more deformity, discomfort or danger to the patient than would occur if the growth was allowed to remain undisturbed.

In the removal of chondromata, as in the operative technic of other neoplasms, thorough asepsis and complete removal with as little disturbance of normal tissue and as little mutilation as possible in the operative procedure, should be the rule.

Where we have reason to believe from the rapid growth, the occurrence of metastases, or other characteristics that the growth is not pure but mixed with sarcomatous elements, then and in that case the rules and principles which govern the operative treatment of malignant growths in general should be applied.

CHAPTER XI.

ODONTOMATA, OR TUMORS OF THE TEETH.

A clear conception of the histology as well as the embryology of the teeth is necessary in order to understand the formation, growth, and production of the tumors arising from these structures.

Histology.—The teeth are composed of four principal parts, which may be classified as follows: From within outwards is, first, the pulp, which supplies through its blood vessels and nerves nutrition and innervation to the tooth; second, situated outside of this, and as a result of the formative action of the pulp cells, is the dentine which encloses the pulp and makes up the principal part of the tooth, giving it form and shape; third, outside the dentine, and in a measure giving protection to this structure upon the crown, is the enamel; fourth, surrounding the root and covering the dentine is the cementum. That portion of the tooth within the alveolus is called the fang. The exposed part is known as the crown, and the connecting medium which is grasped and enclosed by the gums is known as the neck.

Dentine.—The dentine, as stated, makes up or comprises the principal part of the tooth, and excepting at the point of the fang where the blood vessels and nerves enter the pulp through the nutrient canal, it entirely encloses the pulp cavity. The dentine is harder than bone, and has nearly the density, and is often likened to ivory. It must be considered as a modified tissue made up of dense fibrous tissue which has been impregnated with lime salts. In the dentine, and running

through the ground substance as waving lines in a direction radiating from the pulp cavity to the enamel or cementum are closely set channels, the dentinal tubules. The matrix immediately surrounding the tubules is specialized, very dense, and forms the dentinal sheaths. The tubules in their course from

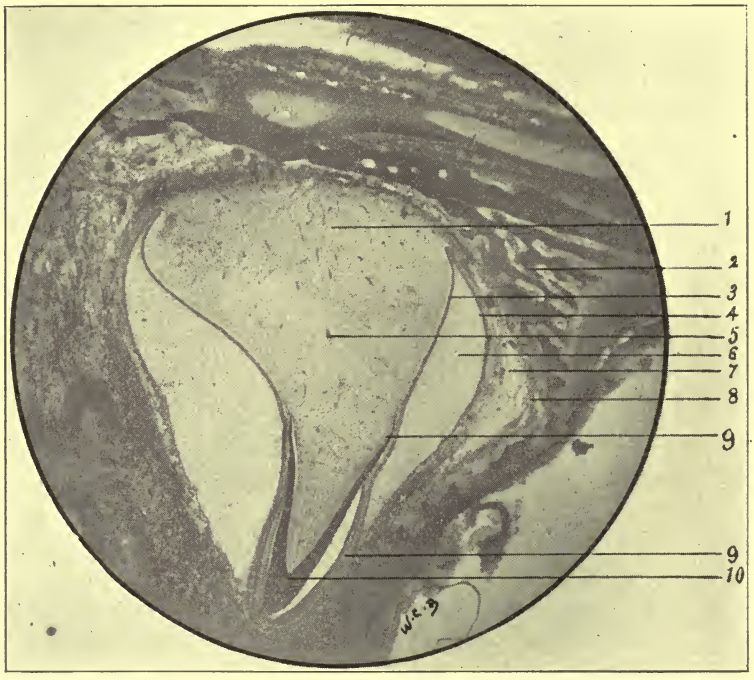


FIG. 46.

1. Dental papilla.
2. Bony trabeculæ of jaw.
3. Inner enamel cells.
4. Outer enamel cells.
5. Blood vessel.
6. Enamel pulp.
7. Inner layer of dental sac.
8. Outer layer of dental sac
9. Odontoblasts
9′ Enamel.
10. Dentine.

the pulp to their termination diminish slightly in size, and give off numerous anastomosing branches. When they reach their termination at the junction of the dentine with the enamel or cementum they terminate in tapering ends, or in

loops, which make a junction with other tubules, or in irregular clefts, the interglobular spaces. The parallel course of the tubule gives the dentine the appearance of a fine striation. These tubules contain fine fibers which are the processes given off from the connective tissue cells (the odontoblasts) lining the pulp cavity. The interglobular spaces contain protoplas-

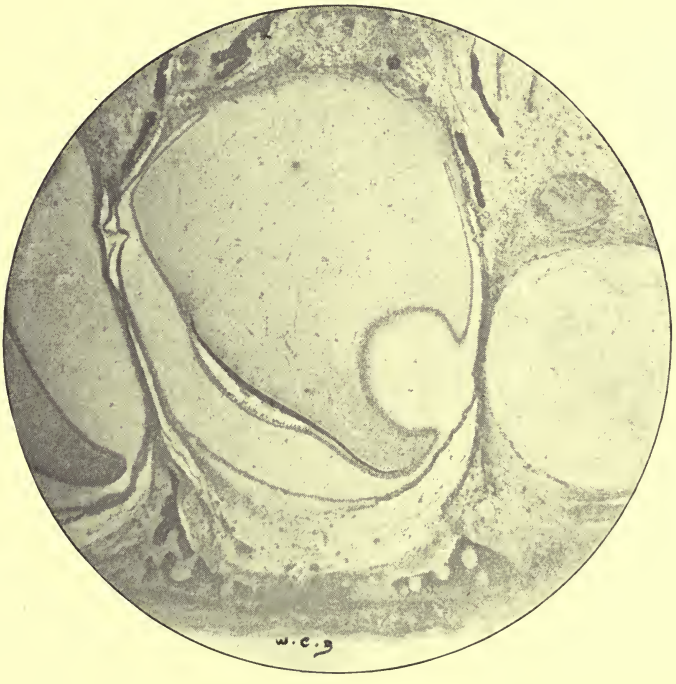


FIG. 47.
Less advanced stage of deciduous teeth.

mic connective tissue cells which are in direct communication on the one hand with the lacunæ in the cementum, and on the other with the dentinal fibers of the odontoblasts.

Enamel.—The enamel is much harder than the dentine, and encloses the latter as a protecting layer over the crown of the tooth. It is composed of hexagonal homogeneous fibers which are firmly united by a cement substance and placed

perpendicular to the surface of the dentine. (Fig. 49.) Next to the dentine there are numerous clefts between the enamel prisms which communicate with the interglobular spaces, and indirectly with the dentinal tubules. The outer surface of the

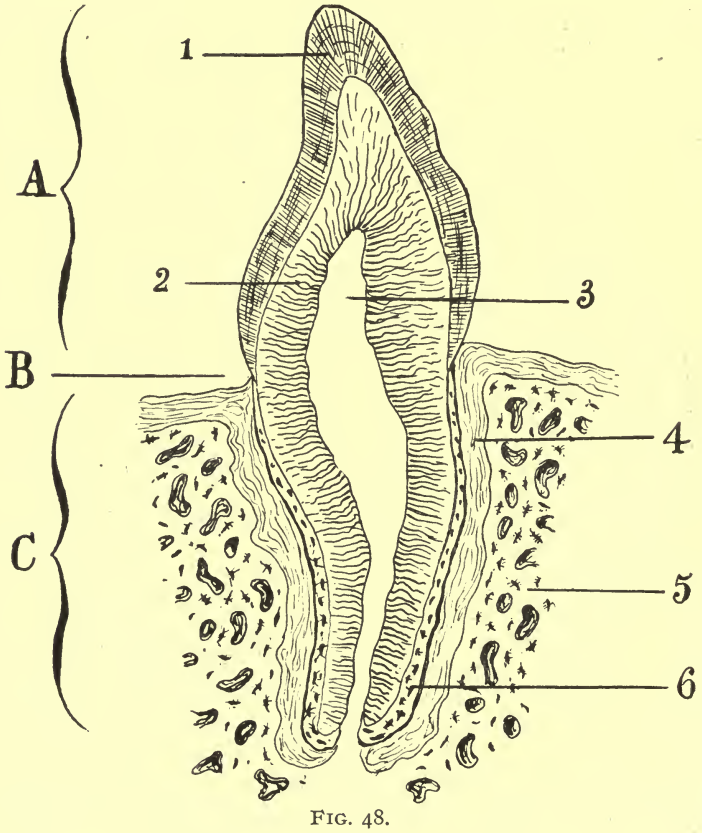


FIG. 48.

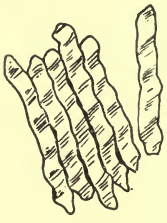
A. Crown. B. Neck. C. Fang.
1. Enamel. 2. Dentine. 3. Pulp cavity. 4. Dental periosteum.
5. Bone of jaw. 6. Cementum.

enamel is covered by a thin but resistant membrane, the enamel cuticle.

The cementum encloses the dentine throughout the fang of the tooth and is composed of tissue resembling normal bone,

having lacunæ, canaliculi, lamellæ, and occasionally Haversian canals. The bone cells lying within the lacunæ are in more or less direct communication with the odontoblasts in in the pulp cavity through the dentinal tubules.

Pulp of the Tooth.—The central cavity of the tooth is known as the pulp cavity, and contains the pulp, which is a soft, jelly-like mass having stellate and spindle cells, blood vessels, and nerves. The cells permeate the pulp and form



[Isolated enamel prisms, or rods.

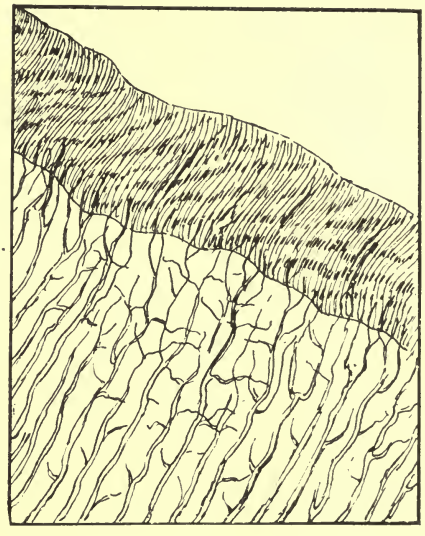


FIG. 49.
Longitudinal section of dental tubules and enamel.

upon the internal surface of the dentine a layer which is primarily made up of columnar cells, but later after the dentine has been formed assumes the form of pavement epithelium. They are the odontoblasts or their successors which were active in producing the dentine. As before stated, those cells situated upon the dentine send off long, protoplasmic processes into the dentinal tubules. The blood vessels enter the pulp cavity through the opening at the bottom of the fang and break up, after many subdivisions, into a capillary network

upon the internal surface of the dentine. The nerves enter the pulp cavity through the same aperture as the blood vessels, and after many subdivisions freely supply the odontoblastic layer of cells. Lymphatics have not thus far been demonstrated within the pulp cavity, although the connective tissue spaces of this cavity are in more or less direct communication with the adjacent lymphatic vessels. The pulp takes its origin from the connective tissue immediately beneath the invaginated epithelial cells by a process of hyperplasia. It is in direct communication with the tooth capsule or follicle. This capsule is to be seen during the first few months of fœtal life as a fibrous envelope surrounding the rudimentary tooth. The capsule is quite thick and comes to enclose the tooth from the root upwards. It is composed of two layers, the inner being loose and vascular, and the external more dense and fibrous. (See Figs. 46 and 47.)

Embryology. *Development of the Teeth.*—The teeth take their origin from two kinds of tissue. One of these is the epithelium of the mucous membrane of the mouth, and the other the connective tissue of the jaw, consequently they are of epiblastic and mesoblastic origin. This fact must not be lost sight of in the consideration of the tumors of the teeth. At about the sixth or eighth week of fœtal life, as a first process in the formation of the teeth, a slight linear thickening of the mucous membrane in the form of a half circle, immediately over the jaws and at the site of the future tooth, occurs. This growth of epithelial cells is from the under surface of the epithelial layer of the mouth, and dips down into the connective tissue, forming what is called the dental ridge. At about the tenth week the dental ridge develops upon its lower surface epithelial outgrowths or bulbs, which become invaginated or cup-shaped. At about this time the dental papillæ are produced by cells directly beneath these cup-shaped bulbs of epithelial cells by a process of hyperplasia in the connective tissue cells. This before-mentioned cup-shaped mass of epithelial cells is the future enamel organ, and as it envelops

the papilla is composed of three distinct layers of cells, an outer columnar layer in direct communication with the dental ridge and mucous membrane of the mouth, and an inner layer also of columnar cells which is the invaginated portion and

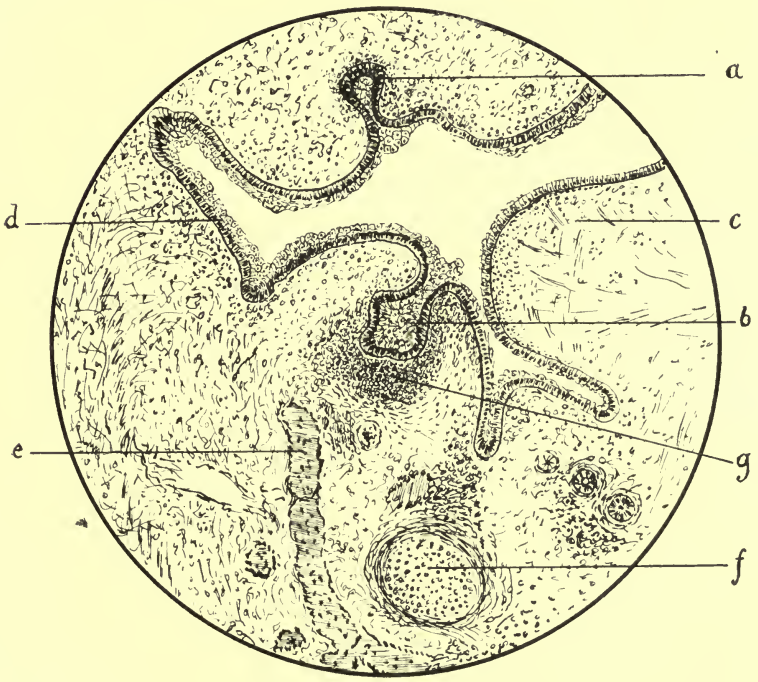


FIG. 50.

Early development of germ organ. (Four to six weeks iutra-uterine.)
a. Enamel organ, upper tooth. b. Enamel organ, lower tooth.
c. Tongue. d. Cheek.
e. Cartilage of inferior maxillary. f. Meckels cartilage.
g. Beginning dental papilla.

the direct continuation of the outer layer. Between these two layers is the more or less thick zone of stellate epithelial cells making up the enamel pulp. Later this enamel pulp becomes pressed together into a very thin, hard plate. The enamel cells of the inner or invaginated layer are alone concerned in the production of the enamel. These cells form the

enamel membrane, and the cells of this membrane produce the prisms in columns, which go to make up the future hard enamel. (Figs. 50 and 51.) Coincident with, or shortly before the formation of the enamel, the superficial cells of the papilla, the odontoblasts, elongate, and arrange themselves in a continuous row around the exterior of this tissue and produce the

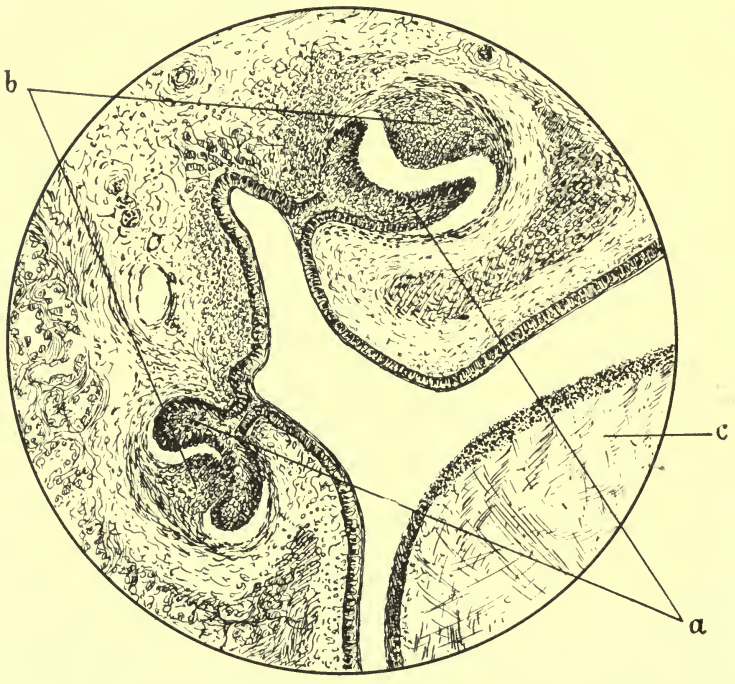


FIG. 51.

Later development of germ organ.
a. Enamel organ. b. Dental papilla. c. Tongue.

dentine. The processes of the odontoblasts extend into the dentinal tubules of the newly formed dentine as the dentinal fibers. The enamel and dentine are first laid down as soft tissues, but later, in consequence of the deposit of lime salts, they become extremely hard. The cementum covering the fang is formed after the eruption of the tooth by the ossification of

the connective tissue forming the dental sack. The permanent teeth are formed in much the same manner as are the deciduous. They take origin from the same epithelial ridge and make their appearance and are to be seen by microscopic section during the first few months of fœtal life. (Fig. 52.)

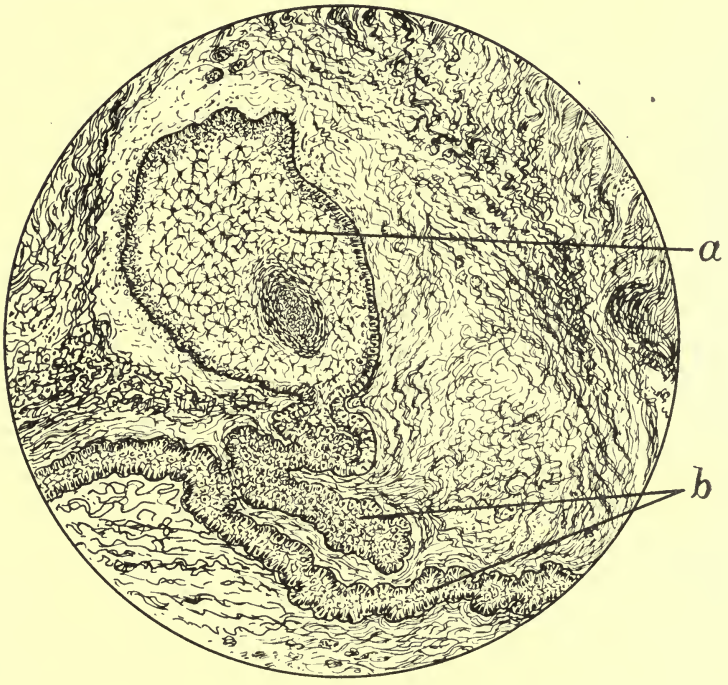


FIG. 52.

Showing enamel organ of permanent tooth.

a. Enamel organ of permanent tooth.
b. Cords of epithelial cells from mucous membrane.

Tumors of the teeth may be divided into cystic or solid, benign or malignant. Sutton has made the following classification which is followed by most recent writers.

1. Epithelial odontome: From the enamel organ.
2. Follicular odontome.
3. Fibrous odontome.
4. Cementome.
5. Compound follicular odontome.

} From the tooth follicle.

6. Radicular odontome: From the papilla.
7. Composite odontome: From the whole germ.

This classification is based upon the histological structure of the growths.

While the writer desires to retain this classification in the main and believes in grouping tumors according to their histological structure or cause, he will, nevertheless, change the epithelial species so as to include solid and cystic epithelial growths and then add a species of cysts, including simple and dentigerous cysts. This would make the classification as follows:

1. Epithelial odontome. } From the enamel organ.
2. Cystic odontome. }
3. Simple cystic odontome. } From the tooth follicle.
4. Dentigerous cysts.
5. Fibrous odontome.
6. Cementome.
7. Radicular odontome: From the papilla.
8. Composite odontome: From the whole germ.

Epithelial Odontome.—Dr. W. N. Maissin, in *Virchow's Archiv* for 1894, describes two solid benign epithelial tumors of the upper jaw of a new-born child. These were in close proximity, the one as large as a Turkish bean, the other, the smaller, the size of a cherry. These growths, covered by a normal membrane, were pale-reddish in color, painless, and very hard in consistency. They were of sufficient size so as to project the upper lip outwards preventing the child both from closing its mouth and taking nourishment. Upon the fourth day both tumors were removed by excision, and upon microscopic examination were seen to be covered by an epithelial membrane and to be made up of epithelial cells, columnar, cylindrical and flattened in character, and held here and there together by very fine fibers, the cells dipping down into the tissues in the form of columns. The microscopic examination

demonstrated the fact that they corresponded to, and took origin from, the enamel organ at about the fourth month of fœtal life. The growths were benign in character. Solid epithelial growths taking origin from the enamel epithelium, and being present at birth, represent very rare tumors. The above named writer states that up to the time of his report he had been unable to find any case reported which corresponded in details to his own.

It is quite within the range of possibility that epithelial growths malignant in character can take origin from the enamel organ, but so far as the writer's reading extends none such, which can be clearly shown as taking origin from this tissue, have been reported.

Cystic Odontomes.—As has before been stated in the histology and embryology of the teeth, a wall of epithelial cells on the under surface of the mucous membrane, and skirting the jaws in the form of a half circle, grows into the connective tissue beneath. From these solid columns individual pegs which later become bulbous, grow out to form the various teeth, both deciduous and permanent. As these various bulbs come to produce the enamel organs they are cut off from the columns of cells from which they have had their origin, by the tooth capsule growing around the rudimentary tooth and shutting it up in a distinct sac. It thus happens that the primal dental ridge or column of embryonal cells which grew into the subjacent tissues from the lower surface of the mucous membrane, and the various pegs which were projected from this wall to form the teeth, are sequestered within the tissues and have not further function or use. (Fig. 53.) Many of these cells unquestionably undergo fatty degeneration, and are absorbed, but many nests or columns remain more or less permanently within the tissue. As a result of the central absorption of these columns, or in consequence of their hyperplasia and growth into the adjacent tissue, cysts are formed. These cysts are usually multilocular in character, small, and contain a straw-colored and thickish fluid. It is a curious fact that

notwithstanding the great mass of these embryonal cells which lie dormant within the tissues having no function, there are are so few epithelial tumors to be found in these regions. It is probably true that in no other tissue or organ of the body are there such masses of useless embryonal cells, lying dor-

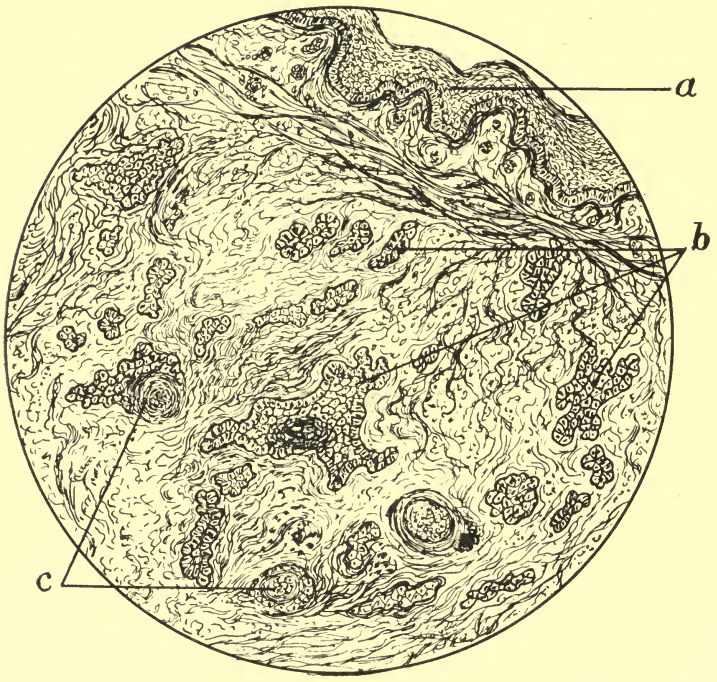


FIG. 53.
Nests of epithelial cells.
a. Mucous membrane.
b. Nests of epithelial cells arranged in placs.
c. Arranged in pearls.

mant within the tissues, as occurs in the above-mentioned situations.

Epithelial growths both benign and malignant taking origin from these epithelial nests are practically unknown. So far as the writer is aware but one solid benign epithelial growth has been thus far reported taking origin from these

cells. Cystic growths as a result of proliferation in or from these columns or nests of cells does occur but is still very rare. Kruse, in *Virchow's Archiv* for 1891, reports three cases of multilocular cysts of the lower jaw taking origin from the sequestered cells of the enamel organ. In each of these cases the tumor was situated in the lower jaw. They were composed of fibrous tissue and columnar cells, in which were many small cysts, the diameters of which were not more than one and at the most two cm. In each case the tumor was preceded by severe and prolonged irritation, inflammation or suppuration of the infected parts. The first growth was in a man twenty-nine years of age, and had been noticed since his eleventh year. It followed an abscess of the gum with a loosening and finally a falling out of the affected teeth. It was situated upon the right side of the lower jaw, and equalled in size a goose egg. The growth was very irregular and its outer and inner surfaces presented irregular bony growths in consequence of an inflammation of the adjacent periosteum. Between the points of the bony growth fluctuation was distinctly to be felt.

The second case occurred in a girl twelve years of age, and the tumor was of one year's growth. The neoplasm was preceded by, and accompanied with, very severe tooth-ache and swelling of that side of the face. Nearly the entire right half of the inferior maxillary bone was expanded by the growth of the cyst until its walls were in places as thin as tissue paper, and at many points the bone had disappeared entirely. The growth was of sufficient size to interfere very materially with the functions of the jaw, and was removed by making a section of the inferior maxillary bone.

The third case was in a women thirty years of age, the tumor having been noticed eighteen years previously. This cyst was the result of severe suppurative periostitis which followed the extraction of a tooth. It was also on the right side of the lower jaw. During the last year the growth had increased very much in size and had led to the formation of one

or more fistulæ through which considerable quantities of pus were discharged. The tumor was 13 cm. long by $7\frac{1}{2}$ cm. thick. The surface was very irregular and fluctuated on examination at some points. The bone was very much thinned and in places had entirely disappeared. Some of the cysts could only be made out by microscopic examination, while others were as large as a hen's egg. In all three cases the tumors were removed by the excision of that portion of the jaw implicated. Upon microscopic examination it was shown that the growths corresponded in character and arrangement to the epithelial cells of the enamel organ at the fourth, fifth, and sixth month of fœtal life. Kruse consequently held that these tumors represented the out-growths of the sequestered embryonal cells as found in the lower jaw from the third to the sixth month of fœtal life. It was held that the first process in the formation of alveoli was cell proliferation forming nests, which later as the result of fatty degeneration and partial absorption became converted into cysts. The cysts in two of the cases were only microscopic, while in the third at least some were of considerable size.

Simple Cystic Odontomes.—These cysts are usually in direct connection with the root of a devitalized tooth. They are usually small, often not larger than a pea or hazel-nut, although they have been found of considerable size. The history usually shows that there has been more or less disturbance of the tooth associated with pain and followed by decay at the root. The tooth may be in position or it may have been in part extracted and a portion of the fang broken off and left within the alveolus, or the crown may have been more or less destroyed by disease or traumatism and left within the tissues. Following this devitalization of the tooth or its fang a painless swelling may occur within the jaw surrounding the devitalized portion. In consequence of the tumor ordinarily not reaching any considerable proportions, the expansion of the jaw is not marked, but occasionally these cysts reach considerable dimensions, producing decided ex-

pansion of the bone, and when situated in the upper maxillary bone may be projected into, and more or less fill, the antrum, giving the appearance of a primary antral tumor. Unless infection occurs within the sac there will be but little pain except that caused by the pressure of the growth upon the adjacent bone. Not unfrequently, however, the primary process is one of infection and in that case the sac will be filled with pus. The primal cause in these cases is inflammation leading to the devitalization of a fang which as a foreign body sets up an irritation within the surrounding connective tissue leading to proliferation and the formation of a cyst wall.

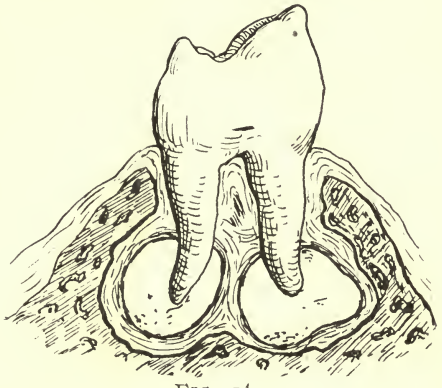


FIG. 54.

This wall may or may not be lined by endothelial cells. (Fig. 54.) The same principle prevails with many foreign substances when impacted within normal tissues. This is exemplified by the silk-knot or bullet, or other foreign substances, which when not infected produce, in consequence of their implantation and irritation, a surrounding wall of connective tissue. The tissues in the immediate vicinity of the foreign body may, in consequence of injury or inflammation, become necrotic, and being absorbed a cavity is produced around which a wall is formed producing a cyst. The same condition prevails where simple cysts are formed by effusion into the lymphatic connective tissue spaces. These spaces become di-

lated, and the connective tissue is forced to the circumference forming a wall lined with endothelial plates. Many bursæ are formed in connective tissue spaces as the result of a more or less constant pressure or irritation, and subsequently become filled with a serous fluid.

Dentigerous Cysts or Follicular Odontomes.—These are the only cysts connected with the teeth that have received any considerable attention from surgical writers. They are usually developed in connection with non-erupted teeth of the permanent set. In a case of irregular or arrested development, or where the tooth is misplaced or misdirected, or so situated that it cannot easily pierce the gum, but remains dormant, it causes more or less irritation of the tooth sac which may develop into a cyst of greater or less size. This cyst usually contains a thick, reddish fluid, and as a rule the non-erupted tooth. The tooth usually lies more or less loose at the bottom of the cyst cavity. These tumors may reach almost any size, causing a great expansion of the bone and such thinning that it often crepitates like parchment. Occasionally in the upper jaw the tumor becomes projected into the antrum.

The following case was recently under the writer's care. Mrs. B., aged thirty-five, of good family and personal history, had noticed for several years a gradually increasing swelling of the left median portion of the lower jaw. There had been a failure of eruption of the second bicuspid tooth upon that side. At the time the patient came under observation there was a pronounced thickening of the jaw. A portion of the growth the size of a hickory-nut projected through the alveolar cavity as a hard, elastic, practically painless, bluish-red tumor. Upon incising the tumor, which was resistant, there was discharged a thick, yellowish fluid. Exploring that portion of the cavity which dipped down into the alveolus and jaw an imperfectly developed tooth was found, somewhat embedded in the meshes of the cyst wall. The superficial portion of the cyst was cut away, while that portion included within the alveolus and the jaw was destroyed by curettage. (Fig. 55.)

Dentigenous cysts are usually slowly growing, painless tumors, which occur in middle or young adult life at the site of a non-erupted tooth. They rarely suppurate and have been noticed in the lower animals. While dentigerous cysts are usually connected with the permanent teeth, they may have as a cause a deciduous or supernumerary tooth. As a rule the growth expands the alveolar process, and may, as in some cases reported, become infected and lead to serious suppuration.

An interesting case reported by F. E. Glesman, of Pomerania, and quoted by Salter, is briefly as follows: A young healthy girl of about eight years had suffered attacks of violent pain in the right superior maxillary bone which spread

FIG. 55.

out to the alveolus and tooth. This pain was relieved somewhat by local applications. A year later another attack occurred, attended with swelling and constitutional disturbances. After the subsidence of the attack the cheek remained somewhat enlarged. These attacks were repeated at short intervals during the next two years. The right side of the face was now very much swollen in consequence of the projection forwards of the right superior maxillary bone. At this time a severe attack occurred attended with fever, and at the end of five days an abscess formed in the zygomatic region, which discharged a very considerable amount of pus. The molar teeth were extracted at this time, and an opening made in the canine fossa which resulted in diminishing the size of the tumor. After five years the left side was attacked in the

same manner as had been the right. These attacks continued until the patient was nineteen years of age. At this time a second operation was performed, and the left antrum opened with the result that a very considerable quantity of fœtid pus was discharged. The antrum now remained permanently enlarged and the cheeks and face very much disfigured. A third operation was made at which both antræ were opened, a portion of the external walls being removed. At this time upon exploring the left antrum with the finger, the crown of a molar tooth was discovered attached to the bone. It was extracted with difficulty. The right antrum, at about the same location, had a cuspid tooth attached to the wall. This was also removed.

A second case, published by Mr. Fearn of the Durby Infirmary, in the *British Medical Journal* of 1864 is briefly as follows: Patient was a girl thirteen years of age, and had a hard tumor occupying the horizontal ramus of the left jaw. The growth had been noticed for about half a year. The right side of the inferior maxilla was also enlarged, and the teeth were somewhat irregular. The left half of the jaw was resected, when upon examining the tumor it was found to be a cyst within the bone which had produced expansion of the walls of the maxillary bone. The cyst was lined by a vascular membrane, and at its bottom was found a cuspid tooth which was the cause of the disease. The case was also attended with infection and suppuration.

A case also of interest was published by Dr. Forgt. In this the patient was a woman thirty years of age having a tumor the size of a hen's egg on the right inferior maxillary bone. The right half was removed and upon examining the tumor it was found to be a dentigerous cyst containing the third molar. A case reported by Marshall is as follows: A farmer's wife, aged twenty-nine consulted the doctor for a tumor of the right side of the superior maxilla, situated in the region of the bicuspid and first molar teeth. The tumor occupied the alveolar region and was about the size of a pig-

eon's egg. The tumor was firm and unyielding and had had a slow, painless growth. It had only given the patient inconvenience on account of its size, and in consequence of the disfigurement of the face which it created. The tumor was punctured with a heavy exploring needle, which gave exit to a straw-colored, thick, ropy fluid. Upon exploring the sac with the finger a hard, jagged, substance was detected which was extracted with considerable difficulty, and proved to be a first deciduous molar.

A second case reported by the same author was that of a medical student who had a small tumor in the region of the maxillary tuberosity upon the right side, behind the third molar, which was only partially erupted. The gum was swollen and the jaw considerably enlarged at this point. The tissues were painful to the touch, and considerable spontaneous pain had been felt but no fluctuation could be detected. The tissues were also somewhat swollen upon that side. Upon removing the third molar, which was only partially erupted, a watery fluid mixed with pus was discharged. Down deep in the alveolus five small teeth were removed.

Fibrous Odontomes.—In the development of the teeth the connective tissue immediately surrounding them becomes condensed and undergoes differentiation into two layers. The outer layer is dense and fibrous, the inner vascular and more porous. These subsequently unite to form the tooth sac or follicle. The sac at the base of the tooth is in direct relation with the papilla. In the normal condition as the development of the tooth takes place, it presses upwards in its growth against the upper portion of the tooth sac causing its absorption as well as the over-lying mucous membrane, when the eruption of the tooth takes place. Occasionally the contained tooth does not become erupted but remains sequestered within the tooth sac, which takes on increased thickening in the form of successive laminæ of fibrous tissues, thus producing a growth in the center of which will be found a rudimentary or ill-formed tooth.

Not unfrequently in these laminæ around the tooth, or teeth, deposits of calcareous salts in the form of scales are found. These growths, which do not reach any great size, are hard, somewhat irregular or nodular, and present the characteristics and microscopic appearance of fibroid growths. Sutton believes that in many cases the thickening and over-growth of the capsule is the result of rickets; that the tendency which is so strongly present in this disease for the periosteal membrane to become more or less thickened holds good here in the production of fibrous odontomes.

A case recently under the writer's care was that of a boy aged twelve, who for the past few years had experienced more

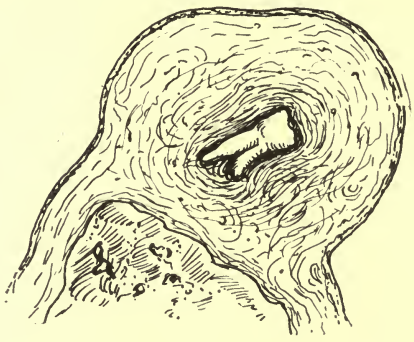


Fig. 56.

or less pain, with a feeling of soreness and tension, in the right upper jaw. He finally noticed an expansion of the alveolar process, and also that the adjacent teeth were somewhat loosened. A growth, somewhat larger than a hickory-nut, was shelled out of the parchment-like bone after the extraction of two of the molar teeth. The tumor was resistant, quite smooth, and on section showed a laminated structure impregnated with lime salts, and in the center of which was an imperfectly developed tooth. (Fig. 56.) It is stated by Sutton that these tumors are more frequent in the lower animals than in man.

Cementomes.—These growths may represent a simple thickening of the cementum covering the fang of the tooth,

converting it into a more or less irregular mass of bone. Several such cases are pictured in Virchow's work on tumors. In other cases the entire capsule may be implicated with more or less thickening and irregular deposits of lime salts. In those cases where the hypertrophy is confined to the fang the growth may be circumscribed, taking the form of an exostosis, or the growth may involve the roots of two or more adjacent teeth, and locking them together produce a tumor of considerable size. In case the entire capsule is affected and thickened in the form of laminæ it may subsequently be ossified, and the tooth then embedded in a very considerable mass of cement tissue. This class of tumors also occurs in the horse.

Compound Follicular Odontomes.—These tumors, according to Sutton, are the result of a thickening and sporadic calcification of the tooth capsule. Within these growths, clinging to the capsule, are frequently to be found numerous, small, ill-formed, rudimentary teeth known as denticles. There may be but one of these rudimentary teeth or several hundred. These denticles may be composed of cementum, of dentine, or all the three elements of the normal tooth, namely, cementum, dentine, and enamel. It is quite evident that in cases in which these denticles are composed of either dentine or cementum that they must come from calcification of eyelets of portions of either the papilla or capsule of the tooth. When enamel is present as one of the constituents then and in that case sequestration and proliferation of both the enamel cells and capsular elements must have taken place. Connective tissue comes from connective tissue, and epithelial cells from epithelial cells. These growths usually make their appearance in childhood during the period when the permanent and deciduous teeth are developing. They are found not only in man but in some of the lower animals. Sutton obtained two large follicular odontomes from a Himalayan goat. The two growths contained three hundred denticles. Logan removed such a growth from the jaw of a horse which contained four hundred small, half-formed teeth. Fellander met with a

case in a woman twenty-seven years of age. In this case the painless enlargement of the right upper jaw had been noticed since her twelfth year. The canine, bicuspid, and first molar teeth had not erupted. The growth contained nine single teeth quite perfect in formation, the crowns being covered with enamel, also six masses composed of adherent single teeth. A year later a tooth made its appearance at the site from which the previous teeth had been removed.

A case reported by Windle and Humphreys is as follows: In a boy aged ten neither the deciduous nor the permanent right lateral incisors or canine had erupted, but in their stead a tumor of considerable size made its appearance in which there were forty small, imperfectly-formed teeth. A case has been reported by Hildebrand of a child aged twelve years who suffered from a tumor of both the lower and upper jaws, from which at different times three or four hundred well-formed teeth had been removed. These teeth seemed to be reproduced during a number of years almost as fast as they were removed.

Radicular Odontomes.—This class of tumors have their origin from the papillæ of the teeth. These growths ordinarily occur after the crowns have completed their development. Very few tumors of this species have been observed up to the present time in man. In the cases thus far observed they have grown to a considerable size and are very hard and irregular. In some of the cases the growth has been attended with severe and often excruciating pain and profuse suppuration. The radicular odontome described by Windle and Humphreys was obtained from a man aged twenty-five. The growth was situated in the lower jaw on the right side near the second molar tooth. It was attended with severe pain and profuse suppuration. In the seventh month after he first noticed the growth, it became liberated in consequence of the destruction of the adjacent tissues and fell into the mouth. It measured 2 cm. in height and $2\frac{3}{4}$ in width. Radicular odontomes occur more frequently in the lower ani-

mals than in man, and are especially frequent in the rodents.

Composite Odontomes.—This name is applied to tumors which are composed of all the elements of the tooth germ, enamel, papilla, and follicle. They seem to bear little resemblance to normal teeth and often are of very considerable size. Occasionally the germs of two or more teeth consolidate to form the tumor. This particular species of odontome seems to be confined to man, as thus far no cases have been observed in the lower animals. Among the few cases reported the majority have reached a very considerable size, and have been mistaken for bony tumors or exostoses. Many of the cases have been associated with severe suppurative processes. A case reported by Heath in "*Injuries and Diseases of the Jaws*" is as follows: Miss C., aged eighteen, was brought to me with considerable swelling of the right side of the lower jaw, some of which was evidently inflammatory and partly the result of previous treatment; but there was, I thought, sufficient evidence of expansion of the jaw to warrant the opinion that a tumor was present. I therefore recommended the removal of a portion of the jaw. Suppuration was then present, and with the finger a rough surface of apparently exposed bone could be felt, but this I regarded as the result of inflammatory action excited by the injuries and irritation of the injured growth, since partial necrosis of the jaw involved by cartilaginous or malignant growths which had been irritated by exploratory measures is, in my experience, by no means common. In the following September the patient was much improved in health, and the swelling was diminished by the subsidence of the inflammation. But a considerable enlargement of the lower jaw was still present with an opening externally. From the mouth a white mass was visible, which appearing among granulations, looked like necrosis, and I agreed that an attempt should be made to remove this although I could not think it accounted for the expansion of the jaw. Under chloroform it was soon found that the white mass was not bone, but a tooth. After a good

deal of difficulty this was lifted out of its bed by means of an elevator. This mass was made up of dentinal structures and measured one-half inch anterio-posterior, one inch transversely, and one-half inch from above downwards. It weighed 315 grains. The specimen consisted of enamel, dentine, and osteo-dentine.

Another case is reported by Forgt. A man, aged twenty-five, presented himself with a hard, smooth tumor of the left side of the lower jaw from which he had suffered since five years of age. The teeth posterior to the first bicuspid were wanting. The growth, which was as large as a hen's egg, was removed by dividing the jaw in front of the first bicuspid and posteriorly through the ramus. The growth when removed was a hard, irregular mass and consisted largely of dentine which was here and there tipped with enamel. The tumor had its origin in the fusion of the last two molars.

A composite odontome which occurred on the right lower jaw of a girl aged seventeen is reported by Prof. Annandale. Nine months before this case came under observation an abscess formed and ruptured over the growth. The tumor was dislodged and weighed three hundred grains. The molar teeth at the site of the tumor had not erupted. M. Michon removed an enormous composite odontome from the antrum of a man aged nineteen which weighed 1,080 grains. A case is reported by Dr. Duka, that of a woman aged twenty-six, from whom he removed a very large composite odontome from the antrum. There had been in this case a muco-purulent discharge from the corresponding nostril for six months.

Hilton records a case, that of a man aged thirty-six, who had suffered from an osseous growth of the superior jaw for thirteen years. In this patient the growth had pressed the wall of the antrum and cheek forward and produced sloughing of both. The eye-ball became displaced and finally burst as the result of pressure. For a long time there had been a profuse suppurative process going on around the growth which was attended with the discharge of numerous small pieces of

bone. Finally the mass dropped out, leaving an enormous cavity. The growth, which was a composite odontome, weighed nearly fifteen ounces. A large number of these growths of very considerable size have been removed from the maxillary bones. In the superior maxillary they have been mistaken for exostosis, necrosis, and often for malignant growths.

Diagnosis.—Sutton in his work on tumors (1894) makes the astonishing statement that up to that time not a single odontome excepting dentigerous cysts had been correctly diagnosed before operation. It is unquestionably true that the majority have been mistaken for osteomata, necrosis, or malignant tumors. If we take into consideration that in every case of odontome, barring the cystic forms taking origin from the epithelial nests, or of simple cysts situated at the roots of devitalized teeth, there has been a failure of eruption of one or more teeth, this will aid us materially in making a correct diagnosis. While this statement may or may not be absolutely correct in that supernumerary teeth may be the cause of growths within the jaw, it will for all practical and clinical purposes hold good. Again the odontomes with few exceptions occur in childhood or young adult life. They are of slow growth, usually requiring years in order to produce any considerable expansion of the jaw. Composite odontomes are very seldom associated with infection or suppuration. These growths have been mistaken for exostoses and osteomata, but this should not occur as the latter are firmly attached at the site of their origin and are immovable. They are frequently mistaken for necrosis. Necrosis comes on suddenly, progresses rapidly to suppuration, then gradually declines until the separation of the necrosed bone. They have also been mistaken for sarcomatous growths. Myeloid sarcoma in the lower jaw is the growth most likely to be mistaken for an odontome, but in a sarcoma the teeth will already have erupted. The sarcomatous process is ushered in with toothache, the teeth taking root in the infected region becoming loosened, and when extracted the trouble does not

cease, but the jaw slowly expands, the process being slow but still more rapid than the growth of an ordinary odontome. There will be more or less discharge from the alveolar cavity from which the teeth have been drawn. The process becomes painful, and the adjacent tissues are swollen in consequence of infection.

PROGNOSIS.—Odontomes being benign growths the prognosis is good under proper treatment.

ÆTIOLOGY.—The solid wall of epithelial cells which takes origin from the under surface of the oral mucous membrane is projected into the tissue beneath. From this wall many small columns of epithelial cells are sent out. These columns correspond to the future teeth. By far the greater proportion of these cells are either subsequently absorbed after having undergone fatty degeneration or remain as dormant nests sequestered within the tissues until irritation or inflammation occurs producing proliferation. There are a few cases on record in which epithelial growths have occurred in the jaws apparently as the result of irritation or inflammation, these growths having taken origin from the above-mentioned sequestered cells. It is a curious fact that there are more superfluous embryonal epithelial cells sequestered in the jaws than in any other place in the body. Epithelial tumors taking origin from the above-mentioned cells are among the rarest tumors we meet with. Cystic and solid odontomes taking origin from these cells are very infrequent, while epitheliomata, malignant in character, having the same origin, are practically unknown. It is stated by Kruse, writing in 1891, that up to that time not more than one dozen cases had been reported of cysts of the maxillæ taking origin from the epithelium of the enamel organ. Kruse and some others hold that they take origin from the column of cells which project to form the tooth and subsequently become shut off in eyelets. Others hold that they take origin from the epithelium of the glands of the mucous membrane as matrix.

Dentigerous cysts are apparently caused by errors or

irregular development of the tooth itself. Simple cysts are the sequence of devitilization of the root or portion of the crown, which then acts as a foreign body within the tissues. Fibrous odontomes, cementomes, compound follicular odontomes, and radicular adontomes are very similar processes, as all have to do with the capsule or papilla. The tumor is caused in either case by an excessive growth in the capsule, in which, in some cases, lime salts are deposited in more or less regular order. In the composite odontome the tumor contains enamel as well as dentine and cementum, consequently the enamel organ must play a part in its production. The same is also occasionally true with the compound follicular odontome. Traumatism, and irritation or inflammation may result in growth of tissue and the formation of a tumor.

TREATMENT.—Sutton has called attention to the fact that odontomes being benign in character do not require for their removal excision of the jaw. The composite odontomes on account of their hardness and the fact that they are imbedded in the antrum or inferior maxillary require for their removal that they be uncovered and then dislodged from their cavity. The cystic growths require the destruction of the cyst wall and then the packing of the wound. The principles which are applicable to the removal of benign growths in general are applicable here. In the composite follicular odontome a number of operations may be necessary in order to remove the successive crops of denticles as they are produced.

CHAPTER XII.

ANGIOMATA OR HÆMANGIOMATA.

These tumors are caused by an abnormal formation of blood vessels, either capillaries, arteries, veins, or even blood spaces. The genus is divided into four species. 1st. Capillary Angiomata. 2d. Arterial or Venous Angiomata. 3d. Cavernous Angiomata. 4th. Plexiform Angiomata.

Capillary Angiomata, or Nævi, "Port Wine Mark", or "Mother's Mark."—This form of angioma is with very few exceptions congenital in origin and is of quite frequent occurrence. It is held by S. Pollizer and De Paul that thirty per cent. of all children when born are affected with this form of angioma. This growth usually implicates the skin or mucous membrane and is often situated upon the face or scalp. They also frequently occur upon the neck and chest, in fact there is no part of the surface of the body which is entirely exempt. They are said most frequently to be situated in the occipital region beneath the occipital protuberance. (Figs. 57 and 58.)

Histology.—In their histology the capillary angeiomata are represented by a growth of capillaries and venules within the corium. They also occasionally extend beneath the corium. into the subcutaneous tissue, producing in that case a growth of some slight prominence.

Size, Frequency and Appearance.—Capillary angiomata may be single or multiple and in size varying from those not larger than small specks or grains of red pepper, to one which covers a considerable part of the face, an entire

limb, or nearly the entire body. The border of the capillary angioma is usually but very slightly, if at all, elevated above that of the normal skin. Its surface is usually smooth and covered with normal epidermis, but occasionally this epidermis collects in slight elevations forming small excresences which fall off spontaneously, or as the result

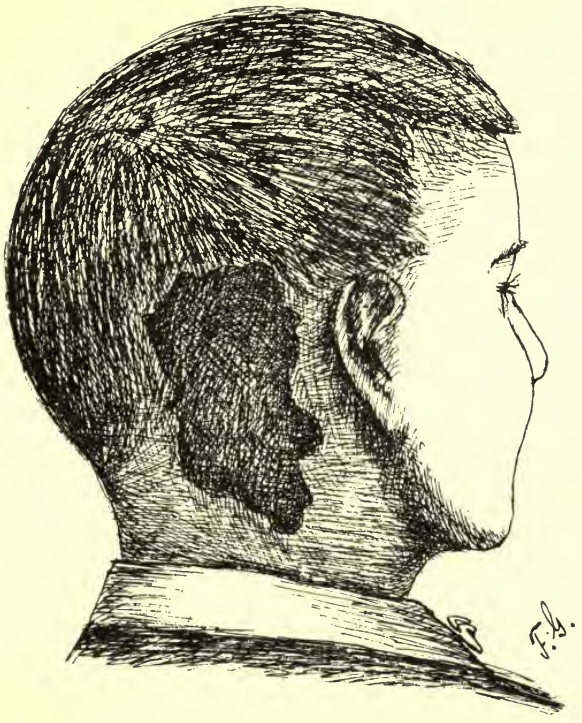


FIG. 57.
Capillary angioma.

of a traumatism, giving rise to slight hæmorrhages. The color of these angiomata varies from bright red to a port wine or venous color, the color depending very largely upon the amount of tissue overlying the vessels, as well as upon the character of blood, venous or arterial, which penetrates the nævus. The color is increased by the dependent position of the part or by any condition, mechanical or emo-

tional, which increases the amount of blood within the nævus. The border is usually well defined, the discoloration of the angioma being separated from the normal skin by an abrupt and well-defined line. Occasionally in the immediate vicinity of an angioma of considerable size there are others of lesser dimensions scattered here and there in the otherwise normal and healthy skin.

As a rule the capillary angiomata are congenital, but they show little disposition to increase or lessen in size in

FIG. 58.
Microscopical section of a capillary angioma.

after years. They are stationary blemishes within the skin. Occasionally, however, one which is of small size or unpronounced in color may disappear during the first few weeks following birth. It is also true that they occasionally increase in size, although this is extremely rare. They are benign, harmless growths, if they can be called growths, and are important only in consequence of their unsightly appearance.

Nævus Aranæus, or so-called Spider Cancer, usually makes

its appearance upon the face of young adults. Unlike the capillary angioma it is seldom congenital, and is seen with especial frequency upon the cheeks beneath the lower eyelids. It represents a very small red center with distinct capillary vessels branching from this in various directions.

Arterial and Venous Angiomata or Telangiectasis.— These tumors are either congenital, or make their appearance during the first few months following birth. It is probbly true that in most cases they are really congenital, but of such insignificant size as to escape early detection. The arterial or venous angiomata consist of a conglomeration of small arteries and veins joined together by a quantity of areolar tissue in which there is often more or less fat. The vessels are possessed of an endothelial lining, outside of which is a more or less thickened, distinctive fibrous coat. While primarily or subsequently implicating to some extent, and in many cases the skin, these growths are situated usually in the subcutaneous tissue. They make up a very considerable tumor which projects decidedly from the surface, often causing a bright-red or bluish discoloration of the skin. They are often encapsulated and present upon palpation a somewhat soft and irregular surface. They can be made to largely disappear by pressure, they do not cause pain, and are of irregular growth. (Fig. 59.) The venous angiomata frequently occur at the saphenous opening, and are made up of a number of varicose, elongated and dilated veins, which are held together by a small amount of fibrous tissue, the mass usually being distinctly encapsulated, barring the afferent and efferent vessels. The writer has in his operative work not unfrequently encountered in this situation these venous angiomata which have reached the size of a hen's egg and even larger. Upon examination they are smooth, painless, and slightly movable growths, with an irregular consistency. They should be differentiated from hernia and from enlarged lymphatic glands. They do not present an impulse upon coughing, nor tension or increase in

size upon standing, and are irreducible. They are dull upon percussion, of slow growth, do not disappear when the patient lies down, are usually associated with some disturbance of circulation in the saphenous vein, and being unassociated with pain can usually be readily differentiated from a femoral hernia. They are often larger than lymphatic glands, and have not the uniform consistency, mobility, or regularity of outline of these glands.

Venous and capillary angiomata very frequently occur in the rectum in the form of hæmorrhoids. The venous form produces the columnar pile and is made up of dilated vari-

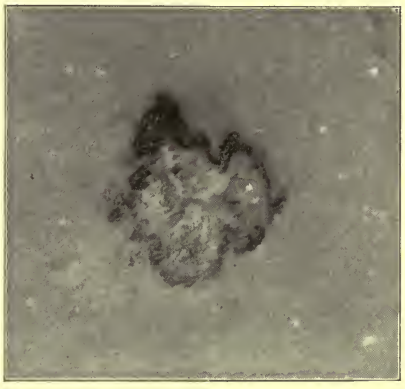


FIG. 59.

Arterior venous angioma in a child four months old, one-half natural size.

cose veins connected together and surrounded by a quantity of connective tissue. The nævus hæmorrhoid is usually situated high up in the rectum, is of small size, not larger than a ten-cent piece, has a bright vermillion color, bleeds readily, often almost persistently, and is made up of a mass or conglomeration of capillaries and veins.

The arterial angiomata may also occur upon the face, be congenital in origin, and present the appearance of a decidedly elevated, bright-red, rapidly-growing, pulsating tumor. Such a neoplasm came under the writer's observation some few years ago as a congenital growth upon the upper eyelid and

outer surface of the right eye. The tumor was very vascular, extremely red, very soft, and grew rapidly. It was made up of a mass of small arteries and veins held together by an insignificant amount of connective tissue.

Cavernous Angiomata.—This is one of the most frequent forms of angiomata which come to the surgeon's attention. They are congenital, or are usually observed only after the first few months of life. They usually come under observation as subcutaneous growths situated upon the face, neck, chest, hands and feet, although they may be found and do occur upon every portion of the body. They also, sooner or later in their growth, implicate the skin. When first discovered, a few weeks after birth, there is usually a slight elevation of the skin with perhaps here and there enlarged veins, leaving the area in radiating lines to disappear within the healthy tissues some distance from the site of the growth. Beneath the skin is to be felt a somewhat soft, irregular, perhaps ill-defined, mass, which in some instances might easily be compared to a bunch of earth-worms. In other instances they are seemingly cystic. These growths often have, and perhaps as frequently do not have, a capsule. In their growth they are usually markedly progressive, increasing in size from month to month, and often even from week to week. They are situated not only subcutaneously but are also found within the bones, the brain, in the post-bulbous tissue of the eye, and internally within the liver, kidney and spleen. They are also found in the mucous membrane of the nose and pharynx and in the mammary gland. (Fig. 60.)

Histology.—They are composed of freely-intercommunicating spaces lined with endothelial cells and bounded by thin layers of fibrous tissue. Taking origin as they sometimes do from the telangietatic form they may present dilated vessels as well as blood spaces. In the liver they occur with especial frequency in women of advanced age, and destroy more or less completely the lobules of the liver in which they grow. They are seldom situated upon the surface of the

liver. Growing in the orbit as post-bulbous tumors they project the eye forwards, causing it to become very prominent. In their growth they may interfere with or destroy sight, cause considerable pain, and produce tumors which are decidedly pulsating in character and which produce a marked bruit noticeable both to the patient and the physician. It is ex-

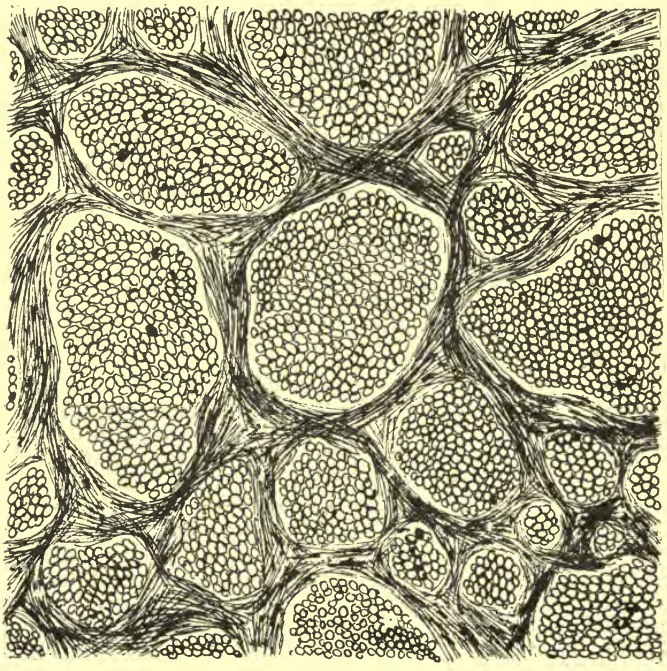


FIG. 60.
Microscopical section of a cavernous angioma.

tremely difficult and probably impossible in most cases to differentiate the post-bulbous angioma from an aneurism in the same situation.

A case of this kind was recently operated by the writer in his clinic. A young man, twenty years of age, received an accidental but severe blow directly over the supra-orbital arch of the left eye. He was stunned by the concussion, but soon

regained his equilibrium, and, aside from some pain and soreness in the region of the eye, experienced no inconvenience for some weeks. Following this there was a slow but gradually increasing prominence of the eye, some disturbance of vision, a dull pain in the post-bulbous region, and a consciousness of a whizzing sound at the back of the eye. Various remedies were given and an effort made by compression to force the eye back into its socket. The only result of this treatment was a threatened ulceration of the cornea. As time progressed the eye became more prominent and was almost projected from out the orbit. There was loss of sight and a pronounced bruit to be felt and heard. Believing that I had in this case either an angioma or an aneurism of the ophthalmic artery or of its branches, the writer exposed and tied the internal carotid artery just above its origin. Following the ligation there was a cessation of the bruit within the orbit and a gradual recession of the eye.

The patient left the hospital in two weeks, at which time there was almost complete recovery, barring the restoration of sight. It is now more than one year since the operation and the patient has remained perfectly well and without any manifestations of the previous condition. In this case it was held by the physician in charge that we had an aneurism of the ophthalmic artery as a result of the blow. It was impossible at the time of the accident or thereafter to establish the existence of a fracture, consequently we were unable to determine whether we had an aneurism, the result of a traumatism, or an angioma. A similar case, having a like cause and symptoms, has since come under the writer's observation.

Plexiform Angiomata. Cirsoid Aneurism.—(Fig. 61.) This form of angioma is of comparative unfrequent occurrence. When it occurs it usually makes its appearance during young adult life. These growths are as a rule in direct connection with arteries and veins of medium size, and are most frequently found upon the scalp, neck, hands, and the soles of the feet. When situated upon the scalp they are usu-

ally in direct communication with the temporal, occipital, or posterior auricular arteries. They grow in the form of long, irregular elevations which pulsate vigorously and give the impression upon examination as though a bundle of large arteries were placed directly beneath the skin. Anatomically

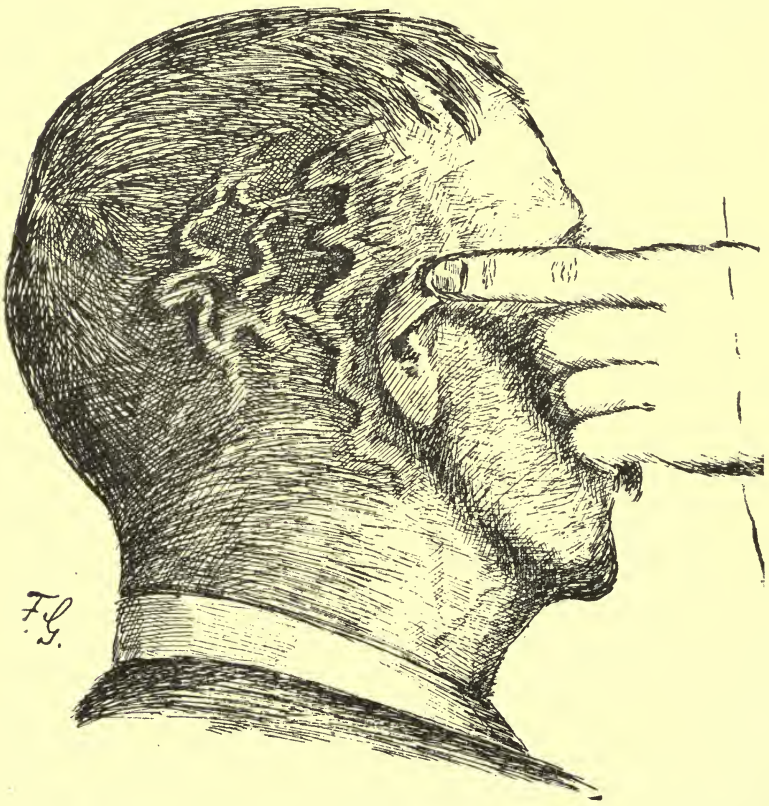


FIG. 61.
Plexiform angioma.

they consist of a number of elongated, enlarged tortuous arteries and veins of medium size as well as numerous enlarged capillaries all bound together by a quantity of connective tissue. They not only pulsate very vigorously, but they give a very decided and superficial bruit. In their course they slowly

increase in size, often producing pressure with more or less absorption of the underlying bone if situated upon the head and perhaps sufficient pressure upon the scalp so as to interfere with its circulation and cause ulceration and severe hæmorrhage. They are to be differentiated from aneurism by their location and superficial position, by the fact that a number of vessels of more or less uniform caliber can be differentiated by the different effect of pressure, by the age of the patient, and by the peculiar spongy and doughy sensation which they impart upon examination. If an ulcer or traumatism opens one of the vessels alarming, and even fatal, hæmorrhage may occur.

Various mixed forms of angiomata may occur, as the angio-fibroma, in which case there is within the growth an excessive amount of fibrous tissue; angio-lipoma, where there is a considerable amount of fat associated or intermingling with the vessels and connective tissue; angio-myxoma, where the vessels and connective tissue have associated with them a considerable amount of myxomatous tissue; and angio-sarcoma, where a considerable proportion of the growth consists of round or spindle cells making up a malignant tumor. The angio-sarcomata are not unfrequently found within the fascia of the neck and extremities.

ÆTIOLOGY.—Congenital conditions play a very considerble part in the production of an angioma. They are found frequently at the site of the branchial arches either of the face or neck as well as at other fissural openings which are permanent in character. In the neck they may be superficial or deep. Injuries and mechanical causes unquestionably play a part in the production of these tumors. Fibrous inflammatory processes may lead to the dilation of the blood-vessels and subsequently to the formation of an angioma. Virchow held that in cavernous angioma of the liver the formation of the new fibrous tissue and its subsequent contraction was the first step in the dilatation of the vessels. Others again

hold that the dilatation of the vessels is primary to the formation of fibrous tissues. The plexiform angiomata are thought frequently to be the result of an injury. Simons held that the angiomata depended upon a vaso-motor disturbance in the nervous system, by which the vessels of a certain part became permanently dilated. Unna thought that they resulted from pressure upon the fœtus by the hard parts of the mother. Pollitzer believes them to be caused by extreme degrees of flexion or extension of the limbs, producing compression upon the cutaneous vessels. Thoma holds that

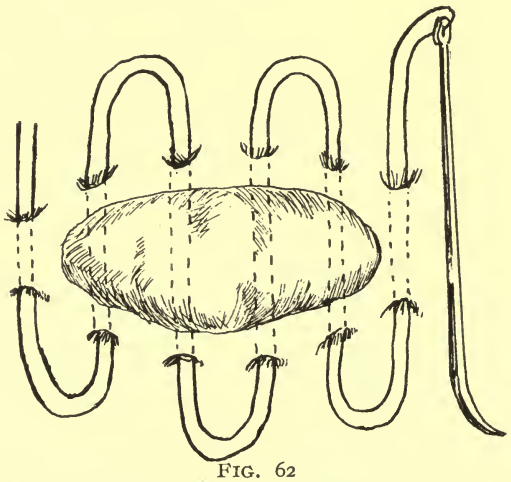


FIG. 62

Erichsen's method of multiple ligation of angiomata.

histo-mechanical causes are productive of angiomata in many cases. He maintains that when the blood pressure in the capillary vessels is above the normal new capillaries are formed, also that when the rapidity of the blood current is increased in the capillary vessels they become dilated.

DIAGNOSIS.—The angiomata are ordinarily easy of diagnosis. The nævus, or mother's mark, is diagnosed at a glance. The telangiectatic and cavernous forms although difficult and often impossible to differentiate without a microscopical section, are nevertheless easy of diagnosis in so far

as there being an angioma is concerned, provided they are accessible to examination. The situation, form, strong pulsation and superficial bruit is sufficient ordinarily to establish a diagnosis of the plexiform angioma.

Prognosis.—Angiomata may be said to be benign growths and ordinarily do not affect the health, well-being, or life of the individual. It is, however, true that in some exceptional cases, as the result of ulceration or injury, an excessive and even alarming amount of blood may be lost. In other cases, as the result of sepsis, thrombosis may occur, resulting in pyæmia and even death. Occasionally these growths as the result of thrombosis inflammation, or from some unknown

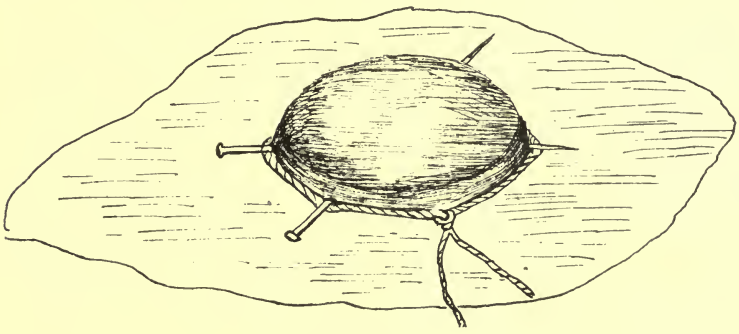


Fig. 63.

cause, undergo regressive changes becoming smaller and in time disappearing.

Treatment.—The capillary angiomata if of large size are usually beyond remedial measures. When situated upon the face they are only treated for the cosmetic effect. When small, spider-like nævi are encountered destruction of the central vessel by ignipuncture, electrolysis, or the application of the point of a tooth-pick dipped in nitric acid will usually be curative of the condition. The larger blemishes or port-wine marks, situated upon the face may often be relieved of much of their redness and unsightliness by the destruction of many of the capillaries through electrolysis or ignipuncture. Where the blemish is small the briefest application possible of the

flat surface of the blade of the Paquelin cautery will often destroy the vessels and leave nothing behind but a white and almost invisible scar. When the angioma is so situated and of such a size so that excision can be practiced without leaving an unsightly scar this may be done.

Treatment of arterial, venous and cavernous angiomata. With few exceptions excision is the best method of treatment in this class of growths. The growth is enclosed by two semi-lunar incisions which go outside of the growth through healthy tissue and down to the muscle beneath. The growth is then quickly removed. In cases where the angiomata are situated largely subcutaneously, during an excision two or three afferent arteries of considerable size coming from the deeper tissues are usually cut across and require ligatures; the wound is then closed by sutures. The efferent veins are usually visible within the substance of the

FIG. 64.

skin. These cases may often be treated successfully by electrolysis or ignipuncture.

When situated upon some portion of the face, and especially if upon the eyelids, and the growth is large and prominent, excision cannot be practiced without a subsequent plastic operation and perhaps severe deformity. In such cases multiple ligation is often the most advisable procedure to follow. It is attended with little loss of blood, and if the part be subsequently kept aseptic, but little pain and almost no suppuration results, and from the ligation there is very slight subsequent deformity. For the young operator at least this method will often be found most advisable.

In multiple ligation (Fig. 62) one-half of the double ligature may be stained black with ink for the purpose of differentiation. If the black loops upon one side are then cut

and the white upon the other a series of ends are made which should be tightly tied together. It is well as the knots are drawn tightly to puncture the constricted portion at various points for the purpose of evacuating the pent-up blood and allowing the constricted portion to collapse. Smaller angiomata may be treated by having a double thread passed beneath the base and then tied in halves. (Figs. 63 and 64.) It is necessary in order to cure an angioma by constriction that all of the growth be included, consequently the needle must be made to pass entirely beneath and not through it.

John A. Wyeth, in the *American Medical Journal* of June 27, 1903, reports a number of cases of angiomata treated successfully by the injection of boiling water into the tumor.

Lilienfeld (Beiträge zur Klinische Chirurgie, xxxviii, 2; Berliner Klinische Wochenschrift, August 17th) reports cases of angiomata successfully treated by the injection of alcohol into the normal tissues surrounding the tumor. [Append to p. 250.]

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Von Bergmann has used a curette in a number of cases of cavernous angiomata, which consist largely of soft, spongy tissue. He incises the skin and then rapidly cuts away all of the spongy tissue with a sharp curette, ligating the bleeding vessels and uniting the margins of the wound. This method is attended with much greater loss of blood than in rapid excision and cannot be recommended unless the growth is so situated that excision cannot be practiced. The treatment of the plexiform angiomata is the most difficult. They have been treated by almost every known method, including injection, ligation, multiple ligation, excision, electrolysis, and ignipuncture. The method giving the best result is primarily multiple ligation of the different vessels, and then subsequent to this the excision of the mass and the uniting of the surfaces by numerous sutures.

CHAPTER XIII.

LYMPH-ANGIOMATA.

All interfascicular clefts and meshes are lined by endothelial connective tissue cells and are in direct connection on the one hand with the lymphatic radicles and on the other with the hæmic capillaries; consequently there is a most intimate relationship between the two sets of vessels, as well as a close similarity in the neoplasms which they produce.

In comparison with the angiomata the lymph-angiomata are rare forms of tumors. They occur as the result of the formation of new lymphatic vessels and lymphatic spaces in connection with the dilatation of those already existing. They may be congenital ar acquired.

This genus is usually divided into three species, namely: 1st. Capilliary lymph-angiomata. 2nd. Cavernous lymph-angiomata. 3rd. Cystic lymph-angiomata.

The first two species correspond very closely both in their histology and anatomy with the true angiomata, the one marked difference being that the vessels or spaces contain lymph in the place of blood. In a few, however, of the lymph-angiomata the fluid contained therein is a mixture of lymph and blood.

The first species, or the *capilliary lymph-angioma*, is usually congenital in origin. (Fig. 65.) It is quite true that it may not be observed or observable at birth, but this is frequently on account of its diminutive size. If not noticeable at birth it usually makes its appearance during the first few weeks thereafter and is caused by an increase or growth of new lymphatic vessels within the tissues affected. They may

be made up of capillary lymphatics and be colorless, or they may contain a few hæmic capillaries and present a more or less pinkish appearance. When pricked pure lymph, or a mixture of lymph and blood, escapes. They occur in the skin and mucous membranes in two forms either as an aggre-

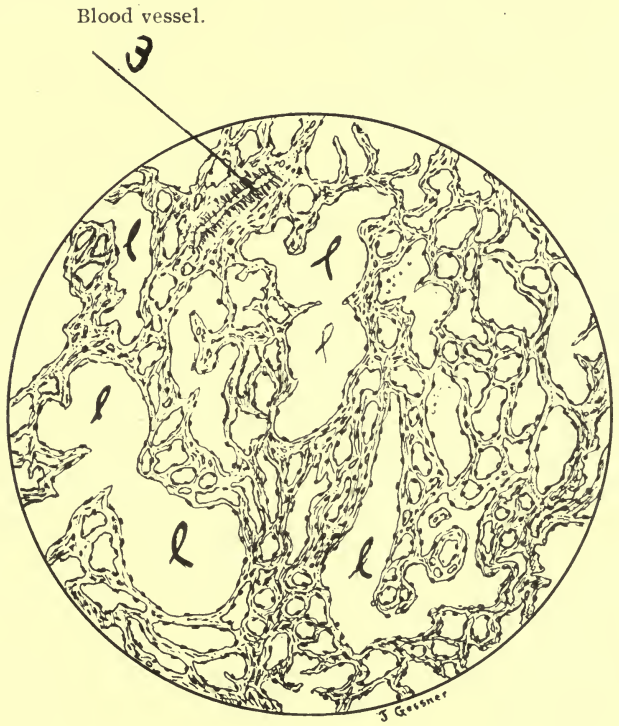

FIG. 65.

Capillary lymph-angioma from the peritoneum. (After Thoma.)
111. Lymphatic vessels.

gation of capillary vessels producing a slight elevation of the affected surface above that of the surrounding skin or mucous membrane, or as clusters of small vesicles thickly studding the tissue of the corium. While either of these forms of capillary lymph-angioma may affect any portion of the cutaneous or mucous surfaces they are most frequently situated upon the inside of the thighs, over the lower surface of the

abdomen, in the groins, or about the genitals. A flattened, slightly elevated, colorless or slightly pinkish capillary lymph-angioma situated upon the surface of the skin may be small in size, not larger than a pin's head, or two or more cm. in diameter. Congenital lymph-angiomata also occur upon the dorsum of or within the tongue. A small, circumscribed area, or perhaps one-half of the posterior aspect, or nearly the entire dorsum of the tongue may be implicated, producing a patch of small, pale-pink papules, projecting above the surface. If the entire lymphatic system of the tongue, or some portion thereof, be implicated, a very considerable hypertrophy is produced which is known as *macroglossia*. This hypertrophy is, however, confined largely to the mucous membrane. The growth is gradual, painless, or only gives a feeling of heat, tension and weight, and not unfrequently becomes so excessive as to prevent the child from retaining the tongue within the mouth. The organ is then a very large, unsightly mass whose weight may effect a deformity of the lower jaw. This form of lymph-angioma may also implicate the mucous membrane covering the inside of the cheeks and the gums. It also frequently implicates one of the lips, producing a more or less circumscribed, somewhat irregular and very decided thickening of the same, resulting in pronounced deformity of the face known as *macrocheilia*. Enlargement of certain portions of the body and especially of the cutaneous and subcutaneous tissues as the result of a blocking up of the lymphatic vessels and an arrest of the lymphatic circulation very frequently occurs. These conditions when in an aggravated form are usually known as *elephantiasis*. The condition, however, may be congenital occurring in the form of a more or less circumscribed growth in which there is not only an arrest of lymphatic circulation and an increase of the number of lymphatic vessels, but also a decided increase of the connective tissue of the part. As seen in the lower extremities, the part implicated becomes gradually enlarged due to the thickening and œdema of the skin and subcutaneous tissue

until often of enormous size. The same condition occurs in the scrotum, in which case, owing to the blocking up of the lymphatic vessels there occurs such œdema and proliferation of connective tissue as to produce a tumor of great size, reaching, it may be, as far as the knees or even farther, and weighing twenty or thirty pounds. In these cases the obstruction of the lymphatic channels may be and usually is the result of the entrance into them of the parasite *filaria sanguinis hominis*, its embryo or ova. An arrest of the lymphatic circulation may also be due to the pressure of the plastic exudate following a localized inflammation or to thrombosis of the lymphatic vessels, or to growths within the same, or be congenital. Probably the most frequent cause met with is that of infection either of the tissue immediately implicated or those more or less remotely situated.

Cavernous lymph-angioma.—This form (Fig. 66 and 67) of tumor corresponds in its general structure to the cavernous angioma and may easily be mistaken for the latter growth. In its construction it is made up of dilated lymphatic vessels and connective tissue spaces which communicate more or less intimately the one with the other. The spaces are lined by a single layer of endothelial cells, and between the spaces there is a greater or less quantity of connective tissue. There may also be some adenoid tissue, fat or myxomatous tissue. The growth is made up largely of caverns and contains either a clear lymph or lymph more or less intermixed with blood. The tumors are large, lobulated, soft, and fluctuating and may be easily mistaken, in consequence of their soft, lobulated character, for fatty tumors. They may be found subcutaneously and are especially frequent in the neck and axillæ, where they occasionally form tumors of very considerable size. The walls of the cavernous lymph-angiomata are more delicate, more easily torn, and more transparent than those of the angiomata.

Cystic lymph-angioma.—These tumors are made up of cysts of greater or less size and occur most frequently in

thelateral regions of the neck and about the sacrum. They are occasionally large, tense, round, deeply-seated and distinctly fluctuating cysts containing a clear fluid or one mixed with blood. They may be mistaken for branchial cysts or cysts occurring from the breaking down of angiomata, or for congenital cysts of the neck, or for dermoids. While these cystic lymph-angiomata most frequently occur in the

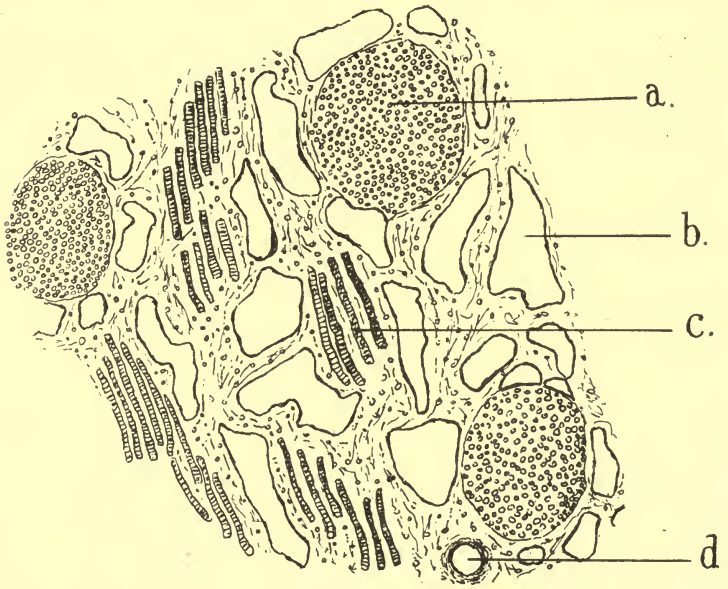

FIG. 66.
Lymph-angioma of the tongue. (After D. J. Hamilton.)
a. Lymph-adenoid deposits. b. Lymphatic spaces. c. Muscle.
d. Artery.

neck they may be situated in other portions of the body, as in the groin or in the subcutaneous tissue. They have also been found between the folds of the mesentery and in the kidney.

The writer not long since removed a cystic lymph-angioma as large as a croquet ball from the popliteal space of a young man. The cyst had apparently been the result of an injury to the popliteal space, the traumatism being followed by inflammation and a good deal of disturbance of both the

hæmic and lymphatic circulation. The cyst had a distinct fibrous wall, was situated beneath the popliteal vessels, contained a straw-colored fluid, and was lined with endothelial cells. It was completely enucleated without any very considerable difficulty.

The cystic lymph-angiomata occasionally occur in the groins as small distinct clusters of cysts making up an irregular mass of some considerable size.

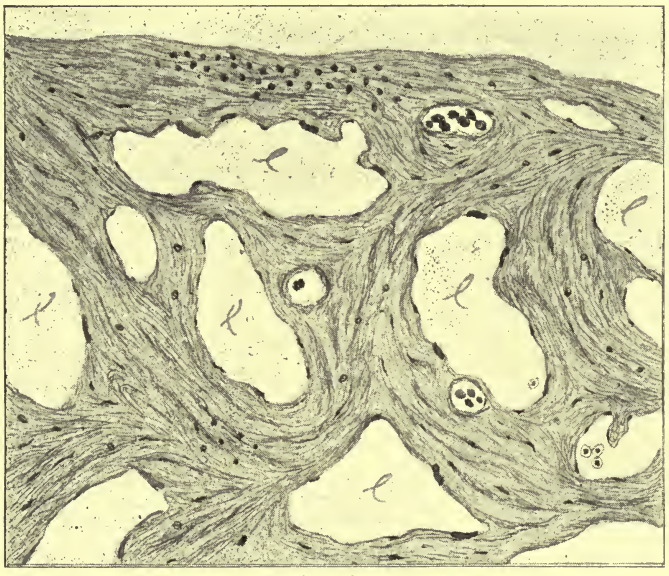

FIG. 67.

A cavernous lymph angioma of the forearm. l. Lymphatic spaces.

ÆTIOLOGY.—A very considerable majority of the lymph-angiomata are of congenital origin and result from some error of development. The close and intimate relationship between the capillary lymphatics and the capillary blood vessels, and the similarity in histology between angiomata and lymph-angiomata leads one to believe that the causation of the two forms of growth are very similar. Many lymph-angiomata are not congenital, making their appearance some weeks, months, or it may be years after birth. In many instances,

whether of congenital or of post-natal origin, the prime factors in their production are some conditions which obstruct or increase the tension in the lymphatic circulation or irritate the lymphatic vessels. These may be inflammatory exudates, intra-capillary growths or thrombi, micro-organisms, parasites, their embryo or ova, blocking, obstructing, or irritating the lymphatic vessels. The majority of cases of lymph-angioma and elephantiasis are due to congenital defects or to infection. Throughout the area of the obstructed lymphatic circulation there is a dilatation of the lymphatic vessels, an œdema and distension of the connective tissue spaces and a growth or hyperplasia of the connective tissue within the area drained by the obstructed circulation, leading to a thickening of both skin and subcutaneous tissue and the formation of a tumor-like growth. Unquestionably the same process does produce true tumors.

Symptoms.—The symptoms of lymph-angioma are such as may be produced by the pressure of the growth upon the adjacent sensitive structures or such as may result from an interference with the lymphatic circulation and the increased tension in the lymphatic vessels. There may be lymphatic œdema, tension, heat, and even a throbbing pain.

Diagnosis.—Capillary lymph-angiomata when occurring on the internal surface of the thigh, over the lower abdomen, or about the genitals and situated within the corium make their appearance either as an aggregation of capillaries producing a thickening and elevation of the skin, or as a cluster of distinct and separate vesicles. Either of these if punctured give off a clear fluid or one mixed more or less with blood. They frequently occur as distinct, elevated papillæ upon the dorsum of the tongue. The most frequent condition is that of increased number and size of the lymphatic vessels situated within the mucous membrane or within the corium, producing a very considerable enlargement of the part implicated, and making up a tumor which is often difficult to differentiate from an angioma, except that it gives off a clear

fluid, or one slightly tinged with blood, upon being punctured. In macroglossia the diagnosis depends upon the chronic course, progressive enlargement and freedom from fever and usually from pain. In macrocheilia there is chronic, progressive and somewhat irregular thickening of the lip, most frequently situated in the upper lip, which upon puncturing gives off a clear fluid. The large cavernous lymph-angiomata in consequence of their large, lobulated size and cystic condition may require the use of the hypodermic needle to differentiate them from fatty tumors and from cysts. Cystic angiomata of large size, situated within the neck, coming from the dilatation of lymphatic vessels or spaces will be difficult of differentiation from other cystic tumors, especially those taking origin at the site of the branchial clefts, as well as those which are dermoid in character or congenital in origin. One will be aided in differentiating cystic lymph-angiomata from dermoids by the use of the hypodermic needle, but if they are situated in the anterior line of the neck or laterally over the branchial clefts probably nothing short of operative measures will suffice for differentiation. This, however, is in a measure quite immaterial as the treatment of the two forms of cysts is quite similar.

TREATMENT.—The treatment of the capillary and cavernous lymph-angiomata where they are causing disturbance of function or an unsightly appearance, or where they are progressive in growth, should be that of excision, where this can be practiced. The affected portions are included in eliptical incisions and the cut surfaces re-adjusted by means of sutures. This treatment is especially applicable to lymph-angiomata affecting the lips, skin, and tongue. A very considerable portion of the lip may be removed by excision, as is done in the removal of an epithelioma, and the cut surfaces re-united without any special deformity of the part. In case of macroglossia A-shaped incisions may be made, removing the entire affected mass, when the wound is reunited making an almost normal and presentable tongue. Where excision

is not practicable in the lymph-angiomata, or thought unadvisable, electrolysis or ignipuncture may be practiced. This method of treatment is not, however, as serviceable or successful in cases of lymph-angiomata as it is in pure angiomata, largely for the reason that these punctures do not coagulate the lymph to the same extent as they do the blood. They, however, cause a shrinking of the connective tissue of the part, and thus, and to that extent, lessen the size of the growth. In cystic lymph-angiomata enucleation should be practiced where this is feasible. In a considerable number of these cases, and especially those situated within the deep structures of the neck and beneath the deep cervical fascia and which insinuate themselves not only between the muscles, but often between the large and important blood vessels and into the anterior mediastinum, complete enucleation is anatomically and surgically an impossibility. In such cases the cyst or cysts should be incised, packed with iodoform gauze and drained, care being taken to remember that lymphatic cysts as well as cavernous spaces are in direct relation with open lymphatic spaces or vessels, and therefore to preserve the cyst wall and wound in an aseptic condition.

CHAPTER XIV.

MYXOMATA.

A myxoma is a tumor composed of connective tissue cells between which there is a homogeneous or slightly granular, gelatinous substance. The myxomata correspond very closely in their structure with the Whartonian jelly of the umbilical cord and to the vitreous humor of the eye, the vitreous humor of the eye being the only substance in the adult human body which at all corresponds to myxomatous tissue. If the cellular elements of a myxoma are very sparce the tumor will be almost translucent, extremely soft and seemingly cystic in character, while on the contrary if the cellular elements are numerous the tumor will have a whitish or milky appearance, be much harder in consistency, and transmit but little light. The cells may be stellate, spindle-form, or round, or a mixture of these forms may occur in the same tumor. It is at least the writer's microscopical observation that the uniform, regular, and beautiful stellate cells of the umbilical cord, with the large amount of amorphous intercellular substance which appears in so many schematic drawings, does not occur with the same precision and regularity in myxomatous tumors There is more likely to be a conglomeration of cells in which all kinds are more or less freely represented with a varying amount of intercellular substance. (Figs. 68 and 69.) The myxoma ordinarily has about the consistency of thin jelly. Its substance is tremulous and in appearance it resembles the pulp of a grape. It refracts light freely, thus giving the surface a glistening appearance. Mucoid tissue is differentiated from subcutaneous tissue by its soft, gelatinous consistency

and by the great amount of intercellular, homogeneous gelatinous substance holding mucin which it contains. This mucin may sometimes be demonstrated by adding dilute acetic acid which causes a white precipitation. Mucoid tissue occurs in the adult human body only in the vitreous humor of the eye, consequently myxomatous tumors show a departure from the normal type of tissue in which they spring and are

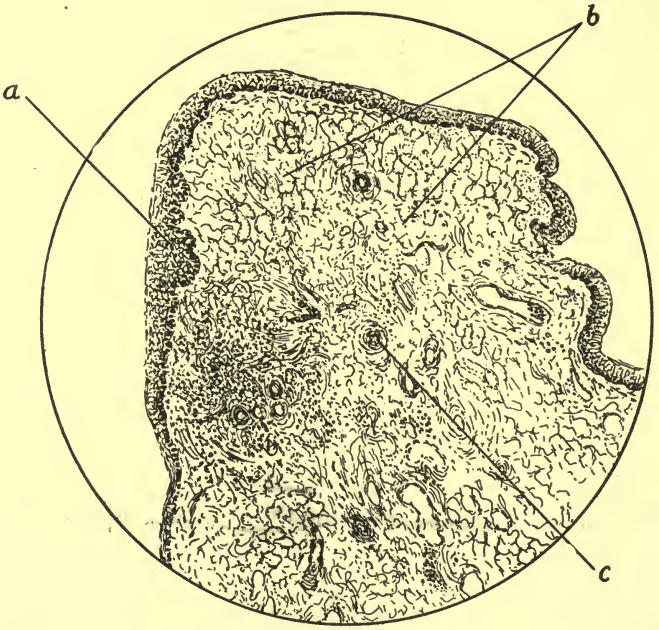

FIG. 68.

Nasal polypus (mucous) under a low power.
a. Epithelium. b. Stroma. c. Blood vessel.

consequently heterologous to a certain extent, seemingly with a malignant tendency toward the formation of myxosarcomata. The well-known fact that the different forms of connective tissue can pass into each other by a process of metaplasia should be taken into account in considering the myxomatous growths. The external surface of a myxoma, when taking origin from a mucous membrane, is covered either by the epithelium of that membrane alone or by the

mucous membrane entire and, it may be, the submucous tissue. Myxomatous tumors taking their origin from the mucous membrane often contain some and even much glandular structure. (Fig. 70.) Where the tumor takes origin from the connective tissue spaces it usually has a thin, delicate, fibrous covering. When subcutaneous or situated within

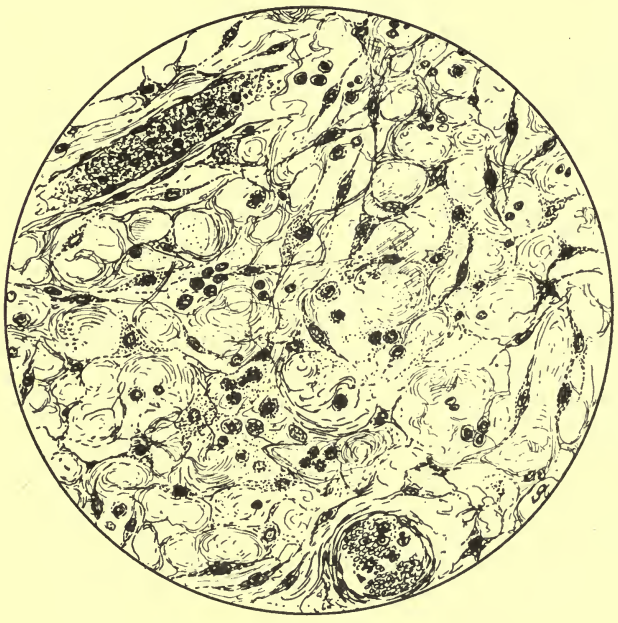

FIG. 69.
Myxomatous tissue under a high power.

the corium it may have a normal skin covering or only a coating of epidermis.

Situation and Frequency.—Myxomatous tumors occur most frequently within the nose and especially from the Schneiderian membrane covering the middle meatus, and from the middle turbinated bone. Not unfrequently they also occur within the various cavities connected with, or adjacent to, the nose, especially the antrum of Highmore and the frontal sinus. They occur in the larynx, but much less frequently than in the nose. They are found in the middle

ear and in the external auditory meatus. They occur in the subcutaneous tissue and in the skin, in the mammary glands, salivary glands and testicles. They have been found subcutaneously at the angle of the jaw, in the lower lip, in the orbit, in the lungs, in, or upon the periosteum, where they have a thick, fibrous envelope and growing from the mar-

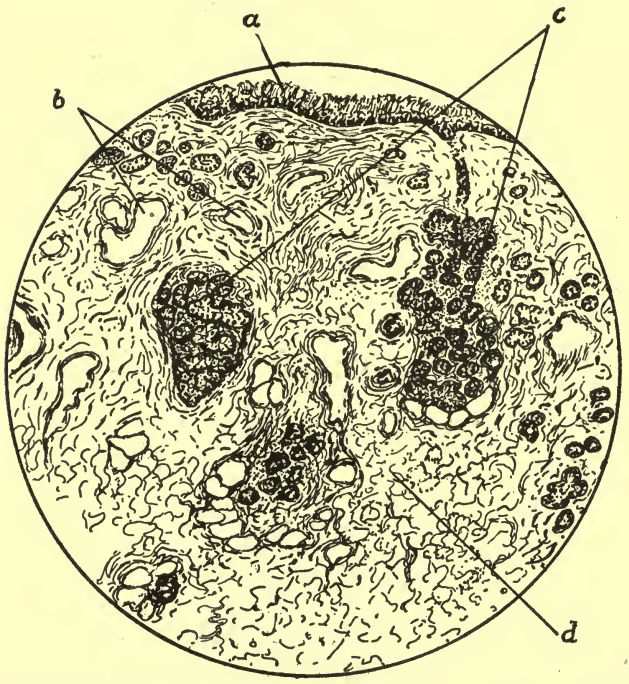

FIG. 70.

a. Epithelial layer. b. Blood vessels. c. Mucous glands. d. Myxomatous tissue.

row of the bone. They take origin from the dura mater of the brain and spinal cord, and with comparative frequency from the nerve sheaths of the peripheral nerves. They also occur from the mucous membrane of the uterus and even within the uterus itself. They occasionally occur in the rectum and bladder. It may be said, however, that outside of

the mucous membrane of the nose myxomatous tumors are of very rare occurrence.

They usually make their appearance in adult life, seldom being seen in childhood and rarely as a primary condition in old age. A few cases, however, have been reported of myxomatous tumors of the nose occurring congenitally, and others where they have been seen in childhood and in infancy. Dr. Dunbar Roy and Dr. Brown have both reported congenital cases of myxomatous tumors. While myxomatous tumors are usually well encapsulated they may be more or less diffused through the tissue without being confined by a distinct envelope.

Appearance and size.—Myxomata occurring as nasal polypi may be as small as a bird-shot or of such size as to completely fill the naso-pharynx. Johnson, of Baltimore, reported a large myxomatous tumor in the naso-pharynx which measured two inches in length and three-quarters of an inch in thickness. Myxomata being enclosed within a capsule usually have a distinct form and are most frequently pear-shaped. They are composed of soft, trembling-like masses of gelatinous substance which is more or less translucent and of a pearly or slightly milky appearance. They refract light, may be readily indented with a probe, and are freely movable, painless growths. While nasal polypi occur singly, they are more frequently found as multiple growths. Occurring within the larynx, they are usually small, single, more or less pedunculated painless growths, which alter more or less the tone of the voice, and may interfere with respiration. Growing from the uterine mucous membrane, pure myxomata are certainly rare, the most frequent form of polypus occurring here being a myoma, but myxomatous growths having the characteristics of the nasal polypus are occasionally taken from out the cervical canal. Myxomata of considerable size have been removed from the body of the uterus. Occurring upon the surface of the skin, and especially from the breasts, scrotum, labia and perineum,

myxomatous tumors are occasionally seen taking the form of distinct polypi, with long, delicate, slender pedicles. Occurring in the substance of the breast, in the testicle and salivary glands they are usually circumscribed, encapsulated, painless, more or less lobulated, soft, semi-fluctuating, slowly-growing tumors, which are extremely rare in their occurrence. Occurring upon or taking origin from the connective tissue of nerve sheaths, myxomata have not unfrequently been observed and described as growths of very considerable size, being oblong, more or less irregular, soft, and often lobulated. In consequence of their pressure upon the nerves, they may produce more or less pain. The myxoma of the breast is said to be, and undoubtedly is, the rarest form of connective tissue tumor affecting this gland. Of seven examples collected by Gross one was hyaline, one was hyaline and hæmorrhagic, two were lipomatous, two contained a considerable quantity of fat and an increased number of blood vessels, making a myxo-angio-lipoma. In the bladder a myxoma is said to be found only in childhood, and to resemble a nasal polypus in character. Situated subcutaneously or within an organ, they are sometimes cystic or soft in character, and at other times fibroid.

Mixed forms.—It is a fact well established by microscopic examination of myxomatous tumors that they are very frequently not pure and do not correspond in microscopic detail with myxomatous tissue so often figured and idealized in works upon histology and pathology. The star-shaped connective tissue cells mature, or, as they are often called, immature or embryonal, with a structureless intercellular substance, do not frequently occur in pure form in tumors which the writer has examined. Very often there is an admixture of stellate, spindle and round cells, with a small amount of intercellular substance. The cells may be so numerous as to greatly predominate the intercellular substance. In other cases there is a very considerable amount of fibrous tissue, making a tumor which is harder in consistency than the pure myxoma,

a myxo-fibroma. (Fig. 71.) In some cases, a considerable quantity of fat may be present either within the cells or in the intercellular substance, making a myxo-lipoma. In other cases there is a very considerable increase in the number and size of the blood vessels, which ordinarily are very small and sparse, producing a red, pulsating, vascular growth, a myxo-angioma. Again, the tumor may contain more or less of cartilage or bone, presenting irregular, hardened areas, a myxo-osteo-chondroma. A condition which is most unfortunate, but nevertheless so frequent that it seems almost a distinct tend-

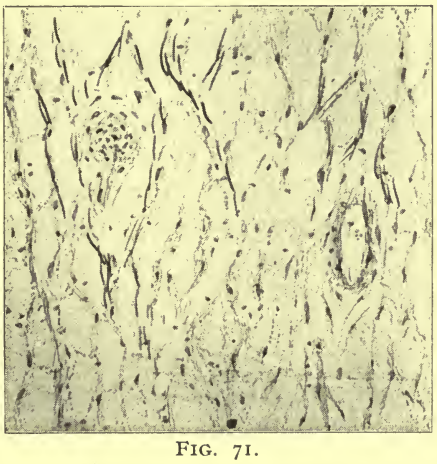

FIG. 71.
Nasal polypus. A myxo-fibroma

ency in myxomatous tumors, is their association with round or spindle cells in such numbers and with such an arrangement as to constitute malignancy and make up a myxo-sarcoma. These tumors grow rapidly, produce such pressure upon adjacent parts or organs as will result in destruction of tissue, recur frequently if removed, produce metastatic deposits, and are malignant growths. There is unquestionably something in the myxoma which, as the result of irritation, injury, infection, inflammation, or from some unknown cause, shows a decided predisposition toward malignancy. To such an

extent is this true that some hold all myxomatous tumors to be mildly malignant. A myxoma which takes on a sudden, unexpected and rapid growth should be placed under suspicion as being probably in part sarcomatous in character. Myxomatous degeneration, which occurs occasionally in benign and malignant growths, must be differentiated from myxomatous growths. Degenerative changes also occur in myxomatous tumors by which they become converted into cysts, or they may undergo fatty degeneration, becoming more or less fluid in character. Secondary changes may also occur in myxomata, such as ulceration, the formation of blood cysts and inflammation.

Ætiology.—The causes of myoxmatous tumors are probably much the same as those of the other connective tissue group of neoplasms, such as the fibroma, lipoma and osteoma. It is well established that they seldom occur upon a perfectly healthy mucous membrane. Probably in the great majority of cases there has been, or is, a chronic inflammatory condition of the mucous membrane with more or less hyperplasia or degeneration of structure from which the tumor or tumors take their origin. Boerhaave, in 1818, put forth the theory that they originated from irritation or retention of secretion in the nasal fossæ. Wookes holds that they are the result of a chronic catarrhal process, with caries of small areas in the middle turbinated bone. Upon a spicula of bone, as the result of chronic inflammation, a proliferation of connective tissue occurs, and later the formation of a polypus. Bosworth, Casselberry, Grunwald and others believe that they take their origin from a previous ethmoiditis. John Wright thinks an œdematous rhinitis is of great importance as a causative factor. Many writers hold that the primary process is one of chronic inflammation, that this is succeeded by hypertrophy of the mucous membrane, and following this a budding process which results in the formation of polypi. Zuckerhandl's investigation on the cadaver show that two-thirds of all nasal polypi originate from the middle nasal

fossæ beneath the middle turbinated bone. He thinks that the muco-purulent secretion present by decomposition in the middle fossa excites irritation and furnishes a favorable soil for their production. Hopmann thinks that the causative condition is some interference with the venous escape, which leads to an œdematous condition. Vaso-motor paresis, by favoring œdematous transfusion, may bring about the same result. Casselberry believes in a myxomatous diathesis. There can be but little doubt but that chronic inflammation, irritation, injury, retained secretions and micro-organisms or their ptomains within the nasal fossæ, or the nasal mucous membrane, plays an important part in the causation of this class of tumors. When occurring elsewhere in the body, as upon the nerves, within the glands, or within or beneath the skin, the causative conditions are much the same as prevails within the other connective tissue tumors. They may, however, seemingly occur upon mucous membranes otherwise healthy. They occur upon the periosteum as rounded growths surrounded by a dense layer of connective tissue. Occurring with the bone they may destroy this by pressure, producing liquefaction and finally cystic formation. Brolby holds that myxomata are in reality soft fibromata.

Symptoms.—Myxomata occurring in the nasal cavities primarily cause irritation with an increase of the normal secretion. Perhaps one of the most pronounced symptoms is frequent sneezing, or violent attacks of sneezing attended by a profuse watery discharge. There is often a pronounced and disagreeable burning and itching within the nose, caused by the increased amount of fluid oozing through the mucous membrane. With the increase of the size of the growths there is a more or less stenosis of one side, or it may be of both sides, providing the growths are situated in both nasal passages. The stenosis is due to the growths obstructing the nasal cavities, and in part to the swelling of the mucous membrane and to œdema. Not unfrequently, as the result of infection, a muco-purulent discharge occurs, which may be

offensive in character and lead to infection of the adjacent cavities, attended with more or less heat, inflammation, fever and pain. Asthma and hay fever are also frequent accompaniments of nasal polypi. There are also not unfrequently ocular symptoms which may be the result of pressure or infection, or be reflex in character. Aural symptoms, the result of chronic catarrh of the middle ear, or the result of obstruction of the Eustachian tube, also occur. In case of pronounced nasal stenosis, laryngitis or bronchitis may occur as secondary conditions. The tone of the voice is also altered, the patient acquiring a more or less nasal tone, or "dead voice," in consequence of the obstruction in the nasal fossæ.

Diagnosis.—The above-mentioned train of symptoms should lead one to examine the nasal fossæ, when a correct diagnosis can be made. Inspection of the nasal fossæ should be done by means of sunlight or a light equally as good. The light is thrown from a head-mirror through a speculum and made to illuminate the nasal fossæ. A polypus may then be seen, if present, as a smooth, pear-shaped, moist, glistening, pearly, slightly-translucent, freely-movable growth which is readily indented with a probe, is painless, and which often changes its position on inspiration and expiration. Their pearly color, shiny appearance, softness, movability, translucency and freedom from pain are sufficient, ordinarily, to differentiate them from fibromata or other benign growths or from malignant growths. The myxomata within the nasal cavities are very rarely attended with hæmorrhage, which condition occurs so frequently with the malignant growths and in some of the angiomata and fibromata. A myxoma growing from the roof of the nasal cavity must be differentiated from a meningocele. The latter has not the pearly appearance, motion, translucency or moisture of a polypus; in addition its tension is increased by straining and crying or coughing, or by any act which increases the pressure within the cranial cavity as well as by the dependent position of the head. Myxomata growing within the larynx are likely to produce irritation with

cough and an increase of secretion with more or less of hoarseness. Occurring within the aural cavity, usually in the middle ear, as the result of a chronic catarrh, they often project through a rent in the drum-head as soft, glistening, moist, painless, small, freely movable growths. Occurring upon the surface of the body, especially from the mammary and genital regions, they are pedunculated neoplasms of slow growth, which appear as soft, painless, more or less lobulated tumors, usually of small size, with a covering of epidermis or even the true skin. They also may project from the surface of the body, or from an organ, as large or small hemispherical elevations. Occurring in the muscular areas or subcutaneously, or as parenchymatous growths, they are soft, lobulated, encapsulated, slowly growing, painless tumors which are extremely rare and which cannot be readily differentiated from the other connective tissue tumors before excision, or at least before incision.

Prognosis.—Myxomatous tumors are benign growths which under ordinary conditions will not produce metastatic deposits or recur after complete removal, or affect, except mechanically, the health, comfort or well-being of the individual. It is quite true that they may, in consequence of their affecting a stenosis of one or both nasal fossæ, cause mouth-breathing, with laryngitis or bronchitis as a sequence; or in consequence of infection cause septic inflammation within the cavities adjacent to the nose, or perhaps seriously interfere with vision or with hearing. These conditions are the result of mechanical pressure. It is seemingly true, however, as has been already stated, that there is in myxomatous tumors a certain tendency toward malignant degeneration or infection, whereby a benign tumor, as the result, apparently, of continued irritation or severe traumatism, or the result, perhaps, of unskilled efforts at removal, or where complete eradication has not been effected, takes on malignant characteristics. What seems to the surgeon operating in the nasal fossæ to be nothing more than a benign myxoma may, as the

result of an incomplete or bungling operation, become a myxo-sarcoma. It seems also that the myxomata which show a decided tendency towards malignancy are largely confined to the nasal fossæ.

TREATMENT. Before any operative measures are undertaken looking to the removal of neoplasms within the nose the nasal cavities should be rendered as nearly aseptic as possible by the use of the antiseptic sprays or douches. Myxomatous tumors when causing pressure, irritation, or functional disturbance should be removed. If encapsulated and situated subcutaneously or between muscles or within glands they may, after exposure of the capsule by incision, be treated by enucleation the same as any other benign growth. When situated upon one of the peripheral nerves, growing as they do from the nerve sheath, the continuity of the nerve itself should be preserved. Situated within the rectum, or taking origin from the mucous membrane of the cervix and appearing as polypi, their removal may be effected by torsion of the pedicle with or without ligation. When situated within the bladder and producing functional disturbance, polypi may be removed by the snare, or evulsed by forceps after a preliminary cystotomy. Surgeons who are sufficiently familiar with the cystoscope and who are expert in the use of the cystoscopic snare may remove these growths without external incision. When situated within the middle ear, if projecting through a rent in the drum-head, they may be removed by the snare, or evulsed by forceps, or be removed with the curette, or they may be destroyed by injecting into them a ninety-five per cent. solution of alcohol. When situated within the larynx they may be removed by the wire snare, or evulsed or destroyed by electrolysis, or in case they are of very considerable size, or inaccessible from above, they may be removed after doing laryngotomy. The treatment of nasal polypi, however, on account of their frequency, is a matter of much greater importance. This treatment is, and has been, most varied. In times past they have been injected

with a solution of tannic acid, tincture of iodine, tincture of the chloride of iron, and even chromic acid has been used. Before undertaking to remove nasal polypi the mucous membrane should be cocainized for the purpose not only of relieving pain and aiding manipulation, but also for the purpose of lessening the hæmorrhage. Evulsion of nasal polypi has been practiced to a large extent by using a pair of long, fenestrated forceps. The polypus is seized, its pedicle twisted, and the growth forcibly extracted. Curettment has been recommended and practiced by some surgeons either with or without incision through the alæ of the nose to the nasal bone. The curette has been recommended not only for the removal of visible and invisible polypi, but also for the removal of portions of mucous membrane, and even more or less of turbinated bones. This method is to be condemned. It is unscientific, unsurgical, harmful, bloody and unnecessarily severe. It destroys healthy tissue in great amount, making no distinction between that which should be preserved and that which is to remain. The method cannot be condemned in too strong terms. Injections, unless those of alcohol, are probably not practiced at the present time anywhere or to any extent. Evulsion, which the writer has practiced very considerably, is most unsatisfactory in that it is inexact, is bloody, and does not remove ordinarily the base of the polypus. It simply crushes and disintegrates the portion seized, and often allows a new tumor to spring up from the part left adhering to the mucous membrane. After the removal of the polypus by evulsion the hæmorrhage is ordinarily so considerable, though not alarming to the ordinary surgeon, as to render further exact work impossible at that sitting. The galvanocautery loop is made use of for the removal of nasal polypi by many specialists in nasal surgery, and if used with care, discretion and skill its work is effectual, and in doing this it accomplishes a very desirable end, that is, the arrest of hæmorrhage. A specialist in nasal surgery has often informed the writer that he can remove almost any number of polypi from

the nose with the galvano-cautery loop with the loss of scarcely a drop of blood. The statement so often made by some nasal surgeons that they can always seize a nasal polypus directly at its attachment to the Schneiderian membrane and remove it entire without injury to the nasal mucous membrane must, I think, be received, at least in many cases, with some doubt. A careful microscopical study of nasal polypi will show that they are often outgrowths from or hypertrophies of the mucous membrane, and that their removal without leaving even a gap within this membrane is an impossibility. It is also apparent that where one has two or more nasal polypi crowded into the nasal fossæ it will be impossible by sight or touch to place the wire loop exactly at the base of the pedicle. Much of the work is done in the dark, and to a certain extent is guess work. The means perhaps best adapted for the use of the general surgeon or general practitioner in the removal of nasal polypi is the cold wire snare. A most excellent instrument is Bosworth's snare. The loop may be slipped over the polypus by carrying it along the nasal septum up toward the middle fossa or middle turbinated bone, where it is gradually tightened by drawing upon the cross-bar. It is true that by this method there is some slight hæmorrhage which may interfere somewhat with the removal of subsequent polypi if any exist, but this, however, is not a serious obstacle. In localized hypertrophy of the mucous membrane, or in small multiple sessile myxomata, the curette may be used, if used judiciously, for their removal, or the flat surface of a small, slender, galvano-cautery knife may be used for their destruction. The cardinal principle in the operative treatment of myxomata of the nose is thorough and complete removal, associated with as little injury as possible to the normal structures. Following the removal of myxomatous growths the nasal cavities should be kept aseptic by means of nasal sprays and douches. If there is any great hæmorrhage after the operation the nasal cavity may be plugged with a strip of iodoform gauze.

CHAPTER XV.

LYMPHOMATA.

A word of explanation or perhaps of apology is necessary in introducing this subject in a work devoted entirely to tumors. The only reason the writer has for considering the subject is that the enlargement of the lymphatic glands is very largely due to growth of new tissue.

A lymphoma is a benign tumor formed of lymphoid tissue. It may not be out of place here to devote a few words to the consideration of the gross and microscopic structure of a lymphatic gland and of lymphatic tissue. Lymphatic glands lie in the course of the lymphatic vessels. In certain well-defined situations these vessels divide and subdivide, producing a net-work of vessels or sinuses and then almost immediately reunite into lymphatic vessels which correspond in character, number, and size with the lymphatic vessels before the division already spoken of has taken place. In this meshwork of vessels and sinuses formed by the division of lymphatic vessels the lymphatic glands are formed. If we consider the external appearance of the lymphatic glands we find that they vary greatly in size, form, and general characteristics. Ordinarily the lymphatic glands are so small that they are scarcely detected upon the most careful examination. As they increase in size they may be noticed as small, soft, roundish, grayish masses perhaps not larger than a pin's head, or a bean, or they may become as large as a hen's egg or even larger. While ordinarily the lymphatic gland of any considerable size is said to have a form not unlike that of a kidney, they are, however, of every conceiv-

able shape, form and size, their form being influenced largely by the pressure of adjacent glands or adjacent structures. Assuming that the lymphatic gland is more or less kidney-shaped we find upon one border a depression known as the hilus at which the different vessels enter. These vessels emerge from the gland at various points throughout its convex surface.

A lymphatic gland is covered by a distinct fibrous capsule which gives off from the internal surface at numerous points strands of fibrous tissue which penetrate the gland in every direction. These fibrous bands, or trabeculæ, separate and give support to the various macroscopic and microscopic structures of the gland.

A lymphatic gland is divided into two parts, the cortex and the medullary portion. Upon section the cortex is seen skirting the external circumference as numerous round bodies which are known as the secondary nodules or follicles. From these nodules numerous columns or pillars of adenoid tissue are projected into the interior of the gland constituting the medulla. Between the nodules and between the columns of medullary tissue the lymphatic sinuses are found, the nodules and columns of lymphatic tissue and the sinuses being held in position and supported by the trabeculæ before mentioned. (Fig. 72.)

Adenoid tissue is in no sense of the term glandular tissue, as the name lymphatic glandular tissue might imply, but it is simply a modified form of connective tissue and has its origin from the mesoblast. Adenoid tissue considered microscopically consists of a fine reticulum of connective tissue in the meshes of which are innumerable small, round cells known as the lymph corpuscles or lymphocytes. (Fig. 73.) In a section of a lymphatic gland or of other adenoid tissue these cells are usually so numerous and so closely packed one upon the other that the fine reticulum of connective tissue in the meshes of which they are to be found is not distinguishable. In very thin sections, however, or if the specimens are treated

by penciling for the purpose of brushing away many of these round cells, then and in that case the reticulum of connective tissue can be made out.

Lymphatic or adenoid tissue is found not only as a constituent of the lymphatic glands, as in the neck, beneath the jaw, in the anterior and posterior mediastinum, in the mesentery or pelvis or following the course of the larger blood vessels,

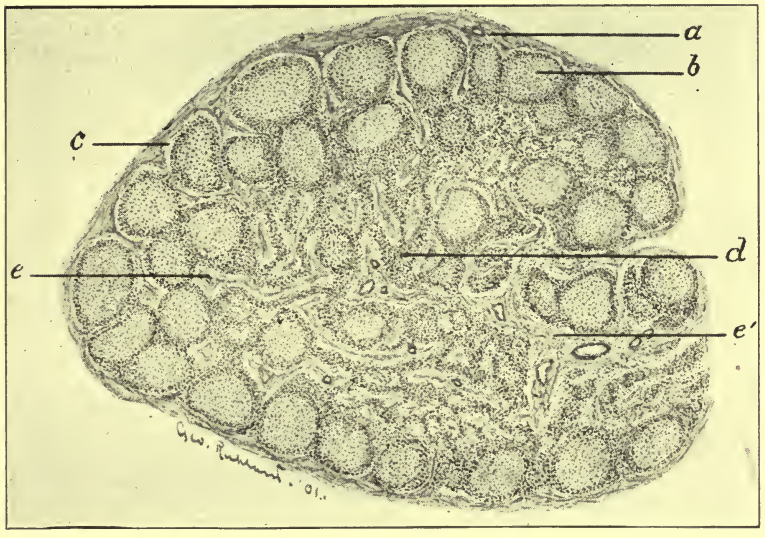

FIG. 72.
Normal lymphatic gland.

a. Capsule.
b. Cortical lymph follicle.
c. Perifollicular lymph sinus.
d. Medullary substance.
e. Trabecula.
e'. Trabecula with blood vessels.

or in the tonsils, or spleen, but it is also found throughout the mucous membrane of the naso-pharynx and gastro-intestinal canal. Not all of the adenoid tissue in the naso-pharynx and gastro-intestinal canal belongs to true lymphatic glandular tissue. Much of the adenoid tissue, both in the nose, pharynx, stomach, and intestinal mucous membrane, is temporary in character, increasing and diminishing, forming and disappearing from time to time upon local or constitutional conditions as

the case may be. Most of the secondary nodes or follicles of the lymphatic glands and some of the lymphatic nodes in the mucous membrane have here and there within their structure or nodes light, spherical areas which are known as germinal areas and in which karyokinetic changes take place. Into these germinal areas leucocytes enter, undergo division

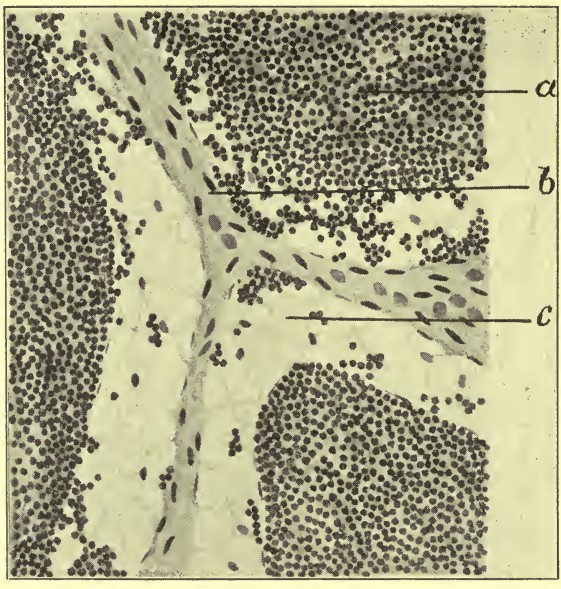

FIG. 73.

a. Lymph follicle made up of lymphocytes.
b. Fibrous trabecula.
c. Perifollicular lymph sinus showing fine reticulum.

and the new cells find their way into the lymphatic channels as lymphatic cells or lymphocytes and from there into the blood vessels as white blood corpuscles or leucocytes.

ÆTIOLOGY.—A lymphoma, as already stated, is a tumor made up of lymphatic or adenoid tissue. As a rule these tumors, as they come to the attention of the surgeon, are the result of a pronounced overgrowth of the lymphatic glandular

tissue in some particular area, which in consequence of pressure or excessive growth becomes fused together into a very considerable mass forming a neoplasm. Hyperplasia or excessive growth of lymphatic glandular tissue is due to a variety of causes. This excessive growth may take place with great rapidity, in which case in a few days, large masses of adenoid tissue making up tumors of very considerable size appear where formerly there were none to be detected. These changes are in the acute cases The growth, on the other hand, may be insidious, very slow, intermittent perhaps in character, so that months and perhaps years are required before the affected glands reach any considerable size. The growth of the glands from whatever cause is primarily the result of an increase in the number of round cells contained in the reticulum of connective tissue. Where this growth of round cells predominates the glands are very soft and usually the increase in size is very rapid. Where the growth is more chronic in character the cells give place more and more to fibrous tissue and the glands become harder and more resistant. Seemingly any irritant of chemical or bacterial origin which gains an entrance to the lymphatic circulation and passes into the lymphatic glands is capable of causing an increase of growth in the lymphatic tissue. In every acute infection of the mouth or throat, be that infection pyogenic, diphtheritic or scarlatinal there will be produced almost at once hyperplastic growths of the adjacent lymphatic glands. The same conditions occur in the inguinal glands from pyogenic, gonorrhœal or other specific infection about the genitals.

Enlargement of the lymphatic glands and especially of the cervical glands frequently occurs in childhood and youth and is presumably due to a scrofulous condition or to some defect in the constitution of the individual. Most of these cases unquestionably are due either to a low grade of pyogenic or saprophytic infection the sequence of a chronic nasal catarrh, or are tubercular in origin. Cases of chronic adeni-

tis or hyperplasia of the lymphatic glands are among the frequent pathological conditions which require the physician's or surgeon's attention. Chronic enlargement may be due to tuberculosis, syphilis, carcinoma, sarcoma, or leucæmia. Enlargement of the lymphatic glands may also be physiological in character, as is shown by the increase in size of the axillary glands in cases of lactation in which there is an absence of pathological process within or in the neighborhood of the mammary gland.

PATHOLOGY.—Atrophy occurs in the lymphatic glands in old age and is attended with a diminution of the cellular elements from absorption or from degenerative change. In acute lymphatic enlargement the result of pyogenic or pathogenic infection the glands are hyperæmic, infiltrated with fluid, often the site of hæmorrhages and also the site of active cell proliferation. The sinuses are distended with blood cells both red and white and with endothelial cells the result of desquamation. Both the follicles and medullary cords are increased in size, this increase being the result of proliferation of cells and an exudate into the glands from the capillaries. In these acute processes following the disappearance of the cause a subsidence of the swelling may take place and the glands return again to their normal condition, or in cases where the infection is intense suppuration or necrosis of the gland structure may take place. In other cases the gland does not return to its normal condition but remains permanently enlarged. In these cases where the process becomes more or less chronic there is as a result an increase of the connective tissue of the gland and a lessening of the cellular elements with an increase in size and number of the blood vessels and a thickening of the trabeculæ and the capsule. In syphilis the lymphatic glands in the vicinity of the initial lesion become primarily affected. Later the subcutaneous glands in many portions of the body become implicated, especially the post-cervical, the axillary, inguinal, and the epitrochlear. Microscopically they represent largely an increase of connective

tissue of the gland. In tuberculosis the gland after the implantation of the bacilli shows characteristic changes—the formation of giant cells and gray tubercles. These tubercles may coalesce forming a mass of considerable size and finally undergo caseous degeneration. This caseous material may liquefy, be absorbed or be converted into a calcareous mass. Not unfrequently the bacilli and tubercles become seques-

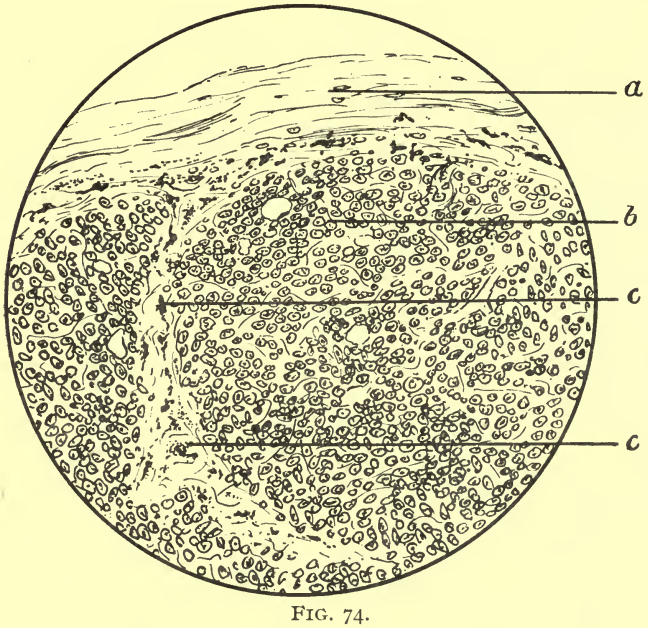

FIG. 74.
Lymphatic Gland. Pseudo-leucæmia.
a. Capsule.
b. Lymph follicle.
c. c. Pigment in the lymph sinuses.

tered by the formation of connective tissue around them and as a result the process is temporarily arrested, or a secondary infection and suppurative process may be engrafted upon the tubercular infection. In leucæmia or pseudo-leucæmia the lymphatic glands affected become quite variously enlarged and on section the cortical substance cannot ordinarily be differentiated from the medullary. (Fig. 74.) In pseudo-leucæmia

in which the glands are so frequently enlarged they may be either very soft or quite hard. In the former there is a pronounced proliferation of the lymphocytes. These predominate and make up the greater portion of the gland. Where the gland is hard the lymphocytes are comparatively few in number and the connective tissue is greatly increased, making up for the deficiency in the cellular elements. In leucæmic conditions

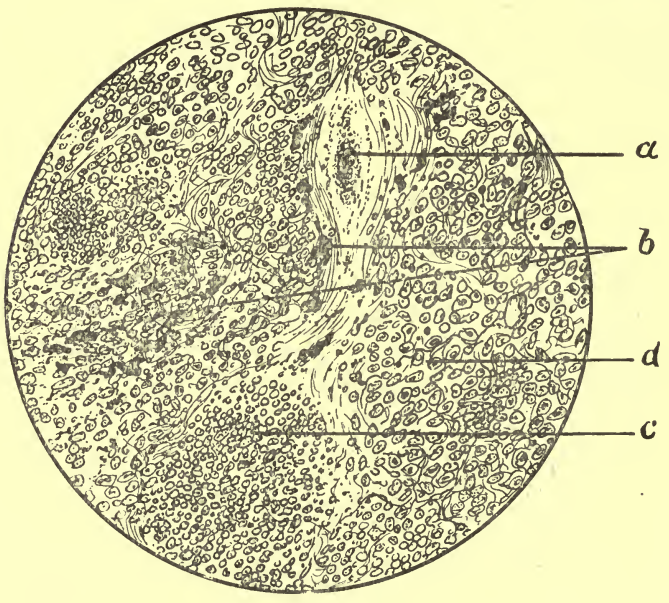

FIG. 75.
Section of spleen. Leucæmia.
a. Blood vessel. b. Pigment in sinus.
c. Follicle. d. Splenic pulp.

of the spleen this organ is in its first stages enlarged and hyperæmic, often showing in its interior slight hæmorrhages with pigmentation of structure. (Fig. 75.) Primarily in the hyperæmic process the red blood cells are increased. Later the white corpuscles appear both in the pulp and in the follicles, and often in the latter to such an extent that they are greatly enlarged and are seen as white nodes. As the process progresses atrophy or fatty degeneration takes place with an

increase of the fibrous tissue and a hardening of the spleen. In lympho-sarcoma there is an excess of round cells within the gland and primarily a seeming decrease of the connective tissue of the part. In secondary carcinomatous infection of the glands the carcinomatous cells become deposited within the gland, displace and destroy the normal glandular structure, producing a carcinomatous growth which represents in most cases the histological structure of the primary growth.

Diagnosis.—It is necessary in considering the subject of lymphomata, or enlargements of the lymphatic glands, and more especially when about to apply treatment, to be able to differentiate the various causes of these conditions. The acute enlargements of the lymphatic glands of the neck or groin due to pyogenic or pathogenic infection from the mouth or genital region will ordinarily require only a careful inspection of the parts in order to establish a causative condition and the diagnosis. This is certainly true of diphtheria, scarlet fever, gangrenous stomatitis, acute pyogenic infections about the teeth, tonsils, naso-pharynx, or mouth. There scarcely could be any difficulty in determining the cause of enlargement of the lymphatic glands of the groin as the result of acute pyogenic or specific infection about the genital tract or lower limbs. Enlargement of the lymphatic glands upon the surface of the body due to syphilis is ordinarily sufficiently characteristic to prevent one falling into serious error. The glands in syphilis never reach any considerable size. They are round and freely movable, free from pain, never become agglutinated, show no disposition to suppurate, and are attended with or followed by other manifestations of syphilis and, under appropriate treatment, gradually become smaller and finally disappear. The lymphatic glands are very frequently enlarged as the result of tubercular infection. In endeavoring to make a diagnosis or a differentiation from other conditions it should be remembered that the lymphatic glands most frequently affected by the tubercular processes are those situated within the anterior and posterior triangles

of the neck. It is, however, true that the occipital, submaxillary, axillary and inguinal glands are also frequently the site of tubercular processes. There is a tendency in tubercular hyperplasia of these structures for the process to become primarily manifest in infancy and youth and to be associated with systemic conditions which are often known under the name of a scrofulous diathesis. It should be remembered in cases of chronic enlargement of the cervical glands due to tubercular infection that the process is not as a rule primary in the gland structure, but is on the contrary primary in some chronic process of the mucous membrane of the naso-pharynx or in the tonsils, or at the root of a carious tooth or teeth, or in a tubercular ulcer of the tongue or floor of the mouth. Tubercular infection may also occur as the result of an eczema of the scalp or through some slight but nevertheless existent scratch or abrasion upon the skin. It must not for a moment be conceded that the cases of chronic enlargement of the lymphatic glands are all tubercular in character. There is not the slightest doubt but that many of these cases in which the glands affected are comparatively few in number and small in size are the result of absorption of the products of a chronic naso-pharyngeal catarrh or chronic tonsillitis. In these cases infectious material other than tubercular has gained entrance through the lymphatic channels to the affected glands. The characteristics of tubercular glands are often pronounced and easily distinguishable from like conditions due to other causes, nevertheless there are many cases in which at least the primary enlargement will be impossible of differentiation from that due to other causes. If we consider that tubercular infection of the lymphatic glands occurs as a rule primarily in childhood or in young adults in whose family or ancestry there have been cases of tuberculosis, or in those who have been exposed to tubercular infection of a pronounced degree, or who have been much debilitated, over-worked, or poorly-nourished, or in those, who, as the term is ordinarily used, are of a scrofulous constitution, and show a high degree of vulner-

ability with a marked tendency to growth of lymphatic structures as they exist in various parts of the body, the diagnosis will be rendered easier. If we also remember that as a rule the glands progressively enlarge and new ones become implicated, that they show a most pronounced tendency to degeneration, mixed infection, suppuration, agglutination of various glands, the formation of adhesions to the skin and adjacent structures, wtih inflammation of the overlying tissues, the formation of abscesses and a general debility which the process engenders, there can be little difficulty ordinarily in making a diagnosis. It is quite true that there will be mild cases of hyperplastic enlargement of the lymphatic glands of the neck in which primarily it may, and probably will, be difficult to draw the line between infection from catarrhal products, tubercular infection and leucæmia; but with a careful study of the history of the case, with an observation of its course for a time, associated with, if necessary, an examination of the blood, there will in most cases finally be little difficulty in making a positive diagnosis.

The enlargement of the lymphatic glands due to leucæmic conditions present, in so far as the glands are concerned, one of the most interesting subjects to which the surgeon may have his attention invited. The causes of these conditions are not well understood, although it is held by Klebs and others that the process is due to infection. Obratzow had a case of Hodgkin's disease in which it seemingly was transmitted to an attendant. Delbert claims to have isolated and cultivated a bacillus from the spleen of a woman who had leucæmia. He claims to have produced the disease in dogs by injecting the cultivated germs.

Leucæmia is ordinarily divided into splenic, medullary, spleno-medullary, and into lymphatic, or pseudo-leucæmia, or Hodgkin's disease. The pure splenic and pure medullary forms are rare. Most cases of leucæmia proper are of the spleno-medullary form, while there are cases seemingly mixed in character representing in combination many of the charac-

teristics of the spleno-medullary and lymphatic forms of leucæmia.

In considering the differential diagnosis between lymphatic enlargement due to leucæmia and tubercular conditions it may be stated that the enlargement of the lymphatic glands due to leucæmia makes its appearance in the majority of cases after puberty and most frequently in men. The principal physical characteristic of the spleno-medullary form is an enormous enlargement of the spleen. This may reach such anextent as to fill one-half or two-thirds of the abdominal cavity, the spleen being usually smooth and painless, although occasionally its surface is uneven from circumscribed growths of adenoid tissue. With the enlargement of the spleen there is often associated an enlargement of the liver and occasionally an enlargement of the lymphatic glands of the neck, axilla, and inguinal regions. The glandular enlargement is usually slight, however, and occurs late in the disease. In a case of leucæmia that is well advanced there is likely to be pronunced emaciation, loss of strength and energy, weakness and palpitation of the heart and disturbed digestion. Intermittent fever of a high type also frequently occurs. In the case represented by Fig. 76 the temperature would frequently rise to 105 degrees. Upon a thorough evacuation of the bowels the temperature would fall in one hour three or four degrees. The diagnosis is to be made complete in this class of cases by an examination of the blood in which there is an enormous increase of the white corpuscles, while the red corpuscles are usually somewhat or often decidedly diminished. In the case represented by Fig. 76 an examination of the blood showed hæmoglobin fifty-five per cent., red blood corpuscles 3,125,000, white blood cells 172,800. (Plate III.) In this case the myelocytes make up about twenty-five per cent. of the white cells, the lymphocytes are diminished, the eosinophiles are relatively normal, while a small number of nucleated red corpuscles are to be seen.

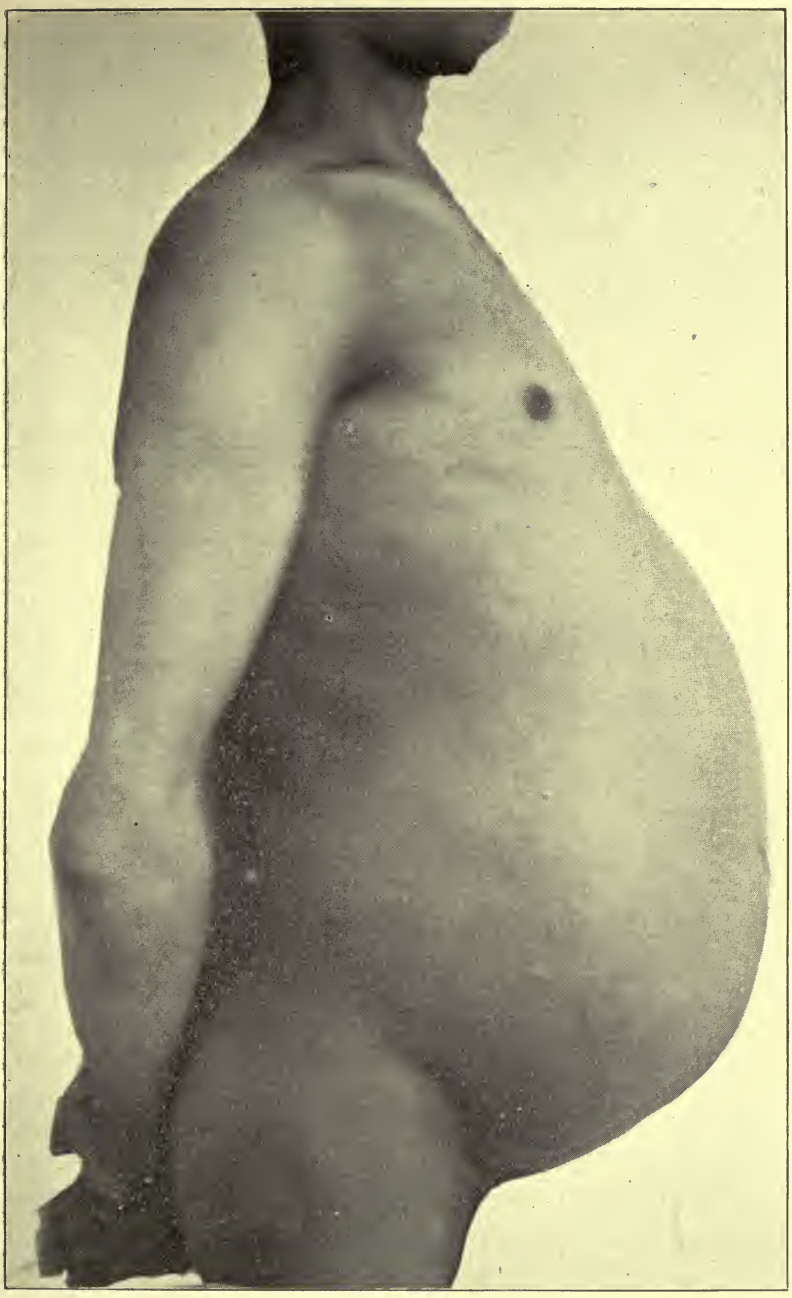

FIG. 76.

Spleno-Medullary Leucæmia.

Male, aged 29. Ill 11 months. Lost 20 pounds. Very weak. Entire skin surface bronzed. Spleen extends to Poupart's ligament on left side and into right side 3 inches beyond median line. Perpendicular measurement 20 inches; transverse 18 inches. Inguinal glands enlarged. Blood count: Red corpuscles, 3,125,000; whites, 172,880. Hæmoglobin 55 per cent. (See Plate III.)

In thirty cases tabulated by Cabot the white corpuscles averaged 438,000 per cubic millimeter, whereas in the normal condition they vary usually between 7,000 and 8,000 per cubic millimeter. In Cabot's cases the red blood corpuscles were reduced on the average to 3,120,000 per cubic millimeter, whereas normally they should be from five to six million. It is readily seen then that in leucæmia proper there is an enormous increase in the number of white blood corpuscles, whereas the red blood cells are markedly diminished in number. It is also noted in leucæmia that the nucleated red blood corpuscles are very numerous, while the myelocytes form about thirty per cent. of the white blood corpuscles.

The characteristics, then, of spleno-medullary leucæmia are that it usually occurs in persons past middle life, that the spleen is often enormously enlarged, that this enlargement is one of the first symptoms, that the liver may also be enlarged but to a less degree, that enlargement of the lymphatic glands if it occurs is usually slight, that the hæmoglobin is often reduced to sixty or even fifty per cent., that the white blood cells are increased from seven to eight thousand per cubic millimeter to 438,000 or thereabouts and that the red blood corpuscles are diminished, that the red nucleated cells are frequent, and also, and this is characteristic, that the increase in the number of white blood corpuscles is very largely due to the increase in myelocytes.

In lymphatic leucæmia, pseudo-leucæmia, or Hodgkin's disease, the first characteristic is the enormous enlargement of the lymphatic glands. This enlargement may be confined, and often is for a considerable time, to one set of glands or to one side of the neck, but sooner or later, especially in severe cases, all, or nearly all, of the lymphatic glands both in the neck, axilla and groins become affected and greatly enlarged. There is probably no condition and no disease in which the enlargement of the lymphatic glands approximates

Senn, in the *New York Medical Journal* for April 18, 1903, reports excellent results in the treatment of pseudo-leucæmia by the use of the Röentgen ray.

In the *Medical Record* for August, 1903, he also reports a case of spleno-medullary-leucæmia apparently cured by the use of the Röentgen ray. [Append to p. 288.]

PLATE III.

a. Red blood corpuscles.
b. Nucleated red corpuscle.
cc. Myelocytes.
d. Eosinophile cell.
e. Polymorph. nuclear leucocytes.

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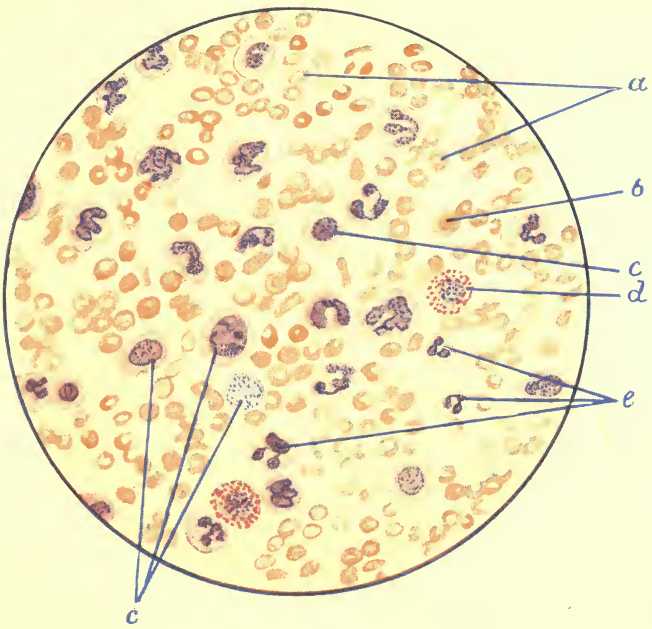


PLATE III.

a. Red blood corpuscles.
b. Nucleated red corpuscle.
cc. Myelocytes.
d. Eosinophile cell.
e. Polymorph. nuclear leucocytes.

to anything like the size which occurs in pseudo-leucæmia. (Figs. 77, 78, 79.)

Growth of lymphatic tissue is not confined to the superficial glands, but often affects the spleen, liver, kidneys, the glands in the anterior and posterior mediastinum, the bronchial glands, mesenteric glands, the glands in the pelvis, and the glandular and adenoid tissue in the mucous membrane of the nose, throat, and gastro-intestinal canal. Although the

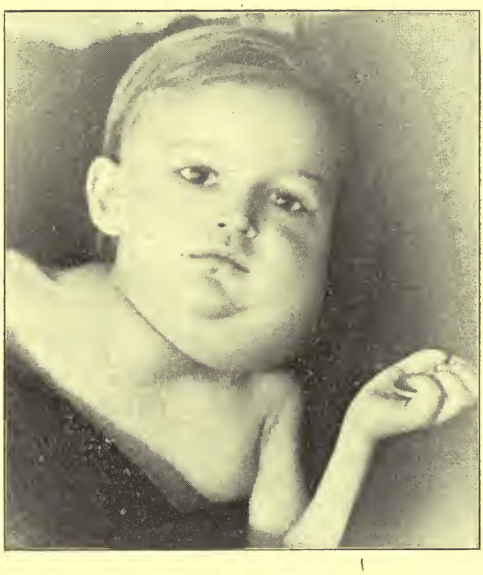


FIG. 77.
Lymphatic leucæmia.
Male, seven years old, died from exhaustion at seven and a half years.

spleen is enlarged probably in all cases of pseudo-leucæmia the enlargement is not characteristic of the disease and does not reach any considerable size. With the enlargement of the lymphatic glands there is usually more or less of emaciation which may be extreme, loss of strength and of energy, palpitation and weakness of the heart, the result of anæmia, and associated it may be with fatty degeneration, inability to

sleep, severe pain in various portions of the body, disturbances of digestion, loss of appetite, disturbance of the bowels, and loss of mental vigor.

In many of the cases of pseudo-leucæmia the patient suffers from an intermittent or more or less remittent form of fever. The fever often reaches a very considerable height, perhaps to 101, 102, and 103 degrees, then becomes less for

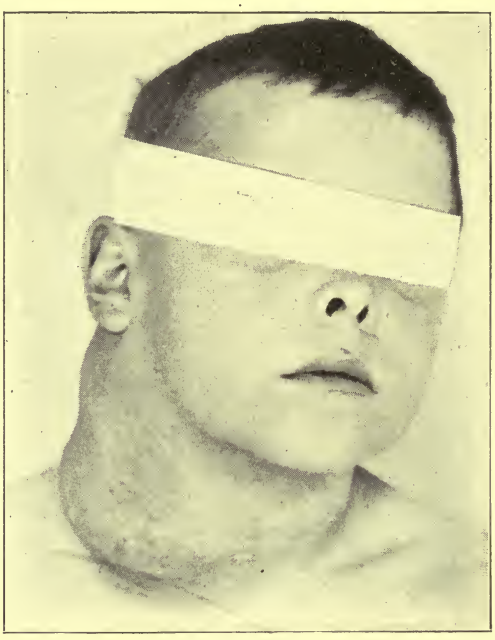


FIG 78.
Lymphatic Leucæmia.
Male, aged nine. Glands enlarged for one year. Recovered after operation. Hæmoglobin 50 per cent. Red corpuscles, 4,100,000; whites, 50,100.

two or three days to disappear for several days when it may return, this condition being kept up at intervals for a long time. With the ocurrence of fever the glands are apt to become markedly enlarged. Not all cases, however, of pseudo-leucæmia suffer from fever, weakness, palpitation of the

heart, gastro-intestinal disturbances, or from loss of strength and energy. Notably one case which was under the writer's care in which the cervical glands were enormously enlarged the patient remained apparently in almost perfect health. In Hodgkin's disease the blood changes are almost as charac-

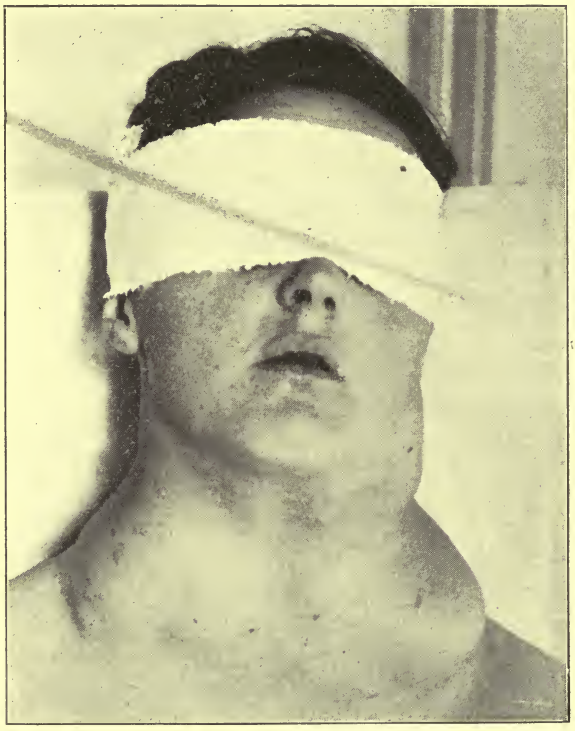


FIG. 79.
Lymphatic Leucæmia.
Girl, aged fifteen. Glands enlarging for two years. Hæmoglobin 90 per cent. Red corpuscles 4,000,000; whites, 9,900.

teristic and diagnostic as they are in leucæmia proper. There is a decided anæmia, the red blood cells being reduced on an average to about 3,000,000 per cubic millimeter. In this condition, in contrast to leucæmia proper, nucleated forms

are rare. The white blood corpuscles are usually somewhat increased although to nothing like the extent to which they are in leucæmia. They may vary anywhere from 8,000 to 200,000 per cubic millimeter, of which, and this is characteristic, twenty per cent. are lymphocytes. Of these either the smaller or larger ones may predominate. In case represented by Fig. 79 the hæmaglobin was ninety per cent. red corpuscles 4,000,000, white cells 9,900.

Carcinomatous enlargement of the lymphatic glands.—It is scarcely necessary to say that lymphatic glands taking origin from the mesoblast as they do are never the primary site of a carcinomatous growth. They become affected only secondarily in consequence of the epithelial cells or germs of the carcinomatous tissue gaining an entrance into the lymphatic circulation and becoming arrested in the lymphatic glands, where, if they find conditions suitable for their growth, they convert the glands into secondary carcinomatous foci. These glands are usually hard, often painful, not freely movable nor well-defined except in the first stages of the condition in consequence of the cells permeating the capsule of the gland and causing a periadenitis and adhesions to the adjacent structures. The glands may become subsequently, in consequence of the cells infiltrating the adjacent structures, absolutely fixed and immovable. The condition can only be satisfactorily and confidently diagnosed and differentiated from other conditions by a search for the primary disease.

Lympho-sarcoma.— This condition has been to some extent mistaken for and confused with Hodgkin's disease, but they are pathologically distinct diseases which have no relationship, and are absolutely separable, running different courses, due to different causes, presenting different symptoms and having a different prognosis and treatment.

Lympho-sarcoma is a malignant disease, a sarcomatous condition engrafting itself upon or within the lymphatic glands and it may be in these glands a primary condition. It possesses when fully established all of the symptoms and possi-

bilities of a malignant disease. Lympho-sarcoma primarily as it affects a few isolated glands in the neck, axilla, or groin, may not be distinguishable from benign conditions, especially from tubercular disease producing enlargement of the same set of glands. The disease is rare, being in no way compared in frequency to tubercular adenitis or even to lymphatic leucæmia. Very many of the lymphomata that have been referred to the writer at different times with a diagnosis of lympho-sarcoma have, following operation and microscopical examination, been proven to be tubercular in character. Some few cases, however, of lympho-sarcoma have come under the writer's observation and have presented the following characteristics: Primarily there is a simple enlargement of the lymphatic glands perhaps on one side of the neck. These glands present nothing especially characteristic, being round, freely movable, reasonably hard and without special pain. The condition, however, is constantly, and it may be quite rapidly, progressive. The adjacent glands become implicated and sooner or later the disease spreads to and involves the glands on the opposite side of the neck, perhaps also the glands beneath the clavicle and those in the axillary spaces. There is not only an increase in the number of glands implicated, but also a steady increase in the size of those affected. The adjacent glands become fused together, the sarcomatous tissue is not confined by the capsule, but grows into the adjacent tissue producing a solid, painful, often inflamed, immovable, perhaps also irregular, hard, board-like mass of tissue which is inseparable from either the overlying, intervening, or deeper tissues. In the cases which have come under the writer's observation there has been later in the course of the disease metastatic deposits subcutaneous in location in different portions of the body. In one case particularly the writer observed during the last few months of life a number of these metastatic growths springing up beneath the skin in various portions of the body and growing with very marked rapidity. They were more or less hard and in some places the hardness

was extreme. The metastatic growths were often attended with considerable pain and not unfrequently with pronounced inflammation. Metastatic deposits also frequently occur in the viscera.

The characteristics, then, of lympho-sarcoma after a few months of progress are (1) that the growths are not confined to the lymphatic glands, but that they infiltrate the adjacent tissue, converting the whole into a more or less hard, often extremely hard, immovable solid mass. (2) That there are often metastatic deposits subcutaneously situated in various portions of the body or within the viscera, and that these grow with considerable rapidity. (3) The effect upon the constitution is far greater than in any other chronic lymphatic affection and early leads to loss of strength, emaciation, and death.

Prognosis.—It is scarcely necessary to dwell upon the prognosis or treatment of the ordinary specific or pyogenic affection of the lymphatic glands. The prognosis is that of the primary disease. The prognosis of tubercular affections of the lymphatic glands, in so far as the glands themselves are concerned, is good although it is true that from these glands as foci or from the original focus further local or systemic infection may occur. It is also true that the majority of children and young adults who suffer from pronounced tuberculosis of the lymphatic glands of the neck succumb sooner or later to general systemic tuberculosis. The prognosis of chronic splenic leucæmia with or without enlargement of the lymphatic glands is nearly always bad. The majority of cases succumb within two years in spite of treatment. The prognosis of acute leucæmia and acute pseudo-leucæmia is extremely bad, the majority of patients succumbing in from three to six months. In chronic lymphatic leucæmia the prognosis is much better, some of these cases either recovering or the condition becomes so chronic that the patients live on for years while perhaps the majority succumb

in from two to five years. The prognosis of lympho-sarcoma is that of a malignant disease or of a sarcomatous growth.

TREATMENT.—The treatment of syphilitic adenitis is that of syphilis. The treatment of tubercular enlargement of lymphatic glands which have reached any considerable size is primarily systemic, improving if necessary the patient's hygenic surroundings in the way of dry apartments, fresh air, sunlight and out-of-door exercise, protecting him from cold, and giving him nutritious food such as beef juice, raw meat, milk and vegetables. Surgically the treatment of tubercular glands is that of removal. The time and the method are matters of the most serious moment. Under ordinary conditions glands which are enlarging and which have reached a considerable size should be removed. One of the greatest mistakes in this class of cases is in allowing the disease to progress until it has implicated not only all of the glands in a particular region, but has resulted in marked degenerative change inflammation and perhaps mixed infection.

In the removal of lymphatic glands of the neck incisions waving in character should be made. This will establish flaps which give the greatest exposure to the diseased portions, rendering the technic much easier, saving time, avoiding serious complications and preventing, what is important, a long straight cicatrix. In the incisions and dissections the external jugular vein, the spinal accessory nerve and the superficial branches of the cervical plexus should, if possible, be preserved. The glands are often adherent to the internal jugular vein or are situated at the upper border of or beneath the clavicle. Owing to this they should be shelled out with great gentleness and circumspection. The internal jugular vein often overlaps the glands and it is only by exposing it throughout and beyond the extent to which the glands are adherent that they can be removed with any degree of safety. If the glands are directly and strongly adherent to the vein the connective tissue and capsule should be divided over the gland and an effort made with the blunt, smooth handle of the

knife to shell the glands out of their beds. It not unfrequently happens, however, in consequence of the changes in the anatomical relationship of the parts or the strong adhesions or friability of the vein, that it becomes lacerated. It is always well where one is working in close proximity to the vein and there is fear of rupture to apply both above and below the point a temporary cat-gut ligature. If the vein is torn without being isolated the hæmorrhage will be severe and often alarming. If the vein is reasonably exposed a pair of forceps may be applied both above and below the rent, and following this the vein ligated. The writer when encountering these conditions has occasionally closed the slits by seizing them with a pair of forceps and then applying a ligature, or by sewing up the rent with a small needle and thread. He has, however, as a rule found great difficulty in applying these methods. The greatest satisfaction has been obtained by completely isolating and ligating the vein both above and below the rent. In consequence of the extended dissection which is necessary in many of these cases it will be found best and often necessary to establish drainage at the close of the operation. This may be maintained for twenty-four or thirty-six hours and then removed.

Leucæmia.—The lymphatic glands when enlarged in spleno-medullary leucæmia do not require surgical treatment. In lymphatic or pseudo-leucæmia, in consequence of the uncertainty as to the ætiology, the treatment is not well settled. The administration of some preparation of arsenic is often of the greatest value in these cases. We should remember, however, in judging the effects of any single remedy that the enlargement of the lymphatic glands in these cases is often paroxysmal and not unfrequently incident to the rise of fever, which is so commonly present, and on the other hand that the subsidence of the fever is often associated with a decrease in the size of the growths. There can be scarcely any doubt, however, but that arsenic has in many of these cases a decidedly beneficial action. In many cases as the patient is brought

fully under the influence of arsenic the glands cease enlarging or diminish decidedly in size. In consequence of this beneficial result in many cases it is most desirable both before and after operative measures to keep the patient fully under the influence of this remedy. Phosphorus has also been given with advantage in some cases. Aside from this a generous diet of easily digested food is indicated, with perhaps the administration of cod liver oil, iron and other tonics. It is very necessary in the different forms of leucæmia in which the hæmoglobin and red blood corpuscles are both diminished and the patient is weak, debilitated, and easily worn that they refrain as much as possible from active exertion. It has been held by some that the disease was primary within the first set of glands implicated, much as in tuberculosis, and that if these glands were removed the course of the disease might be materially modified or arrested. There can be but little doubt, in cases of lymphatic leucæmia in which the enlargement of the glands is pronounced and confined to a limited area or to those on one side, or perhaps even occurring on both sides, that they may be removed with success and to the advantage of the patient, Considerable fever, decided enlargement of the spleen or wide distribution of the enlarged glands are contradictions to operative measures. In a number of the writer's cases in which the glands of the neck alone were decidedly enlarged the patients seemed to be distinctly benefited by their removal. It has been stated by some writers that the glands in lymphatic leucæmia never show marked adhesion to adjacent structures or decided agglutination, and that they are easily and readily shelled out of the connective tissue capsule which surrounds them. While this is in some cases true in others the very reverse holds good. It must uot be forgotten that in some of these cases the hyperplastic growth does not remain confined within the capsule of the gland, but is so exuberant that it passes through this structure mingling with like growths from adjacent glands and also invading the connective tissues. These

cases are not malignant in any sense of the word. They are simply cases of Hodgkin's disease. In such a case as this the writer has found the glands not only strongly agglutinated but so adherent to the surrounding tissues that they could only be separated therefrom by the use of the knife, and in some cases the surrounding tissues were so matted together that they were scarcely distinguishable. In one case in particular the writer spent two and one-half hours upon one side of a neck in clearing out the enlarged glands contained therein. In this case, though there were dozens of glands of all sizes removed, there were not more than one or two which could be shelled out of their beds. Such an operation is one of the most difficult that the surgeon can encounter and one of the most trying ordeals through which a patient may be called upon to pass. In cases in which the major portion of the subcutaneous lymphatic glands are involved, as perhaps those of the neck, axilla, and groin, operative measures are not advisable. In these extreme cases the spleen and liver are frequently implicated as well as the lymphatic tissue throughout the naso-pharynx and gastro-intestinal canal. They represent a general cachexia or a constitutional disturbance which could only be rendered worse by the loss of blood to which the patient would be subjected in any operative measure that might be undertaken.

Lympho-sarcoma.—The treatment of lympho-sarcoma is that of a malignant disease and while benefit may be expected in some few cases perhaps by the administration of arsenic the only course to be relied upon is a complete and radical extirpation of these structures. Even this will very often not succeed on account of the sarcomatous elements or the infectious germs having passed outside of the gland capsule into the adjacent tissue. In these cases, however, both before and after operative measures it is well to keep the patient under the influence of arsenic.

CHAPTER XVI.

MYOMATA.

A myoma is a benign tumor composed of muscular elements which are usually bound together in bundles by connective tissue. The connective tissue may be interspersed between the muscular elements and make up a considerable part of the growth.

Myomata are divided into two classes: 1st. Those composed of striped muscular tissue and known as rhabdomyomata, myomata striocellulare; and, 2nd, Those composed of unstriped muscular tissue and known as leiomyomata. The former were first described by Zenker.

Tumors consisting of striped muscular tissue are of rare occurrence and usually congenital in origin. They have occasionally been found growing from or within the muscular tissue of the heart, in which case they are of small size, ordinarily not exceeding that of a cherry. They seem in some way to be incompatible with life, as infants possessing these growths are usually either born dead or live but a few hours. One case, however, is reported in a man in his twenty-first year, and another in a child three days old.

Tumors composed of striped muscular tissue have been found in the biceps muscles and in the tongue. In the latter situation they are usually congenital in origin and may produce tumors of considerable size, which resemble in their appearance the lymphatic growths of the tongue known as macroglossia. These tumors not only occur in situations where they may take origin from striped muscular tissue, but also in organs and situations where this form of tissue does not nor-

mally exist. Such is the case when they occur in the kidney, where they have frequently produced tumors of considerable size. They have also been found as small, circumscribed growths in the testis, scrotum, wall of the stomach, orbit, sacrum, uterus, wall of the bladder, where they occasionally produce vesicle polypi, and also in the retro-peritoneal tissue. Newman found a tumor composed of striped muscular tissue in the scrotum of a boy three and one-half years old. Virchow found one in the wall of an ovarian tumor. They have also been found growing from the wall of the œsophagus, from blood-vessels, and in the intestinal canal. These growths are not unfrequently mixed in character, containing not only a considerable quantity of fibrous tissue, but also occasionally glandular tissue, and in some cases spindle cells, converting them into myosarcoma. This is especially true of the myomata which have occurred within the structure of the kidney. When situated in the kidney, testis, scrotum, bladder, orbit, or gastro-intestinal canal they may require surgical interference. They are, however, at best only rare growths which are seldom encountered by the surgeon and which ordinarily are only matters of pathological curiosity.

Leiomyoma.—Myomata composed of unstriped muscular tissue are of frequent occurrence and consequently of great interest and importance to the surgeon. They may and do occur wherever unstriped muscular tissue is found. They have, however, most frequently been observed taking origin from the uterus, prostate gland, Fallopian tubes, ovaries, ovarian ligaments, round ligaments, from the pelvic peritoneum immediately adjacent to, or making up, the broad ligaments, from the œsophagus, gastro-intestinal canal, bladder, scrotum, walls of the arteries, and from the skin, nipples, and breast.

Myomata have, on account of their color, hardness, situation, and general appearance, been mistaken for fibromata. Macroscopically they, except in the rarest instances, show nothing upon section which would indicate that they were

composed of muscular tissue, being usually hard, grating under the knife, showing large numbers of whorls, and presenting a dense grayish or whitish appearance, which is seemingly far more characteristic of fibrous than muscular tissue. Myomata occasionally, however, show on section a bright red surface like normal muscular tissue. An intra-ligamentous myoma which the writer recently removed showed on section a border of grayish white tissue, while centrally the growth had the color of normal muscular tissue. This is often the result of an excessive amount of contained blood. The connection, however, between myomata and fibromata seems to be a close one, both tissues taking origin from the mesoblast and being often intimately connected.

Senn, in his work on Tumors, states that all myomata spring from a matrix of myoblasts. Minot, in his work on Embryology, holds that no histogenetic distinction can be made between smooth muscular and fibrous or connective tissue, that the smooth muscular tissue is not genetically distinct from connective tissue and that the mesenchymal cells in the aorta and umbilical cord form both smooth muscular and connective tissue, and also that the mesodermic tissue of the genital cord is converted indifferently into either muscular tissue or connective tissue. It is a well-known fact that in the formation of arterioles in new tissue the vessels provide themselves with muscular coats out of seemingly connective tissue cells. The histological distinction between muscular and fibrous tissue or myomata and fibromata is often difficult to establish. Macroscopically it is absolutely impossible to differentiate the one from the other, and often in well-stained specimens this differentiation is not readily made out. It must be borne in mind that the size of the muscular cell and that of the nucleus vary greatly, at times being as large as those in coarse muscular tissue and again almost as small as those of normal fibrous tissue. Between these extremes there is every gradation. The writer believes, however, that all tumors which contain muscular tissue or in which the muscular

tissue predominates, or is the chief and most important element, should be termed myomata.

Mixed Forms.—In myomata the muscular tissue is always mixed with more or less of fibrous or connective tissue, but in a great proportion of these cases this is not sufficient to change the character of the growth. Where the fibrous tissue is very considerable, perhaps equalling or exceeding the muscular, the growth should be termed a myo-fibroma. The characteristics of the tumor, in so far as contour, hardness, appearance on section, and rate of growth are concerned, are not changed by this admixture.

Myo-angioma.—Under ordinary conditions a myoma receives its blood supply at various points from its capsule and by means of small vessels, and in consequence of this its rate of growth is slow. Occasionally, however, they have a very rich blood supply. This blood may be in distinct vessels of considerable size which reach the growth through the capsule at many points and permeate the tumor along the fibrous septa, distributing branches to the various bundles of fibres, the telangiectactic myomata, or the blood may be confined in spaces, blood caverns, which permeate the tumor in various directions and in some cases make up a very considerable part of the growth. These tumors have occasionally such a rich blood supply that they take the characteristics of erectile tissue and increase or diminish in size rapidly at different times, as before and after hæmorrhage or menstruation. Virchow thinks these growths originate during pregnancy.

Myo-adenoma.—It is of rare occurrence to find in a myomatous tumor glandular tissue. But few such cases have been reported. The glandular tissue may take origin from the glands or epithelial outgrowths of the overlying mucous membrane, as in the case of a sub-mucous myoma or a myoma taking origin in the mucous membrane which often occurs, or they may be the result of outgrowths of the vestiges of the Wolffian ducts which are composed of epithelial cells and which lie one upon either side in the uterine wall. Ordinarily the

Wolffian ducts in this situation undergo complete atrophy, but this is not always the case. Fig. 80 represents a microscopical section of an intramural myo-adenoma which the writer removed by a hysteromyomectomy.

Myo-cystoma.—The myomata are quite frequently cystic in character. The cysts may be the result of an œdematous condition of the lymphatic spaces in consequence of inflammation or irritation, or the result of some obstruction of the

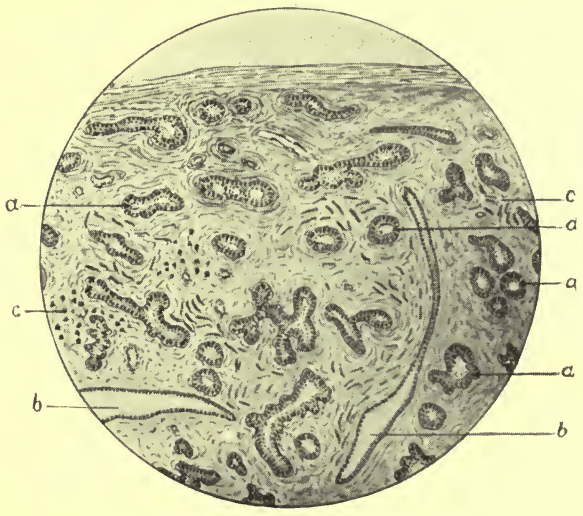


FIG. 80.
Uterine myo-adeno-fibroma.
a. Acini. b. Ducts. c. Stroma.

venous or lymphatic circulation. They may also be the result of an admixture of glandular elements in the tumor or due to remains of the Wolffian ducts or outgrowths from the Mullerian ducts or be the result of degenerative change in the growth whereby portions are softened and liquefied or absorbed and the cavity or cavities filled with a serous exudate. (Figs. 81 and 82.) These cysts are formed in myomata as the result of degenerative processes.

Myo-myxoma.—Some myomata are extremely soft, grow with considerable rapidity and are composed of muscular bundles between which are round and branching cells with a considerable amount of gelatinous intercellular substance.

Myo-sarcoma.—Occasionally a myoma shows the characteristics of malignancy by rapid growth, adhesions to and infiltration of adjacent structures, and metastases. These

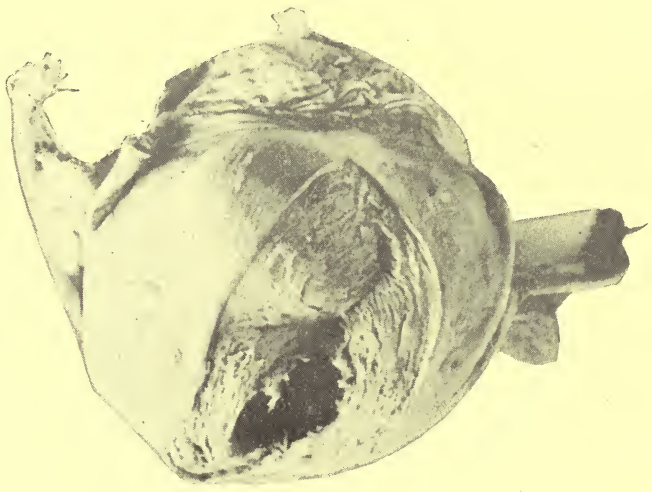


FIG. 81.
A cyst formed in an intra-mural myoma as the result of degenerative change.

tumors are composed in large part of round or spindle cells and are malignant.

Myo-carcinoma.—An epitheliomatous growth upon the cervix or a carcinomatous growth within the cervical canal, and a myomatous tumor within the body of the uterus are not uncommon. This is, however, a mere coincidence. At the trigone of the bladder, in the uterus and ovary myomata have been found in which there were carcinomatous nests. This combination, at least in the uterus, must presuppose either an ingrowth of epithelial cells or remnants of the Wolffian ducts. Fig. 83 represents an epithelioma covering the en-

tire vaginal portion of the uterus and extending into the cervical canal as far as the body of the uterus. A submucous myoma is also seen growing from the fundus. There is also a cyst of the left ovary. The uterus and adnexa were removed by vaginal hysterectomy.

Myomata very frequently undergo degenerative change. This may be either hyaline, fatty, or calcareous in character and in consequence more or less of muscular tissue is softened, converted into liquid or into an almost homogenous tissue

FIG. 82.
Multiple cysts formed in an intra-mural myoma as the result of degeneration.

which does not take the analine stains. The tissue after degeneration may be absorbed, with the result that a cavity or cavities of greater or less size are produced, or the tissue may undergo mucoid degeneration and be converted into mucin. They may undergo calcareous degeneration in which fine particles of chalky matter are deposited throughout certain districts of the tumor, converting this into a calcareous mass. These deposits of lime salts may also occur in regular order, thereby producing more or less of seemingly well-formed bone.

Uterine Myomata.—It will be necessary in order to get anything like a comprehensive idea of the myomata to take them up separately as they occur in the different organs and tissues of the body. In the furtherance of this plan we will consider first the myomata which take origin from the uterine tissue.

I desire in the first place to enter into a discussion regarding their histology. This is done in consequence of the

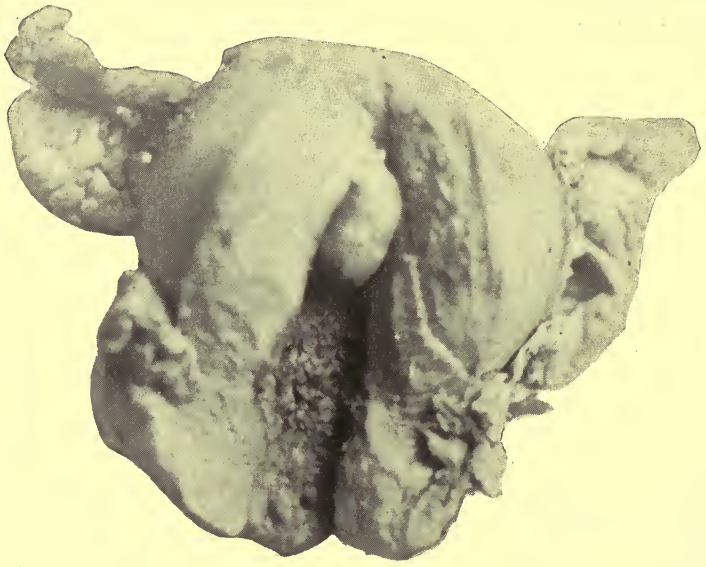


FIG. 83.

Epithelioma of the portio vaginalis uteri which has extended through the cervical canal; also a submucous myoma and a cyst of the left ovary.

seeming difference of opinion among writers, many holding that these growths are fibrous in character, others that they are fibro-myomata, while still others seem to have no well-defined idea as to their histological structure. In consequence of this uncertainty I have taken, without selection and as they came, twenty-five uterine tumors from the pathological laboratory of the Wisconsin College of Physicians and Surgeons and had microscopical sections made from them. From these

microscopical sections photomicrographs have been made which are herewith presented. These microscopical sections I have carefully studied, and here present their characteristics, which are in the main easily seen by a study of the photomicrographs.

Fig. 84 shows large muscular nuclei which in cross section are round, and in longitudinal section elongated. In a portion of the section which is shown in the photomicrograph

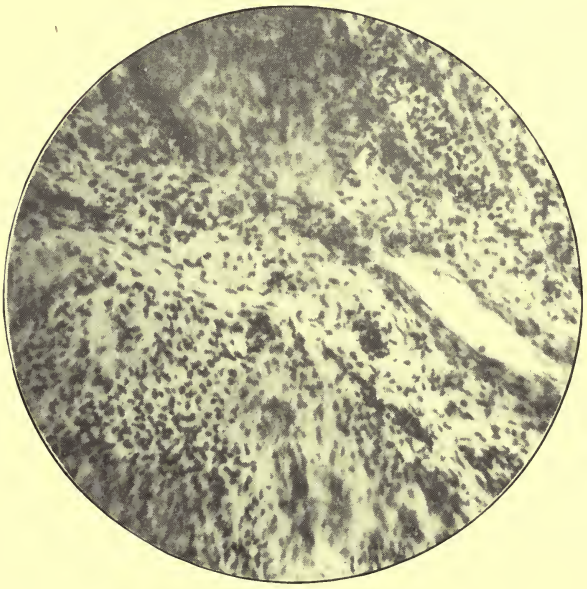


FIG. 84.
A photomicrograph of a uterine myoma.

the fibres are cut transversely and show only the nuclei. The specimen is almost wholly made up of muscular tissue.

Fig. 85. Here the photomicrograph shows the area to be made up almost entirely of muscular tissue, the nuclei being elongated and large. In the microscopical section, however, the specimen shows large bundles of muscular

fibres separated by and bound together with a small quantity of connective tissue.

Fig. 86. This specimen is rich in blood vessels and is made up of a loose connective or fibrous tissue. There are in this specimen a great many branching and round connective tissue cells and connective tissue spaces, but very little muscular tissue. The specimen also shows myxomatous de-

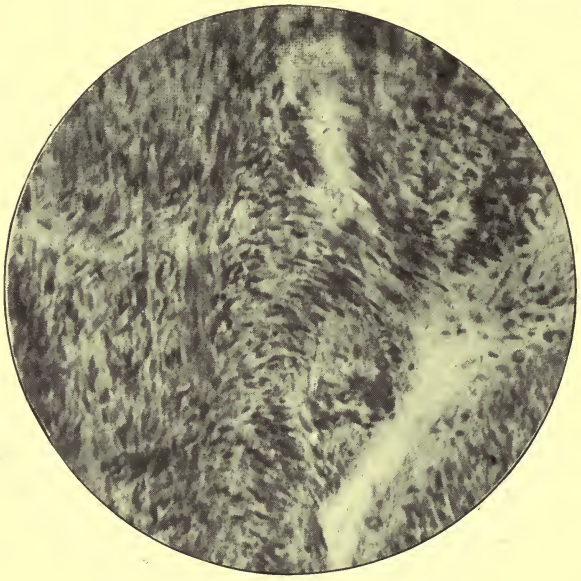


FIG. 85.

A photomicrograph of a uterine myoma. Cells and nuclei large.

generation. In other words, this is a soft or œdematous fibroma which has undergone myxomatous change.

Fig. 87 shows large and elongated nuclei. The growth is composed almost entirely of muscular tissue, the bundles of which are cut lengthwise and crosswise and separated by or bound together with a small quantity of connective tissue.

Fig. 88. The photomicrograph here speaks for itself, the nuclei where the tissue is cut longitudinally being very large and elongated. In those fibres which are cut transversely the nuclei are round and large. Some are cut diag-

onally, and consequently the form of the nucleus is correspondingly changed.

Fig. 89 shows little but muscular tissue, the nuclei being very large and much elongated. The white streaks in this specimen represent hyaline degeneration.

Fig. 90. In the photomicrograph the muscular tissue is cut transversely to a large extent. In some portions it is cut

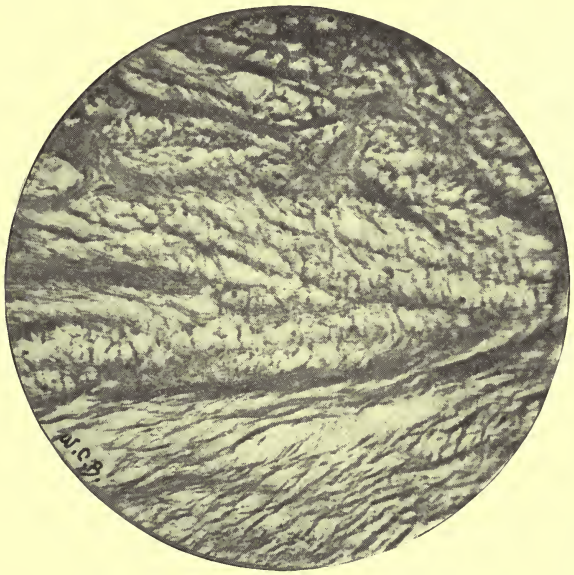


FIG. 86.
A photomicrograph of a soft uterine fibroma which has undergone myxomatous change.

longitudinally. A microscopical examination of the specimen shows that the tumor is composed almost entirely of muscular tissue in which the nuclei are very large. The white areas represent hyaline degeneration.

Fig. 91 microscopically shows great strands of muscular tissue with large nuclei.

Fig. 92. The photomicrograph here shows the tumor to be composed almost entirely of muscular tissue with large nuclei which are in part cut longitudinally and in part trans-

versely. The microscopical section shows the growth to be quite vascular, and upon one border is the uterine wall, the tumor being an intramural growth. It is interesting in this specimen, as in many of the others representing intramural growth, to study the histological structure of the tumor in comparison with the uterine tissue. In each and every case the uterine tissue shows less of muscular tissue with smaller

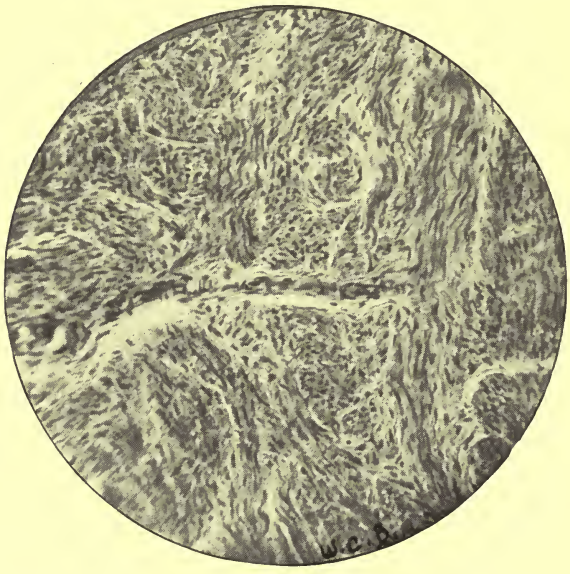


FIG. 87.
A photomicrograph of a uterine myoma.

fibres but more of fibrous tissue with greater compactness of structure than is the case with the myoma.

Fig. 93. In this section there are many whorls in cross and longitudinal sections, the fibres having large nuclei. There is also much hyaline degeneration. The tumor is almost entirely muscular in character.

Fig. 94. It is plain to be seen in this photomicrograph that the growth is composed almost entirely of muscular tissue, the nuclei being large and round when cut transversely,

and large and elongated when cut longitudinally. The white areas represent hyaline degeneration.

Figs. 95 and 96 are nearly all muscular.

Fig. 97. Here there are great patches of hyaline degeneration. The nuclei are large, elongated, and the tissue muscular in structure.

Fig. 98. This figure shows great strands of muscular tissue with very large and elongated nuclei when cut longi-

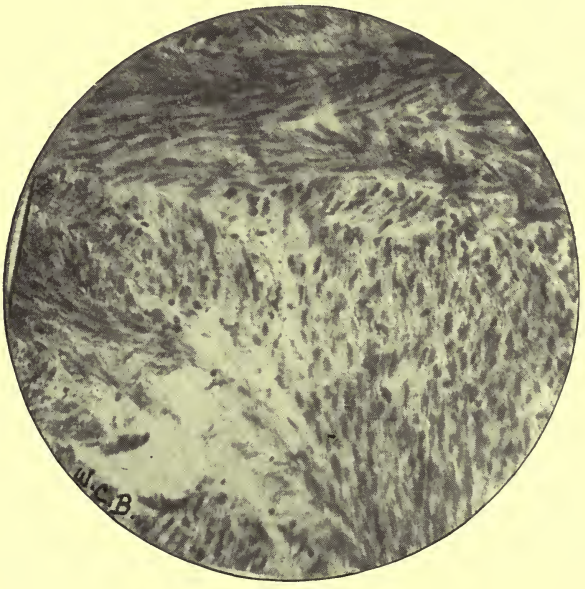


FIG. 88.
A photomicropraph of a uterine myoma. The white areas show hyaline degeneration.

tudinally and large round nuclei when cut transversely. There is, however, in the specimen marked areas of degeneration.

Fig. 99 shows hundreds of small muscular bundles cut crosswise and separated by fibrous tissue. In nearly the entire specimen the muscular fibres are cut transversely. There is also hyaline degeneration.

Not all of the twenty-five specimens are shown, but those

given are well representative of the whole. Out of twenty-five specimens carefully studied but one was found in which there was almost no muscular tissue and which could be called a fibroma. It is also curious to note the extent of the degeneration. Nearly every growth shows marked hyaline degeneration, in which there is a want of nuclear stain and which in the photomicrograph looks white. It is also readily noticed that there is a very great variation in the size of the

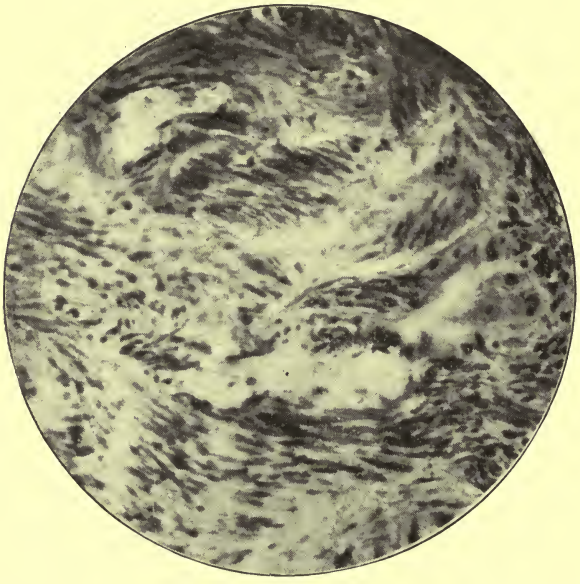


FIG. 89.

A photomicrograph of a uterine myoma. The cells and nuclei, large white areas show hyaline degeneration.

muscular tissue and nuclei. In a few this muscular tissue and these nuclei are so small that they might be mistaken for those of fibrous tissue, while in many they are extremely large, approximating in size the largest muscular fibres and nuclei. I think it may be reasonably stated from the examination of the foregoing specimens that the tumors which take origin from the uterus are in nearly every case myomata and not

fibromata or even fibro myomata, that they contain as a rule more of muscular tissue with larger fibres and nuclei than does the normal tissue of the uterus.

Fig. 100 represents a section of the uterine wall with an intramural myoma.

Situation of Uterine Myomata.— They are differentiated in accordance with their situation and occur primarily either within or beneath the mucous membrane, and project into

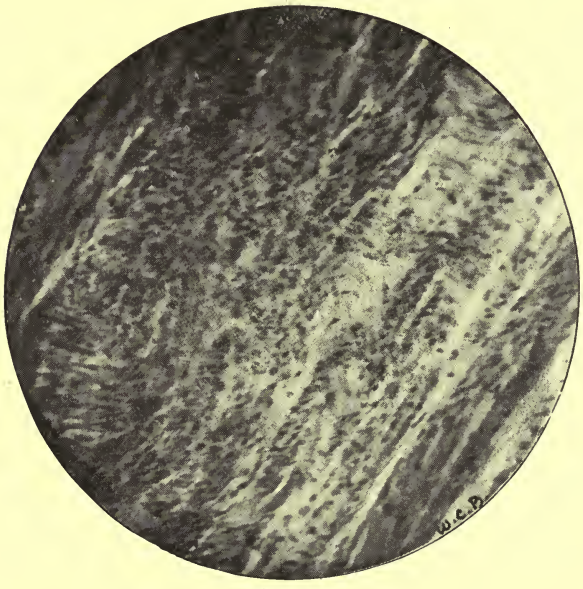


FIG. 90.
A photomicrograph of a uterine myoma. White spots and streaks show hyaline degeneration.

the uterine cavity as more or less pedunculated, submucous myomata, or they occur in the body of the uterus reasonably distant from both the mucous membrane and the peritoneum and show little or no disposition to approach either surface. These are the intramural or interstitial myomata. They are also situated directly beneath or adjacent to the peritoneum and project in their growth into the abdominal cavity, as subserous, pedunculated myomata. The symptoms which these

tumors produce in their growth are dependent very much upon their situation.

Age.—Myomata of the uterus are practically never observed before puberty and seldom before the twenty-fifth year. Kelly thinks that the uterine myomata probably exist during fœtal life, though not producing symptoms until after puberty. They occur quite frequently between twenty-five and thirty-five years of age, and perhaps most frequently

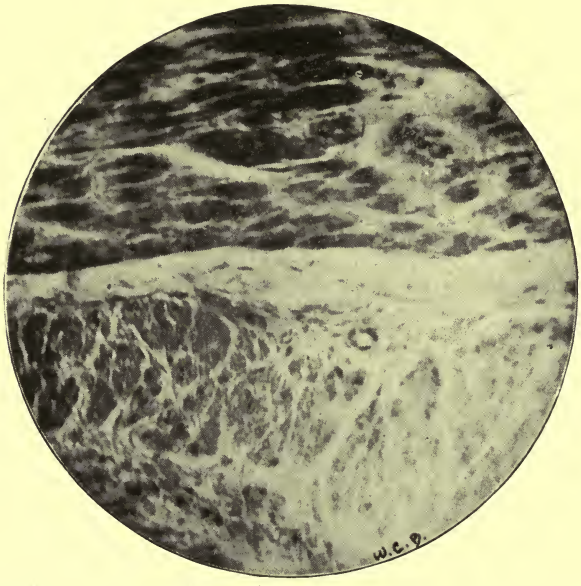


FIG. 91.
A photomicrograph of a uterine myoma. The specimen is almost pure muscular tissue.

between thirty and forty. They make their appearance very seldom after forty-five, or after the menopause, although in three patients now under the writer's care the first symptoms in one which led to an examination and the disclosure of an interstitial myoma occurred during her fifty-third year, some four years after the menopause. In another patient with multiple myomata of the uterus the first symptoms which led

to their disclosure were manifested at fifty-eight. In the third patient the first symptoms were manifested in her sixty-second year. One of these cases was operated upon and the diagnosis confirmed by a microscopical examination of the growth. The other cases are still under observation, although there can be little doubt of the correctness of the diagnosis.

Rate of Growth.—The growth of uterine myomata is extremely variable and depends upon their blood supply, their situation, the age of the individual, as well as upon the loose-

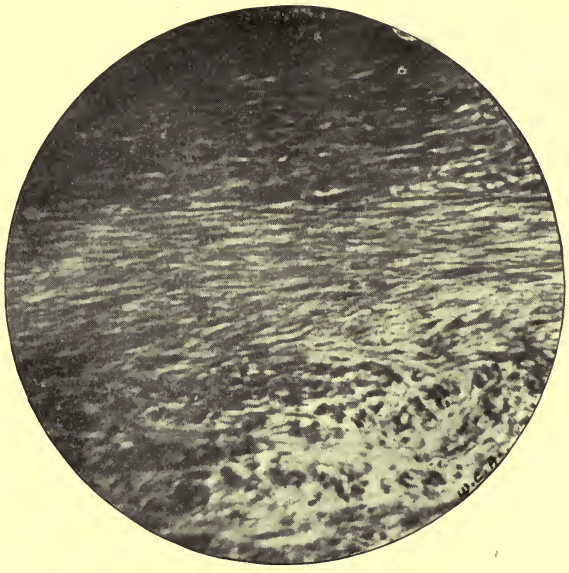


FIG. 92.
A photomicrograph of an intra-mural myoma, the growth is very vascular.

ness or density of their structure. Some writers hold that the amount of contained fibrous tissue influences markedly the rate of growth. Myomata ordinarily require from one to five years to reach any considerable size. Mathews Duncan's rule was that they might reach the size of a fœtal head in one year, a man's head in three years, and the uterus at full term in twelve years. Pedunculated tumors do not grow as rapidly as the sessile, while the interstitial have the most rapid growth of

all. A myoma which is extremely vascular or loose of texture may grow with marked rapidity, and in a few years produce great disturbance in consequence of its size and weight. The size of the uterine myoma is extremely variable and ranges from those which are not larger than a bird-shot to those which weigh from fifty to one hundred pounds. With the growth of a myoma there is always an hypertrophy and increase in growth of the uterine tissue and if the tumor lies

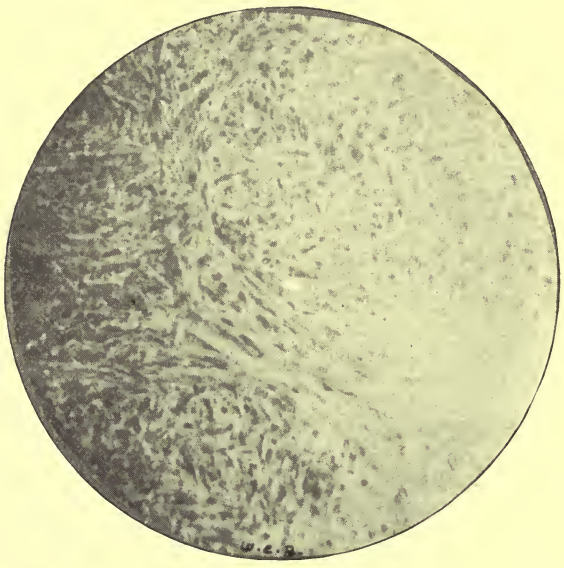


FIG. 93.
A photomicrograph of a uterine myoma. Specimen shows much hyaline degeneration.

near the mucous membrane there is an increase of thickness and vascularity of this tissue.

Myomata situated beneath the mucous membrane or peritoneum have a distinct tendency to project on the one hand into the uterine cavity and on the other into the abdominal cavity, and at the same time to become pedunculated. This pedunculation may be carried to such an extent that the pedicle becomes finally separated and the growth lies loose

either within the uterine or abdominal cavities. Growths which are interstitial and reasonably equally distant from the mucous membrane and peritoneum produce a more or less uniform or pear-shaped enlargement of the uterus. The submucous myomata are usually single, while the subserous are more frequently multiple, and when multiple they usually vary markedly in size. When growing from the submucous or sub-

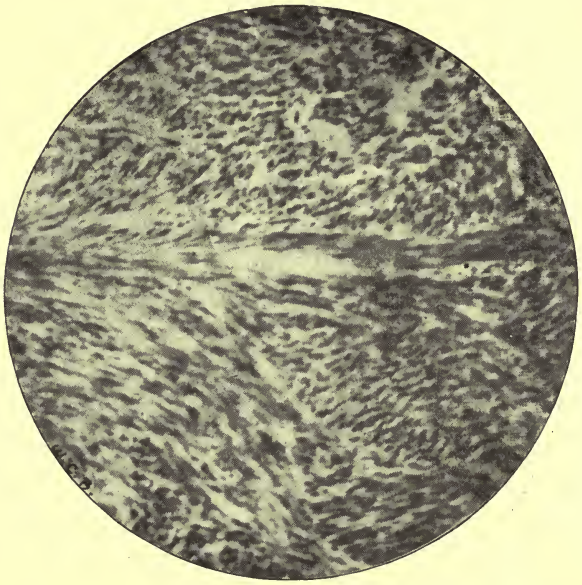


FIG. 94.
A photomicrograph of a uterine myoma. The cells and nuclei very large.

peritoneal tissue or membrane their pedicle may be long or short or the growths may be sessile.

SYMPTOMS AND CLINICAL COURSE.—It is practically agreed by all writers that uterine myomata do not exist or produce symptoms before puberty. It is very frequently the case that one or more of these tumors are present and grow for years without producing symptoms. In fact, it not unfrequently is true that the patient considers herself in the best of health, is free from pain and disturbances of every kind, and only becomes

aware of the existence of one of these growths when she observes her increase in size or accidentally feels the growth. Ordinarily, however, there are symptoms, and one of the first of these is pain which is menstrual in character, often severe, and not unfrequently the pain is attended with soreness in the pelvis and a feeling of weight and heaviness. Perhaps quite as frequently the first symptom is excessive menstruation, which occurs, according to Kelly, in fifty per cent. of the

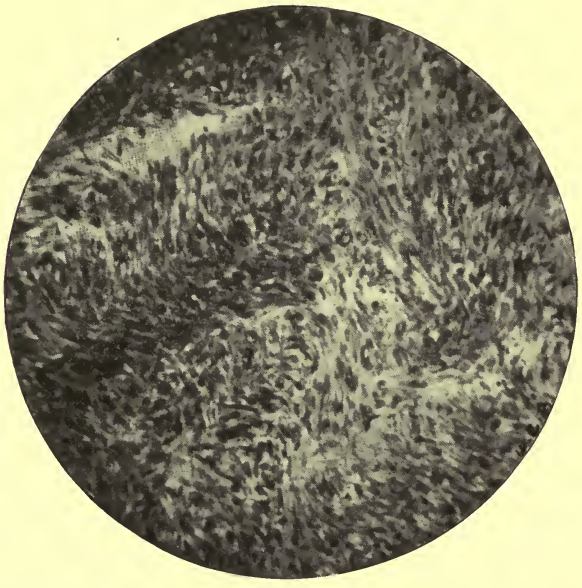


FIG. 95.
A photomicrograph of a uterine myoma. Cells and nuclei very large.

cases. Primarily this is simply an increased menstrual flow. Following this it becomes profuse, then excessive, and then its duration is lengthened often from three or four to eight or even ten days. Succeeding this the menstrual periods become more frequent, occurring every two or three weeks, and lasting a week or more, until finally the patient flows at least one-half of the time. As a result she becomes decidedly anæmic and pale with a yellowish skin, dilated pupils,

and colorless mucous membrane. At the same time there is often distress, vertigo, tinnitus aurium, dyspnœa, palpitation, great weakness, and heart murmurs and occasionally epistaxis. In married women sterility or repeated and early miscarriages are indicative of these growths. Not unfrequently in the history of a myomatous uterus inflammatory conditions more or less limited to the pelvis make their appearance. These inflammatory conditions are not only acute in course but septic

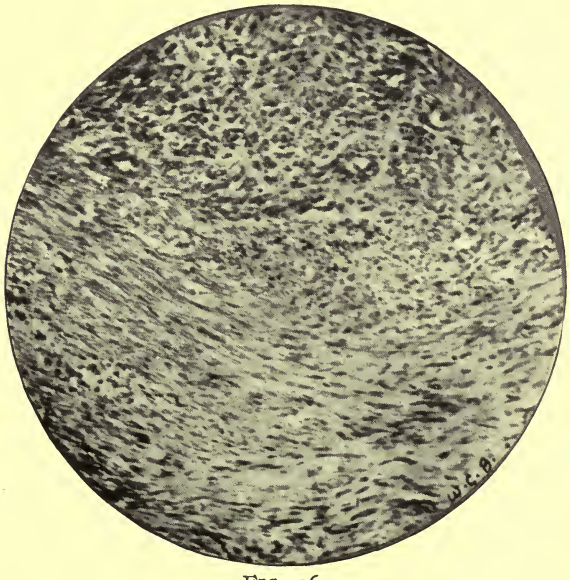


FIG. 96.

A photomicrograph of a uterine myoma nearly all muscular.

in character, and are attended with pronounced fever, severe pain and marked constitutional disturbances. The inflammation may be in the tubes or ovaries, and result in hydro- or pyo-salpynx or abscess of the ovary. The inflammation may result in the formation of abscesses adjacent to the tubes, or within the pelvis. It also occasionally happens in the history of a myoma that the growth itself becomes infected, this infection leading to a rapid increase in the size of the tumor,

pronounced pain, high fever, great debility, and perhaps to the formation of pus. This infection may result from the use of the uterine sound or from osmosis from adjacent organs. A case very recently came under the writer's observation in which the use of the sound was followed in a few days by high fever and great tenderness with increase in size of the tumor.

A myomatous uterus having reached a considerable size may produce such pressure upon adjacent organs as will be

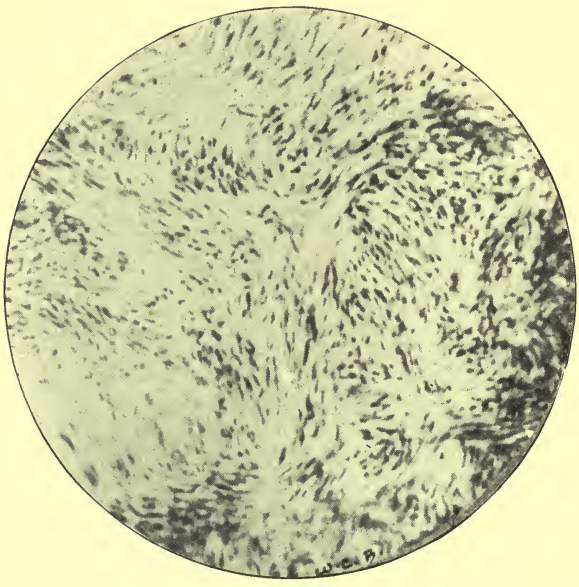


FIG. 97.

A photomicrograph of a uterine myoma. Specimen shows much hyaline degeneration.

painful, annoying, and even most serious in character. These growths when situated within and perhaps just filling the pelvis, may just at the time of the menstrual flow become considerably enlarged, congested, and then impacted, producing serious pressure upon the bladder or urethra and upon the rectum or ureters. A patient was recently under the writer's care with a uterine myoma which comfortably filled the pelvic cavity and caused no special disturbance except at the

menstrual periods when such pressure was exerted as to render the voluntary evacuation of the bladder impossible. It was with the greatest difficulty in this case that the bladder could be entered with a catheter. The pressure against the adjacent structures may at times produce severe pain. After rising out of the pelvis and resting on the pelvic brim the tumor may, in consequence of its weight, produce hydronephrosis or hydro-ureter, the former of which may pass into

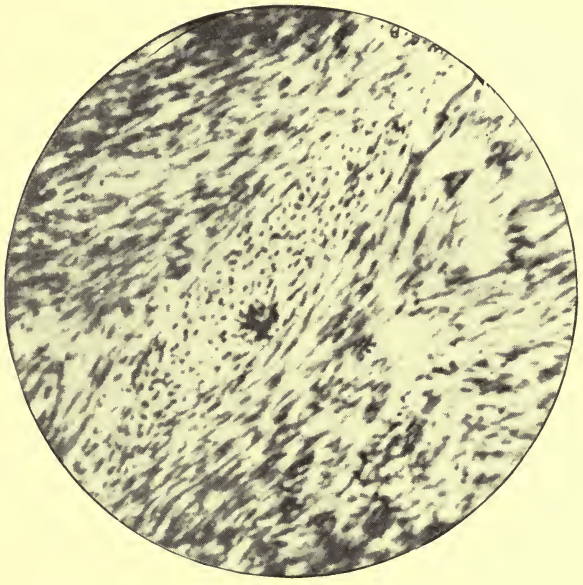


FIG. 98.
A photomicrograph of a uterine myoma. Specimen shows great strands of muscular tissue.

pyonephrosis in consequence of infection; or it may produce pressure upon the iliac veins resulting in œdema of the lower limbs; or upon the colon or intestines producing obstruction of the bowels; or upon the stomach or against the diaphragm interfering with digestion, nutrition, and even respiration. These tumors quite frequently, in consequence of their traumatism or pressure upon the peritoneum, produce circumscribed or localized attacks of peritonitis which are attended

with severe pain, tension of the abdominal walls, constipation, and it may be some degree of fever.

Pregnancy occurring in a myomatous uterus may lead to abortion, and if this does not occur, there is usually a marked disposition thereto, with frequent and severe uterine contractions which can be seen and felt, extreme pain, great sensitiveness and soreness of the uterus and of the growths. These neoplasms during pregnancy also take on a more rapid growth

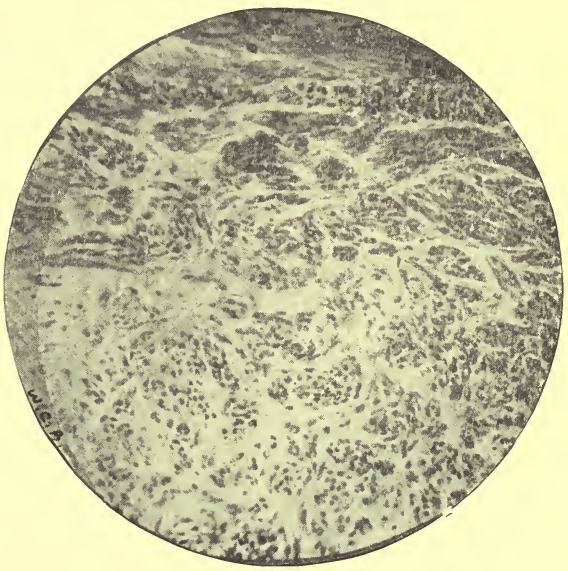


FIG. 99.
A photomicrograph of a uterine myoma; most of the fibres cut transverse. Hyaline degeneration.

in consequence of the irritation and increased blood supply. It occasionally happens in the course of a submucous myoma that it becomes extruded into the uterine cavity and its pedicle so elongated and stretched as to interfere with or arrest the circulation, and in consequence degeneration and necrosis occur in the growth and it comes away piece-meal, shredded and disorganized. In these cases, in consequence of asepsis and uterine contraction the tissue may be without infection

and the patient without fever. On the other hand, an arrest of circulation through the pedicle may cause gangrene of the growth, and infection following this may subject the patient to a most serious risk. The mass in the gangrenous state may be extruded into the vagina, where it may also cause septic complications.

ORIGIN AND ÆTIOLOGY.—Runge traces the origin of uterine myomata to round, indifferent cells. Virchow thinks they come from a hyperplasia of existing muscular fibres. Kleinwachter holds that they come from the middle coat of

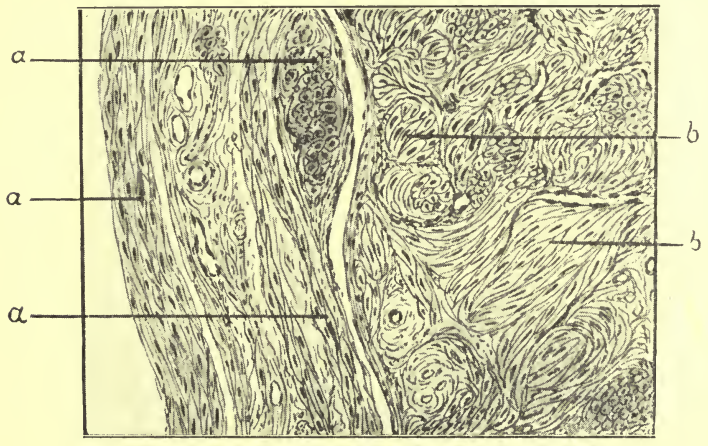


FIG. 100.
A microscopical section of an intra-mural myoma showing the uterine wall.
a. Uterine wall. b. Tumor.

the blood vessels. Hauser thinks they take origin in some cases from the remnants of the Wolffian ducts. They are probably never congenital, although Beigel found one in a child ten years of age. The majority of writers, and especially of pathologists, hold that they occur more frequently in the unmarried than in the married, although Senn states that uterine myomata are more frequent in married women than in single. Occurring as they do after puberty there can be no doubt but that the congestion and irritation incident to

periodical menstruation is the great exciting cause. They are often due to heredity and when so are often found in almost every female member of many successive generations. They are held by some to be produced by over-nutrition resulting from unnatural excitement or irritation. There is little doubt but that inflammatory processes, increased blood supply from natural or unnatural causes, unusual irritation, excessive, irregular or painful menstruation are frequent causative factors in the production of these growths. It is held by some that the rest which married women obtain, during lactation, from the periodical attacks of uterine congestion is a great factor in the prevention of growths of this class. Their ætiology is probably not dissimilar to that of other benign neoplastic tumors.

Diagnosis.—The physician's attention may be called to the possibility of a uterine myoma by the occurrence of symptoms which have already been given, such as excessive and frequent menstruation, severe pain, and, in married women, sterility or abortion. Nothing, however, short of a physical examination will render a diagnosis secure. Ordinarily if the abdomen is not excessive in thickness or tense a bimanual examination will readily establish the presence or absence of a myoma or myomata. This is especially true if they be subperitoneal, when under ordinary conditions they can be readily outlined and their relation to and connection with the uterus defined. The forefinger of one hand in the vagina may be swept over the anterior and lateral surfaces of the uterus while the fingers of the other palpate its posterior surface. It is often of the greatest advantage to explore the posterior surface of the uterus through the rectum.

Tumors which extend into the broad ligaments must be differentiated from tense ovarian cysts, from dermoids, and from extra-uterine pregnancy. The ovarian cysts and dermoids under ordinary conditions will be freely movable from the uterus, the latter is likely even early to displace the uterus, while an extra-uterine pregnancy will not be so well-

defined, will be less movable, more sensitive, often posterior to the uterus, and give an entirely different history. Intramural tumors produce a pretty regular and pear-shaped enlargement of the uterus which may reach almost any size, the growth often being uniform, regular and smooth. The condition must be differentiated from pregnancy.

Submucous myomata also increase the size of the uterus. They are likely to be single and to cause excessive, prolonged and frequent menstruation. If they become decidedly pedunculated, and the pedicle is long, the uterus in contracting forces them in part or entirely through the cervix, where they can be felt and often seen. It is often desirable in carrying out the examination to place the patient under an anæsthetic or to repeat the examination.

Myomata ordinarily impart a feeling upon examination which is distinctive. They are very hard and of uniform consistency, being much harder than a pregnant uterus or a cyst. Occasionally, however, a myoma may be cystic, very vascular, or quite soft. Intramural and submucous myomata distort and elongate the uterine canal and often by dragging upon the uterus elongate to a very considerable extent the vagina. Intra-ligamentous growths of every kind are especially liable to displace and distort both the uterus and the vagina.

Prognosis.—It has been truthfully stated by Matthews Duncan that patients suffering from large uterine myomata seldom reach old age. The prognosis depends upon the rapidity of growth, and upon the complications which arise. As has already been stated, many patients live for years without manifesting symptoms or any ill effect as the result of the growth of these tumors. The fact, however, must be recognized that although for a time they seemingly are not incompatible with perfect health, they nevertheless expose the patient to a very considerable variety of serious risks.

The most frequent cause of death in uterine myomata is hæmorrhage. The loss of blood may cause death in a short time or remotely through anæmia or fatty degeneration of the

heart, or other intercurrent complications. Many a patient is worn out from exhaustive hæmorrhages, severe pain, loss of sleep, and inability to take a proper amount of nourishment.

Rotation or torsion may occur about the vagina or cervix in intramural growths, or a twisting of the pedicle and strangulation in subserous and submucous tumors, resulting in serious consequences. Infection produces high fever, great constitutional disturbance, and occasionally, unless interference is instituted, the death of the patient.

Impaction or incarceration within the pelvis may produce serious pressure upon the bladder or ureters, and tumors of large size which have risen out of the pelvis may also cause pressure upon the ureters and pyonephrosis with its attending dangers.

Pregnancy occurring miscarriages are frequent and there is seemingly more or less metritis almost constantly present during the term of pregnancy. Localized attacks of peritonitis are also frequent in this class of cases. Then not unfrequently as a complication pyosalpynx or abscess in the neighborhood of the Fallopian tubes occurs. While the growths are small and if the patient does not become pregnant or suffer infection there is little danger, and the prognosis is consequently good, but with large growths the patients are constantly subject to a great variety of very serious risks.

Treatment.—The treatment of myomata of the uterus may be considered under one of three heads: expectant, palliative, and surgical. Every uterine myoma of small size and slow growth which is not producing symptoms should be treated expectantly. It is a well-established fact that uterine myomata following the menopause often either remain stationary, diminish in size, or entirely disappear. The writer could point in his own experience to a large number of myomatous growths which have thus gradually disappeared after the cessation of menstruation. One case in particular which was examined a few days since in which ten years ago there

was a myomatous uterus which reached to the umbilicus and which now, some five years after the cessation of the menstruation, has entirely disappeared. In consequence of such facts these growths at this period of a woman's existence, unless there are pronounced indications to the contrary, should be treated expectantly. Patients who have chronic nephritis, consumption, diabetes, or other incurable disease which is likely to terminate fatally within a few years, and who are suffering from myomata, should under ordinary conditions receive expectant treatment.

Palliative Treatment.—This treatment is instituted for the relief of symptoms such as hæmorrhage, pain, impaction, or pressure. Hæmorrhage my be controlled in part or wholly by rest in bed, the administration of ergot, or by curettement. When we remember that the tumors which produce hæmorrhage are usually situated either interstitially or beneath the mucous membrane and that they produce congestion, hypertrophy, and an increase in the number and size of the blood vessels of this membrane it is easily seen that a curettement, by relieving the hypertrophy and destroying the blood vessels, may often be of the greatest service. Curettement, however, is often difficult in consequence of the elongated and tortuous cervical canal, but when it can be practiced, with a subsequent swabbing of the uterine cavity with pure iodine, with or without a packing with iodoform gauze, it will often control for weeks or months, or perhaps permanently, the most distressing hæmorrhage. The writer has seen as a result of curettement in these cases a most exhausting and alarming hæmorrhage permanently arrested. Galvanism has been used by many for the same purpose and with the same happy results.

Tumors which in consequence of impaction in the true pelvis are producing pressure symptoms upon adjacent organs should by position or by vaginal pressure be forced out of the pelvis into the general abdominal cavity. It often happens that patients suffering from smaller growths which are producing heaviness, weight, and dragging in the pelvis, with

symptoms of vesical irritation, may be relieved of much of their distress by vaginal tampons or by the use of a suitable support. In cases in which there has occurred a mild degree of uterine infection, perhaps as the result of the passage of a sound or from osmosis from adjacent organs, rest in bed with hot vaginal douches and the administration of ergot, accompanied with free evacuation of the bowels, will often be of the greatest service and will frequently suffice to put the condition under control in a few days. In cases of localized pelvic peritonitis the result of traumatism, incident to the growth and pressure of subserous tumors, rest with the application of heat to the abdomen and the use of small doses of morphine may afford much comfort and be of the greatest benefit to the patient.

Indications for Radical Treatment.—It has been already stated that myomata of small size which are growing slowly and not producing symptoms should be treated expectantly. On the contrary, myomata of medium size which comfortably fill the pelvis, whether they be single or multiple, and which have had a decided growth during a few months of observation, and which are likely to produce symptoms from pressure, should be removed. Myomata which are of sufficient size so as to produce serious or painful pressure upon the urethra, bladder, rectum, ureters, vessels, or nerves within the pelvis should be removed. Myomata which are large and which may produce pressure upon the colon or stomach or disturbances of the gastro-intestinal canal, or pressure upon the ureters with hydroureter or hydronephrosis, or pressure upon the iliac veins, should be removed. Myomata which are growing rapidly, and those which are causing severe pain, or invalidism, should be removed. Myomata which are causing severe hæmorrhage which is not controllable by rest, the administration of ergot, curettage, or galvanism, should be removed. Myomata which have become infected and have increased greatly in size, with pronounced constitutional disturbances, and in which the condition is not relieved by rest, should be removed. Myomata which have suffered torsion

of their pedicles or where there is torsion or rotation of the vagina or cervix, should be removed.

The radical treatment may be considered under three heads, Myomectomy, Hystero-myomectomy, and Pan-hysterectomy.

Myomectomy.—By myomectomy is meant the removal of the tumor itself with the preservation of the uterus, tubes, and ovaries. This method should always be practiced if the

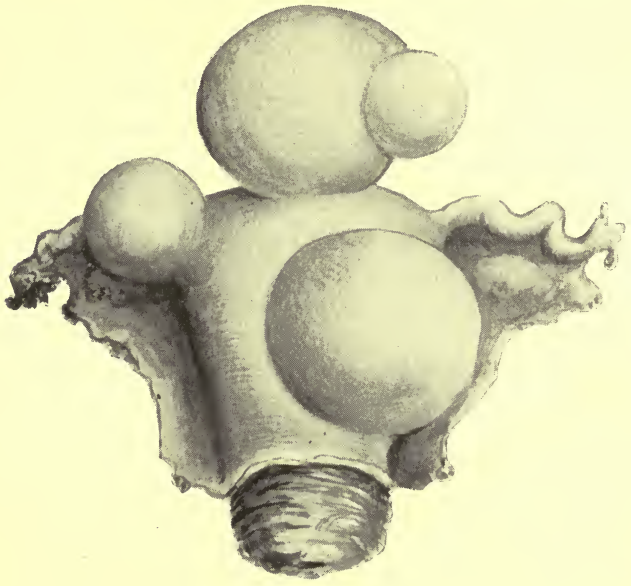


FIG. 101.
Myomata of the uterus.

conditions are favorable and the patient under forty-five years of age. It not only preserves important organs and functions, thus preventing a premature menopause with its distressing train of symptoms, but it also often preserves to the woman the possibility of child-bearing. Tumors which are especially suitable for this method of treatment are the subserous, pedunculated growths, no matter what their size or number. The more distinctive the pedicle

the easier the technique. Sessile growths may also be removed with perfect confidence, as well as intramural tumors which are distinctly definable, well circumscribed, and which are not too large. In the removal of subserous, pedunculated growths, after opening the abdomen by free incision, and, preferably, with the pelvis elevated, the tumor should be seized with strong forceps and delivered through the wound, when large gauze pads are packed beneath the pedicle and about the wound so as to protect the intestines and other

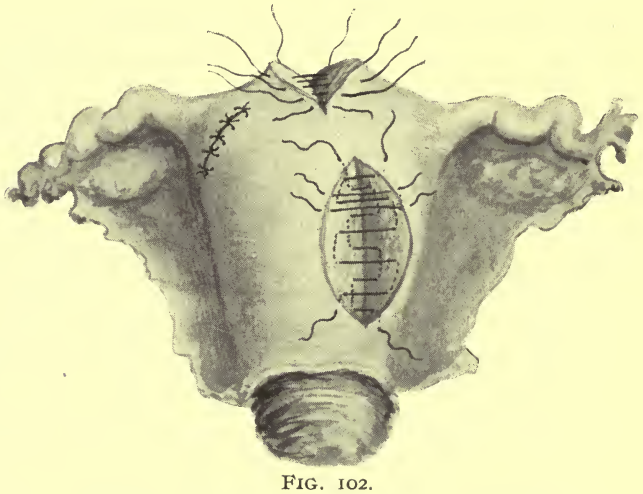


FIG. 102.
Method of closing wounds after myomectomy.

organs or tissues from exposure, injury or possible infection. A V-shaped incision should then be made through the base of the pedicle, either before or after controlling the circulation with forceps or by preliminary ligation of the base of the pedicle, and the tumor removed. The V-shaped incisions are then united by interrupted, through-and-through sutures, or the parts are coapted layer by layer with a continuous catgut suture, which is finally made to coapt the peritoneal covering. (Figs. 101, 102.) The greatest care must be exercised in bringing the surfaces together to do it evenly and nicely

and to control absolutely every bleeding vessel. With asepsis and the barring of accidents and shock the only risk which the operation has is that of hæmorrhage, and this can under ordinary conditions be easily controlled either by previous ligation of the pedicle close to the uterine wall, by picking up and separately ligating the bleeding vessels with fine catgut in the line of the incision, or by carefully and firmly coapting the entire cut surfaces.

In myomata which are more or less sessile and which project into the uterine tissue, and especially those which are interstitial, the problem of closing the wound after enucleating the growth is a much more serious one. If the cavity is only of reasonable size it can be readily closed by catgut sutures, but if the cavity is large any method will be attended with more or less difficulty, uncertainty and liability of subsequent bleeding. This question as to how far one can go in the removal of sessile, and especially interstitial, growths with safety is an important one. If the method is practised with safety the cavity must be completely obliterated. There can be no dead spaces to invite hæmorrhage and infection. The larger the cavity the greater the difficulty in coapting the surfaces and the more likelihood of subsequent hæmorrhage or infection.

Under ordinary conditions myomectomy should be reserved for pedunculated and sessile growths irrespective of size and number, and interstitial growths which have not reached any very considerable size. With these limitations and with proper hæmostasis the operation has everything to commend it.

Myomectomy may be contraindicated in severe anæmia from hæmorrhage and is contraindicated where there are inflammatory conditions and especially in septic processes in the adnexa or malignant processes in the uterus.

Hystero-myomectomy, or Supravaginal Amputation of the Uterus.—In doing this operation, unless the woman be near or beyond the menopause, one or both ovaries should be pre-

served. The operation is especially indicated for interstitial myomata of large size in which should enucleation be practised there would be left such a cavity in the uterine wall as to make its obliteration by suture difficult, hazardous, or impracticable. (Figs. 103, 104.) It is also practised in cases of myomata, single or multiple, which are not well defined or easily outlined, or where they are multiple in number and associated with submucous myomata which cannot be easily

FIG. 103.
Hystero-myomectomy.
c. Amputated cervix. a. Sub-serous myoma.
b. Intra-mural myoma.

reached. It may also be indicated in cases of severe hæmorrhage. The operation can ordinarily be easily and quickly performed and it is one which, when not attended with complications, has a very low rate of mortality. It is ordinarily done by the writer where there is no indication to save the ovaries, as follows: After opening the abdomen and delivering the tumor or uterus the first ligature is applied to the broad ligament near the pelvic wall, and outside of the tube and ovary and made to include the ovarian artery and large veins which lie together and upon the same plane at the

top of the broad ligament. This bunch of vessels is picked up with the thumb and finger and the aneurysmal needle carrying a strong ligature passed beneath the vessels, when the ligature is securely tied. A pair of hysterectomy forceps is then placed centrally to the ligature and the tissue between them divided. A second ligature is made to include the round ligament which, with its adjacent structures, is more or less vascular and requires ligation. A pair of forceps is again

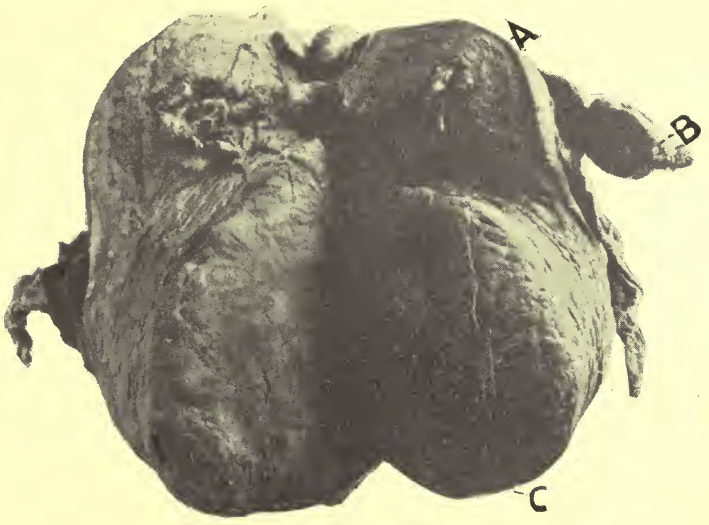


FIG. 104.
Hystero-myomectomy.
a. and c. Intra-mural myomata. b. Fallopian tube.

placed near the uterus and the round ligament, with the tissues included, incised. A third ligature is made to hug the side of the uterus at the point of reflection of the peritoneum onto the bladder and includes all the tissues in which are the anastomosing branches between the uterine and ovarian arteries. By passing the third ligature at the side of the uterus the uterine artery is controlled without cutting off its supply to the cervix, which is important in order to prevent excessive atrophy or degenerative change. At the

same time the ligature is far enough removed from the ureter to prevent the possibility of injury to this important structure, while it controls absolutely the hæmorrhage. The same process is then carried out upon the opposite side. An incision is now made across the front of the uterus just above the blad-

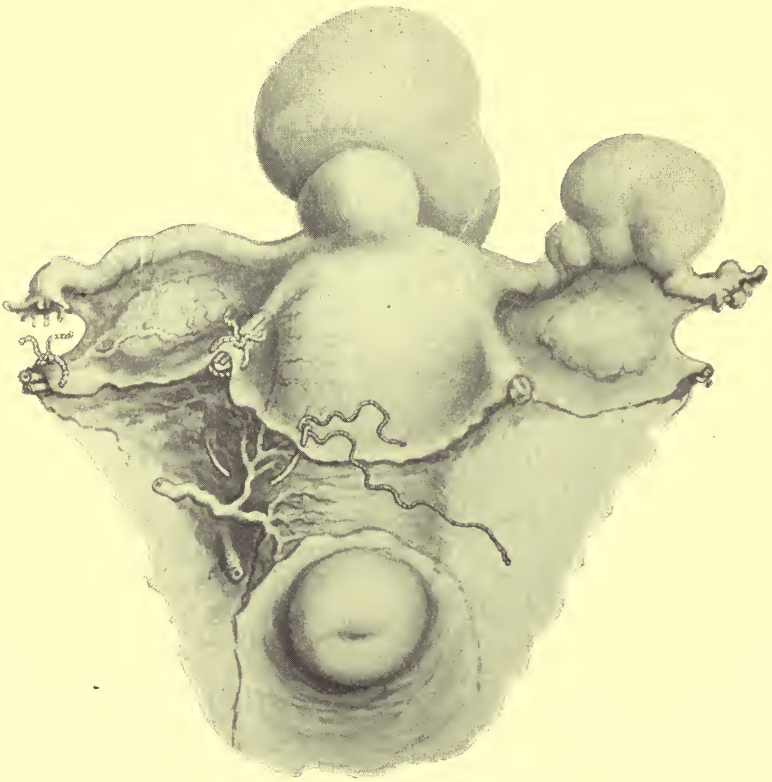


FIG. 105.
Needle shows place where anastomosing branch of uterine artery is tied.

der and this organ reflected downwards for an inch or more. The cervix is then cut through as far as the uterine cavity by a V-shaped incision. The uterus is then carried forward when a like incision is made posteriorly and the uterus removed. The tissues of the cervix are then united by catgut sutures, a sufficient number being passed from before back-

wards through the entire tissues so as to coapt the surfaces and to prevent the possibility of hæmorrhage, or the cut surfaces of the cervix may be united by a continuous catgut suture in tiers. (Fig. 105, 106.)

Complications of Hystero-myomectomy.—While the uncomplicated operation is easy of execution and has a low death rate the one attended with complications may be most difficult, tedious, and hazardous.

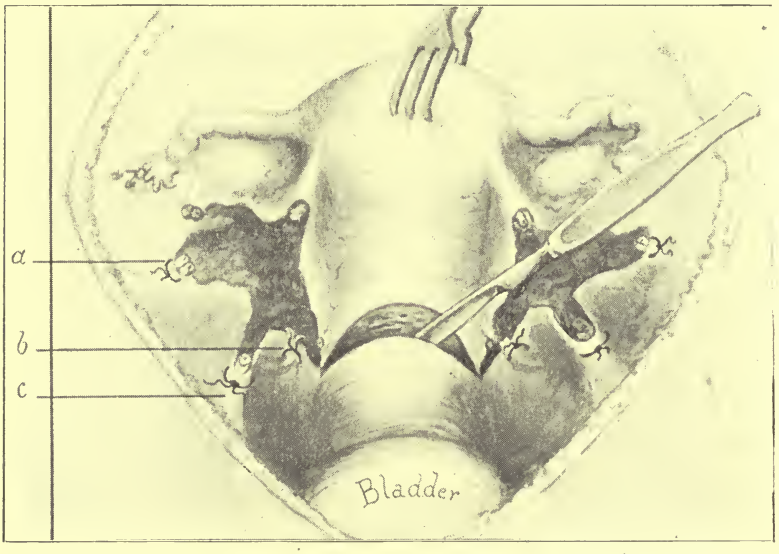


FIG. 106.
Hystero-myomectomy showing ligation of vessels and amputation of cervix.
a. Ovarian artery. b. Uterine artery. c. Round ligament.

Inflammatory adhesions. These may bind down or embed the tubes and ovaries and perhaps cover them snugly with omentum or connect them with the appendix, bowel, or pelvic wall. The first step here should be to deal with the complications. Where there are simply adhesions to adjacent organs or embedding of the tubes and ovaries in a mass of plastic exudate, they should be carefully enucleated from

the structures posteriorly and externally by intelligently following with the tips of the fingers the points of least resistance. In this way they can be separated from the omentum, adjacent bowel, or pelvic wall and lifted out of the pelvis. The operation is then proceeded with in the usual way.

In cases of hydro- or pyosalpynx, and especially in the latter, great precaution should be exercised before enucleating the tubes in consequence of their possible rupture; that the bowels be well protected by pads of sterilized gauze, or sterilized towels, from accidental infection. The same methods of treatment are applicable in cases of ovarian abscesses in order to prevent if they rupture infection of the general peritoneal cavity. Where circumscribed collections of pus exist adjacent to a pyosalpynx or in the pelvic cavity it will be often impossible to enucleate the masses without breaking directly into the abscess cavities. In these cases not only should the greatest precautions be exercised in having the abdominal contents protected by gauze from infection, but the abscess cavity should if possible be aspirated before being broken into. When broken into the pus must be removed as completely and rapidly as possible by gauze sponges. Such a case is best dealt with by removing the entire uterus, following which the pelvic regions are most carefully mopped out, the gauze protectives removed, and the whole pelvis then flushed with a normal salt solution. Drains of iodoform gauze should be placed in the vagina and suprapubicly. Such a condition is represented by Fig. 107. A young woman aged thirty-five had suffered for years with a large and gradually growing intramural myoma, associated with several small subperitoneal growths. The uterus reached above the umbilicus, and in its growth had been complicated by several attacks of acute pelvic peritonitis attended with great pain, high fever, sweating, and the general symptoms of septicæmia. Upon opening the abdomen there was little to be seen except a mass of adhesions and adherent intestines. In endeavoring to enucleate the right ovary and tube an ab-

scess cavity containing several ounces of pus and situated alongside of the tube was broken into. The tube was very long and was as large as an adult's finger. The pus was quickly removed with sponges, the intestines having been previously well protected by gauze from infection. The hands were also thoroughly washed before proceeding further. In uncovering the left tube which reached down into the pelvis

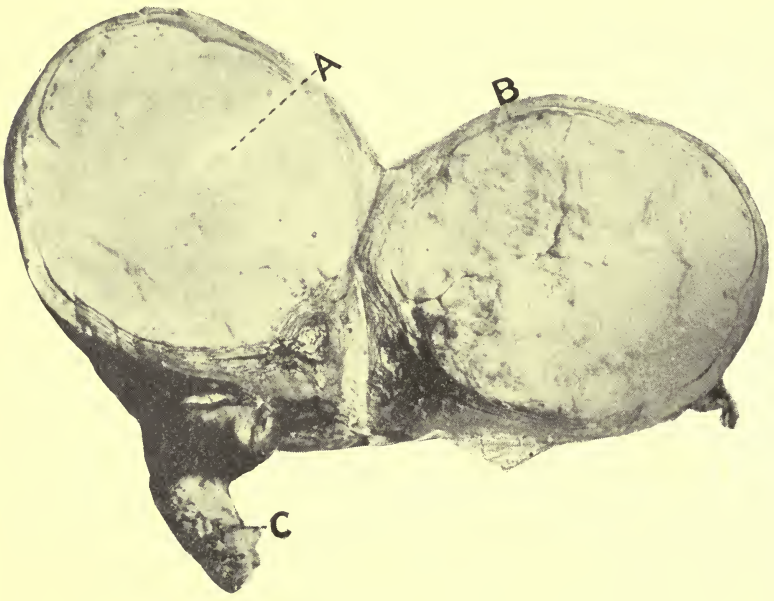


FIG. 107.
Panhysterectomy.
a. Intra-mural myoma. b. Uterine wall.
c. Enlarged Fallopian tube.

a much larger abscess was broken into. This pus was sponged away as best we could from the field of operation. The left tube was very large and long. The broad ligaments were then tied off and the entire uterus removed. The pelvic cavity after being sponged out was flushed with a normal salt solution and gauze drains placed in the vagina and suprapubicly. The patient made an uninterrupted recovery.

Tumors which are situated in or near the fundus of the

uterus are most easily dealt with and present the fewest complications. Tumors which are situated in the body of the uterus and which reach any considerable size displace the tubes, ovaries and ovarian vessels, making their direction perpendicular rather than transverse. In these cases the vessels hug the sides of the tumor very closely, are often spread out, and not always easily defined. They, however, come together near the wall of the pelvis beneath the sigmoid flexure or cæcum, and here they can be gathered up with the fingers and ligated.

Tumors which take origin from the cervix either anteriorly, posteriorly, or lateraly, as wellas those which grow into and separate the broad ligaments or raise the reflected portion of the peritoneum from the pelvic floor present in their operative technique the most difficult problems encountered in the removal of this class of growths. The neoplasms growing from the cervix in front beneath the reflected portion of peritoneum may grow over the bladder, raising its peritoneum and pushing the bladder down beneath the symphysis. They may also grow downwards beneath the bladder and push this organ upwards and forwards until perhaps it reaches the height of the umbilicus.

In this class of tumors one should constantly be on his guard and note accurately if the bladder is situated over the tumor and rises high in the abdomen. If the growth is simply raising the reflected portion of the peritoneum and producing pressure upon the bladder which is beneath the pubes, it may be enucleated in the usual way after incising the peritoneum. If the growth is beneath the bladder a cross cut must be made from near the origin of the round ligaments, the operator being extremely careful to cut above the upper portion of the bladder. This organ is then gradually separated by a blunt dissection through the cellular tissue and pushed down and over the growth by pressing it down carefully with gauze sponges. No great force is permissible, as the walls of the bladder in these cases are very brittle and

easily torn. Having released the tumor from its covering it may be removed by enucleation or hystero-myomectomy.

Growths which take origin from the posterior surface of the cervix may not only raise the reflected portion of the peritoneum from the pelvic floor, but get beneath the sigmoid flexure and perhaps become impacted in the pelvis. They often present extreme difficulties in their removal, in that the isolation of and ligation of the ovarian vessels represents at times a complicated technique. If the ovarian vessels cannot be secured beneath the sigmoid flexure or near the uterus, Kelly recommends that an incision be made in the peritoneum as it is reflected from the sigmoid onto the tumor on its outer side. The finger is introduced into this opening and an effort made to separate the bowel from the growth and reach the ovarian vessels. If this cannot be done it may be possible to drag the tumor to the right and ligate the vessels near their entrance into the uterus. If this can be done an effort is made to secure the uterine artery, after which the cervix may be divided and the vessels on the opposite side ligated, or the operation may be commenced by ligating the vessels upon the right side, and then dividing the cervix, when the uterine artery is secured and the tumor rolled out and unfolded from its peritoneal covering, when the ovarian vessels are ligated and the tumor removed.

In tumors which project upon the right side the operation may be commenced by ligating the broad ligament on the left, securing the uterine artery and then incising the cervix and securing the uterine artery on the right, and as the tumor is rolled out of its bed the ovarian vessels are secured.

Some of the smaller myomata situated low down in the cervix may be attacked and removed through the vagina by an anterior incision with a separation of the bladder, or by a posterior incision into Douglas' cul-de-sac.

Tumors which grow into and separate the folds of the broad ligament distort, displace, and separate the constituent parts such as the tubes, round ligaments, ovarian vessels, and

ovary. These growths if situated near the fundus and if pedunculated or even sessile may often, either with or without previous ligation of the ovarian vessels at the side of the pelvis, be enucleated by simply making a longitudinal incision through the top of the broad ligament and then with the finger separating the tissues from the growth, while it is

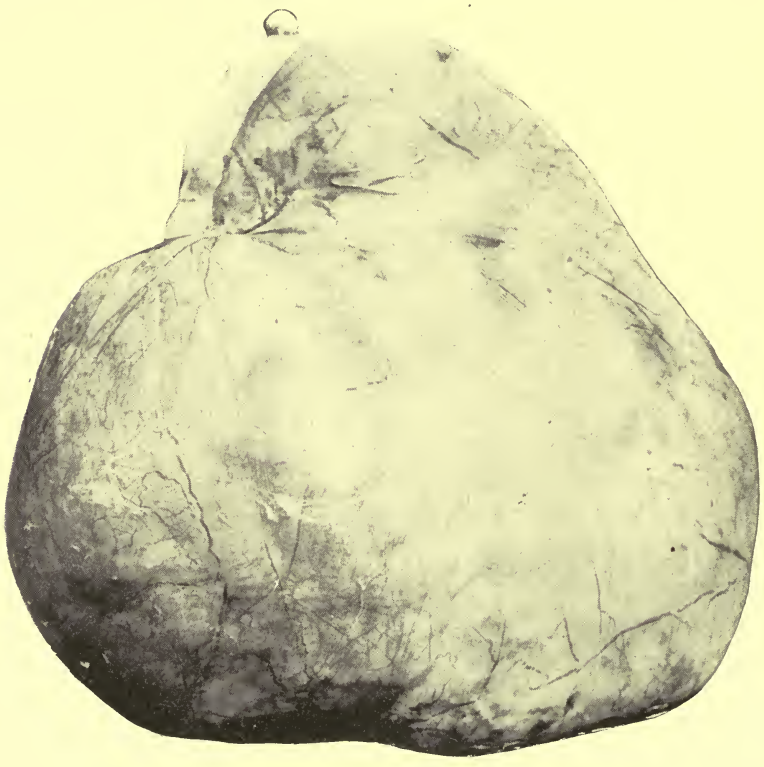


FIG. 108.
An intra-ligamentous myoma.

dragged out of its bed. Fig. 108 represents an intra-ligamentous growth which was enucleated from the right broad ligament almost without tying a vessel. The uterus, tube and ovary were not disturbed.

The remaining sac represents sometimes a serious com-

plication. It may be obliterated by continuous catgut sutures or brought to the abdominal wound and lightly packed and drained with iodoform gauze. In some of these cases even if the tumor is situated low down and sessile or embedded in the uterus an enucleation may be done instead of a hystero-myomectomy.

Myoma of the Uterus with a Cyst of the Broad Ligament. This combination may present a serious complication and one difficult to be dealt with. The method of procedure will depend very largely upon the relation of the cyst to the uterus. Ordinarily the myomatous uterus should be dealt with first, and following this the cyst enucleated. It may be necessary in some cases to tap and then enucleate the cyst in order to obtain room to deal with the uterus. The following interesting case was recently operated upon by the writer: Miss S., aged twenty-eight, had noticed during several months a decided increase in the size of the abdomen. On examination it was discerned that a tense, globular tumor not only filled the pelvis extending down to the perineum, but also partially filled the abdomen, extending as high as the umbilicus. In making a pelvic examination one finger could be passed partially by the tumor along the vagina which hugged the left pelvic wall. The tumor presented an indistinct sense of fluctuation. To the left and above the tumor was a hard, irregular, movable mass which reached to the ribs. On opening the abdomen this mass was seen to be a myomatous growth which had been carried up to and almost under the ribs by a broad ligament cyst developing under it. The uterus contained four myomata, three subperitoneal, and one large intramural growth. The uterus was amputated through the cervix, leaving the left ovary. The cyst wall was then exposed by a slit in the broad ligament, tapped, and slowly and with difficulty shelled out of its bed. The cyst wall was very brittle and tore repeatedly. In the pelvis it was intimately attached to the floor and to the wall of the vagina. (Fig. 109 represents the growth removed.) The cavity

left by the enucleation was so large that it seemed best to drain it. The pelvis was drained through the vagina. The cervix was stitched near the lower part of the wound and the upper layer of the broad ligament was united just above this. A considerable quantity of iodoform gauze was packed into the cavity. Drainage had to be maintained for a considera-

FIG. 109.
a. Intra-ligamentous cyst. b. Myomata of uterus.

ble time as the large sac obliterated slowly. Otherwise the patient made an uninterrupted recovery.

Impacted Tumors.—These often present complications in that it is difficult to release them from their incarceration, and while unreleased it is almost impossible to secure by ligature the broad ligaments. Such a growth should be seized

with strong forceps and if it cannot be dragged out while gentle rotation is made an assistant should, by making pressure with two fingers in the vagina, force it out of the pelvis. By this means they can be released from the pelvis into the abdomen, where they can be dealt with.

Pregnancy and a Myomatous Uterus.—This condition is not likely to occur where the growths are large or situated near the mucous membrane, but frequently occurs where the myomata are small and especially if they are situated beneath the peritoneum. If the myomata are not large nor growing from the neck of the uterus where they might obstruct labor they should be left undisturbed. Small and multiple intramural or subperitoneal myomata although predisposing the patient to abortion may and often do produce nothing more than severe, cramp-like pains with uterine contractions which often are readily relieved by rest and opiates. Tumors situated upon the uterine neck if of some size are likely to be serious obstacles to delivery. They may be removed at any time, but preferably toward the close of the term, either through the vagina or through the abdomen. If the growths are projecting into the parturient canal and are of such size and number as to require a hystero-myomectomy they may be left until about the termination of pregnancy when the child should be extracted and the uterus amputated.

Submucous Myomata.—These growths, as a result of uterine contraction, become pedunculated and are not unfrequently forced from the cavity of the uterus into the vagina. When pedunculated they may be removed, following dilatation of the cervical canal, by dividing the pedicle with a wire ecraseur and then extracting the growth. When in the vagina as large pedunculated or sessile growths they may be removed by attacking the pedicle or by morcellement.

The writer recently was called to a neighboring city one terrifically hot July afternoon to operate on a strangulated umbilical hernia in a very stout woman. After the completion of the operation and the serving of dinner, and at about

nine o'clock at night, he was taken to the house of a maiden lady who was suffering from a very large submucous myoma which had been projected into and completely filled the vagina. It was nearly as large as a fœtal head. The attending physician gave an anæsthetic and with the assistance of a half-trained nurse, a lamp for a light, a Sims speculum, a pair of Emmet's strongly curved shears, which proved very useful indeed, and a pair of volsellum forceps and a knife,

FIG. 110.

Multiple myomata of the uterus removed by panhysterectomy.
c. Cervix.

the mucous membrane was incised and then piece after piece of the growth cut away and removed until the entire mass had been gotten rid of. The patient made an uneventful recovery.

Large submucous myomata which cannot be reached through the contracted cervix may be removed by the method of Professor Martin, formerly of Berlin, namely, by opening

the abdomen, incising the uterus, and then removing the growth, following which the wounds are closed.

Pan-hysterectomy.—This operation is indicated in cancer of the uterus, complicating myomatous growths, and in extensive septic processes implicating the adnexa, in severe infection of the uterus and uterine growths, and in some cases of multiple myomata. (Fig. 110.)

Myomata Taking Origin from the Broad Ligaments.—The most superficial muscular layer covering the fundus of the uterus takes its origin from or belongs to the peritoneum and extends with this into the broad ligaments. From this muscular tissue a myoma may arise which may be unilateral but more frequently is bilateral. These growths are not frequent and ordinarily do not reach any great size. In their growth they displace the uterus by pushing it to the opposite side and may, if large, produce pressure upon the pelvic organs or carry the uterus out of the pelvis. They have been known to weigh as much as twenty pounds. They are to be differentiated from pedunculated broad ligament tumors, which take their origin from the side of the uterus, and from growths of the ovary. Their differentiation from broad ligament tumors will be difficult unless the pedicle of attachment to the uterus can be made out, which is ordinarily the case. From cystic growths of the ovary they may be differentiated by their hardness and perhaps irregularity of form. In solid growths of the ovary the differentiation would ordinarily be impossible. Occasionally these tumors take on a very rapid growth, which is due, according to Sutton, to infection.

TREATMENT.—If they are producing symptoms, and if of any considerable size, they should be removed. This can ordinarily be done after opening the abdomen by slitting the broad ligament transversely with the pelvis, taking care not to injure important vessels, and then shelling the growth out. The cavity caused thereby should be closed with a continuous catgut suture in layers.

Myomata of the Fallopian Tubes.—As is well known, the

muscular tissue of the horns of the uterus is projected into the Fallopian tubes in two layers, longitudinal and circular. In these layers a myoma may arise. These growths, however, are rare and seldom reach any considerable size. When occurring it is usually as small, nodular masses, most frequently situated near the extremity of the tube.

Myomata of the Ovary have also been described, but they are exceedingly rare growths, it being a question with histologists whether there is normally any muscular tissue within the ovary, His and many others holding the idea that the spindle cells of the ovary are muscular cells. The usual solid growth here, which is also rare and which contains muscular tissue, is a myo-fibroma. This may reach a considerable size as a hard, nodular, usually decidedly pedunculated tumor which may float around in the abdomen and produce ascites by its traumatisms. The principles of treatment which are applicable to cystic tumors of the ovary will hold good here.

Myomata of the Round and Ovarian Ligaments.—These ligaments are but offshoots of the uterus and are made up of muscular and fibrous tissue. The round ligament is occasionally the site of a myomatous growth which may be situated either within the abdomen or within the inguinal canal. In the former location it produces a tumor lying at the side, and in front, of the body or the uterus, and is more or less immovable. These growths seldom reach any considerable size. Within the inguinal canal they have reached the size of a hen's egg, and have often been difficult of differentiation from a hernia. They are, however, dull upon percussion, usually very hard, not specially sensitive, and present no impulse upon coughing or straining. They are also immovably fixed in position.

Myomata situated in the ovarian ligaments are also rare and usually small in size. They would be difficult of differentiation by a physical examination, which, however, would not be material, from tumors of the Fallopian tubes or broad ligaments. Tumors of the ovarian and round ligaments, if creat-

ing disturbance, may be removed by the usual surgical procedures.

Myomata of the Œsophagus.—These growths take origin from the muscular layer, and may be either pedunculated or sessile. They may project either into the lumen of the œsophagus or externally. They have the characteristics of myomatous tumors in regard to growth and in consequence of their situation, if they reach any considerable size, are apt to produce obstruction or stricture with all of the symptoms attendant thereto. It would be impossible to differentiate accurately myomata from tumors which were malignant in character without operative measures. The age, the slowness of the growth, the absence of metastases and the non-interference with the health of the individual, except by pressure, would, however, be important aids.

TREATMENT.—If a growth is situated sufficiently high in the œsophagus it may be possible to remove it by œsophagotomy, and if low by gastrotomy.

Myomata in the Stomach.—Myomata have not unfrequently been observed taking origin from the muscular wall of the stomach, in which case they are most likely to project into the stomach as pedunculated growths, or they may project externally beneath the serous membrane, or they may be more or less diffused. They have, when pedunculated and situated within the stomach or within the pylorus, produced the symptoms ordinarily ascribed to malignant growths, such as hæmorrhage, pain, extreme nervousness, mental disturbance, vomiting, dilatation of the stomach, and emaciation.

Myomatous growths have occasionally been observed taking origin from the wall of the small intestines, in which they may produce, when reaching any considerable size, obstruction or invagination.

Myomata have frequently been found taking origin from the rectum either as sessile or pedunculated growths and extending either into the lumen or into the abdomen. Senn

removed a pedunculated subserous myo-fibroma from the ectum after opening the abdomen.

Pedunculated growths situated in the stomach or intestines, if they can be diagnosed, might readily enough be removed after opening the viscus from which they had taken origin. If subserous they may, after opening the abdomen and incising the peritoneum. be enucleated. Taking origin from the rectum and appearing as pedunculated growths they could be readily removed after ligating the pedicle.

Myomata of the Pharynx.—Myomata have occasionally been observed springing from the wall of the pharynx as pedunculated and sessile growths. Middledorph has given the particulars of a case in which a myoma took its origin from the posterior wall of the pharynx. A myoma springing from the pharyngeal wall and projecting into its lumen is likely to produce a distressing cough in consequence of the irritation with dysphagia and dyspnœa. These growths are accessible to sight or touch, consequently the presence of a growth is easily established.

TREATMENT.—If situated high up in the pharynx the mucous membrane should be divided over the growth, when it can be shelled out with the finger or a curved enucleator. If taking origin low down or pedunculated they may be removed by the galvano-cautery wire, or evulsed. If sessile it may be necessary to do a pharyngotomy through which opening the growth can be removed.

Myomata of the Larynx.—Myomata have occasionally been removed from the larynx. In this situation they are as a rule small, hard, nodular, often pedunculated, growths. They are likely to produce great irritation, change of voice, and excessive cough. This may be associated with laryngeal spasm and perhaps with stenosis. They may produce sudden death by obstructing the larynx. The diagnosis can be made by the symptoms and the use of a laryngeal mirror.

TREATMENT.—They may be removed if pedunculated by evulsion or by the use of the galvano-cautery wire. They can

occasionally be dragged into the pharynx by a sponge probang. where they can be seized and the pedicle divided. They have also been destroyed by the application of chromic acid. All of these manipulations are rendered more easy by local anæsthesia of the pharynx and larynx.

Myomata of the Skin.—A goodly number of myomata have been described by different observers as taking origin from the cutaneous surface. Virchow saw a man in whom there were a dozen small myomata situated about the breast. Sutton observed one growing from the skin of the scrotum in a boy a few months old. Dr. Serg Marc removed one from the skin of the occipital region in a child a few weeks old. They have most frequently been observed growing from the regions of the mammæ or nipples and in these situations have been observed by a number of physicians. When occurring in the skin they are supposed to take origin from the muscular tissue of the corium, from the *arrectores pilorum.* In the subcutaneous tissue of the scrotum and penis muscular tissue is also to be found. Taking origin from the skin they are usually small, hard, irregular tumors of slow growth. If causing disturbance they may easily be removed.

Myomata of the Bladder.—Virchow states that myomata in the bladder are largely confined to the region of the prostate gland. Terrier and Hartman have collected the statistics of sixteen cases of myomata taking origin from the wall of the bladder. Seven of these cases occurred in women and eight in men, while in one case the sex was not given. Of the sixteen growths ten projected into the bladder, four were subperitoneal, while one grew in both directions. In these cases the tumors were in the region of the trigone six times, three times in the anterior wall, two times at the summit, once in the posterior wall, and once the growth included nearly the entire bladder. In size they varied from that of a walnut to that of a child's head.

Symptoms.—If situated within the bladder and especially if near the trigone they may obstruct a ureter and cause hy-

droureter. They are extremely likely to produce irritation, a feeling of uneasiness, frequent urination, cloudy urine, and even hæmaturia.

Diagnosis.—The above-mentioned symptoms should lead to an examination which may be carried out with a finger in the rectum or vagina while the other hand is placed over the region of the bladder. Tumors which project into the bladder can be readily and positively made out by the use of Nitze's cystoscope after having injected from six to eight ounces of clear boric acid solution into the bladder.

Treatment.—In tumors which are subperitoneal the abdomen should be opened, the peritoneal covering incised, and then the tumor enucleated. Following this the parts are united by buried sutures. Where the tumors project into the bladder they may be reached either by the perineal or suprapubic route, preferably the latter. After opening the bladder they may be removed after dividing the mucosa by enucleation and if pedunculated by torsion of the pedicle. Nitze removes pedunculated tumors of small size from the bladder with the greatest ease by the use of his operation cystoscope.

CHAPTER XVII.

NEUROMATA.

Neuromata have been divided into the true and false. The former are still further divided into the ganglionic, myelinic, and the amyelinic. True neuromata are of extremely rare occurrence, and it has been claimed by many clinicians and pathologists that there are no neuromata in the true application of the term. A neuroma proper must be composed largely of new nerve elements. There must have been a proliferation of nerve tissue causing at least a part of the new growth, and it is quite immaterial whether this new tissue be nerve fibres or ganglionic cells, or an admixture of the two. At the present time it seems to be well established that true neuromata, or tumors due to the proliferation of nerve tissue, do really exist and are occasionally encountered; that these tumors when examined histologically answer all of the requirements of a new growth of nerve tissue. They may be situated wherever nerve tissue is found and they seemingly most frequently have their origin from the sympathetic nervous system. Ganglionic neuromata, or nerve tumors made up, at least in part, of ganglionic cells, have been found taking origin from the thoracic, lumbar, hypogastric, adrenal, and solar plexuses of the sympathetic. In these cases there has been, according to the histological examination, an abundant proliferation and new formation of ganglionic cells.

Neuromata composed of nerve fibres have been found in connection with syringomyelia, in tabes, in the normal cord, and also in multiple growths situated within the skin. The

t e uromata seem especially liable to affect children and young adults, and while they are ordinarily of slow growth and seldom reach any very considerable size, some have been reported which have attained large dimensions. While usually single they may be multiple and are usually quite soft, somewhat resembling in their consistency a lipoma. They are usually insensitive growths and if pure are entirely innocent, not causing local infection or metastasis. If they are causing pain or producing functional disturbance they may be removed, provided, of course, that they are accessible.

False Neuromata.—False neuromata are of comparatively frequent occurrence. They may be subdivided into the neuro-fibromata, the diffuse neuromata or Recklinghausen's disease, the plexiform and the traumatic neuromata.

A false neuro-fibroma is usually a small, fusiform growth situated upon a nerve. Histologically the growth is a fibroma and composed of fibrous tissue taking origin from the perineurium or the endoneurium. It is a false neuroma in the sense that while the growth itself may contain nerve fibers or even ganglion cells, these are only the normal fibres of the nerve, or cells of a ganglion, and do not represent proliferated nerve tubules or cells. The new tissue or growth is made up of fibrous or connective tissue and is situated either upon the nerve or the nerve fibres are separated and to some extent enclose the growth. These tumors when situated subcutaneously and if upon a sensitive nerve are usually known as painful subcutaneous tubercles. When thus situated they give rise, upon irritation, compression, or exposure to cold, to intense radiating pain. A neuroma taking origin from a motor nerve is less painful than one taking origin from a sensitive nerve, in fact the former is usually quite insensitive.

A benign false neuro-fibroma growing from or upon a motor or mixed nerve seldom leads to a disturbance of motion or to anæsthesia. The false neuromata are not always small. On the contrary they may reach the size of an orange. They are usually fusiform in shape, their long axis corresponding to the

axis of the nerve. While these growths are often single they also are frequently multiple, every branch of a plexus being at times implicated. They are frequently found upon the cranial nerves, especially the fifth and seventh. When situated upon the seventh they are usually very painful. They are also occasionally found upon the spinal nerves, where they have produced pressure upon the cord, paralysis, and even death. Smith has reported a case of neuroma of the right Gasserian ganglion which caused excruciating pain and finally death.

These growths are usually found in young adults and if causing pain or disturbance they should be removed. If taking origin from an important nerve in their removal the continuity of the nerve should, if possible, be preserved. A tumor growing from a nerve can usually be removed without section of the nerve. If the tumor is intramural and that portion of the nerve involved excised, the nerve should be immediately reunited. If the portion resected approximate an inch and a half or two inches a bridge of strands of silk should be strung across this interval as a scaffolding, upon which and through which the nerve fibres may be projected from one end of the divided nerve to the other.

Diffuse Neuromata, Neuro-fibromatosis, or Recklinghausen's Disease.—These growths are composed of a generalized or diffused thickening of the nerve sheaths causing it may be numerous eliptical or spherical growths, or there may be a generalized enlargement of the nerves. The growths are usually encapsulated and well defined, but occasionally on the contrary their limits are not easily determined. While these growths may be few in number they are occasionally extremely numerous having reached in some cases several hundreds in a single individual. They are made up of fibrous tissue taking origin from the endoneurium of the primary nerve bundles and are usually whitish in color and fine in texture. While any part of the peripheral nervous system

including the sympathetic may be affected the cervical nerves seem to be the most frequent site of the disease.

The growths are usually not very sensitive unless exposed to considerable pressure or irritation. Paralysis or motor disturbance is usually rare unless the affection attacks the roots of the spinal nerves. The condition may occur at any time during life and is usually slowly progressive toward a fatal termination. It is held by C. Adrain that the disease resembles very much the nævi, that it is either congenital in origin or occurs in young adult life, also that it is often hereditary. Of twelve cases reported by Adrain three occurred in three children in two inter-related families. The growths are usually benign, but seem to have a distinct tendency to become malignant. If a particular growth becomes over-sensitive or painful, or the site of special functional disturbance, or unsightly, it may be removed, otherwise no treatment thus far instituted is of any avail in warding off the final fatal termination.

Plexiform Neuromata.—A plexiform neuroma is usually a congenital growth involving the subcutaneous nerves. It is most frequently situated about the face and neck in connection with the fifth or cervical nerves. The tumor is usually of a soft, gelatinous type and composed of a number of thickened, tortuous nerve strands held together by connective tissue. When dissected Thompson states that the mass looks like grains of boiled tapioca strung on a string. While the growth is ordinarily subcutaneous it may dip deeply into the muscular tissue. Pomorski narrates a case which implicated the intercostal nerves and had grown into thepleura. Bruns collected the statistics of forty cases. In fifteen of these the tumors were located in the temples or upper eyelids; in eight, in the posterior part of the neck; in three, in the nose and cheeks; in four, on the lower jaw; in seven, on the breast and back; and in three cases they were located on the extremities.

In the plexiform neuromata one branch or all of the branches of a given nerve distributed to a certain area may be-

come involved. They are large and elongated tumors something like varicose veins. The overlying skin becomes stretched and thin. Such a tumor has been compared to a bag containing a lot of vermiform bodies, and it has been thought to present upon palpation many of the characteristics of a varicocele. In the plexiform neuromata the individual cords may be quite small or they may reach the size of a lead pencil or even that of a man's finger. Campbell Morgan publishes the particulars of an interesting case which is as follows: A young lady was first noticed to have an irregular swelling extending from the palm of the hand to the elbow. The swelling felt like a string of beads and was not painful when pressed. She was under observation for seven years, during which time there was a steady increase in the size of the growth. The arm was then amputated. On dissection all of the branches of the musculo-spiral nerve below the elbow were found to be enormously and diffusely enlarged, the enlargement extending from the elbow to the palm of the hand. The enlargement was irregular and at places the nerves enormously thickened.

The plexiform neuroma is an innocent growth which does not produce local infection or become disseminated.

TREATMENT.—If they are unsightly or producing functional disturbance they should be dissected out and removed.

Traumatic Neuromata.—The great majority of these growths as seen by the surgeon follow either division, injury, or excision of one of the peripheral nerves. They have often been called amputation neuromata, in which case they occur upon the terminal extremities of the divided nerves. While they are probably always present following an amputation, their size depends largely upon the amount of irritation to which the nerve ends are subjected in the healing process. Nerves which, following an amputation, are drawn out, cut short, and allowed to retract into the healthy tissue where they are separated by a considerable distance from the wound, develop upon their extremities, in the healing process, as a rule, painless neuromata of insignificant size. If, however,

the end of the nerve is sequestered within the cicatricial tissue and subjected to irritation, especially if the healing process is attended with much inflammation or suppuration, or the nerve becomes attached to the bone or is pinched or irritated by muscular contraction or by newly-formed fibrous tissue, then the neuroma is likely to be very large. The process is not always confined to the extremity of the nerve, but may extend for a considerable distance, often several inches, along the nerve axis producing decided enlargement, a condition which corresponds in all essential particulars with the terminal bulb.

Traumatic neuromata also form upon the extremities of a resected nerve. The size of these false neuromata depends in a measure upon the succeeding irritation and also upon the measures taken, or the absence of such measures, looking to the restoration of the continuity of the nerve. If the nerve is divided or excised in its continuity a neuroma will form upon the proximal and distal extremities. The proximal neuroma will be the larger of the two. If the nerve be immediately sutured and the work done in a skillful manner the neuromata forming will be small. If the nerve be immediately sutured and the ends be not evenly and nicely coapted the neuromata forming will be quite large, and if no measures looking to the restoration of the continuity of the nerve be taken the neuroma will be still larger.

Traumatic neuromata may result from an injury to a nerve without the nerve being divided.

Histology.—It is often stated that the traumatic neuromata are composed entirely of newly-formed fibrous tissue. From a study of my specimens, of which there are several dozen, I find that while the major portion of the bulbs are made up of fibrous or connective tissue they all contain a large number of nerve fibres. Many of these nerve fibres in the young bulbs are in process of formation. (Fig. 111.)

Clinical Symptoms.— The traumatic neuromata in consequence of the nerve fibres being pinched, irritated,

and compressed in the bulbs are the cause of numbness, prickling, and unpleasant sensations in the amputated limb. They are often painful upon pressure or muscular contraction and usually very sensitive to even slight disturbances, and when hyperæmic or much irritated so extremely painful that life even seems a burden and the wearing of an artificial limb an absolute impossfbility.

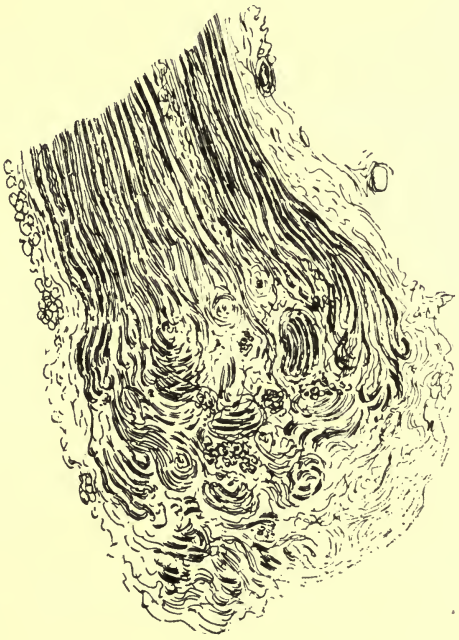


FIG. 111.

PROPHYLAXIS.—In amputations draw out and remove two or three inches from the ends of the nerves so that they will not be subjected to irritation in the healing process, or during the subsequent wearing of an artificial limb. In division or excision of a nerve when possible practice immediate suture under strict aseptic precautions.

TREATMENT.—Painful amputation neuromata should be removed. They may be exposed by incision, the bulbs iso-

lated, and the nerves divided well above the bulbs. If the proliferation of connective tissue which caused the formation of the bulb has extended into the terminal portion of the nerve this should also be exposed and removed. It occasionally happens that the terminal portion of the nerve is quite as much at fault as is the bulb, being enlarged, hyperæmic, and very sensitive. In these cases it would be useless to remove only the bulb. If the pain and sensitiveness are to be relieved the portion of the nerve affected must also be removed.

The neuromata are occasionally the site of myxomatous degeneration in consequence of which they are rendered much softer and more like a lipoma. The connective tissue of nerve structures is also occasionally the site of malignant change. This condition is not a degeneration, but an active process by which malignancy is engrafted upon benign structures. These growths are either sarcomatous or endotheliomatous in character. Keene has recently reported a case of endothelioma taking origin from the Gasserian ganglion and infiltrating the adjacent structures. The patient suffered most excruciating pain throughout the branches of the fifth nerve. This pain was not relieved by the removal of the ganglion. Sarcomatous growths have frequently been reported in connection with neuromata and they have usually been of the spindle-celled variety. A sarcoma or an endothelioma being engrafted upon or within the structure of a nerve is likely to produce severe pain, spasm, and often paresis or paralysis of the nerve implicated. The neoplasm will take the course of, and be attended with, the symptoms of malignancy, infiltrating the adjacent tissue, causing metastases, and if the nerve be a sensitive one, most excruciating pain. The treatment of these growths should be that of malignant tumors.

CHAPTER XVIII.

GLIOMATA.

A glioma is a tumor composed of neuroglia and is found in the cerebro-spinal centers and in certain embryonal peripheral processes of the brain, namely, the retina, and the optic and olfactory nerves. Gliomata take origin only from the neuroglia, which is a supporting tissue confined to the cerebro-spinal axis and the above-named nerves. The neuroglia has the same embryological origin as the nervous system, namely the epiblast, and consequently is held by many to be embryologically epithelial tissue or to correspond to the epithelial tissues.

The neuroglia has the characteristics of connective tissue. It supports, sustains, and embeds the nerve fibres and cells. It has no active function as has epithelial tissue. It combines with connective tissue in producing sarcoma and endothelioma, but never with epithelial cells producing carcinomata. Its function and behavior is that of a connective tissue. It is well to remember in this connection that the muscular fibres of the sweat glands comes from the epiblast.

The neuroglia when examined histologically is found to be made up of a variety of cells known as glia-cells. The smaller of these contain a single nucleus and the larger sometimes two or more nuclei. The cells are composed of a mass of protoplasm which surrounds the nucleus and sends off protoplasmic fibres which radiate in every direction.

For convenience the cells in the neuroglia may be divided into two principal classes, one known as the spider cell which has a small cell body, a single nucleus and long,

rigid, almost straight and practically non-branching processes. These cells occur largely in the white substance of the brain and spinal cord. The other variety of cell is known as the mossy cell. It has a large cell body from which a great number of branching, waving processes extend into the subjacent structures. These cells are found chiefly in the gray sub-

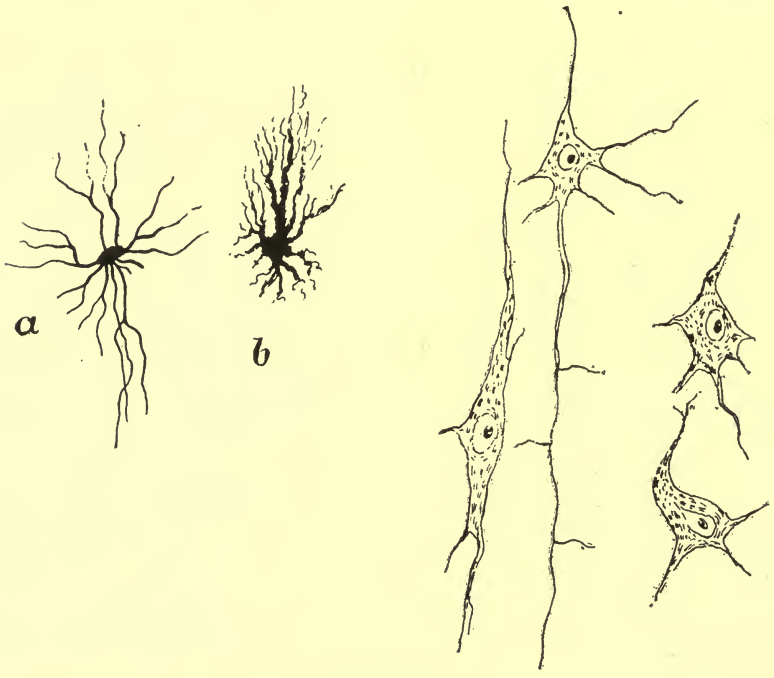


FIG. 112.

Neuroglia cells.
a. "Spider" cell.
b. "Mossy" cell.

Ganglion cells.

stance of the brain and spinal cord. (Fig. 112.) Between the cells there is an intercellular substance which may be homogeneous, finely fibrillated, or slightly granular. The cells being situated near together their processes cross and recross each other in every direction producing a very fine network of protoplasmic strands. These strands surround and enclose the indi-

vidual nerve cells and fibres and act as a sustaining and protecting tissue. In the white matter they take the place of the neurolemma which here is absent. While these two classes of cells represent those most frequently found in the neurogliar tissue there is, however, almost every gradation in size between the small spider cell and the large mossy cell. Some of the neurogliar cells are spindle shaped.

The gliomata occurring as they do in the brain and spinal cord take origin from the neurogliar tissue. They are tumors which at least in the brain are of quite frequent occurrence and are found with special frequency in the brain cortex. They may, however, occur in the white substance, in the ganglia at the base of the brain, in the pons, in the medulla oblongata, and in the spinal cord. They occur with special frequency in children and young adults, although they have been found in persons fifty years of age. The glioma corresponds very closely in its structure to the neuroglia and is seen upon microscopical section to be composed of nucleated cells having a large number of long, radiating processes and an intercellular ground substance. In some of the gliomata the number of cells is small and the intercellular substance correspondingly large. In gliomata which are extremely rich in cells the intercellular substance is not only very limited but the ordinary innumerable protoplasmic fibres coming from the cells seem to be very few or are even indistinguishable. (Fig. 113.)

The gliomata have been divided according to their consistency into the glioma durum in which the cells are sparse and the growth hard, and the glioma molle in which the growth is made up largely of cellular elements and is quite soft. There is also a third subdivision, the glioma telangiectaticum, in which there is an increase in the number and size of the blood vessels. This may be carried to such an extent as to produce a pulsating tumor and one which bleeds profusely if incised. The gliomata are ordinarily tumors which are not well defined. They are seldom if ever encapsulated, but on

the contrary shade off imperceptibly into the adjacent tissues where there is both a macroscopical and microscopical infiltration. Von Bergmann says that nine-tenths of the gliomata are diffuse.

In color the gliomata correspond to, but are usually slightly redder than, the adjacent tissue. In consistency they are usually slightly harder than the brain tissue, although they may be translucent and as soft as the vitreous or as hard as the pons. They may be single or multiple, although they

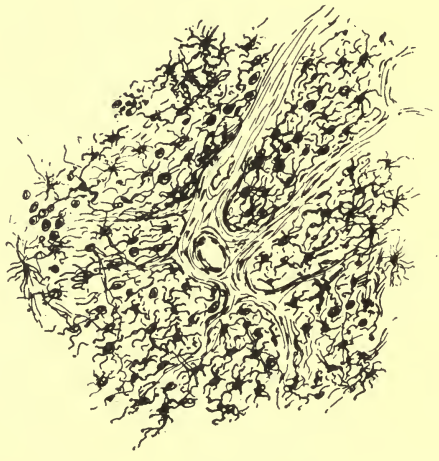


FIG. 113.
Neuroglia tissue A glioma.

are usually single. They may be small, not larger than the end of the finger or as large as a good-sized orange. They grow slowly and do not interfere seriously with the nerve tracts or produce symptoms of compression for a considerable time.

Degeneration.—Gliomata not unfrequently undergo degenerative change and as a result cysts filled with blood or with a clear fluid occur. In both instances the sequence of events are degeneration, softening, absorption, and hæmorrhage. Calcareous deposits also occur in these growths. The

cells themselves may also undergo œdematous or granular degeneration.

CAUSATION.—There is little positive knowledge in regard to the causation of gliomatous tumors. In some cases they are seemingly of congenital or embryonic origin. Again they not unfrequently follow injuries and many believe that toxic or infectious agents are the cause of these as well as of many other morbid growths.

Gliomata as Brain Tumors.—Intracranial growths are either encapsulated, circumscribed and distinct, or non-encapsulated and more or less diffused among the adjacent tissues. When encapsulated they simply push aside the tissue in which they occur. When diffuse they destroy more or less of tissue and take its place. Encapsulated tumors if situated upon the surface can ordinarily easily be shelled out, while the non-encapsulated, in order to effect complete removal, must be cut out with a knife or shears going wide of the area apparently infiltrated. This method cannot be well practised except in the frontal and occipital regions, and a tumor which is diffused must be small in order that the method be practicable.

Brain tumors are of comparatively frequent occurrence. Seydel, in the Pathological Institute in Munich, in 8,488 autopsies found that one brain tumor occurred in every eighty-five sections. In the Heidelburg Institute Von Beck in 6,177 autopsies found fifty cases of brain tumor, or one to every 123 deaths. It may be estimated that in about one per cent. of the deaths there is to be found upon careful section a neoplasm within the brain. Hale White, in Guy's Hospital Reports, in 100 tumors of the brain found that forty-five were tubercular, twenty-four gliomata, ten sarcomata, two glio-sarcomata, five carcinomata, four cystomata, one lymphoma, one myxoma, five gummata, and three were non-differentiated. Of these 100 cases twenty-six, or a little more than one-fourth, were either gliomata or glio-sarcomata. In fifty of the cases reported by Von Beck nineteen were gliomata. In eighty-

five cases reported by Seydel thirty-nine were either sarcomata or glio-sarcomata. It may be estimated then that about one-fourth of all brain tumors are gliomata and take origin from the neuroglia. It is stated by Von Bergmann that nine-tenths of all gliomata are diffuse, or non-circumscribed. He also estimates that not more than twenty-five per cent. of all gliomata are operable. This is on account of their situation, size and their non-encapsulation.

Brain tumors are more frequent in men than in women. They occur with especial frequency between the ages of ten and forty.

Location.—According to Von Bergmann about seventy-per cent. of all brain tumors occur in the motor areas, nine per cent. in the cerebellum, seven per cent. in the frontal regions, two per cent. in the occipital regions, and three per cent. in the temporal region. In their histology sarcomata represent thirty-seven per cent. of the whole, the gliomata sixteen per cent., cysts seventeen per cent., angiomata six per cent., fibromata three per cent., echinococcus ten per cent., cysticercus twoper cent., and non-classified three per cent. According to the same authority twenty-five per cent. of all operations for tumors of the brain end fatally, while five per cent. of the patients surviving the operation are much improved thereby.

Symptoms and Course.—The symptoms of a neoplasm of the brain may be divided into general and special. It must, however, be understood that there is no pathognomonic symptom of a brain tumor, and it is only by combining the various symptoms and noting the order in which they occur that one is able to arrive at a diagnosis. Among the general symptoms, or those which are present in nearly every case of glioma of the brain are, 1st. Headache, severe almost continuous pain usually situated in some particular region of the head which often, but not always, corresponds to the site of the tumor. This pain at first may not be severe nor continuous, but usually as time progresses and the tumor in-

creases in size the pain becomes almost continuous and more severe, until finally it may be excruciating. The pain is often associated with tenderness or increased sensitiveness on percussion or palpation over the area occupied by the tumor. There are probably very few intra-cranial tumors in which severe headache is not one of the first symptoms.

Another symptom which is nearly as constant is dizziness or vertigo, and by vertigo is meant that which is due to a disturbance within the brain, an increase of the intra-cranial pressure and which has no connection in any way with the condition of the stomach. It is cerebral in character, vertigo in severe cases is almost constant, very distressing and may be present not only when the patient is standing or sitting, but also when he is lying down. The vertigo makes the patient very unsteady in walking, he staggers like a drunken man and often must support himself to prevent falling by clutching at near objects.

Nausea and vomiting are also symptoms which are frequent and these also are cerebral in character.

A fourth symptom of very great importance in the diagnosis of intra-cranial growths is choked disks, papillitis, neuritis, or atrophy of the optic nerve which is supposed to result from the increase of the intra-cranial pressure or to a disturbance of the venous return circulation. Disturbance in the circulation of the optic nerve is often present for a considerable time before an impairment of the sight occurs.

With these four cardinal symptoms, headache, vertigo, vomiting, and disturbance of the circulation in the optic nerve producing choked disk there is associated often weakness, it may be prostration, an unsteady gait owing to the vertigo, or to inco-ordination, weakness of the limbs from impairment of the muscular sense or even paresis or paralysis. Often there is also mental indifference, or dullness going on even to coma, and if the pressure is great, a slow pulse, disturbance of respiration and it may be Cheyne-Stokes respiration. Where headache and dullness of intellect are present the eyes

should be examined for indications of increased intra-cranial pressure. It is quite true that these four cardinal symptoms may not be present in every case of brain tumor, but two or more of them are nearly always present and the four are usually present more or less pronounced, and often very prominent.

Tumors of special regions.—Special symptoms depend upon the particular relations and upon the situation of the growth. Nearly three-fourths of all intra-cranial neoplasms being situated in or near the motor areas will in their growth create disturbances of these areas which will be manifested by contractions or paralysis of the muscles supplied by the peripheral nerves. Of course it is to be understood that the symptoms will vary with the motor region implicated. Primarily with a tumor in the motor region there is likely to he cramps within the muscles supplied by the nerves which take origin from the affected area. The tumor produces compression or irritation or disturbance in this area, which disturbance is transmitted by the nerves to the muscles and causes them to contract often violently. The contractions may be clonic or tonic, may last for but a moment or continue for minutes or even hours. The contractions are primarily limited to a certain set of muscles and consciousness is not disturbed, but the contractions may become general and consciousness be lost. The area implicated may be such as to effect one or two fingers which will tremble violently, or if the mouth or face center is implicated there may be a contraction of the angle of the mouth or alæ of the nose, or an eyelid, or all the muscles of the face may be implicated. If the leg or foot center is primarily irritated there may be spasms affecting the muscles of a toe or of certain muscles of the thigh or leg. These conditions may result in paresis or paralysis with an increase in the sensibility of a limb or part, and an increase of the reflexes, or there may be a diminution of sensation, depending upon the situation of the growth.

Tumors of the motor areas are then not only attended with headache, vertigo, vomiting, and choked disks, which are the usual symptoms of intra-cranial growths irrespective of their situation, but they have special symptoms depending upon irritation of the motor areas. There may be primarily a feeling of numbness confined to the finger or toe, or a limited muscular area, but sooner or later there is likely to be a disturbance of muscular contraction in the form of spasms. During these contractions the patients do not loose consciousness, although in some cases they have a regular epileptic convulsion. There is, however, often a feeling of mental heaviness and the muscles implicated usually become weakened.

Tumors in the frontal lobes.—The general symptoms, so far as headache, vomiting, vertigo, and disturbance of the optic nerves is concerned, remain the same except that a tumor here situated is likely to cause a choked disk primarily upon the same side as the tumor, or the disturbance in the optic nerve will be greater upon this side. Later if primarily affecting but one eye it will implicate both. A tumor situated in the frontal lobes is also likely to cause a hæmorrhagic choroiditis or retinitis in the side upon which the tumor is located. In fact hæmorrhage into the choroid is very characteristic of a tumor situated within the frontal lobes.

Another symptom of marked value, especially of tumors situated in the left frontal lobes, is disturbance of intelligence. Patients become obtuse, indifferent, drowsy, and often weak-minded. They are incapable of mental exertion, whereas tumors situated in the frontal lobes of the right side are likely to cause mental excitement, extreme nervousness, and even delirium. Tumors of the frontal lobes which cause pressure upon, or irritation of, the motor areas will cause cramps or even convulsion in the muscles supplied by the nerves taking origin from the center irritated.

Tumors in the occipital region.—Here there are again

the four cardinal symptoms of a brain tumor, and here also, as in the frontal lobes, if the growth is situated in the immediate neighborhood of, or produces pressure upon, the motor areas cramps are likely to occur in the muscles supplied by the particular area irritated.

The symptom of special importance in tumors of the occipital lobes is hemianopsia, blindness in one-half of the field of vision of one or both eyes, and, it may be, diplopia. Hemianopsia usually indicates a lesion of the cuneus of the same side.

Tumors of the temporal region.—Tumors in this region while presenting perhaps less marked cardinal symptoms than in the other areas do produce a condition of especial importance in a diagnostic sense, and that is aphasia or a disturbance of speech. In considering the different forms of aphasia one must keep strictly in mind the area which dominates that particular form of speech interfered with. In motor or ataxic aphasia the patient misnames objects seen. He may, and probably is, aware of his error, but cannot correct it. The process is not due to a mental disturbance, but to some defect of the muscular co-ordination and the growth causing motor aphasia in which the patient misnames or uses incorrect words is situated in the posterior part of the third frontal convolution, in the Island of Reil, and in the tissue situated between these two centers.

The form of aphasia known as agraphia, in which the patient is unable to write in consequence of his having lost certain memories which enable him to exercise his finger movements, is situated in the posterior part of the second frontal convolution. Word deafness or sensory aphasia in which the patient does not understand spoken language, may be caused by a tumor situated in the posterior part of the first temporal convolution. Word blindness, in which there is a loss of memory of printed or written symbols, is caused by a disturbance of the center of vision situated in the occipital lobe. Tumors may also be situated in the cerebellum, where

they are likely to produce, in addition to the cardinal symptoms of brain tumors, excessive vertigo and vomiting, unsteadiness of gait, as if the patient were intoxicated, pain situated over the site of the tumor and inco-ordination of the muscles of the extremities.

In making a diagnosis of an intra-cranial growth it is desirable if possible not only to determine that a growth is present, but its situation according to localizing symptoms, and also whether it is in the cortex or is subcortical, whether the growth is large or small, single or multiple, and its character. The great majority of gliomata situated within the cranium are cortical. If there is a loss of sensation or hemiplegia it is indicative of the growth being situated within the internal capsule. If the patient is suffering from multiple growths the different areas affected show the results of the irritation.

It is also necessary to determine as nearly as possible the size of the growth, and this can only be told by the extent to which the intra-cranial pressure has been altered, the severity of the symptoms, as well as to the fact that a growth having started in one center has progressed from there to, and invaded, distant centers. The number of adjacent areas implicated will indicate approximately the size o the neoplasm. The character of the growth must also be determined. The gliomata if possible must be differentiated from the tubercular growths, which are extremely common and which usually occur in patients manifesting symptoms of tuberculosis in other portions of the body. They must be differentiated from the poro-encephalitis cyst which is usually the result of an infantile inflammation or hæmorrhage and which is often associated with a marked degree of paralysis. They must also be differentiated from hydrocephalus. Here the differentiation will not be difficult ordinarily if both lateral ventricles are implicated, and especially if there is considerable enlargement of the skull. With accumulations of fluid in one ventricle the differentia-tion may be impossible.

Gliomata of the brain should also be differentiated from syphilitic gummata. Here the diagnosis will be aided by a history of the patient having had syphilis.

An intra-cranial growth should be differentiated from uræmia, in which an examination of the extremities will be of

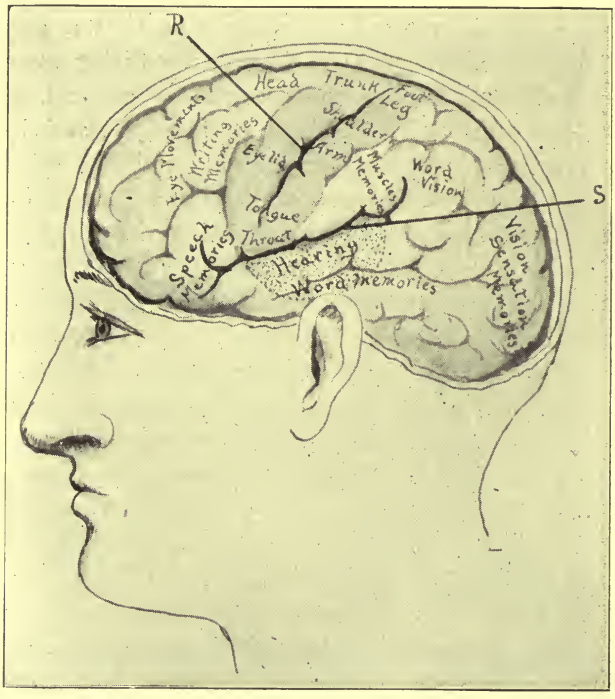


FIG. 114.
R. Fissure of Rolando.
S. Fissure of Sylvius.

aid and an examination of the urine will disclose the fact of kidney disease.

They must be differentiated from carcinomatous growths which in the brain are always secondary and follow a carcinomatous disease of some other organ. From the sarcomata they cannot ordinarily be distinguished and with these growths they are also often combined.

They should be differentiated from cases of circumscribed ence phalitis, ninety per cent. of which follow traumatisms and are the result of a laceration of the membranes or brain. If infection occurs in these cases an abscess in the cortex will follow. (Fig. 114.)

Gliomata of the Orbit.—Gliomata are not of unfrequent occurrence taking origin from the retina. This condition, which usually occurs in fœtal life or early childhood, may affect both eyes. It begins in some one of the inner layers of the retina and in its growth produces more or less distension of the globe and finally penetrates either through the cornea or at its edge, or around the optic nerve or ciliary vessels. The condition is usually a progressive one. The adjacent tissues become infiltrated, the glands of the head are attacked, nodular processes form on the bones of the skull, and metastasis occurs in the brain or in internal organs. After removal the growth has a distinct tendency to recur, in the tissue of the socket and later inside of the cranium. It is held by many pathologists that this condition is one of pure glioma. If this be true we can scarcely escape the conclusion that gliomata are occasionally malignant in the sense that they recur after removal, invade adjacent tissues, and finally produce metastases and death. It must be conceded, however, that the majority of clinicians and pathologists hold this condition to be that of a compound tumor, a glio-sarcoma.

A case recently under the writer's care was that of a boy aged nine years who fell off a street car, injuring his left eye. The eyeball, in consequence of an intramural growth, was removed when so large that it seemed ready to burst. This was one year after the accident. The growth seemingly was well confined within the eyeball and was diagnosed as a glio-sarcoma. Three months following the operation the growth returned in the orbital cavity. It was again removed, but returned and then it was removed again on July 4, 1901. The condition of the patient is shown in Fig 115. The boy at this time was pale, somewhat emaciated and presented a tumor of

considerable size projecting from out the orbit. The growth was surrounded by eliptical incisions, the skin being removed and also much of the walls of the orbit with all of the soft tissues. The tissues at the site of the exit of the optic nerve were thoroughly cauterized with a Pauquelin cautery. The boy made an uninterrupted recovery from the

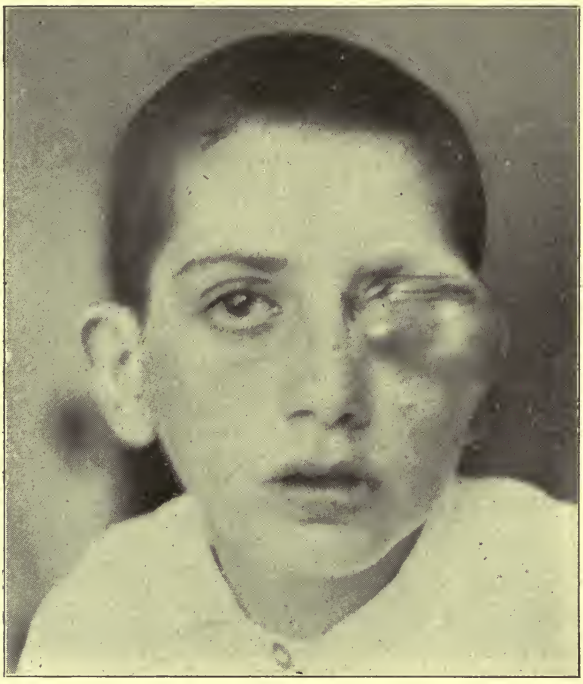


FIG. 115.

effects of the operation, but in a few weeks the growth appeared again and in a few months ended his life.

Gliomata of the Spinal Cord.—The usual starting-point of the gliomata in this situation is in and around the central canal. The cells are either small or large, and some contain many nuclei. They grow from the center of the cord, expanding and pushing the tissue asunder, and finally against the spinal canal, producing pressure and it may be paralysis. The

gliomata in this situation being inside the cord are not amenable to surgical interference.

PROGNOSIS.—It must be admitted that the prognosis of the gliomata is not good. Those situated within the spinal cord are not amenable to surgical treatment, while nine-tenths of those situated within the cranium are diffuse. The gliomata taking origin from the retina present all of the indications of malignancy, while many of those growing within the cranium are in part sarcomatous.

TREATMENT.—It is stated by Von Bergmann that not more than ten or fifteen per cent. of the gliomata are operable. This may be due to their location, to their size, or to their non-encapsulation. Operations may be undertaken in cases of gliomata for the purpose of relieving some of the distressing symptoms or for the purpose of curing the disease. Where the symptoms of intra-cranial pressure are pronounced and if the situation of the growth is such that its removal is known to be impossible, a trephining is done for the purpose of relieving in part the pressure, and is often of the greatest advantage to the patient. In these cases it is advised that the dura be not opened, as the brain is likely to be forced through the slit, causing hernia of the brain. Operations are also undertaken for the removal of the growth. It is a curious fact, but one which is apparent by the study of the statistics of operations, that although the diagnosis of brain tumor is reasonably certain, operative measures for removal in a very considerable proportion of the cases fail to locate the tumor. The patients are, however, often benefited as a result of these exploratory operations.

In opening the skull the osteoplastic method is preferable, and it is most desirable to have a free opening. The skull may be opened with the electric saw, the chisel, or the trephine. The difficulties here are the location of the tumor and the dangers those of hæmorrhage and sepsis.

If the tumor can be located and it be situated within the cortex, and its size be not too great, it can be removed. If

encapsulated it can be readily shelled out. If more or less diffused the surgeon must with shears or knife cut wide of the growth, going into healthy tissue.

It is most desirable to remove the growth entirely if possible. It may often be difficult to determine accurately the extent or limits of the growth on account of its varying but little from the normal brain tissue in color and consistency. After its removal the hæmorrhage is controlled by suture or by means of iodoform tampons, the latter being packed in the cavity and held there by firm compresses.

Tumors within the Cerebellum.—About ten per cent. of the gliomata occur in this situation. In the operative technique they present difficulties ten fold greater than occurs in the removal of a tumor from the cerebrum, in that the cerebellum is difficult of access lying deep in the neck and being covered by a large number of strong muscles. Terrier attempted to obviate this difficulty by opening the skull above the superior curved line of the occipital bone, incising the dura and lifting the occipital lobes, and he thought then to divide the tentorium and reach the growth, but after opening the skull and incising the dura the brain was pressed with such force into the opening that he was obliged to desist in the operation.

One of the greatest difficulties in reaching a tumor in the cerebellum is to avoid wounding the lateral sinus. In the writer's examination of skulls he finds that as a rule the sinus is placed about midway between the superior and inferior curved lines of the occipital bone. The opening in the skull must be made below this. Incisions which have been recommended for the purpose of exposing the cerebellum are made as follows: One commencing near the outer extremity of the superior curved line of the occipital bone over the base of the mastoid is carried down as far as the tip of the mastoid process. From the top of this incision a second is carried along the superior curved line of the occipital bone to the occipital protuberance and from there down the neck corresponding to

the base of the skull. The tissues are now separated from the occipital bone upon that side, nearly as far as the foramen magnum, when the skull may be opened below the lateral sinus and the cerebellum palpated. As the opening in the bone is small and the wound very deep it has been proposed for the purpose of gaining greater room to separate the lateral sinus, after it is exposed, from its groove, ligate it and then drag it upwards out of the way, giving greater access to the cerebellum. If the sinus is wounded the hæmorrhage is likely to be terrific and difficult to control, and probably in the great majority of cases the better method is to try to gain access to the tumor from below the sinus without disturbing it.

CHAPTER XIX.

PAPILLOMATA OR FIBRO-EPITHELIOMATA.

A papilloma is a small, usually well-circumscribed, and more or less irregular outgrowth upon an epithelial-clad surface. They are found upon the surface of the skin and mucous membranes, upon the interior of cysts, within glands, and upon the internal surface of ducts. The surface of the body is covered with stratified squamous epithelium, which dips down into and lines the various ducts and glands connected therewith. The mucous membranes are lined with squamous, columnar, or ciliated epithelium, either in a single layer or stratified. The glands are lined by a modified columnar epithelium, the cysts by a simple, or stratified, columnar epithelium, and the ducts by a simple squamous or columnar epithelium. In all of these situations the epithelial structures rest upon a modified connective tissue basis which is supplied by blood vessels, lymphatics and nerves. Wherever these conditions prevail, and especially where papillæ or villi normally exist, papillomata may be formed.

The genus papilloma is divided into three species: 1st. The papilloma, or wart, which occurs upon the surface of the skin and upon mucous surfaces having stratified squamous epithelium. 2d. The villous papilloma which is found upon mucous surfaces covered with columnar or squamous epithelium. 3d. The intra-cystic and glandular papillomata, or those which take origin from the interior of cysts, glands and ducts.

CAUSATION.—There can be no doubt but that irritation either mechanical, chemical or bacterial, as well as inflamma-

tion, plays a very important part in the production of papillomata. When occurring upon the delicate skin of a child's hand they are often due to the mechanical irritation which occurs in the child's play in consequence of the hands becoming so frequently soiled or impregnated with dirt. The condylomata occurring upon the glans penis or prepuce, about the vulva, or near the anus, are usually the result of the irritation of unhealthy discharges or are due to the specific or pyogenic organisms contained within these discharges. The papillomata which occur within the nose are often the sequence of nasal catarrh, while those in the larynx not unfrequently follow a laryngitis due to an excessive or immoderate use of the voice. As they occur in the ovary, gastro-intestinal canal or breast, they are probably the result of irritation, or the action of toxic or infectious material incident to the course of chronic inflammatory processes.

Warts.—Papillomata upon the surface of the skin are ordinarily known as warts or verrucæ. They occur frequently in childhood and may be single or multiple, large or small, sessile or pedunculated, hard or soft. Warts have certain peculiar characteristics. They may make their appearance suddenly in crops and quite as unexpectedly disappear. When occurring upon the surface of the skin they usually have a slow, uniform growth, and having reached a certain size remain stationary perhaps for months or years, or during life, or they may gradually or quickly disappear. At other times their growth is irregular, now growing rapidly and then again seemingly remaining stationary. They are usually quite free from pain unless injured or inflamed, following which they may be extremely painful, ulcerate or bleed profusely.

The first species of papillomatous growths has been divided into various sub-classes. One of these, known as a seed-wart, or verrucæ vulgaris, frequently occurs upon the hands or portions of the body subjected to irritation, and forms large, hard, horny, flattened projections, which have

an extremely irregular surface as the result of an unequal growth of the papillæ, or the irregular surface may in part be due to a desquamation of portions of the epithelial covering. They may be of almost any size from that of a pin head to a growth which is several inches in diameter. In color they are usually decidedly darker than the approximating skin, and with the lapse of time the color often deepens while the hardness increases.

Another sub-class is that known as the filiform wart, verrucæ filiformis, which occurs at the border of a nail or nails as narrow, slightly elevated lines. These warts are usually quite soft, not much elevated, have a smooth surface and correspond in color to that of the adjacent skin. They may form an interrupted, elevated line almost completely encircling the border of one nail or of several nails, or the borders of the nails of the fingers of both hands may be implicated.

Another subdivision is that known as the flat wart verrucæ plana, which is a flat, soft, smooth wart, often of considerable size and of slight elevation.

A man aged forty presented himself, stating that three years previously a wart had made its appearance on his back (Fig. 116.) It had had a steady, uniform development, been free from pain and had caused no disturbance. It represented very much in appearance and size a ladies' watch, being in perpendicular diameter one and one-half inches, in transverse one and one-eighth and one-half an inch in thickness. It hung by a pedicle one-quarter of an inch long and not larger than a straw. It was the color of the normal skin and quite as soft. The growth was removed by dividing the pedicle with a pair of sharp shears. There were several other pedunculated warts about the size of grains of wheat upon the patient's back.

Warts which occur at the muco-cutaneous borders or upon the mucous surfaces covered by squamous stratified epithelium are usually spoken of as condylomata. These growths occur with special frequency upon the glans penis, upon the

internal surface of the prepuce, and about the vulva and anus. They grow with unusual rapidity, often springing up in a few days and attaining in this time considerable size. They are soft, not having the hardness of the ordinary seed wart, this softness being due to the maceration of their superficial epithelial layers. Their color is usually lighter than the normal skin, although if denuded of their superficial epithelium they appear red in consequence of exposure of the papillæ. In

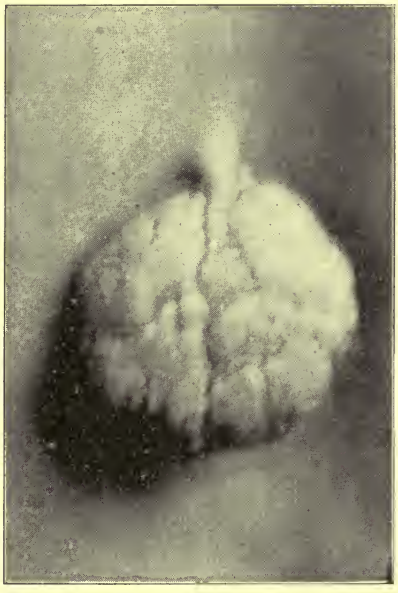


FIG. 116.
A pedunculated wart taking origin from the lumbar region.

shape they may be sessile or pedunculated, upon their surface very irregular or smooth, and in consistency hard or soft. They are also not unfrequently the occasion of the production of a very disagreeable odor. They correspond to the ordinary wart in that they are painless, and having reached a certain size often remain quiescent for a considerable time and then disappear as suddenly and as unexpectedly as they came, or they may become permanent. (Fig. 117.)

Papillomatous growths having the same general characteristics as the wart, although possessing less of the horny epithelial covering, are found upon the inside of the lips, the buccal aspect of the cheeks, the palate, vestibule of the nose, and in the larynx. A papilloma situated near the border of the tongue the size of a cherry-stone and of some months duration was recently removed by the writer.

The following was a papilloma taking origin from the soft

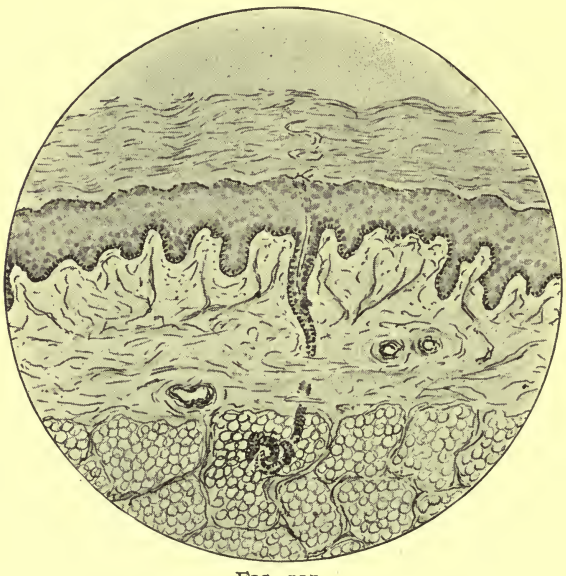


FIG. 117.
Normal skin.

palate: A young man about seventeen years of age, from a neighboring city, presented himself to the writer, having a pedunculated tumor about the size of a small cherry and with the surface appearance of a strawberry, taking origin from the right side of the palate. The growth was of a deep red color, had a pedicle perhaps one-fourth of an inch in length which was not larger than an ordinary knitting needle. The tumor had caused the patient a good deal of annoyance on account of the irritation and cough which it engendered.

Papillomata occurring in the larynx may be single or multiple, sessile or pedunculated. They are usually small, seldom reaching the size of an ordinary cherry, and are most frequently situated upon the true vocal cords or beneath the point of attachment of the cords to the cartilage. They are likely to cause, in this situation, a good deal of disturbance, as irritation with a harassing cough, and more or less of hoarseness, and if arrested in their movements between the vocal cords may cause great distress, dyspnœa, aphonia, and perhaps suffocation. They occur in this situation most frequently in children and young adults, and have the same epithelial covering as the papillomata upon the surface of the skin, that is, a stratified, squamous epithelium, which at times may become hard and horny.

HISTOLOGY.—Warts as they occur upon the surface of the skin, or upon surfaces covered with stratified squamous epithelium, are the result of a hypertrophy of the connective tissue of the papillæ and of the epidermis covering the same. As a rule when examined under a microscope one sees the papillæ not only much broadened but also enormously elongated, often two or three times their normal width and eight or ten times their normal length. (Fig. 118.) There is also an equal hypertrophy of the epithelial structures covering the papillæ, the rete cells dip far down between the papillæ, making the epithelial columns much broader and longer than normal, while upon the surface the layer of squamous cells is very much thickened and becomes dry, hard and horny in texture. There are, however, many exceptions to this rule. In one specimen the growth may be due almost wholly to a hyperplasia of the connective tissue of the papillæ and an increase in the size and number of its blood vessels. In these cases the surface of the wart may be covered by an almost normal stratified squamous epithelium. and the growth thus produced will be largely fibrous in character and have a surface which corresponds in color and in density to the normal skin. In another specimen the connective tissue of the papillæ may be

scarcely at all hypertrophied, while the growth is made up of proliferated epithelial cells. Again the proliferation may be largely confined to either the rete cells or to the superficial squamous cells. As a rule the greater the amount of cellular tissue in a papilloma, especially if the horny layer is deficient or not hypertrophied or desiccated, the softer it will be. If, as is not unfrequently the case, the growth is covered by a

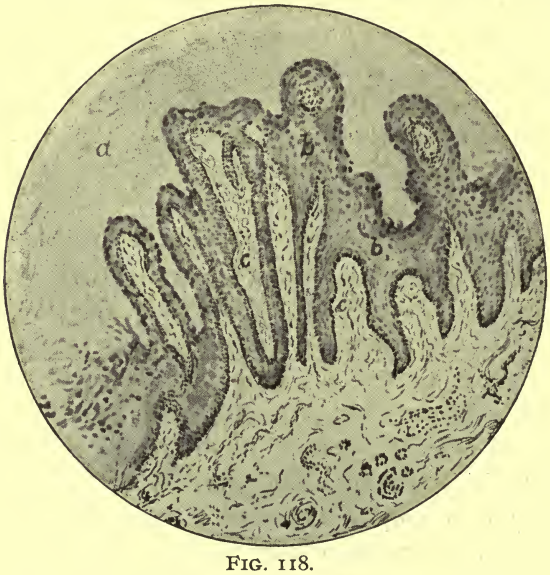


FIG. 118.
Papilloma of skin.
a. Thickened horny layer of epidermis.
b. Proliferation of rete cells.
c. Hypertrophy of connective tissue papillæ.

thick layer of desiccated epithelial cells it will be dry, hard and horny in character. On the contrary, if the surface is covered by a layer of normal squamous epithelium and the hypertrophy represented largely by a proliferation of rete cells, the growth will be as soft as the normal skin.

Degenerative Changes.—A wart is liable, as the result of traumatism or infection, to inflammation or ulceration, and if pedunculated may in consequence of thrombosis of its main vessel, or torsion of its pedicle, become gangrenous.

DIAGNOSIS.—Under ordinary conditions there should be no great difficulty in making a diagnosis of cutaneous warts. They must, however, be differentiated from epithelial growths of a malignant character. The soft wart which does not represent an exuberant growth of horny epithelium will scarcely ever lead one into error in diagnosis, and it is only those which have an excessively dry, horny, squamous epithelium that are liable to be mistaken for an epithelioma. Under ordinary conditions a wart is not indurated and does not present the hard, board-like base which is so characteristic of an epithelioma. The benign growth, unless it has been the site of a recent traumatism or infection, is not likely to be ulcerated, and should ulceration occur it will respond to proper treatment in a way that is impossible in the case of an epithelioma. Then the duration of the wart without producing metastases, and its very slow growth, at times remaining for long periods stationary, will aid one very materially in arriving at a correct diagnosis.

The writer recently had under his care a gentleman who had suffered a leg amputation some thirty years previously. The operation was done for a railroad injury, and was performed in the repair shops. The flaps became infected at the time of the operation and the wound never entirely healed. The bones were covered but the adherent flaps were the site of an ulcer, perhaps one inch in diameter, which led down almost to the bone. From this ulcer there had been for these thirty years an almost constant discharge, which, when the patient came under observation, was most offensive. The entire end of the stump, over an area some three or four inches in diameter, was covered by a large, somewhat irregular, decidedly elevated and very horny papilloma. In this case one could hardly escape the conclusion that the papillomatous growth was the direct result of the irritation either of the discharge itself or of the germs or ptomains which it contained.

Many people, and some writers, hold that warts are contagious and inoculable, and it is possible that to some extent

this may be true. Majocci, Cornill and Babes have described a specific germ, the bacillus parri, and hold that this germ is the cause of warts. Kuhneman recognized a bacillus in the prickle cell layer from which he thought warts originated as cause.

PROGNOSIS.—As has been stated warts are extremely curious growths, coming at times most unexpectedly as single or multiple growths or in crops, and disappearing again without apparent cause. In the great majority of cases they disappear spontaneously after a few months or years. Those which remain as more or less permanent growths can under ordinary conditions be easily removed by appropriate treatment. It is, however, true that in an occasional instance an epitheliomatous growth may become engrafted upon what was otherwise a benign papilloma. This has perhaps occurred with sufficient frequency so as to render the treatment of papilloma a matter of considerable impartance.

TREATMENT.—No reliance can be placed on internal medication. In the cure of these growths the first consideration must be given to the matter of cleanliness. The part should be thoroughly cleansed with soap and water as often as necessary, and carefully dried and a vigorous effort made to maintain the part in a thoroughly dry, clean and aseptic condition. This may be all that will be necessary in order to cause the warts to disappear. If more is necessary after a thorough cleansing one may apply an alcoholic solution of salicylic acid, one to five hundred, or a solution of formalin, to the individual warts, or paint them with a collodion composed of salicylic and lactic acid each one part, flexible collodion six parts; the application to be repeated frequently for one week, when the warts will likely have disappeared. A one per cent. sublimate solution in tincture of benzoin is also excellent. A weak solution of carbonate of potassium is highly recommended by some as a wash for the hands when one is suffering from warts. The writer has seen a large number of filiform warts disappear as if by magic after a bath or two in a

solution of carbonate potassium. If the warts are solitary they may be clipped off with scissors and the base lightly touched with the end of a tooth pick which has been dipped in nitric acid; or if the warts are large and extremely troublesome nitric acid may be carefully applied to their surface with the end of a match, being careful to protect the healthy skin, and after two or three days the part which has been destroyed by the acid should be carefully cut away with a sharp knife, when the second or third application may be made, as will be necessary. In the removal of warts an effort should be made to so treat them as to leave no unsightly cicatrices behind, as this condition is absolutely unnecessary.

Treatment of Condylomata.—The treatment of these growths is not essentially different from that of the common wart. Constant effort, however, is necessary in order to maintain cleanliness and dryness. In order to attain these ends the parts should be frequently bathed with an antiseptic solution, thoroughly dried, and then dusted with an astringent or antiseptic powder, such as bismuth, oxide of zinc, calomel or boric acid. If this is not sufficient the growths may be removed with the shears and the base cauterized. Papillomata situated upon the internal surface of the lips, cheeks, or upon the palate if pedunculated may be removed by twisting off or cutting the pedicle. If sessile they may be seized with toothed forceps, lifted up and cut away with shears, the rent in the mucosa being united with catgut sutures.

Villous Papillomata.—In the gastro-intestinal tract from the cardiac extremity of the stomach to the anus, the epithelial covering of the villi is of the simple columnar type. Papillomata in the gastro-intestinal canal may and do occur in almost every situation, but their frequency is seemingly in almost direct proportion to the distance from the cardiac extremity of the stomach, being most frequent in the rectum. In the stomach they are of occasional occurrence, and this is especially true of the pyloric extremity. At the pylorus they

produce both sessile and pedunculated growths. They occur in the large and small intestines, but are found with special frequency in the rectum, where they produce villous growths, pedunculated or sessile, soft or hard, small or so large as to occasionally cover a very considerable portion of the rectum. The villi are easily denuded of a portion of their epithelial covering, when they bleed readily, and portions of the growth

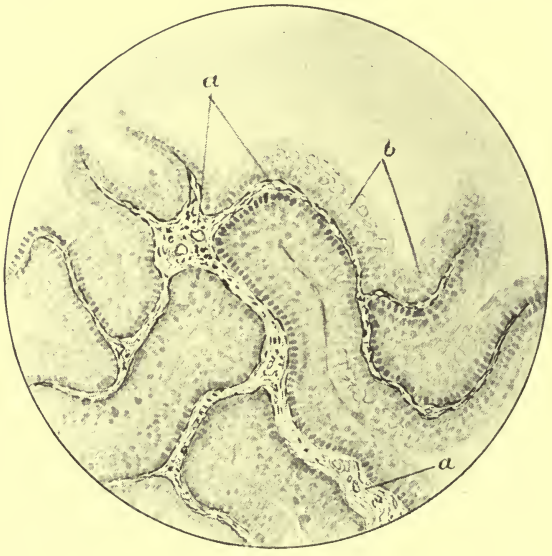


FIG. 119.
Papilloma of bladder.
a. Connective tissue of papillæ.
b. Proliferation of bladder epithelium.

may also be detached and pass with the stools. In some cases in consequence of the sessile character of the growth and as the result of irritation or inflammation they become ulcerated and acquire an unnatural induration.

HISTOLOGY.—The histology of villous papillomata differs very materially from that of warts, especially as the former occur in the rectum, bladder and kidney. (Fig. 119.) In these situations, notwithstanding the fact that the epithelial covering varies from the columnar, which is the case in the rectum, to the

stratified squamous which occurs in the bladder, the growths macroscopically, and to some extent microscopically, are not dissimilar. In these situations the villi are made up almost entirely of epithelial cells, which surround and enclose a very slender filament of connective tissue with its blood vessels as a stalk, while outside of this there has been an abundant proliferation of epithelial cells, producing a tuft which under the microscope is not unlike a digit. The growths consist in very great part of epithelial cells, which undoubtedly accounts in a large measure for their bleeding so readily, in consequence of injury or detachment of the cells exposing the vessels.

A couple of years since a patient past fifty presented himself to the writer in an emaciated condition and complaining of pain upon defecation, with bloody and mucous discharges and a feeling of fullness in the rectum. Upon examination there was discovered a very irregular mass, with a somewhat indurated base and ulcerated surface, which seemed to implicate pretty much the entire thickness of the rectal wall. The growth was so extensive, encircling the major portion of the rectum, and so broad, measuring some two and one-half inches of the length of the bowel, and so intimately connected with the submucous tissues that resection of the bowel was practised. The patient made an uninterrupted recovery, and a microscopical examination of the growth showed it to be a pure villous papilloma. (Fig. 120)

Symptoms and Course.—Papillomata occurring in the pylorus are most frequent in young adults and are likely to cause pain in the epigastric region, distress after eating, vomiting of food, hæmorrhage into the stomach with hæmatemesis, or the passage of bloody stools, emaciation, and obstruction of the pylorus, with dilatation of the stomach.

Diagnosis.—The condition should, if possible, be differentiated from a benign ulcer and from malignant disease. Ulceration is most likely to occur in young anæmic girls or in young women. There is a certain tender area. The condition is relieved or cured by diet and medication. Carcinoma

occurs later in life, is progressive, and does not yield to medical treatment or diet.

TREATMENT.—If a diagnosis can be established and the condition is progressive the stomach may be opened and the growths removed with scissors, reuniting the divided mucous membrane with fine silk sutures. Papillomata of the small or large intestine will not ordinarily be attended with symp-

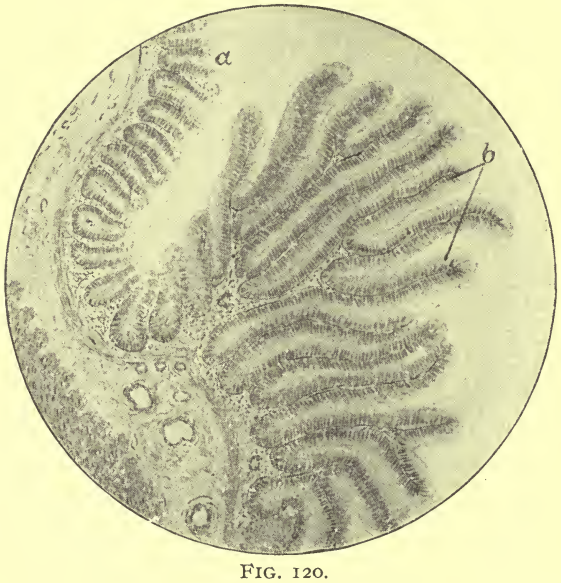


FIG. 120.
Papilloma of rectum.
a. Normal mucous membrane.
b. Papillomatous villi.
c. Connective tissue.

toms sufficiently distinct or localized as to render operative measures possible. Should, however, a tumor be produced operative interference may be undertaken looking to its removal.

Papillomata of the Rectum.—The diagnosis will depend upon the symptoms and course and upon a rectal examination. The symptoms will be pain and tenesmus on defecation, attended with bloody or mucous discharges and a feeling

of fullness in the bowels; there will also be anæmia. Or there may be but slight pain on defecation with slight hæmorrhage. Rectal inspection, or digital examination, may disclose a soft, feathery mass of small or large size, or a sessile growth of some density. The absence of induration at the base should ordinarily be sufficient to differentiate it from a carcinoma, while its soft, pedunculated or feathery character will be sufficient to establish the diagnosis.

TREATMENT.—If pedunculated the base should be ligated and the growth removed. If sessile it may still be ligated and removed, or if too large removed with scissors and a sharp curette and the base cauterized. If the growth is too large for this treatment, on account of the liability of subsequent contraction of the bowel or the fear of hæmorrhage during the operation, the bowel may be resected.

Recently a patient presented himself complaining of anæmia and bloody stools. He was sent to the hospital, and upon dilatation of the sphincter there was seen, at the very lower limit of the rectum, a somewhat firm, reasonably smooth papillomatous growth running transversely to the long axis of the bowel and about two and one-half inches long, one and one-half inches high, and one-fourth of an inch in thickness. The growth was ligated with multiple ligatures and removed.

Papillomata of the Bladder.—Papillomata are occasionally found taking origin from the mucous membrane of the bladder. Here the growths are seemingly due to a circumscribed proliferation of the submucous tissue about the blood vessels. Papillomata in this situation correspond very closely to the chorionic villi. They may be either sessile or pedunculated. They usually occur, in so far as the writer's observation goes, as long, wavy, delicate, soft, feathery processes, which appear through the cystoscope as long, delicate tufts, easily disturbed, and waving forwards and backwards in consequence of any commotion of the water in the bladder, as the branches of a tree are swayed by a gust of wind. They are often so delicate that they are easily denuded of their epithe-

lium or their branches broken off, following either of which occurrences they bleed freely. They are most frequently situated at the base of the bladder, and they may implicate the orifice of one or of both ureters, or the entire base of the bladder may be studded with them.

Symptoms and Course.—Papillomata of the bladder are likely to cause more or less of vesical irritation, followed by catarrh, with something of pain and frequency of urination. In the great majority of cases there is, sooner or later, as a conspicuous symptom, hæmorrhage from the bladder, which primarily is intermittent and not very severe, but as the growths increase in number and in length the hæmorrhage is likely to be severe, more or less continuous and even alarming. The hæmorrhage leads to great weakness, excessive anæmia, and even death of the patient. The condition must be differentiated from a solid tumor and from an epithelioma, both of which may cause hæmorrhage. A solid tumor of any considerable size may be felt by bimanual examination. An epithelioma would be difficult of differentiation, it is not likely, however, to cause the same amount of hæmorrhage, but more of a cachexia, with greater loss of flesh and severer pain. The papillomata, aside from the hæmorrhage and irritation, and possibly cystitis, which they cause, are benign and so far harmless growths, while an epithelioma, being malignant, is likely to occasion induration with adhesions of some portions of the bladder and adjacent structures or distinctive hardness with greater constitutional disturbance. A cystoscopic examination, if the water in the bladder can be made clear enough and the bleeding arrested for a sufficient length of time, will usually aid materially in establishing a diagnosis.

Treatment.—Internal medication may be instituted for relief of hæmorrhage, and for this purpose the fluid extract of ergot may be of decided value. Locally for the same purpose irrigation with very hot boric acid water may be practiced once or twice a day. This will not only aid in arresting the

hæmorrhage, but relieve more or less completely the catarrh or cystitis. If these measures are not sufficient, and ordinarily they will not be, and if the growth is large the bladder should be opened either through the perineum, or preferably supra-pubically, when the growths can be seized with long forceps and twisted off or removed with strongly curved shears or a sharp curet. When removed there should be nothing left of the pedicle, and if necessary this may be destroyed with a Pacquelin cautery.

Papillomata of the Kidney.—Villous growths also occasionally occur in the kidney, where they may be unilateral or bilateral. They take origin from the mucous membrane of the pelvis and form the same delicate, wavy tufts as occur in the bladder. It is thought by some that villous growths of the bladder are secondary to like growths of the kidney, that portions of the tufts are broken off and carried into the bladder and become implanted about the orifice of the ureter, where they grow. It has been not unfrequently noticed that these growths are situated about the orifice of the ureter, especially in cases where there are villous growths in the pelvis of the kidney.

Symptoms, Course and Treatment.—They are likely primarily to cause more or less pain and distress in the lumbar region, attended with soreness and later with hæmorrhage. If the growth reaches any considerable size it may cause dilatation of the pelvis, undue sensitiveness of the kidney upon palpation and sufficient enlargement so that it may be detected by bimanual examination. If the condition is unilateral and a probable diagnosis can be established, the symptoms being severe, the kidney may be exposed, the pelvis incised, and the growth removed with shears or a sharp curet, or if this seems to be impracticable the kidney may be removed. If both kidneys are implicated reliance should be placed on internal medication.

Papillomata of the Urethra.—Papillomata in this situation correspond closely in structure to the papillomata of the

mouth and have a stratified, squamous epithelial covering. They are usually small in size, seldom exceeding that of a cherry stone, are bright-red in color, and have an irregular, somewhat fissured surface. They occur with special frequency in women, near the extremity of the meatus. They are exquisitely sensitive and occasion a good deal of sharp, cutting pain during urination. They also occasionally cause a slight amount of hæmorrhage and tenesmus during urination, with more or less constant distress. By separating the urethral orifice they can readily be seen as red, strawberry-like projections, springing usually from the floor of the meatus. If occasioning any special distress the part should be cocainized and the papilloma seized with a pair of tooth forceps and removed with a pair of sharp slender shears. The opening in the mucous membrane may be closed by one or two sutures of catgut.

Papillomata of the Vagina and Uterus.—Papillomata of the vagina are comparatively rare. They may occur as soft, sessile or pedunculated growths, single or multiple, and in color correspond to the mucous membrane of the vagina. They cause by their growth some slight irritation of the vaginal mucosa. If present they should be removed with shears and the base cauterized or the opening in the mucous membrane united by catgut sutures.

When occurring within the uterus they are usually small, pedunculated growths, which give rise to more or less hæmorrhage. It will be impossible to differentiate them from a chronic fungus endometritis, and their treatment will be the same, that is, removal by curettage.

Papillomata of the Trachea.—Papillomata in this situation are of rare occurrence, although they are seen both as single and multiple growths. They are usually of small size, occurring as a rule in children and young adults. Not unfrequently, as is the case with the ordinary wart, they become quiescent after a few months of growth and remain in a non-active state for a considerable time. Clinically they give rise

to irritation with cough which may be spasmodic and they may even occasion dyspnœa and aphonia. Owing to a sudden congestion and rapid enlargement, and especially if pedunculated, they may become impacted between the vocal cords and cause alarming symptoms and even suffocation. If causing cough or other disturbance they should be removed following a tracheotomy.

Intra-cystic Papillomata.—These growths are occasionally found in the ovary. They take origin from either the germinal epithelium on the surface or from the epithelial lining of the Graffian follicles. The latter is formedb y a proliferation and projection into the cortical substance of the ovary of the epithelial layer which covers its outer surface. By a process of proliferation the epithelial cells in either of these situations may produce single, or what is more frequent, multiple papillomatous growths.

Histology.—Whether occurring as single or multiple growths upon microscopic examination they are seen to be made up of branching, tree-like processes, consisting of an axis cylinder of connective tissue enclosing the blood vessels and lined externally by a single layer of columnar cells. Taking origin from the Graffian follicles, both microscopically and macroscopically, the growths are made up of a large number of cysts, large or small, which are studded on their interior, or more or less filled, with papillomatous growths. (Fig. 121.)

The cysts may be so small that they are only microscopic, or so large as to contain a quart or more of fluid. Should the growths be confined to the interior of the ovary its surface will remain smooth and have an unbroken epithelial covering. If the papillomata take origin from the surface epithelium they will produce irregular, soft, fragile, feathery growths, having the characteristics of soft papillomatous tumors. When taking origin from the interior of the Graffian follicles they not unfrequently transgress the limits of the

follicles, permeate the cortex of the ovary and appear upon its surface as soft, villous masses.

Papillomatous growths of the ovary making up the major part of a papillary cystic adenoma not unfrequently reach such a size as to fill the pelvis and even the abdomen. They may be confined in the interior of the various cysts, in which case there will be nothing characteristic either in the

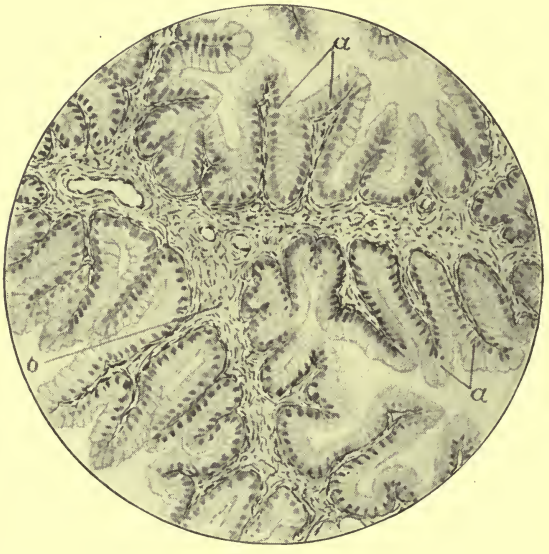


FIG. 121.
Papilloma of ovary.
a. Villous outgrowths.
b. Connective tissue.

manner of their growth or in the appearance of the cyst wall until incision has been practised, when the wall of the cyst or cysts will be seen studded with papillomatous growths. When reaching considerable size and transgressing the limits of the ovary the growth becomes attached to the adjacent structures, whatever these may be, binding ovary, uterus, bladder, abdominal wall and intestines, into one seemingly inseparable mass. It is claimed by many pathologists and clinicians that not unfrequently in the growth of a papillary

cyst adenoma a cyst filled with the cells or infectious material of the papillomatous growth ruptures and its contents is thereby disseminated through the abdomen, the cells becoming attached to the peritoneum of adjacent structures growing and producing secondary papillomatous tumors.

Symptoms and Course.—A papillary cyst adenoma of the ovary is a growth which constantly increases in size and not unfrequently if left to itself attains very large dimensions. If the papillomatous growths are confined within the cystic cavities the tumor will not present symptoms which will enable one to differentiate it from the ordinary multilocular ovarian cyst, except perhaps that it may manifest less of fluctuation and more of hardness and resistance than is ordinarily the case with pure cystic growths. When transgressing the limits of the walls of the cyst a papilloma becomes attached to adjacent structures and fixed. This results in irritation and traumatic inflammation with more or less of fever, soreness and tenderness. The adhesions and immobility of the tumor cause irritation and inflammation of the parietal peritoneum with ascites.

Diagnosis.—Primarily it will not be possible to differentiate the growth from a pure cystoma. The symptoms will be the same and an examination will give a like result. Later in consequence of adhesions the growth becomes fixed both in the pelvis and abdomen and consequently immovable. It loses much of its fluctuation and has a doughy feel with an outline or border not well defined. The character of the growth is not uniform, at some places it may be fluctuant and then at another solid. It causes more of soreness, inflammation and fever than an ordinary cyst. It is not as hard as a solid tumor, and what is of especial importance it causes ascites.

Prognosis.—The prognosis of a papillary cyst adenoma when not attached to adjacent structures is that of an ordinary ovarian cyst, but later, in consequence of the pronounced tendency of these growths to become attached to every adja-

cent structure, to produce irritation and even inflammation of the peritoneum, and to cause a kinking and even obstruction of the bowels as well as marked ascites, the prognosis may be said to be bad.

TREATMENT.—It is extremely desirable that a papillomatous growth of the ovary be removed before it has acquired numerous adhesions to adjacent structures. Although these adhesions are usually soft and comparatively easily broken up they are often so numerous as to implicate the major portion of the contents of the abdomen. In the breaking up of the numerous adhesions, permeated as they are with blood vessels, the hæmorrhage is always serious and at times alarming. I have a patient now in the hospital, a woman aged sixty-two, who came to me a few weeks since on account of an abdominal growth. Fourteen years ago a physician in making an examination of the pelvis discovered a small tumor of the right ovary. She, however, felt no disturbance or inconvenience, as she says, until some six months ago, when the abdomen commenced gradually to enlarge. During the past six weeks this enlargement had been rapid and associated with some fever, a good deal of pain, tenderness and soreness. The patient had lost flesh. Upon inspection the abdomen was seen to be greatly enlarged. On palpation a tumor was discovered reaching above the umbilicus. It was resistant and of unequal density, being at points seemingly fluctuant and then again quite hard. It was sensitive, immovable and had an irregular outline. Vaginally the pelvic roof was found to be more or less fixed, hard and sensitive. The abdomen contained a large quantity of ascitic fluid. Upon opening the abdomen several quarts of reddish serum were discharged. The tumor was then seen to be everywhere attached and to form a part of the adjacent structures. The adhesions and growth were soft. Commencing at the highest point the growth was rapidly separated from the intestines by the pressure of the fingers. The hæmorrhage was profuse. To add to the complexity of the situation many of the cysts were

broken into. Loop after loop of the intestines was freed, leaving at times portions of the cyst wall attached thereto. The growth had also to be separated from the parietal peritoneum on the right side, and finally a large cyst, having many soft adhesions, was separated from and lifted out of the pelvis, and the pedicle which included the right broad ligament ligated. The tumor, which primarily filled the entire lower half of the abdomen, was reduced by the rupture of numerous large and small cysts and the breaking up of the papillomatous growths, until what was left only filled an ordinary wash bowl. The entire growth, including the cyst walls, was extremely fragile and very easily torn. The hæmorrhage, which had been very severe during the operation, due to the breaking up of innumerable soft vascular adhesions, ceased spontaneously at its close. The abdomen was dried, and then going back over the area we removed many pieces of the cysts walls which had been left adhering to the intestinal coils. Their removal in some cases produced bleeding surfaces, which required sutures. At several points on the parietal peritoneum there were also villous outgrowths which were readily removed. It was remarked by one or two physicians, who were witnessing the operation, that the tumor was malignant, but the fact that the villous processes and the cyst wall had not infiltrated, but were only adherent to the coils of the intestines and parietal peritoneum, was indicative that it was a benign rather than a malignant growth. A microscopical examination showed it to be a papillary cyst adenoma.

The writer can scarcely imagine a more perplexing and serious task for a young operator than that he should attempt to remove one of these growths having innumerable adhesions to the abdominal viscera. His first impression is likely to be that the tumor is malignant but it has not the characteristics of a malignant growth. The operator should commence at the upper limit of the growth and carefully but rapidly break up the adhesions with the fingers or gauze pads, going from one portion to another, and at the same time endeavoring in a

measure to limit the amount of blood lost by compression with pads, making no effort, however, to arrest the bleeding entirely, because this would be almost impossible until the tumor had been removed. Following up the growth from point to point, one finally comes to the pelvis, which is usually more or less filled. The adhesions can be readily broken up by passing the fingers between the pelvic walls and the growth, keeping the palmar surface next to the tumor until finally the whole mass is lifted out of the pelvis and the pedicle ligated. Then the operator should go carefully over the various areas which had been implicated, arresting hæmorrhage and removing any portions of the cyst wall or villous growths which have been left behind. If the adhesions are very strong, which is not likely to be the case, the removal of the growth would be next to an impossibility. After removal the pelvic cavity should be dried, and perhaps flushed with a hot salt solution, and the abdomen completely closed or drained, as the judgment of the operator and the possibility of subsequent hæmorrhage may dictate. Oozing from the pelvic walls can be readily controlled by packing in a quantity of washed iodoform gauze and bringing the ends out through the abdominal wound. The patient will need to be sustained if there is much loss of blood by subcutaneous injections of salt solution and by the administration of strychnine and perhaps digitalin.

Papillomata of the Fallopian Tubes.—Papillomata taking origin from the tubes are of rare occurrence, and usually do not reach any very considerable size. If they become large they may be detected by a bimanual examination, and if causing much trouble removed after abdominal incision.

Papillomata also occur taking origin from the glandular structure of the mammary gland and from the galactophorous ducts. In these situations they are likely to cause enlargement of the gland or dilatation of the ducts, producing soft, irregular growths in the former case, and fusiform tumors in the latter. When situated in the ducts they are likely to

cause hæmorrhage from the nipple, and may be diagnosed as malignant growths, although they have nothing like the hardness of the latter tumor. They occur in young adult and in middle-aged women. If causing any special disturbance, and if their diagnosis can be established, they should be excised without interfering seriously with the mammary gland.

CHAPTER XX.

ADENOMATA.

An adenoma may be defined as a tumor growing from an epithelial-clad surface and having the structure of a secreting gland. It, however, differs from normal glandular tissue in that it has no function, ordinarily produces no secretion and is without pervious ducts. It is quite true that in some cases, especially in adenomata of the liver, the neoplastic growths at times produce secretions not unlike bile.

Adenomata are benign growths, and when taking origin from the interior of a gland are distinct and well-defined, being enclosed and separated from the adjacent structure by a distinct fibrous capsule. When taking origin from the cutaneous or mucous surfaces they usually assume the characteristics, or take the appearances, of warty or villous growths, and are then ordinarily pedunculated.

The adenomatous growths may be single or multiple. Situated in the gastro-intestinal canal they are not only often multiple but a dozen or more may be found in the same individual. Situated in the mammary glands they are also occasionally multiple and not unfrequently bilateral.

In size, as a rule, they are small, often not larger than a hickory-nut or walnut, but occasionally, as in the breast and ovary, they have reached the size of an adult head or have even exceeded this. Their rate of growth is usually slow, requiring often several years in order to attain the dimensions of a walnut. This seeming slow growth, however, may be changed by extraneous conditions, the principle of which is the formation of cysts due to dilitation or coalescence of adjacent

acini. These cysts not unfrequently increase quite rapidly in size and thus produce an apparently rapid growth of the adenoma.

In their histological structure they differ very markedly, and while they usually conform with reasonable precision to the gland in which, or from which, they take origin, this is not necessarily the case. An adenoma taking origin from the mammary gland is likely to resemble in structure this gland. The same is true of one taking origin from the prostate or ovary, although adenomata taking origin from or within the kidney frequently conform in structure to the adrenal organs. In their finer structure they may conform to that of either the tubular or racemose glands, and they are either hard or soft, depending largely upon the amount of connective tissue which they contain. An adenoma in one situation may be composed very largely of fibrous tissue and present a smooth, and quite hard surface, while in another it is made up largely of glandular tissue, in which there is only a sufficiency of connective tissue to hold the acini or tubules together, and be quite soft and lobulated. Again, if they contain cysts of considerable size, they will often present the sensation of fluctuation. These growths are frequently not true adenomata, but on the contrary are mixed or compound in character, as, for instance, they may contain a large amount of fibrous or muscular tissue, making up a tumor which is smooth or lobulated, has a slow growth and a considerable degree of hardness upon pressure, an adeno-fibroma, or an adeno-myo-fibroma (Fig. 80), or they may be more or less cystic in character, in consequence of the dilatation of the acini or the absorption of the adjacent walls, or the cysts may be the result of degeneration and absorption of the solid epithelial tubes. These cysts may be single or multiple, large or small, microscopic or macroscopic. Thus is produced an adeno-cystoma, or, if there is also a large amount of fibrous tissue, an adeno-cysto-fibroma. The adenomata, if taking origin from the glandular structure of the mucous membrane, are

likely to take the characteristics of myxomatous tissue. Especially is this true in the naso-pharynx, where adeno-myxomata not unfrequently occur. (Fig. 70.) The adenomata are also occasionally the site of round, spindle or giant-celled infiltration, in which case they may take on the characteristics of malignancy and be in fact adeno-sarcomata. It is held by many pathologists that not unfrequently in the life history of an adenoma the epithelial cells of the tubules or acini, which in the normal state are surrounded by a limiting membrane, the membrana-propria, which supports the epithelial tissues and preserves the adjacent structures from encroachment, override the restrictions of this membrane and grow into the adjacent connective tissue as solid columns of epithelial cells without a limiting membrane and thus produce an adeno-carcinoma.

Degenerative Changes.—Degeneration may be the sequence of traumatism, inflammation, or infection. It may also be the result of an impoverished nutrition, which follows a deficient blood supply. These degenerative changes may take the form of hyaline, fatty, or colloid degeneration, depending upon the situation and environment of the growth, or calcareous deposits may infiltrate the adenoma, taking the place more or less completely of the glandular structure.

Ætiology.—The causation of adenomata, like that of other tumors, is a subject concerning which there is great uncertainty and marked difference of opinion. It seems generally to be conceded that these growths are perhaps more often the result of embryological rests, or of epithelial inclusions which have remained at the original site or wandered into the adjacent tissues, than is the case with almost any other form of neoplasm. This seems to be especially true in adenomata of the kidney, where they often take the form of and seem due to sequestered cells coming from the adrenal glands. The same condition seemingly prevails occasionally in the uterus, where remnants of the Wolffian ducts seem to be the starting point of adenomatous growths in the uterine

wall. In the case of the thyroid it is well known that accessory portions of the gland are to be found in its immediate vicinity, but entirely separated from the main structure.

In the breast the glandular tissue conforms to that of a racemose gland, and takes its origin from the ingrowing of the rete cells of the skin in long, solid cords or columns, which are projected into the subcutaneous tissue, and which bud and subsequently become hollowed out, producing glands with their connected ducts. The same process occurs in the production of the enamel of the teeth and in the formation of the Graafian follicles of the ovary and in the formation of the glandular structure of the skin and mucous membranes.

It is not unlikely that in the breast during the active functional stage or in consequence of long-continued or considerable irritation or inflammation the same or like processes may occur. This ingrowing of the rete cells might take place from the epidermis or the buddings occur in the already existing acini. A considerable number of adenomata are congenital, which is perhaps equivalent to saying that these occur from rests or inclusions of embryonic cells. That they are also occasionally the result of irritation or inflammation, whether traumatic, chemical, or infectious in character, is most likely.

Adenomata of the Mammary Gland.—An adenoma in this situation is seldom pure, being composed as a rule of a sufficiency of fibrous tissue to cause its classification as an adeno-fibroma, or containing a number of cysts it is classified as adeno-cystoma. These two classes of adenomata are those usually encountered in the mammary gland. They are as a rule superficial growths taking origin beneath the skin in the immediate vicinity of the areola as well circumscribed, round or lobulated, quite hard, and distinctly movable growths. While they may make their appearance at any time between the ages of ten and fifty, they are most frequently found in young adults, the fibrous form occurring as a rule between the tenth and twentieth year, while the cystic variety occurs most fre-

quently after the thirtieth year. Their rate of growth is so slow that they usually require three or four or more years to reach the size of a walnut. They are usually quite firm, but still present a distinct, elastic feel, and when occurring directly beneath the skin may produce a circumscribed and well-defined bulging. If in their growth they reach any considerable size their pressure is likely to cause more or less atrophy of the adjacent gland structure. While as a rule they occur more frequently in women they have been found in the mammary gland in man.

Adeno-cystoma.—This variety of tumor is likely to grow more rapidly than the adeno-fibroma and to be somewhat irregular or lobulated in outline, and to present on examination a softer or even a fluctuant sensation. The cysts are the result of a dilatation of the acini or of a coalescence of two or more from pressure and atrophy of the interacinous partitions into one cavity. The contents of the cysts may be fluid, or semi-fluid. These growths ordinarily do not cause spontaneous pain, but if manipulated or pressed upon they are often sensitive and even quite painful.

Histology.—The adeno-fibroma shows acini lined by a single layer of columnar epithelium. This lining, however, at various points in an acinus is often converted into several layers. The acini vary much in size, some being quite short and slender and others very much elongated and widened. They may occur in clusters or bunches, and have only a sufficiency of fibrous tissue to hold the respective parts in place, or the different acini may be separated by a considerable quantity of fibrous tissue. Again the glandular tissue may occur in areas, or, as it were, clusters, and between these the growth is made up of more or less dense fibrous tissue. The cells always possess a limiting membrane which separates them from the adjacent tissue, and which is one of the characteristic differences between a benign and a malignant growth. An adeno-cystoma is made up of microscopic or macroscopic cysts due to the dilatation of one or more acini. These

cysts may be very small in size, or they may attain very considerable dimensions. Upon their walls there are often to be seen projections and villous outgrowths due to the proliferation of the epithelial cells.

Frequency.—Gross states that in 649 tumors of the breast but two were adenomata, and there can be but little doubt but what they are comparatively rare growths.

Diagnosis.—In endeavoring to differentiate glandular tumors from other growths in the breast one should not forget that the former occur almost without exception during the period of greatest functional activity of the mammary gland. The rate of growth of these tumors is slow, several years being consumed in reaching any considerable size. They are smooth or lobulated, distinctly encapsulated and separable from the adjacent tissues. They move with some freedom, slipping under the finger, produce little or no spontaneous pain, are situated ordinarily almost directly beneath the skin and near the areola, do not interfere especially with the functions of the gland, do not cause metastases, nor interfere with the general health or comfort of the individual.

Prognosis.—Being benign growths their prognosis is good.

Treatment.—If they are of any considerable size, the site of painful sensations, or are producing any functional disturbance, or are the source of anxiety to the patient, they may be removed. The gland itself, however, should be preserved, and in their excision as little damage inflicted upon it as is possible. Although distinctly encapsulated they are quite intimately connected with the adjacent structures and cannot be readily shelled out, these connections should be divided as they are met with and the growth then removed. The cavity should be either obliterated by suture in tiers or drained, preferably the former.

Adenomata of the Sebaceous and Sudoriparous Glands.—These growths are of rare occurrence. When taking origin from the sebaceous glands they are closely adherent to the skin, are round or slightly lobulated, elastic, and reasonably

hard growths. They are made up of an aggregation of alveoli, and are to be differentiated from the ordinary wen and from the tumors which are entirely subcutaneous. In size they are usually small, often not exceeding that of a hickory-nut, but in exceptional cases they have become quite large. They are confined largely to persons advanced in years years, and occur most frequently upon the face, scalp, and in the scrotum. Adenomata also occur in the sweat glands, but with even less frequency than in the sebaceous glands. They are due to a budding of the already existing glandular epithelium or to an ingrowing of the rete cells in columns, and are situated either within or beneath the skin. In the differentiation of these glandular tumors from the sebaceous cysts one is guided largely by the facts that they are solid growths and that they present a greater degree of hardness and are usually not so uniform or spherical in their contour. The so-called fungating sebaceous cyst of the head often shows glandular structure upon microscopical examination, and is not unfrequently an adenoma instead of a cystoma. It not unfrequently has its origin from warty or villous outgrowths of a sebaceous adenoma, and following an injury or inflammation takes on ulceration and fungous growth. Any of these growths when reaching a sufficient size so as to attract attention should be removed by enucleation or excision.

Adenomata of Thyroid.—An adenoma in this situation may be made up largely of glandular tissue or may be in part cystic. The thyroid body is primarily a compound tubular gland which in the early stages of the organ has an excretory duct, the thyro-glossal duct opening onto the dorsum near the base of the tongue. This duct before the thyroid body has become fully developed undergoes atrophy and occlusions and the thyroid tubules in consequence loose their excretory duct and become closed alveoli. The histology of the thyroid body shows it to be composed of tubular acini supported and bound together by an intertubular connective tissue into lobules and these again into lobes, the body itself being sur-

rounded by a resistant, firm, fibrous capsule. The acini are lined by a single layer of low columnar epithelium which secretes a colloid material. The epithelial layer of the acini rests upon a distinct membrane known as the membrana propria. The fibrous capsule which surrounds and thoroughly invests the thyroid body is in direct connection with the stroma which binds together the acini into lobules

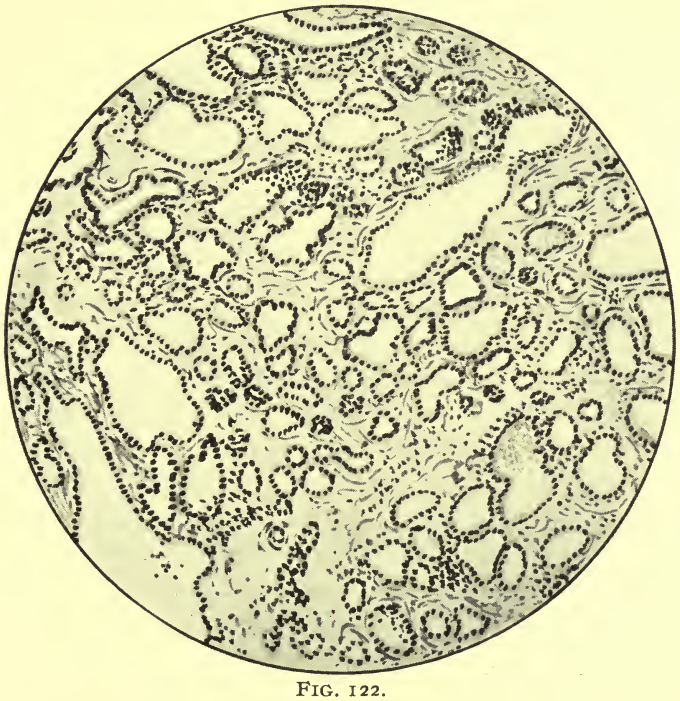


FIG. 122.
Adenoma of thyroid gland.

and the lobules into lobes and in this stroma the blood vessels, lymphatics, and nerves are projected. A single histological element of the thyroid may take on such an active proliferation as to produce a new growth. (Fig. 122.)

In the pure adenomata there is an increase of the glandular tissue producing a tumor which should be quite distinct and encapsulated and separable from the normal gland struc-

ture. Such a tumor may be small, perhaps not larger than a cherry, and single, or there may be multiple growths of considerable size situated in one or both lobes of the thyroid body. If an adenoma becomes largely cystic it may reach an enormous size. The adenomata are frequently enclosed by a layer of normal glandular tissue. If confined to one lobe and of pronounced size the gland becomes asymmetrical, but if the growths are comparatively of the same dimensions and occur in both the lateral lobes the thyroid body will retain its symmetrical form.

An adenoma may also occur in the isthmus where it will produce, if of considerable size, a decided projection at the center of the thyroid gland. The pure adenomata are soft, well encapsulated, painless, slowly-growing tumors of benign character. The cystic adenomata of the thyroid are produced by the dilatation of an acinus or of acini and if the cysts are large they are the result of a coalescence of two or more acini into one cavity. The cyst still retains its epithelial lining, basement membrane, and colloid contents. It occasionally happens that the contents of a cyst in consequence of a hæmorrhage into the cyst cavity becomes extremely fluid.

Degenerative Changes.—Occasionally in the thyroid body all traces of glandular tissue disappear, the body being converted into an enormous cyst containing calcareous plates or having a calcareous shell. (The thyroid shown in Fig. 123 was found on removal to be permeated with plates and shells of calcareous matter.) The colloid material contained within the acini is probably in the great majority of cases the direct result of the secretion of its cells, in some cases it is probably the result of a degenerative change. The acini are also often filled not with pure colloid material, but with an admixture of broken-down cells, blood corpuscles, hæmorrhagic exudates, and colloid matter. The adenomata in this situation are also frequently the site of inflammation, ulceration, or even of suppuration. These conditions may be the result of traumatism with or without in-

fection, or as is occasionally the case the sequence of septicæmia or pyæmia.

ÆTIOLOGY.—As in the diagnosis so in the causation it is impossible clinically in many cases to differentiate the true adenoma, and especially the adeno-cystoma of the thyroid, from other conditions which represent simply a hyperplasia of some one or more of the histological elements of the thyroid body without the production of a distinct and well-circumscribed tumor. Consequently we shall treat the condition of bronchocele or goitre to some extent as synonymous with adenomata, although the two conditions may be, and often are, entirely distinct. It is unquestionably true that in the great majority of cases of bronchocele there is not only an increase in the glandular elements which helps to make up the often greatly enlarged thyroid body, but also a dilatation of their acini. In the sporadic cases sex plays an important part, as the condition is quite rare in the male while it frequently occurs in the female. It also may be due to hereditary influences, occurring not unfrequently in members of many successive families. The age of puberty also is a direct exciting cause, as the great majority of cases make their appearance about this time. Many cases occur, it is true, in children, and others after puberty, but this does not invalidate the rule. Where goitre occurs endemically, as in Switzerland, it is probably the result of toxic or bacterial infection. It seemingly has been well demonstrated that in districts where the water drunk is impregnated with large quantities of organic material bronchocele is extremely prevalent, while in other regions where the drinking water is purer and practically free from deleterious products goitre occurs with far less frequency. It may also be true that where goitre occurs sporadically it is due to changes in metabolism or toxic processes. Patients who suffer from goitre are almost always in a more or less weakened, anæmic and debilitated condition. Their force and power of resistance is below par.

SYMPTOMS AND COURSE.—Bronchocele as it ordinarily

occurs in this country produces at first a feeling of fullness or tightness at the throat. Later, as the growth reaches a considerable size, depending, however, upon its consistency, it may produce serious disturbance of the circulation in the brain, either congestion with headache or anæmia with faintness. Not unfrequently in its course, if unilateral and hard, it will so distort and displace the trachea as to interfere very seriously with respiration, while in cases where still greater pressure is exerted the rings of the trachea may become to

FIG. 123.
Cystic adenoma of thyroid. Lines suitable for incision in the complete removal of medium-sized thyroid.

some extent softened, or absorbed, and their power of resistance so diminished that respiration is at times seriously interfered with or suffocation threatened, and the latter may even become a dreadful reality. Not unfrequently patients with large goitres on lying down at night find themselves breathing with difficulty, unable to sleep, and even struggling for breath. In some cases these patients are forced to suddenly spring up in bed. They clutch at the bed clothes, labor for breath, become livid, and even die as the result of a sudden kinking of the trachea. This lamentable state is, however, usually

preceded by ample warning during which the patients have at various times labored suddenly and urgently for breath. The trachea may also be so compressed that respiration is constantly more or less interfered with.

DIAGNOSIS.—There can be little difficulty ordinarily in making a diagnosis of bronchocele. The fact that in the great majority of cases one lobe is enlarged more than the other, that the growth is intimately connected with the trachea and rises when the patient swallows, that it is usually slow of development and elastic, coupled with the age and sex of the patient and the pressure symptoms will usually be sufficient to differentiate this from any other form of growth occurring within the neck.

TREATMENT.—Primarily the patient should be put in the best possible state of nutrition. The diet should be regulated and the secretions and excretions be placed in as nearly a normal condition as is possible. The majority of patients need tonic treatment. The administration, in some form, of iron, arsenic, quinine, and strychnine is nearly always indicated. In glandular goitres the greatest benefit is often derived from the administration of thyroid extract in five-grain doses to an adult three times a day. Less than this quantity is not often beneficial and more is likely to produce weakness and palpitation of the heart or syncope. In non-cystic cases and in those which are not especially vascular hypodermic injections of tincture of iodine into the enlarged glandular structure is of the greatest value. This is usually attended with some momentary pain in the neck, ears, or jaws, and is followed by a traumatic inflammation of the gland structure immediately surrounding the puncture, with swelling which lasts for a few days, and then there is a contraction of the inflammatory exudate with a matting together and an increase of density and lessening in size of the gland in this particular region. The injection may be repeated every seven to ten days and given under strict antiseptic precautions. Each subsequent injection should be as far away from the previous

one as is possible. Many cases of goitre are thus readily diminished in size or made to disappear. Many surgeons use a two per cent. solution of carbolic acid, but in the writer's experience it has been much less satisfactory, being more transient in its effects than the iodine.

It occasionally happens during the treatment by hypodermic injections that the patient, if the gland is rapidly decreasing in size, becomes weak and debilitated, loses flesh and suffers from palpitation of the heart and occasional attacks of dizziness. This seemingly is due to the changed metabolism in consequence of the rapid destruction of the glandular tissue and in cases in which it does occur the injections should be discontinued for a short time.

Operative Treatment.—An operation becomes indicated in adenomata which will not yield to the above line of treatment, especially if they are cystic; and is imperative in cases in which they are of sufficient size so as to produce serious pressure symptoms upon the trachea, adjacent blood vessels, and nerves. If the growth which is producing the disturbance be circumscribed, well defined, and encapsulated enucleation may be practised by exposing the cyst or growth by free incisions and then enucleating it by means of blunt dissection. In the great majority of cases, however, the growth is so inseparable from one or even both lobes that excision of at least an entire lobe becomes a necessity in order to obtain the desired relief for the patient. In practising excision one may resort to any form of superficial incision which best exposes the part to be removed. Under ordinary conditions a long, curved, transverse incision crossing the lower part of the neck and with its concavity upwards affords the best means of exposing the parts. (Fig. 125.) One may, however, use a straight, angular, slightly slanting, or a V-shaped incision. The incision through the skin must always be a long one, completely exposing the very limits of, and going even beyond, the parts to be removed. Nothing can be more disadvantageous or produce greater difficulties or hindrances

or more retard the progress of the operation than a short, insufficient skin incision.

In incising the deeper structures care should be taken to avoid the anterior and external jugular veins and then the surgeon works down carefully through the platysma, fascia and other muscles until he is directly upon the gland itself, which is easily determined by the appearance of a number of

FIG. 124.

Cystic adenoma of the thyroid. Entire gland removed. Line of incision.

large tortuous veins which are a part of its capsule. The sterno-hyoid, sterno-thyroid, and omo-hyoid muscles are usually stretched tightly over the growth and require division. If the surgeon endeavors to enucleate the thyroid without having first divided all of the structure which overlies it he will find himself hopelessly entangled in the fascia muscles and connective tissue spaces which surround the gland and it will be impossible for him to make any intelligent progress. In growths of considerable size it may be necessary to divide a part of the sterno-cleido-mastoid, but under ordinary conditions this muscle can be strongly retracted and

held out of the way. Having reached the growth the knife should be laid aside and the loose connective tissue which connects the gland to the adjacent structure broken up with the finger. This ordinarily can be easily done. The wound is kept widely open and the surgeon works his way to the upper pole of the growth where the superior thyroid artery enters and the corresponding vein has its exit. These are not always recognizable as distinct, individual vessels, but often

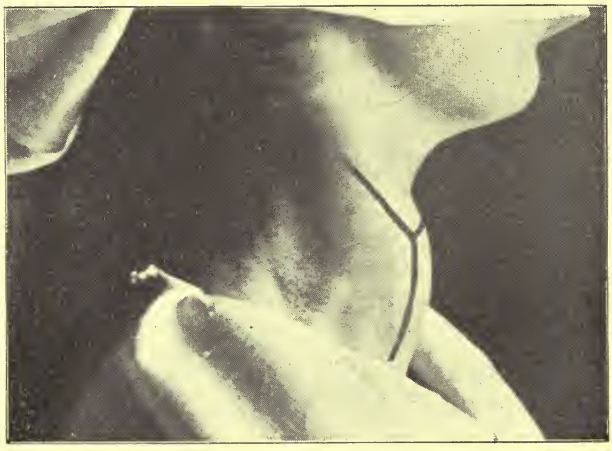


FIG. 125.
Adenoma of right lobe of thyroid. Right lobe removed.
Line of incision.

seem more like strands of connective tissue, they, however, should be included in double ligatures with something of the adjacent connective tissue. They are then divided. Not unfrequently at the upper pole two ligatures are required to reach all of the branches. Absolutely nothing should be cut which is at all resistant without first having been doubly ligated, as it is impossible in this situation to differentiate veins of considerable size, when they are put upon the stretch, from connective tissue. After having ligated and divided the superior thyroid one works his way around the superior pole

toward the isthmus which is not unfrequently firmly adherent to the adjacent rings of the trachea. The isthmus is separated by blunt dissection and then transfixed and doubly ligated upon each side. The corresponding half of the gland is now readily lifted out of the wound the vessels coming directly from below over the trachea, the thyroidea ima artery and vein, are doubly ligated, when the surgeon gives his attention to the inferior thyroid artery and vein. Before ligating these vessels he must be sure that the recurrent laryngeal nerve is not included in the grip of the ligature, and it is probably better in this situation to use a catgut ligature than silk, for the reason that it is more elastic and is not so likely to produce disastrous effects upon the nerve should it be accidentally included in the grip of the ligature. The recurrent laryngeal nerve is normally placed in the groove between the trachea and œsophagus, but in the enlarged thyroid the anatomical relations are all changed, and little or no reliance can be placed upon the position in which the nerve should be normally found. For this reason it has been the writer's practice to commence the enucleation by inserting the fingers beneath the outer border of the gland and then attacking the upper pole, at which point are the superior thyroid vessels, and going from this to the isthmus, when but one-half of the gland is to be removed. When these two parts have been freed the gland can be lifted out of the wound and drawn a distance away from the nerve. The nerve, if possible, should be located and the artery and vein ligated near to the gland. If there is danger of injury to the nerve a portion of the posterior capsule, or even of the gland itself, may be left with the ligature. The vessels are then incised and the gland removed. In cases where it is necessary to remove the entire gland it is best to expose and ligate the vessels in the superior poles and then to either ligate and divide the isthmus, removing each part separately or attack the lower pole of the side which is most accessible. Following the removal the divided muscles should be reunited

and the cavity as far as possible obliterated by tier suture. Ordinarily drainage had best be established for twenty-four or forty-eight hours.

COMPLICATIONS.—Complications which may arise during or following a thyroidectomy are hæmorrhage, injury to the recurrent laryngeal nerves, and sepsis. Serious hæmorrhage can ordinarily be prevented if one is careful in enucleating to

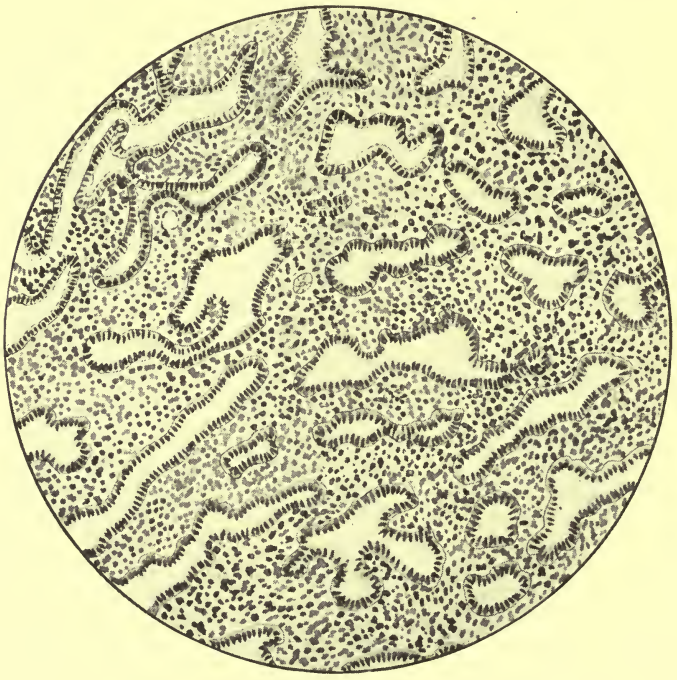


FIG. 126,
Adenoma of stomach

securely ligate all structures which cannot be readily broken up by finger tip pressure before they are divided. Injury, when it occurs, to the recurrent laryngeal nerve, either by severe stretching or division, produces more or less complete loss of voice and is a most serious accident. This most unfortunate occurrence can, however, be avoided, it is believed, in nearly every instance by following the directions above out-

lined. The avoidance of infection of course requires an aseptic operation.

SEQUENCES.—Clinical experience has seemed to teach that the entire thyroid in a young adult should not be removed except for a malignant growth. This is in consequence of certain nervous affections which occasionally follow its entire removal. These conditions very seldom occur when the entire gland is not removed, and it is quite true that they do not necessarily occur when it is. This may be due in part to accessory portions being lodged outside of the main capsule and thus escaping the operative measures. The complications arising from the removal of the entire gland are, first, that state known as cachexia strumipriva, which is not unlike myxœdema and which has been practically non-amenable to treatment. Another nervous condition, which, however, is much less serious and which occasionally follows the entire removal of the thyroid, is that known as tetany. This, however, usually yields to the administration of chloral and tonics. It is also quite likely that the condition known as cachexia strumipriva could now be prevented or controlled by the administration of thyroid extract.

Adenomata of the Parotid Gland.—An adenoma of the parotid is a rare growth. When occurring it is usually a small, painless, distinctly well-circumscribed and encapsulated growth, which is found as a rule only in young adults. The growth is seldom larger than a walnut and on section cavities are seen which contain villous growths having the same general structure as the gland. Compound growths are much more frequent in this situation than are the pure adenomata, and comprise adeno-cystoma, adeno-sarcoma, and adeno-carcinoma. They should be differentiated from the tubercular lymphatic glands which are so frequently found in the lower portion of the parotid. If these growths are of any considerable size and are producing functional disturbance or disfigurement, they may be removed by enucleation, being care-

ful so to place the incision as to do no injury to the branches of the facial nerve or Steno's duct.

Adenomata of the Larynx.—These may be single or multiple, and are usually of small size, and situated anywhere upon the laryngeal mucous surface. A diagnosis can usually be made by the use of the laryngeal mirror. If of sufficient size to cause disturbances, such as cough, more or less hoarseness, or aphonia, they should be removed. Their removal can usually be accomplished by the use of the snare.

Adenomata of the Naso-Pharynx and of the Gastro-Intestinal Canal.—Adenomata not unfrequently occur in the naso-pharynx as polypoid growths having the characteristics of myxomata. They may not be easily differentiated from the ordinary nasal polypus except perhaps that they are slightly less translucent, being somewhat milky in appearance and more resistant than the ordinary myxomatous growth, and upon microscopical examination they are seen to be composed largely of glandular structure. Their treatment is that of the ordinary nasal polypus. (Fig. 70.)

Adenomata of the Stomach.—Adenomata that are situated in the cavity of the stomach are usually small, decidedly pedunculated growths. They are ovoid in shape. Histologically they are made up of long, slender tubes, lined by a single layer of columnar epithelium. (Fig. 126.) Here and there the growths are likely to show pronounced round-celled infiltration. They occur in all parts of the stomach, but are most frequent at the pylorus. They are likely to cause, in consequence of their long pedicle and extreme mobility, great nervous disturbances. Aside from this, if situated in the pylorus, they are apt to produce more or less obstruction, with pain, dilatation of the stomach, vomiting, and emaciation, symptoms which are ordinarily referable to malignant growths. If causing decided functional disturbance and a reasonable diagnosis of a neoplasm can be established the stomach should be opened and the growth removed. While adenomata occur in all parts of the gastro-intestinal canal

they are most frequent in the rectum. Occurring in this situation they pattern very much after the follicles of Lieberkuhn, and occur as a rule in young children as polyoid tumors. Some of these growths may not be larger than a hickory-nut, while others have been discovered as large as a pear. When of considerable size they are usually solitary. When small they may be multiple. They are usually pedunculated and

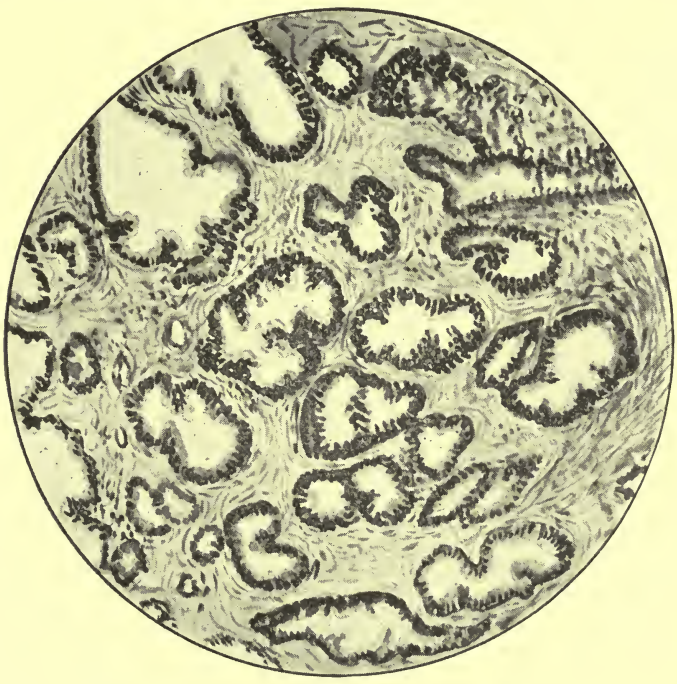


FIG. 127.
Adenoma of prostate gland.

have a thick, strong stalk, which may become so elongated that the growth becomes caught in the grip of the sphincter, causing much distress to the patient and possibly gangrene to the growth. In color they correspond to that of the mucous membrane. On section they are seen to be very vascular and their glandular structure to be made up of large follicles lined with a single layer of columnar epithelium. The follicles not

unfrequently contain a thick mucous secretion. If discovered they should be removed by torsion or the pedicle may be divided after proper ligation.

Adenomata of the Prostate.—The prostatic body is made up of compound tubular glands invested by a stout layer of fibrous tissue, beneath which is placed a thin layer of involuntary muscle. The epithelial lining of the acini is of the short columnar variety. The acini are supported and bound together by a quantity of elastic connective tissue and bundles of muscular fibres. (Fig. 127.) Any one of these structures may become principally or primarily hypertrophied, but only when the glandular structure takes on adventitious growth in a more or less circumscribed and encapsulated area can it be said with any degree of propriety that the growth is an adenoma. The condition occurs most frequently after the fiftieth year of age. It was formerly held that in a great majority of these growths the increase was made up of muscular tissue and that they were in fact myomata. Histologically it may be said with good cause that the hypertrophy in a large measure, at least in many cases, is due to an overgrowth of the connective tissue. In some unquestionably the increase in size is due to hyperplasia of the glandular structure, as my own specimens show. In these cases the prostate may be very greatly enlarged and nodular in form. The growth may be quite distinctly circumscribed and confined to one lobe, or all three of the lobes may be implicated. When reaching a considerable size they produce the ordinary symptoms of an enlarged prostate. These symptoms are produced by an elevation of the vesico-urethral orifice, preventing the complete emptying of the bladder. The quantity of residual urine gradually increases with the growth of the gland until finally ammonical decomposition occurs, then infection, and finally cystitis. Following this there may be a long train of pathological processes implicating the bladder, ureters, kidney, and general system.

Diagnosis.—It would be impossible without a microscopical section to differentiate an adenoma of the prostate from an

overgrowth of connective or muscular tissue. Enlargement of the gland is easily determined by the symptoms, such as frequent and often painful urination, especially at night, changes in the character of the urine and the presence of residual urine. It would be entirely out of the scope of this treatise to go into detailed account of the diagnosis and treatment of enlarged prostate. The growths under consideration

FIG. 128.
Adenoma of ovary.

are important only in so far as they prevent a complete evacuation of the bladder. This condition if present may be relieved or cured in whole or in part by practising one of three methods. The patient may resort to catheter life as a relief, or Bottini's operation may be done by cutting through the enlarged prostate with the galvano-cautery knife and thus lowering the prostatic urethra, or enucleation may be done by

the perineal route or suprapubicly. The methods formerly so much in vogue, namely, that of castration or section of the vas deferens or suprapubic cystotomy, are not practised to any extent at the present time and should not be. Bottini's operation is practically without risk, is quickly accomplished, is attended with almost no pain, does not confine the patient to bed for more than a few days, and for its performance an anæsthetic in very many cases is not necessary, and it may be said in the great majority of cases to accomplish the results desired. The writer's experience with this operation has been most satisfactory. Prostatectomy or the removal of the prostate gland either suprapubically or preferably by way of the perineum is absolutely curative, and is increasing in popularity, and will be unquestionably employed more and more in the future in suitable cases.

Adenomata of the Testicle.—These are rare growths, and when occurring are frequently more or less cystic. They vary in size from that of a hickory-nut to that of a walnut. The cysts frequently contain papillomatous growths. The contents of the cysts are either fluid or semi-solid. Compound growths in this situation are more frequent than are the simple adenomata, and include the adeno-sarcoma, adeno-condroma, and the adeno-myxoma. Many authors look with suspicion upon adenomata in this situation, believing that the great majority of cases are malignant. If occurring they may be enucleated, or if their nature is in doubt probably castration would be the safer treatment.

Adenomata of the Kidney.—Many pathologists and embryologists hold that these growths have their origin in misplaced epithelial elements derived from the suprarenal glands. Thoma thinks they may take origin from the inclusions of the epithelial vestiges of the Wolffian bodies. In some cases the growths contain tubules and irregular spaces lined with columnar epithelium that are held by many to be proliferations of the convoluted tubes of the kidney, with which they are

occasionally connected by one or more tubes. They are often, however, distinctly circumscribed and encapsulated. There is always a decided difference between the epithelial cells of the adenoma and the cells of the normal kidney tubule, the former being more irregular and larger. The growths are usually nodular, elastic, small, and often cystic. The diagnosis would be extremely doubtful without microscopical examination.

TREATMENT.—If causing enlargement of the kidney or functional disturbance they may be exposed by incision, and if practicable enucleated. This being not possible the kidney itself may be removed.

Adenomata of the Uterus.—Pure adenomata situated intra-murally are rare growths. There are two hypotheses for their occurrence in this situation. One is that they take origin from the remnants of the Wolffian bodies or that they are ingrowths from the epithelial or glandular structure of the mucous membrane. They produce the symptoms of, but are different microscopically from, myomata. Their treatment is that of a myomatous growth.

Adenomata of the Fallopian Tubes.—These are usually small growths seldom larger than a hickory-nut. They take origin from the epithelial lining of the tubes. They usually occur in the form of papillomata and in their growth distend the tube. They are made up of glandular tissue, the recesses being lined with columnar cells. If producing a tumor of any considerable size or causing functional disturbance they may be excised.

Adenomata of the Ovary.—An adenoma may take origin from the Graafian follicles and according to Waldyer and Klebs also from the remnants of Pfluger's ducts. They occur as globular or nodular growths and vary greatly in size. The pure adenomata are usually small, but when complicated by cystic formations may reach great size. Histologically there are numerous follicles which often show on the inner surface beautiful villous processes lined by one or more layers of

columnar epithelium. (Fig. 128.) Their treatment corresponds to that of other ovarian growths.

Adenomata of the Liver.—These also are rare growths and are usually encapsulated spherical tumors and may be either single or multiple. In size they range from that of an ordinary cherry to that of an orange. In color they correspond closely to that of ordinary hepatic tissue. Histologically they are composed of solid columns of cells which toward the center of the growth acquire a narrow lumen. The growths are made up in considerable part of blind ducts which contain a fluid resembling, to a certain extent, bile. In their arrangement they conform often in a general way to the histology of the liver, only that the cells are often larger. Although benign growths they cause metastases in the spleen. Their growth is slow, and their diagnosis would be impossible without opening the abdomen. W. W. Keene and Von Bergman have both successfully removed adenomata from the liver.

CHAPTER XXI.

CYSTS OR CYSTOMATA.

A cyst may be defined as a sac composed of fibrous tissue and usually lined by one or more layers of epithelial cells which surround and enclose a cavity containing fluid or semi-solid substance. Cysts perhaps vary more in their construction, contents, situation, and methods of development than any other class of tumors. The contents of a cyst may be fluid or semi-solid, but its characteristics will depend very largely upon the structures in which, or from which, it has been developed. Cysts of the sebaceous glands represent in their contents the changed secretions of that gland. Mucous cysts, or cysts springing from the mucous membrane, are filled with a mucoid substance. In a pancreatic cyst the contents conform closely to the pancreatic fluid. Serous cysts contain serum. A hæmorrhagic cyst may contain more or less changed or disorganized fluid blood. Dermoid cysts often contain in their interior products which are normal to the epiblast or mesoblast, such as hair, bone, and teeth. Galacteal cysts contain milk. When the gall bladder, kidney, or ureter are converted into cystic tumors they contain more or less of bile or urine. The contents and characteristics of a cyst, then, depend almost entirely upon its situation and upon the character of the cells which line its interior, whether these normally produce mucus, bile, sebaceous material or pancreatic fluid.

The cyst's contents may also undergo certain changes, such as the following: It may become infected and converted into pus, as occurs in the suppurating ovarian cyst, in suppur-

ating gall bladder, the suppurating sebaceous cysts, or in pyonephrosis. The contents also may be converted in consequence of inspissation into a more or less solid mass. This takes place in the sebaceous cyst and in the gall bladder. In the latter the writer has encountered, in consequence of obstruction of the common duct, bile so inspissated that it was as thick as jelly and had to be removed with a spoon. In obstruction of the cystic duct the gall bladder may be converted into a great sac containing only clear, colorless mucus. The character of the contents is also often changed in consequence of hæmorrhage into the cyst cavity. This is seen with especial frequency in ovarian cysts where the fluid normally is thin and transparent, but may become, in consequence of hæmorrhage, dark brown in color, somewhat thickened and very turbid in character. The lining of a cyst may consist of a single layer of columnar, cuboidal or ciliated epithelium, or the epithelial lining may be stratified, or while usually consisting of a single layer it may be collected at various points into more or less irregular heaps. Some cysts, especially the congenital serous cysts, are lined by endothelium derived from connective tissue plates, or, as in the case of hæmorrhagic cysts, the wall may be made up, primarily at least, of connective tissue rendered more or less compact by pressure and irritation and without a distinctive epithelial lining. In the case of cyst adenoma numerous follicles are often found upon the interior of the cyst wall, or a budding or proliferation of the lining epithelium may take place, forming new acini which are with the follicles the occasion of the formation of multilocular cysts.

The cyst wall may present a beautiful pearly-white color, be almost transparent, or be milky, opaque and dark in appearance. The cyst stroma is made up of fibrous tissue which is at times very thin, scarcely thicker than tissue paper and made up of but a single layer, a closely set mesh-work of fibres as it were, or consists, as the result of irritation and pressure, of a thick wall measuring one-quarter of an inch or more in thickness.

Cysts are *unilocular* or *multilocular*. A unilocular cyst may be the result of the dilatation of a duct, an acinus, or gland. They may occur in connective tissue spaces as the result of hæmorrhage or serous exudate or may be due to inclusions of the epiblast or the result of congenital defects of development. They may occur in free peritoneal spaces which are normally free from fluid or they may be found in hollow organs or in closed peritoneal spaces. They may be due to the absorption of the adjacent walls and the coalescence of several cysts.

Multilocular cysts frequently take their origin from glandular structure. They are in many instances cysto-adenomata. Their multilocular character often results from the budding or proliferation of the epithelial lining of a single cyst in consequence of which as a result of degeneration and absorption of the center of the bud or process hollow acini and subsequently cystic cavities are formed, or upon the interior of the cyst may be situated numerous follicles which project into the cyst wall and later are converted into distinct cysts. In situations where there are many solid epithelial columns, and especially if these remain in the tissue as embryonal vestiges, as occurs in the jaw in the production of the enamel of the teeth, in the ovaries in the production of the Graafian follicles and medullary cords, in the testicles and in the mucous membrane and skin in the production of glandular tissue, these columns may be the site, in consequence of the disintegration and absorption of microscopic central areas, of the formation of cysts.

Genera and Species.—The division of cysts into genera and species is a subject concerning which there are no fast and fixed rules. It is a matter concerning which scarcely any two writers fully agree and one which is handled largely in an arbitrary manner. It has seemed best to classify cysts into the following genera, namely:

1. Retention cysts.
2. Tubulo-cysts.
3. Hydrocele.
4. Glandular cysts.
5. Cysts of congenital origin.
6. Cysts due to parasites.
7. Miscellaneous cysts.

The first genera may be divided into the following species:

1. Hydronephrosis.
2. Hydroureter.
3. Hydrocholecystis.
4. Sebaceous cysts.
5. Mucous cysts.
6. Salivary cysts.
7. Galacteal cysts.
8. Pancreatic cysts.
9. Hydrometra.
10. Hydrosalpinx.

Hydronephrosis.—This pathological condition may be congenital or acquired, be unilateral or bilateral. In the congenital cases there is an absence or a stenosis of some portion of the ureter or urinary tract. Acquired cases may be the result of a stenosis in the urinary passage situated anywhere between the prepuce and the entrance of the ureter into the pelvis of the kidney. Wherever this stenosis occurs the primary dilatation of the urinary tract is adjacent thereto and extends from there upwards to the kidney. A patient is under my care at the present time who came on account of a stenosed condition of the urethra situated just in front of the membranous portion and due to traumatic injury. There had been progressive contraction of the stricture and finally complete closure, with retention of urine. Upon dilating the stricture we found the membranous urethra dilated into an accessory bladder which held at least one-half pint of urine. The prostatic urethra was not at all dilated.

The stenosis may be in a contracted prepuce. A specimen illustrating this condition is in the museum of the Wisconsin College of Physicians and Surgeons, of Milwaukee, where, in consequence of the stenosis the entire urinary tracts of both sides became dilated. The dilatation may be the result of a tumor or stone in the bladder pressing upon the ureters, or it may be occasioned by an abdominal growth or stone in the ureter or may be due to stenosis of some por-

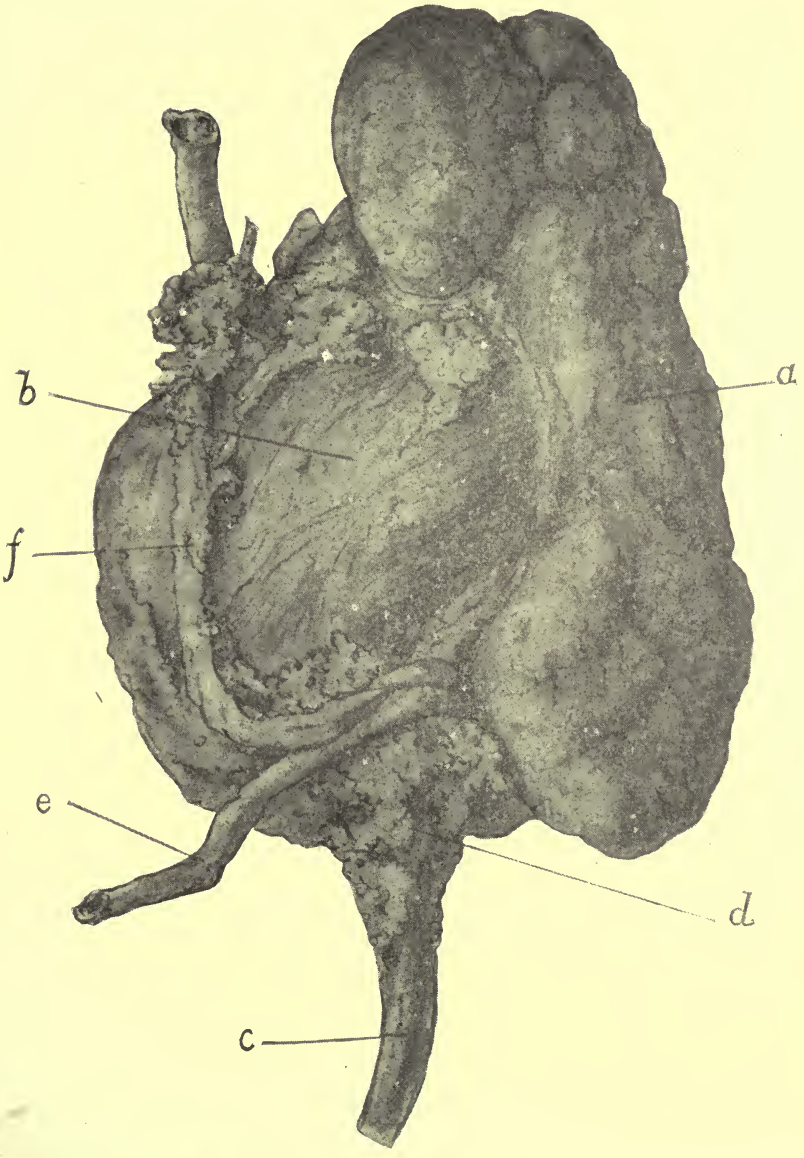


FIG. 129.

a. Atrophied kidney. b. Dilated pelvis. c. Ureter. d. Site of cicatricial constriction. e. Renal artery. f. Accessory renal artery.

tion of the ureter due to a previous inflammatory condition. (Fig. 129.) Here there is a constricted ureter as it opens into the pelvis of the kidney due to the formation of fibrous tissue placed outside of the ureter. This figure shows very considerable dilatation of the pelvis of the kidney with atrophy of the glandular structure. Hydronephrosis may also be due to accidental ligation of the ureter.

Probably one of the most frequent causes of intermittent hydronephrosis is the kinking of a ureter due to the changing position of a loose kidney. In some of these cases as soon as the patients assume the recumbent position and the kidney goes back into place the kinking is corrected and the condition relieved. In several very decided cases of hydronephrosis the writer has found upon operation that the ureter came off from the outer side of the dilated pelvis, presenting the appearance as though this part had been dilated irregularly. When this condition is present the dilated pelvis of necessity produces pressure upon and closes the opening into the ureter. In one of these cases we found the dilated pelvis a veritable gravel-pit containing 1,206 stones besides a handful or more of sand. It is quite true, as stated by Bland Sutton, that in many of these cases no adequate cause for the condition can be found even upon the most careful examination. (Fig. 130.) Observation and clinical experiments seem to have demonstrated that in cases in which the duct of a gland is completely and permanently obstructed the amount of secretion produced is limited and that the glandular structure soon undergoes atrophy and absorption, but where, on the contrary, the obstruction is only partial, or, if complete, is intermittent, the secretion of the gland is not materially interfered with and the amount of fluid retained may produce a tumor of very considerable size. In case the urinary tract in any part of its course becomes obstructed the canal or organs lying nearest the obstruction become first dilated, the dilatation then extending to adjacent canals or organs and finally to the pelvis or the kidney producing there not only dilatation but pressure

upon, and atrophy of, the pyramids and finally converting the pelvis and kidney into a cyst wall practically without glandular structure. In case the tract leading from one kidney is alone implicated, the effect upon the patient's health may not be pronounced, providing infection does not occur, but if

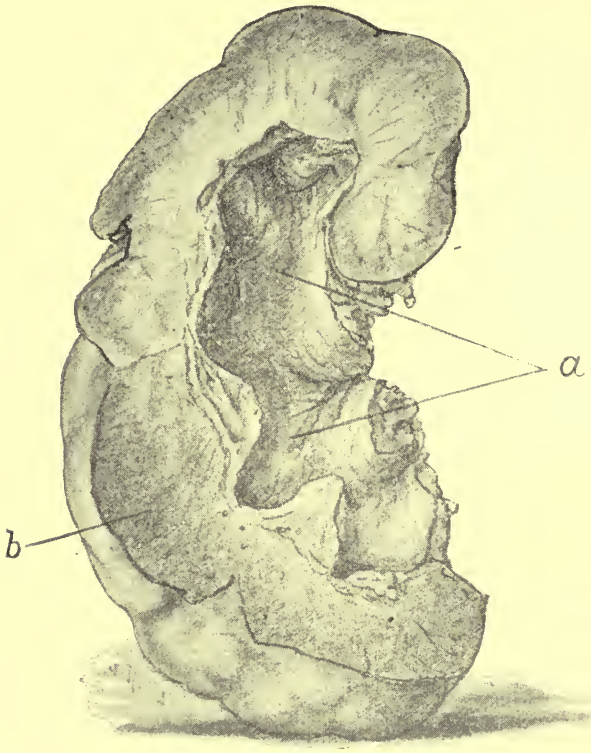


FIG. 130.

a. Dilated pelvis from obstruction of ureter.
b. Thickened cortical substance.

infection takes place, then, and in that case, the hydronephrosis will be converted into pyonephrosis which is a progressive and much more serious condition. In two of my own cases of accidental ligation of a ureter there has been fever and a high pulse rate.

Symptoms and Course.—The symptoms of hydronephrosis are not always distinctive. The condition is usually associated with pain in the loin and side which may be lancinating, pricking, or of a heavy, aching character. The pain is often severe, it may be intense for hours at a time, causing uncontrollable vomiting and requiring large doses of morphine for its relief. A patient came under the writer's observation a couple of days since where the retention was intermittent occurring about once a week and due to displacement of the kidney. The pain came on suddenly, was not severe enough to confine her to bed although causing disability and was likened to the thrust of a hundred needles in the side. As soon as the patient assumed the recumbent position and the kidney returned to its normal position the pain disappeared. In another patient the symptoms were all referable to the stomach, the attack coming on with severe pain in this region and being attended with uncontrollable vomiting. In one patient the attacks occurred with especial frequency during the continuance of several pregnancies. The attacks would come on rather gradually, the pain increasing until it became excessive, lasting for several days and then gradually declining. During the attacks the patient was able to feel a very distinct tumor in the right side. After two or three days of suffering the pain and tumor would gradually disappear and she would pass a large amount of urine. In this case during operation the ureter was found tense and coming off from the outer side of a much dilated pelvis.

Diagnosis.—This will depend upon the character of the pain, the conditions of the urine, the displacement and en largement of the kidney, and a history of the case.

With many patients the fact can be brought out that during the attack there is a diminution of the amount of urine passed, while following the cessation of the pain the amount passed is greatly in excess of the normal. The pain in these cases seldom radiates from the region of the kidney to the bladder unless it is due to a stone in the ureter. It is not unfrequently the case that a patient will observe during the

heighth of the attack a swelling or tumor below the costal arch which disappears after the pain has subsided.

PHYSICAL EXAMINATION.—If an examination be made during the heighth of an attack the kidney will be found enlarged, extremely sensitive upon bimanual palpation, usually readily displaced below the costal arch upon deep inspiration and very elastic. While in the great majority of cases of hydronephrosis the stenosis is intermittent and the accumulation of fluid not great, in some, on the contrary, the tumor has practically filled the abdomen extending to the pelvis, and been mistaken for, and operated upon for, an ovarian tumor. An accurate history of the case will show severe, spasmodic, often excruciating pain, having the position of the kidney and lasting a few hours and then subsiding. During the attacks of pain a tumor situated in the area occupied by the kidney or below the costal arch usually makes its appearance, enlarges and then recedes following the cessation of pain and has the characteristics as regards position and displacement of the kidney.

PROGNOSIS.—The prognosis is good if the cause can be readily relieved. Should the obstruction be only partial or, if complete, intermittent, it will likely occasion the accumulation of considerable urine and the dilatation of the parts, but these states are, however, not incompatible with reasonable health, at least for many years. If the cause cannot be relieved and the obstruction is complete and permanent it will result in absolute destruction of the kidney implicated, and should infection take place death is almost certain unless surgical intervention is taken. Death may also result from anæmia, excessive pain, inability to take food, exhaustion, and anuria.

TREATMENT.—If the pathological process is situated in the prepuce or urethra these conditions should be dealt with according to recognized rules. If a stone in the bladder or an abdominal growth is the causative condition they should be removed. If the condition is due to a stone in the ureter, this

may, if favorably situated, be extracted. If there is displacement of the kidney, nephropexy may be practised. Hydronephrosis has been treated by tapping but the results have not been satisfactory. In the great majority of cases if the opposite kidney is healthy and the cause cannot be relieved, and cystic dilatation is pronounced, nephrectomy should be done in preference to nephrotomy, as the results have been much better and the operation does not lead to an undesirable urinary fistula. The kidney is exposed, after placing the patient upon the sound side with a pillow in the costo-iliac region, by an incision at the outer border of the erector spinæ muscles. This incision if necessary may extend a short distance along the border of the twelfth rib, or iliac crest, and go through the skin and lumbo-sacral fascia at the outside of the quadratus lumborum muscle. The thin layer of fascia which lies between the anterior surface of the lumbar fascia and the fat which surrounds the kidney should be divided. This fat being torn through, the kidney is exposed. The pelvis of the kidney and the ureter are now thoroughly and carefully examined by external palpation for the obstruction. If the obstruction is at the site of the opening of the ureter into the pelvis the ureter below this situation will be collapsed. If it is below this or in the region of the bladder the ureter will be found greatly dilated. If the obstruction be due to stone this can be removed by exploring the pelvis or ureter, if due to a valve or stenosis these may be divided and the kidney saved. If the cause cannot be relieved the kidney should be removed.

Hydrocholc Cysts.—The gall bladder not unfrequently becomes greatly distended in consequence of more or less complete closure of its cystic duct. This condition seemingly is caused by the mucosa of the gall bladder becoming passively inflamed in consequence of which its secretion is greatly increased, and being retained causes dilatation of the gall bladder. This obstruction is usually due to a gall stone which may be small and encysted in the duct, or large and

impacted. The condition is preceded usually by a well-marked train of symptoms. Ordinarily there will have been for a considerable time symptoms of indigestion, with heaviness after eating or a burning sensation when the stomach is empty, with flatulence and constipation. Then there is likely to be severe colicy pain coming on suddenly, becoming very acute and often lasting for hours, after which it gradually subsides. The pain is often attended with nausea and frequent vomiting. It may be referred to the situation of the gall bladder, epigastric region, the posterior aspect, or right side, of the chest or to the top of the right shoulder. The process is not ordinarily attended with fever unless infection occurs. There are, however, many exceptions to this rule. But recently the writer saw a case of acute obstruction of the cystic duct by a stone with dilatation of the gall bladder producing a tumor as large as two fists without infection, where the temperature for several days ranged between 99 and 102° F. On examination the liver is usually found enlarged, somewhat sensitive, the region of the gall bladder is sensitive, and if the examination is made during an attack or when a stone is changing its position the muscles overlying the region will be in a state of greater or less rigidity. Beneath the right costal arch in the situation of the gall bladder it is often possible to feel a tumor which may not be larger than an ordinary pear or as large as a fœtal head. The tumor is usually very sensitive, may be fixed or freely movable, especially from side to side, is tense, elastic, and carried downwards somewhat upon full inspiration. The line of dullness over the tumor is usually directly continuous with that of the liver.

Diagnosis.—Among the indications worthy of note in the diagnosis may be mentioned dyspeptic disturbances, enlargement of the liver, occasional severe pain in the gall bladder region which may be attended with, or followed by, the presence of bile in the urine, or jaundice. The tumor is usually dull upon percussion, the intestine not over-riding it as is often the case in tumors of the kidney, and its dullness is

continuous with that of the liver. It is often held that in cases of stone even in the cystic duct there must have been attacks of jaundice. But this is certainly not true, as two cases have recently been operated in one of which there was a small stone encysted in the duct while in the other there was a very large stone impacted, and in neither of these cases had there been any trace of jaundice. In a case recently under the writer's care, with chronic obstruction of the cystic duct, there was produced a hydrochole cyst of the gall bladder as large as a fœtal head. This tumor could be pushed up and down, to the left side and backwards into the lumbar region like a growth having a long pedicle. On incision it was found to contain a thin, mucilaginous fluid. In another case recently operated where the cystic duct was obstructed by a stone as large as a hickory-nut the gall bladder was dilated to the size of a cocoanut and had a layer of hepatic tissue one-half an inch in thickness extending as a tongue over its entire anterior surface.

PROGNOSIS.—These patients usually suffer greatly from, and may be worn out on account of, the frequently recurring paroxysms of severe pain. Their appetite is disturbed, their nutrition impaired and they may be in imminent danger from the shock incident to the terrible pain which they experience. Two patients under my observation have been so shocked from the terrific pain of a gall stone caught in the cystic duct that they have gone into a state of collapse with thready pulse, cold extremities, sunken eyes, disturbed intelligence, surface bathed with profuse perspiration, and were in imminent danger of immediate death. There is also the added risk of infection which, when it occurs and if not relieved by surgical interference, may prove fatal.

TREATMENT.—The treatment consists in exposing the gall bladder by proper incision, packing about it a sufficiency of washed iodoform gauze, stitching it to the parietal peritoneum and then incising it. After removing the gall stone or stones the bladder is drained for a suitable time, or until the in-

flammation has disappeared. In cases of stones encysted in the duct it is not always a matter of the greatest ease to extract them and it may be necessary to divide the duct over or near the stone or to incise the gall bladder down to the stone in order to render the extraction possible. Unless infection is present the operation in two stages is not necessary. The ideal operation is not thought advisable as the possibility of leaving undetected stones is very considerable and the drainage aids very materially in relieving the cystitis.

Sebaceous Cysts.—While sebaceous cysts occur most frequently upon the head they may be found upon any portion of the cutaneous surface. They are caused by the narrowing or closure of the duct or in consequence of the secretion of the gland becoming inspissated and retained. The condition is hereditary in some cases, occurring not unfrequently in several members of many successive families. The tumors may be single but they are often multiple, half a dozen or more not unfrequently occurring within the tissues of the scalp. In size they vary very much. They may not exceed that of a pin's head or attain the dimensions of a hen's egg. They are directly connected with the skin through their duct and as they increase in size become attached to and immovable from the skin over a considerable surface. They are more or less round, reasonably smooth, semi-fluctuant growths which are situated more or less subcutaneously. They not unfrequently become inflamed as the consequence of injury or infection and occasionally suppurate and discharge their contents leaving a fistulous tract which often does not heal but continues to discharge pus and sebaceous material. Such a fistulous opening or ulcer may become malignant or the sebaceous material and inflammatory exudate may, by adhering to the opening, produce a horn of greater or lesser size. It is quite true that occasionally in consequence of infection or suppuration the contents of the cyst may be entirely discharged and the lining of the cyst destroyed, effecting a complete and permanent cure. (Fig. 131.)

DIAGNOSIS.—The diagnosis rests largely upon the fact that they are small, circumscribed, elastic, semi-fluctuant, and usually distinctly elevated tumors which are inseparably connected with and immovable from the skin.

TREATMENT.—The parts should first be thoroughly asepticized when the cyst is split open and its walls seized upon

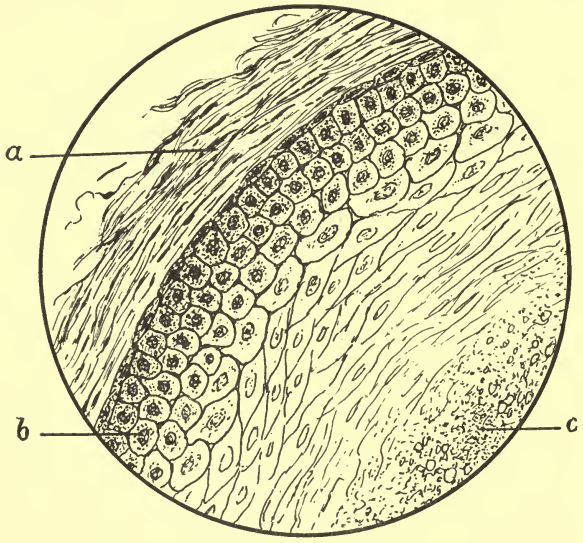


FIG. 131.

Sebaceous cyst.

a. Thin layer of connective tissue, forming wall.
b. Thick layer of cuboidal epithelium, becoming flattened and ceasing to stain towards c.
c. Contents of cyst, consisting of products of fatty epithelium, viz., cholesterin and amorphous débris.

either side with forceps and the cyst wall shelled out. It is necessary that the entire wall be removed in order to prevent recurrence. In cases in which infection and suppuration have taken place the cyst wall will be so fragile that it cannot be extracted by forceps. In these cases the cavity should be thoroughly curetted in order that the cyst wall be completely removed and then the cavity should be drained. With cysts of medium size which occur upon the head it is scarcely neces-

sary after removal to introduce sutures for the purpose of closing the wound.

Mucous Cysts.—Mucous cysts may be situated anywhere upon a mucous membrane. They are due to obstruction of the duct usually the result of inflammation. Those which most frequently come under observation and call for treatment are situated within the oral cavity upon the inside of the lips, or inside of the cheeks, or within the antrum of Highmore. They occur either as small, distinctly elevated, quite hard, whitish semi-transparent growths situated within the mucous membrane or as quite large, tense, shining tumors situated within or apparently upon the mucous membrane. A cystic condition of the mucous membrane of the antrum may develop to such an extent as to more or less completely fill this cavity. The sac is the dilated mucous gland. They seldom give rise to any special disturbance more than as foreign bodies give rise to irritation.

TREATMENT.—In their treatment it is necessary to destroy absolutely the sac or cyst wall. This may be accomplished by picking up the projecting wall with a pair of toothed forceps and cutting this away with a pair of shears upon a level with the mucous membrane. The remaining portion which is not removed should be destroyed by the application to its surface of the end of a match or toothpick which has been dipped in nitric acid. This leaves an eschar which is somewhat slow in coming away, but the cure is usually permanent. In the case of cystic disease of the antrum it is necessary to open the cavity in front by means of a trap door and then remove the cysts.

Salivary Cysts.—The duct of any of the salivary glands may become obstructed producing a cyst which is usually confined to the duct in the immediate vicinity of the obstruction. The salivary ducts which are the most frequently obstructed are those coming from the submaxillary and sublingual glands. These ducts open onto the floor of the mouth at the side of the frænum linguæ and when obstructed produce a small, globular,

elastic, tense, semi-translucent, slightly fluctuant growth which is the size of a pea or small marble, and is situated within or directly beneath the mucous membrane of the mouth. The growth is usually free from any special pain and produces no disturbance other than that caused by the inconvenience of its size. The growth is known as a ranula, and often has coursing over it one or more quite large veins.

TREATMENT.—They require the same treatment as that accorded the mucous cysts—namely, cutting away the free portion and cauterizing that part of the sac which remains, taking care, however. not to wound the adjacent veins.

Cysts of the Sub-maxillary Gland.—It not unfrequently happens that in consequence of obstruction of the duct near its origin that the secretion from the gland is arrested and accumulates in very considerable quantities producing, it may be, a tumor which projects into and raises the floor of the mouth. It often projects downwards beneath and also above the jaw making, it may be, a tumor containing a pint or more of fluid. The growth is very tense, somewhat movable, fluctuant, and situated as it were directly beneath the skin. Its real situation is of course beneath the deep cervical fascia which it stretches and presses outwards to a very considerable degree. Some few years since the writer removed two of these cysts, each of which was as large as a croquet ball and seemed to lie directly beneath the skin and passing under the jaw, could be readily felt as a tense sac beneath the muscles making up the floor of the mouth. Not long since the writer removed a tumor of the sub-maxillary gland, part cystic and part solid, in the duct of which, producing obstruction, he found one-half of a toothpick. These growths are readily enucleated after making an incision commencing back of the angle of the jaw, extending downwards and forwards over the cyst to near the symphysis. The tissues are divided down to the cyst which may be readily shelled out of the adjacent tissues. Occasionally the facial vein requires ligating,

but seldom is it necessary to ligate the facial artery, the tumor being superficial to this vessel.

Sublingual Cysts.—Cysts occurring within the sublingual gland or its ducts, excepting near their outlet in the floor of the mouth, may produce tumors of some size which are placed directly beneath the mucous membrane of the mouth, under which they can be moved. They occur as soft, fluctuating tumors raising the floor of the mouth, interfering with the movements of the tongue and deglutition and it may be with speech.

TREATMENT.—They may be enucleated by dividing the mucous membrane and then shelling them out of the adjacent connective tissue. If they project beneath the jaw, which is rare as they lie above the mylo-hyoid muscle in direct relation to the mucous membrane, they may be removed by making the incision externally and through the mylo-hyoid and then shelling them out of the adjacent structures.

Galacteal Cysts.—These cysts are caused by the obstruction of one or more milk ducts and occur as a rule not as a dilatation of an acinus but as an accumulation in the duct itself which is converted into a cyst. They may be placed near the areola or farther towards the circumference of the gland. They are most frequently noticed within the first few days following confinement and are due to an obstruction of a duct and an accumulation of the gland's secretion. They should be differentiated from inflammatory and infectious processes which are attended with fever, redness, œdema, and more of local distress. Cysts single or multiple of large or small size occur quite frequently in the breast, the result of chronic inflammatory processes by which ducts or acini are blocked and their secretion retained. These cysts are often very hard, but elastic and difficult to differentiate from solid growths except by the use of the hypodermic needle.

Their treatment is that of incision and drainage for the former and excision for the latter, providing they are large and single.

Pancreatic Cysts.—Pancreatic cysts due to retention have been found most frequently in young adults. The obstruction in the pancreatic duct may occur at or beyond the junction of the pancreatic duct with the common bile duct, or in any part of the course of the pancreatic duct. The obstruction may be caused by a calculus, by the formation of cicatricial tissue the result of an injury, or it may be due to displacement of the pancreas or to pressure exerted upon it by a neoplasm. Lloid and some others believe that the cysts which occur following an injury and which have been ascribed to obstruction are in reality due to traumatism and laceration of the pancreas by which the blood and pancreatic fluid gains an entrance to the lesser omental cavity and there produces a cyst which has been mistaken for one coming from obstruction of the pancreatic duct. These cysts may be of slow or rapid development, are usually globular, situated over the site of the pancreas, may be so tense that they feel like a solid growth or present an indistinct feeling of fluctuation. They may be resonant at some parts owing to the transverse colon or stomach overlying them and in other parts dull. The growths are usually quite elastic. In the symptomatology there is usually gastro-intestinal disturbance, mental depression, localized pain, it may be diabetes and changes in the fæces. The fluid of pancreatic cysts often contains urea and will convert starch into sugar and may emulsify fats. It may be translucent or quite turbid. It has a specific gravity of from 1010 to 1012, and often contains albumen, mucein, and blood pigment.

Diagnosis.—A positive diagnosis is often impossible without an exploratory incision.

Treatment.—Some pancreatic cysts are found distinctly pedunculated, in which case the pedicle may be ligated and the cyst removed. If sessile, as is usually the case, enucleation and complete removal of the cyst is at times possible, but attended with pronounced risk. The dangers incident to removal in which the pancreas is more or less lacerated are

shock, hæmorrhage, and sepsis. Unquestionably the safer and better method in sessile growths of the pancreas is to draw off the fluid, carefully protecting the abdominal contents from contact, opening the cyst, stitching it to the abdominal wall and establishing drainage. In the majority of cases the cyst cavity gradually diminishes in size and finally becomes obliterated, but in some cases in which the pancreatic fiuid is constantly discharged into the sac permanent drainage is required.

Hydrometra.—This is an accumulation of the secretions of the glands in the mucous membrane of the uterus due to stenosis of the cervical canal. The condition may follow a labor during which the cervical tissues were severely injured and to some extent destroyed and in the healing process the cervical canal becomes obliterated with retention of the secretion. It may also follow operations upon the cervix for laceration in which the mucous membrane upon one or both sides of the canal has been so injured as to allow the surfaces to unite. One such case came under the writer's observation where there was complete stenosis of the cervical canal with retention of secretions causing great pain and dilatation of the uterus. A case also came under the writer's observation some years ago where during a chronic inflammatory process of the endometrium obstruction took place with such an enormous accumulation of secretion and menstrual flow that the uterus acquired the size in a few weeks of that of a six or seven months' pregnancy. These conditions are usually attended with severe, often excruciating, pain due to the contraction of the uterus, and to excessive dilatation. They are also attended with more or less inflammation and fever.

Diagnosis.—There should be no great difficulty in making a diagnosis after having gained a history of injury or inflammation or operation upon the cervix followed by severe pain, absence of menstruation, and a progressive increase in the size of the uterus. A case recently came under the writer's care of a double uterus and vagina. The

vagina upon the right side being imperforate resulted in the formation of an enormous cyst which filled more than one-half of the abdomen. In this case it was possible to drain the cavity by an opening into the imperforate vagina.

TREATMENT.—The uterine canal should be re-established either by opening it up with a sound and then dilating it with a uterine dilator, or if this is not possible, by making an incision directly through the stenosed tissue and then maintaining the cervix in a patulous condition either by the insertion of a drainage tube or by occasionally sounding and dilating. If the fluid is in a septic condition the uterus should be irrigated.

Hydrosalpinx.—This is a cystic distention of a Fallopian tube in consequence of the closure or stenosed condition of the two extremities.

CAUSATION.—It may be due to a catarrhal salpingitis or to a peri-salpingitis, or be the result of a congenital defect in development in consequence of which the tube is permanently closed and shut off from the uterine cavity. Following these closures the mucous secretions accumulate and cause the distention. It is thought by many that it may be due to, and perhaps often is, the sequence of a pyosalpinx, the germs and pus cells disappearing largely by fatty degeneration and absorption and nothing remaining but the fluid. It may also be due to a serous exudate from the blood.

The size of a hydrosalpinx may vary between that of a goose quill to that of a fœtal head. The wall may be thick or it may be as thin as tissue paper and translucent. The fluid contained within the tube may be perfectly clear or it may be turbid, or even bloody in appearance. Microscopically there are leucocytes to be found, degenerated epithelial cells and blood corpuscles. The fluid within the tube may be absorbed and the tube return to its normal size or its surface may become incrusted with calcareous plates, or infection may take place producing pus and a pyosalpinx.

The process has been variously subdivided into hydrosal-

pinx simplex, in which there is more or less pronounced dilatation of the tube into a sac. This sac is more or less transparent, has thin walls and lies at the side of or behind the uterus. The tube may be so enlarged as to contain a litre or more of fluid.

Hydrops Tubæ Profluens.—This is a condition of hydrosalpinx in which at short intervals, it may be hours, days, or weeks, the contents of the sac are suddenly discharged into the uterine cavity, the discharge often being attended with colicy pain and followed by the appearance of a quantity of fluid in the vagina. This condition causes at times pronounced invalidism, the patient having frequently recurring severe pain, pronounced distress and marked uterine disturbance.

Hydrosalpinx Folicularis.—In this condition the tube is not very much enlarged. In appearance it is like a small dropsical condition. Upon making a transverse incision through the tube the canal is found to be very small and shows a net-work of tissue made up of small follicles containing a thin, serous fluid. These communicate the one with the other. In the cases of hydrosalpinx which are not congenital it is supposed that in the great majority of cases there is or has been a primal infection, gonorrhœal or pyogenic, which has extended from the uterine cavity through the tube to the peritoneum. In consequence of this inflammation the fimbriated extremity of the tube as well as the uterine opening become blocked and occluded.

Symptoms.—The symptoms are pain and soreness, especially upon standing or walking which are increased by pressure or by bimanual examination; often slight fever, painful menstruation, pain upon defecation and more or less tension of the abdominal wall. If both tubes are implicated sterility will result and when one tube is affected, if pregnancy occurs miscarriage is likely to take place in consequence of the uterus dragging upon the adherent tube. The condition often makes its appearance after one or more confinements.

DIAGNOSIS.—The bowels being thoroughly unloaded by a bimanual examination one finds an elongated, sensitive tube at the side of or behind the uterus which must, however, be differentiated from an enlarged ovary and from a pyosalpinx.

TREATMENT.—It is possible for a spontaneous cure to be effected in consequence of the tube emptying itself into the uterus and undergoing subsequent contraction, the opening remaining patulous. In most cases, however, operative interference becomes necessary. In a tube which is very much affected and where the sac is large, tortuous, and thickened, especially in cases of hydrops tubæ profluens, the tube should be removed. This may be done without disturbing the ovary. The mesosalpinx is ligated and then divided close to its attachment to the tube and the tube removed. The edge of the mesosalpinx is then united with a running cat-gut suture. In some cases it may be possible after breaking up the adhesions to make pervious both extremities of the tube or to resect a portion thereof. In any event it is pretty well established that in these cases the ovary or ovaries should not be removed unless they are seriously implicated.

TUBULO CYSTS.

Genus Tubulo Cysts.
- Species Tubulo Cysts.
  1. Cysts of the Vitello-Intestinal Duct.
  2. Cysts of the Urachus.
  3. Parovarian Cysts.
  4. Paroöphoron Cysts,
  5. Cysts of Gartner's Duct.
  6. Cystic Disease of the Testicle.
  7. Cysts of Muller's Duct.

The above species of cysts are the result of dilatations of certain obsolete canals and functionless ducts which were active in embryonic life, but which in the adult serve no useful purpose.

Embryology of the Vitelline Duct.—In an embryo of two or three weeks the yolk sac fills more than one-half of the blastodermic vesicle. At a somewhat later period it is seen

to be connected by means of a thick stalk, the vitelline duct, with the rudimentary intestine. During the sixth week the vitelline duct has grown out into a long, narrow tube, which sooner or later looses its cavity and becomes converted into a solid cord. This is in consequence of the growth of the amnion and the accumulation of the amniotic fluid by which the yolk sac, the future vitelline duct, is pushed or pressed to the surface of the blastodermic membrane and practically obliterated. The amnion, in consequence of its rapid development, comes to fill the blastodermic vesicle and to enclose both the vitelline duct

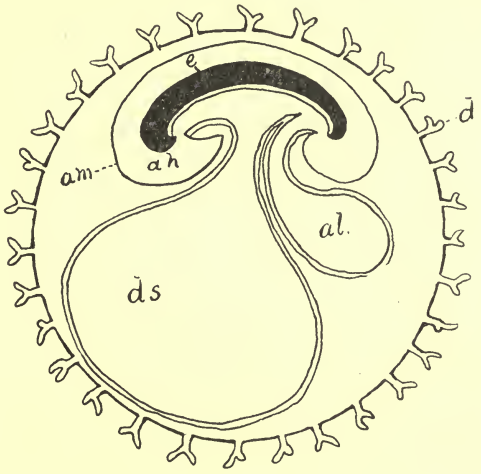


FIG. 132—a.

Ovum with serous membrane, which has developed villi, with a large allentois and an embryo (after Kölliker.) *d*, Vitelline membrane (zona pellucida); *am*, amnion; *ah*, amniotic cavity; *e*, embryo; *ds*, yolk sac; *al*, allentois.

and the neck of the allantois. The vitelline duct is situated between the amnion and the chorion, is attached to about the middle of the small intestine and passes out of the abdominal cavity of the fœtus at the umbilicus with the other structures of the umbilical cord either as a solid epithelial cord which soon undergoes degenerative change and disappears or it may remain patulous throughout a portion of, or its entire length. (Fig. 133, a and b.)

Not long since in making a post-mortem the writer encountered a vitello-intestinal duct springing from the small intestine and having almost the same size, and being some twelve or fourteen inches in length. It ended in a small, impervious cord which was attached to the umbilicus. Occasionally there is connected with the umbilicus bright-red, soft, velvety

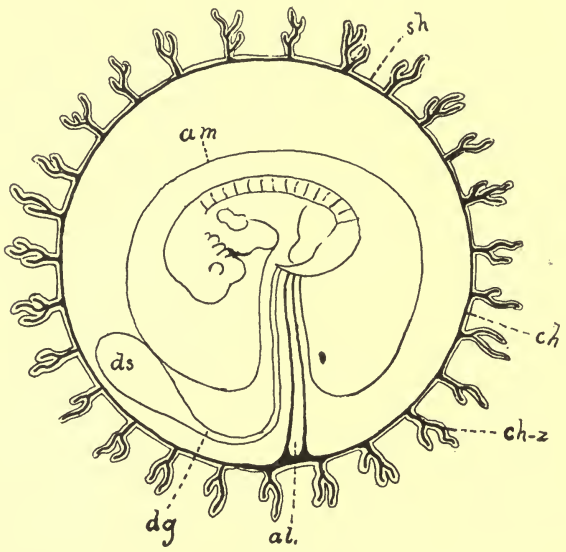


FIG. 132—b.

Diagrammatic representation of a young human ovum, in which the vascular layer of the allentois has become applied to the serous membrane on all sides, and has grown into its villi. The serous membrane from this time forward takes the name of chorion. The cavity of the allentois has diminished and the yolk sac has become very small, but the amniotic cavity is in the act of increasing (after Kölliker). *sh*, serous membrane (serosa); *ch*, chorion; *ch—z*, villi of the chorion; *al*, allentois; *dg*, stalk of the yolk sac (vitteline duct); *ds*, cavity of the yolk sac; *am*, amnion.

growths of small size, sessile or pedunculated, which contain unstriped muscular fibres, mucous membrane and take origin from the remnants of the vitelline duct. Occasionally at birth the umbilicus is the site of a cyst of considerable size which extends both internally and into the tissues of the cord and which represents the unobliterated remains of the vitel-

line duct. This condition subsequently may at times readily be mistaken for an umbilical hernia. There have been cases reported in which at birth this duct was not only patulous as far as the intestine, but was the site subsequently of a fæcal discharge. It occasionally happens that the vitelline duct before or after birth is converted into a sac of considerable

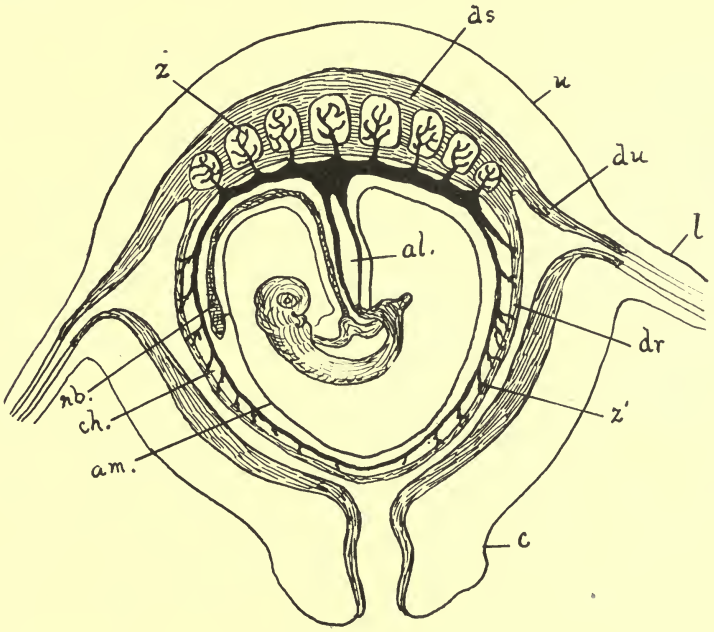


FIG. 132—c.

Diagrammatic section through the gravid human uterus with contained embryo, after Longet, from Hertwig. *al*, Stalk of the allantois; *nb*, remains of the yolk-sac: *am*, amnion; *ch*, chorion; *l*, Fallopian tube; *c*, cervix uteri; *u*, uterus; *z*, villi of the fœtal placenta; z', villi of the chorion læve.

size which remains open at the umbilicus and discharges a mucous fluid. Bland Sutton thinks that this duct is in some way the occasional cause of a stricture of the ileum.

Cysts of the Urachus.—The allantois in the embryo is a closed sac also placed between the amnion and the chorion and, like the yolk sac, becomes pressed against the side of

the blastodermic membrane by the ever-growing amnion. It is primarily in direct connection with the urogenital tract and in assisting in conveying the blood vessels from the aorta to the placenta becomes a closed tube, which extends from the top of the bladder to the umbilicus and then along the umbilical cord to the placenta. (Fig. 132, a and c.) This tube has the same lining as that of the bladder, and while it should be simply an obliterated vestige of fœtal life may remain as an open duct in direct connection with the bladder, and in exceptional cases

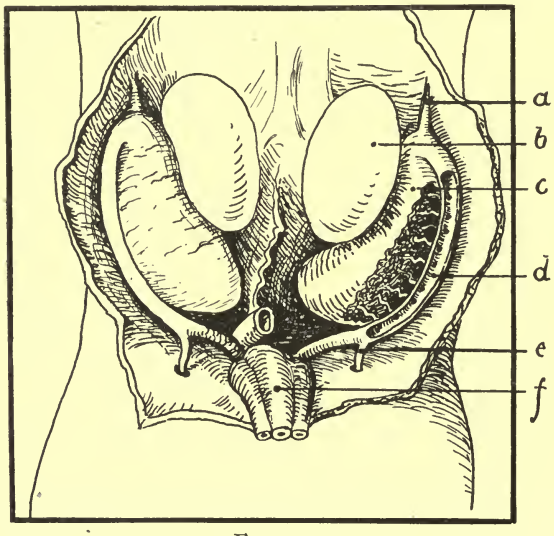


FIG. 133.

Wolffian body and generative gland (ovary), human embryo, at beginning of sixth week. To the right the Wolffian duct is opened. (After Kollman).
a. Diaphragmatic band. b. Germinal gland—ovary. c. Wolffian body. d. Wolffian duct. e. Gubernaculum Hunteri. f. Allantois duct.

may form a cyst which is extra-peritoneal and which may be situated anywhere between the fundus of the bladder and the umbilicus. The duct may even be patulous at the umbilicus and discharge urine.

The causation of an open urachus at the umbilicus seems often to be in direct relation with or caused by a congenital obstruction of the urinary tract somewhere below the urinary

bladder. The condition has not unfrequently been found associated with an absence of, or a stricture of, the urethra, or an obstructing phymosis.

Diagnosis.—Within the tissues of the umbilical cord at the site of the umbilicus there are two solid or more or less pervious, epithelial cords, the one being in direct connection with the intestine and the other with the bladder. These cords may be the site of cystic formations, either in consequence of the ducts remaining more or less pervious, or as the result of the active proliferation of and secretion by the epithelial cells. These tissues in the umbilical cord, which are made up of epithelial cells and capable of producing cysts, come from either the vitelline duct or from the urachus and consequently in a diagnostic sense have only to be differentiated the one from the other. A cyst of the vitelline duct is intra-abdominal, situated below or laterally to the umbilicus, likely to be freely movable and is lined with a mucous membrane characteristic of the small intestine. The urachus is extra-peritoneal, situated in the median line, more or less fixed in this position and is attached by one extremity to the fundus of the bladder and by the other to the umbilicus. It is situated lower in the pelvis than is a cyst or the vitelline duct. Its lining is that characteristic of the bladder. If the cysts are in communication with their respective organs one may discharge fæces and the other urine.

Treatment.—The small, seemingly insignificant cysts taking origin in the vitelline duct and extending into the cord at birth are often cured by the ligation of the cord and the subsequent shrinkage which takes place. It is extremely desirable in these cases that the parts be kept as nearly aseptic as possible during the healing process. Where cysts of considerable size discharging a mucilaginous fluid are found subsequent to birth their treatment should be that of enucleation or excision. Cysts which are in direct relation with the lumen of the intestine may be excised, following the same technique which would be applied in a resection of the bowel.

Cysts of the urachus not in direct communication with the lumen of the bladder may be easily removed, as they lie outside of the peritoneum. Those which are in direct communication with the bladder may still be removed and the bladder wall closed by tiers of continuous or interrupted sutures following which, for the purpose of relieving pressure from the sutured wall, the bladder should be drained for a few days by retaining a catheter therein. In some of these cases it may be best to maintain slight drainage down to the bladder wall, although as a rule this will not be necessary provided the bladder is in a reasonably aseptic condition. The great danger in these cases is that the bladder will become infected through the fistula, consequently perfect asepsis should be maintained and the fistula closed as soon as possible.

Embryology of the Cysts of the Parovarium and Paroöphoron.—In order to understand the formation of cysts taking origin from the parovarium and paroöphoron it is necessary to consider the embryology of the Wolffian body and duct as these play a most important part in their formation. The embryology of these structures is intricate, important, and most interesting, and such that I am able to give it only superficial consideration and would refer the reader for more detailed accounts to some of the many works upon embryology and histology of the genito-urinary system. During the first few days of fœtal life the head kidney subsequently known as the Wolffian body makes its appearance near the vertebral column in what is to be the abdominal cavity. The Wolffian body has a duct known as the Wolffian duct. The Wolffian body has an excretory function and is soon replaced by the permanent kidney. (Fig. 133.) Histologically the Wolffian body is composed of a large number of transverse tubules between which are placed many Malpighian bodies. The tubules are lined with low columnar or ciliated epithelium and are in direct connection externally with the Wolffian duct, which in later life becomes the duct of Gartner. During the formation of the kidney and ovary with which the Wolffian body is inti-

mately associated the latter undergoes atrophy and largely disappears. (Fig. 134.) Both the ovaries and the testicles make their appearance after the Wolffian bodies have reached their full development. Primarily these glands are in a non-differentiated state. (Fig. 135 a, b.) In the construction of the ovary the mesothelial or endothelial cells lining the peritoneum in the immediate vicinity of the Wolffian body undergo proliferation and are converted into germinal epithelium which is the progenitor of the specific or sexual cells of the ovary.

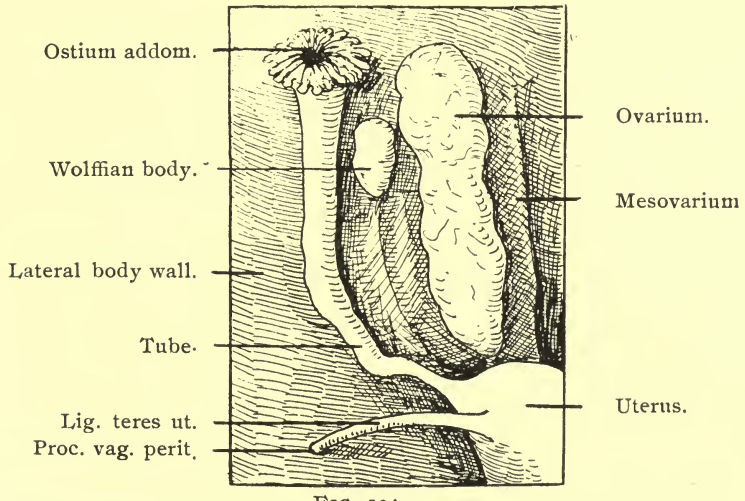


FIG. 134.
Tube, uterus and ovary of the right side at the beginning of third month (after Kollman).

The mesothelial cells or germinal epithelium grow inward in the form of cylindrical masses as sexual cords. At the same time there is an ingrowth of connective tissue cells separating and supporting the cylindrical masses or cells and making up the stroma of the ovary. In almost direct connection with the ovary during its formation and lying in the mesovarium and mesosalpinx are to be found the transverse tubules of the Wolffian body which become the parovarium and paroöphoron and which open into the Wolffian duct now

atrophied and known as Gartner's duct. (Fig. 135 c.) This duct is situated below and near the Fallopian tube and between this tube and the ovary. The transverse tubes of the

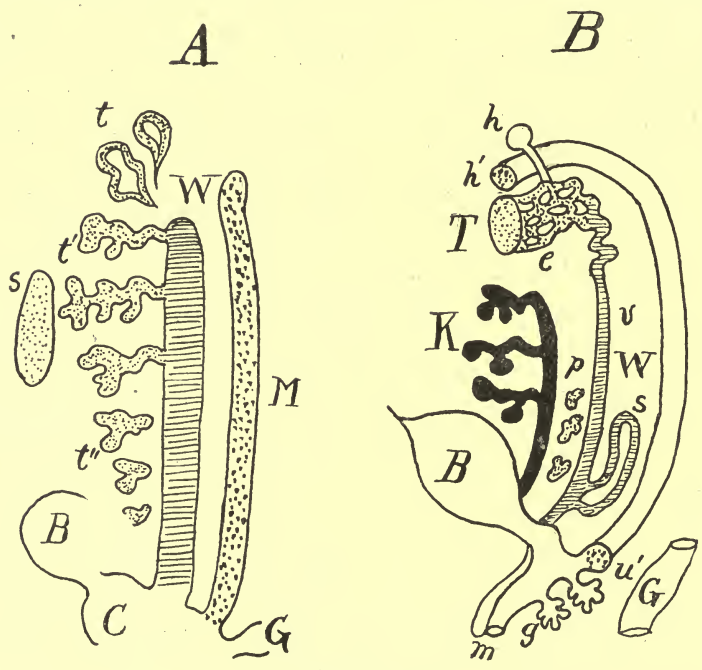


FIG. 135.

Diagrams illustrating development of sexual organs.—In all figures *W*, *M*, *B*, and *G* represent respectively Wolffian duct, Müllerian duct, Bladder and Gut. *A*, *indifferent type* containing fundamental parts: *s*, sexual gland; *t'*, *t''*, *t'''*, Wolffian tubes constituting anterior (pronephros), middle (sexual), and posterior (rudimentary) groups; those of sexual division retain their communication with Wolffian duct. *B*, *male type*,: *T*, testicle; *e*, *e'*, tubes of globus major derived from middle Wolffian tubules; *v*, tube of epididymis, the persistent Wolffian duct; *s*, seminal vesicle; *p*, paradidymis; *h'*, unstalked hydatid; *u*, uterus masculinus, the persistent parts of the Müllerian duct (*M*); *h*, stalked hydatid; *g*, Cowper's glands; *m*, penis; *K*, kidney. *C*, *female type*: *O*, ovary; *P*, parovarium; *p'*, paroöphoron; *W*, Gartner's duct when present; *f*, fimbria; *o*, oviduct; *u*, uterus; *v*, vagina; *h*, stalked hydatid; *K*, kidney. (After *Piersol*).

Wolffian body are closed at the hylus of the ovary and may also be occluded at the point of their entrance into Gartner's duct. The walls of these tubules contain muscular fibres. The tubules of the parovarium may and do pass into the medul-

lary substance of the ovary and have not unfrequently been found in the adult as epithelial cords within the ovarian structure. The paroöphoron consists of the fœtal remains of some of the lower tubules of the Wolffian body. These tubules are situated within the broad ligament and are nearer the uterus than are the parovarian tubules. They may even, according to Waldyer, extend up to the uterine wall. They are lined with a low, columnar or ciliated epithelium and are homologous with the paradidymis in the male. The ducts of the paroöphoron are often closed and filled with epithelial cells. The Wolffian body, whose tubules make up the parovarium and paroöphoron, is a fœtal structure which under normal conditions has no function and should disappear after the formation of the kidney and the ovary. It is well established, however, that rests of these fœtal structures exist throughout life and are frequently the cause of the formation of cystic tumors.

Cystic Tumors of the Parovarium and Paroöphoron.— The parovarium and paroöphoron seem to take on something like functlonal activity at puberty, and at this time cystic tumors taking origin in these tubules not unfrequently occur. Parovarian cysts are practically unknown before the age of puberty and are seldom found in old age. They are most frequently encountered between the eighteenth and thirty-fifth years of age. They may occur as small cysts, in which case they are usually multiple. They may then be seen like a row of small beads extending along the mesovarium. When occuring singly they are almost without exception unilocular and may reach the size of an adult head or even may be larger. They are situated beneath the peritoneum within the folds of the mesovarium and mesosalpinx and project into the peritoneal cavity and have a well-marked pedicle, or they grow down into the broad ligament and later rise into the abdomen, being still sessile in character, or, as not unfrequently happens, they may grow downwards separating the two layers of the broad ligament, and raising the periton-

eum from the pelvic floor, push the uterus to the opposite side, perhaps separating the peritoneum from the posterior surface of the uterus and projecting directly across the pelvis, or they may in their growth so raise the peritoneum as to get under the sigmoid flexure, or cæcum.

Symptoms and Diagnosis.—In the growth of a parovarian cyst which reaches any considerable size there is usually more or less pain, which may be paroxysmal and severe, or be complained of as a dull, indifferent pain, with a feeling of fullness and bearing down. There is usually more or less disturbance of menstruation, which is too frequent, excessive or even painful. The patients are usually young adults. The cysts are almost without exception unilocular or single cysts. They are situated primarily within the pelvis, upon one side close to an ovary and produce in their growth displacement of the uterus, or it may be pressure upon the bladder or rectum. Upon examination they are found to be smooth, reasonably tense and fixed growths, which present a distinctive sense of fluctuation. If they are possessed of a pedicle they will have more or less mobility. They are of slower growth than the ordinary ovarian cyst. They may in consequence of pressure produce hydroureter or hydronephrosis, and in these cases there will be albumen and, it may be, casts in the urine. They are to be differentiated from ovarian cysts, which differentiation, however, is not very essential on account of their similar treatment. Ovarian cysts occur ordinarily at a later date, and are primarily more movable than are the broad ligament cysts. They are not to be mistaken for a distended bladder, which has too frequently been the case. The latter produces a globular, fluctuating, distinct tumor in the median line. The history of the case and the use of the catheter, which in doubtful conditions should never be neglected, will aid in establishing a diagnosis. They are to be differentiated from the encysted tubercular peritonitis, which cysts are more irregular, having nodular surfaces, are more sensitive upon palpation, are attended with more localized pain, are accom-

panied by fever, and usually manifest other symptoms indicative of tubercular trouble. They should be differentiated from ascites, which may be due to a peritoneal growth, tumors of the abdomen, tubercular peritonitis, diseases of the liver or heart. In ascites the fluid gravitates to the flanks and leaves the umbilical region tympanic. The fluid changes its position with the changed position of the patient. The examination shows in ascites no distinct, hard, well-circumscribed tumor beneath the abdominal wall. They should be differentiated from tumors of the Fallopian tubes. These are sausage-shaped and have their long diameter transverse to the pelvis, and have a causative condition distinct and separate from that of a broad ligament cyst. The broad ligament cyst is usually said not to be so tense as the ovarian cyst. The writer has encountered many broad ligament cysts which were extremely tense, and which seemed, in consequence of their tension, to be as hard as an ordinary fibroid.

Upon opening the abdomen the broad ligament cysts present conditions which are usually peculiar to themselves. They are covered by the peritoneum, which is ordinarily freely movable over the cyst wall, and which has a distinct circulation, this circulation being noticeably separable from that of the cyst wall. These cysts, in consequence of their peritoneal covering and this leash of blood vessels, do not present the pearly-white appearance of the ordinary ovarian tumor. Unless they project wholly into the abdominal cavity and are distinctly pedunculated, which is rarely the case, they will be found between the folds of the broad ligament, and these folds can be traced from the tumor off onto the posterior or lateral abdominal walls, or onto the bladder or uterus, as the case may be. The operator finds it impossible to carry his fingers in consequence of this reflection of the peritoneum, beneath the growth. The cyst wall is usually thin and composed of fibrous tissue, lined by low columnar epithelium, which is often ciliated, presenting positive proof that the cyst comes from the parovarium or from the tubules of the Wolffian

body. The cyst contents is usually clear and has a specific gravity of from 1004 to 1007. The contents may be dark, in which case it is usually the result of hæmorrhage into the cyst cavity. According to Pfannensteil, a parovarian cyst occasionally shows papillary growths upon its internal wall, which, however, never reached any considerable size.

TREATMENT.—The removal of the broad ligament cyst is often an extremely difficult and sometimes a hazardous undertaking. If the cyst has a pedicle it may be removed as easily following the withdrawal of its contents as is the case in a well-pedunculated ovarian tumor. A cyst extending deeply into the folds of the broad ligament and situated entirely behind the peritoneum, especially those which have formed strong adhesions to the adjacent structure, are often shelled out with difficulty. Especially is this true if the cyst has been tapped one or more times, a practise, however, which should not be tolerated. After opening the abdomen the vessels of the broad ligament are ligated at the uterine and pelvic walls and the peritoneum opened transversely over the most prominent portion of the tumor, being careful to avoid the important blood vessels. The writer has frequently shelled these tumors out without ligating the ovarian vessels.

After opening the top of the broad ligament the fingers may sweep about the growth and separate it from its peritoneal covering, which may be difficult or very easy, depending upon the amount of precedent pressure inflammation. If the cyst is of considerable size, and after one reaches approximately the base of the cyst, its separation is rendered much easier by withdrawing the cyst contents and then seizing the cyst wall with two or three very heavy, wide-bladed, strong forceps, and dragging on the wall as the enucleation is progressed with. These cysts are often closely connected with the ureter, bladder, or iliac vessel, consequently the greatest care should be exercised in their enucleation. Very frequently what is better than the use of the naked finger is one covered with a rubber glove, or still better, a

small bit of sponge cloth, with which the adjacent structures are carefully and firmly pushed off from the surface of the cyst wall. In this way ordinarily the most adherent cyst may be shelled out from the adjacent structure. If attached to important viscera these attachments should be separated with care, and if necessary the outer wall of the cyst may be left in contact with the viscera, in order to prevent injury to the same. Following the enucleation the cavity should be carefully sponged dry to note if there are any bleeding points, and then the raw surfaces of the broad ligament may be folded in upon themselves and obliterated by an over-and-over, continuous catgut suture.

Cysts of the Paroöphoron.—The paroöphoron, or the yellow body of Waldeyer, is composed of the tubules situated in the lower portion of the Wolffian body. These tubules are placed in the broad ligament below the parovarium and internal to and near the lower border of the ovary. (Fig. 135 c, p.) Waldeyer says they may be found internally as far as the wall of the uterus. The paroöphoron is a remnant of a fœtal structure and is not as universally found as is the parovarium, although in a considerable number of adults it is to be made out. Cysts of the paroöphoron are of less frequent occurrence than are those of parovarium. They cannot be differentiated unaided, at least by operative measures, from the parovarian cysts. Their situation is at the side of the uterus, although they may be found in almost any portion of the broad ligament. They have the characteristics of broad ligaments cysts. They are usually single, seldom reach any very great size, are strictly behind the peritoneum, and contain usually a dark, coffee-colored fluid produced by the pigmented cells in this situation or by hæmorrhage. They are lined by cylindrical epithelium which inplaces may contain cilia. The broad ligament cysts, both parovarian and paroöphoron, are in no way directly connected with the ovary which is situated upon the surface of the cyst and which takes no part in its formation.

Symptoms and Diagnosis.—Cystic tumors situated in the paroöphoron will present the same symptoms and require the same treatment as those situated in the parovarium.

Hydatid of Morgagni.—This is a small, pedunculated growth taking origin from one of the fimbria of a Fallopian tube. Its appearance is not unlike that of a small nasal polypus. The growth is translucent, has a thin wall and watery contents. The pedicle usually is an inch or more in length, very delicate and the cyst itself perhaps the size of an ordinary almond. They have no pathological significance. (Fig. 135 c, h).

Cysts of Gartner's Duct.—The Wolffan duct in post-embryonal life, or such portion as remains patent, is known as Gartner's duct. It receives the transverse tubules of the parovarium and extends between the folds of the broad ligament the cervix and then down the lateral wall of the vagina to near the orifice of the urethra. It is only in exceptional cases that Gartner's duct is patulous. That portion of it situated in the broad ligament usually persists to some extent in adult life. Any portion of this duct may be the site of a cystic formation. Cysts may form in the broad ligament and be large or small and will present the characteristics of a broad ligament cyst. They may occur at the side of the uterus, but have occasionally, perhaps not unfrequently, been found within the wall of the vagina as large or small cysts. These cysts if present or causing disturbance should be removed. It is stated by Bland Sutton that it will often be necessary, especially if the cyst is large, to make an extensive dissection, as they not unfrequently approximate in front the bladder wall, behind the rectum and above the peritoneum. The cavity after removal, if it cannot be closed by tier suture, should be drained. (While writing this article a young woman was brught to me by Dr. Howard, of Columbus, with a cyst as large as a hen's egg situated within the wall of the vagina and evidently taking origin from the remnants of Gartner's duct. After incising the overlying tissues the cyst was dissected out of its bed with much difficulty.)

Cyst of the Testicle.—Embryology. The seminiferous tubes, or the specific elements of the testicle are formed from the germinal epithelial layer of the peritoneum in the same manner as are the cylindrical tubes containing the specific sexual elements of the ovary. The tubuli recti, the rete testis vasa deferentia, and the coni vasculosi of the testicle and the epididymis are produced or come from the head kidney or

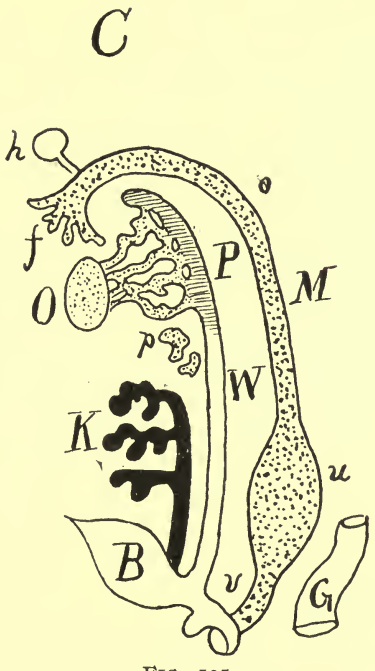


FIG. 135.

the Wolffian body. The head of the epididymis is formed by the Wolffian body while the vas deferens is the transformed Wolffian duct. There are to be found between the testicle and the vas deferens at the border of the globus minor a number of small, twisted, tubules which come from the lower portion of the Wolffian body and which produce what is known as the paradidymis, or the organ of Giraldis. (Figs. 135 B-h; 136 a.) There is also occasionally to be seen a vestigeal remnant of

the Wolffian body situated in the globus minor between the epididymis and the vas deferens, the vasa aberrentia. This small tube varies in length from 1½ inches to 14 inches. (Fig. 136 B.) The tubes of the paradidymis and the vasa aberrentia are lined by low columnar epithelium which occasionally at pointsis ciliated. The tubes are surrounded by a layer of vascular connective tissue. The pedunculated or stalked hydatids common to both sexes probably represent a part of the atrophic duct of the anterior segment of the Wolffian body. The sessile hydatid is limited to males and is the slightly expanded proximal end of Muller's duct. These sacs are usually lined with cuboidal cells and often contain a clear fluid.

From a study of the embryology of the Wolffian body and its intimate connection with the formation of the testicle as well as the consideration of the various embryological rests which occur adjacent thereto, namely in the paradidymis and vas aberrentia, as well as a study of the histology of the cysts which not unfrequently occur in these regions, it seems apparent that many of, if not the majority of, the cysts will be found in relationship to the epididymis and taking origin from these fœtal rests. It has been frequently demonstrated that these cysts have the same epithelial lining and structure which is found in the twisted tubules of the paradidymis as well as in that of the vas aberrentia. Cysts which take origin from these structures are usually found adjacent to the lower portion of the epididymis or globus minor, although Bland Sutton states that these fœtal vestiges frequently occur in the globus major at the head of the epididymis. In the writer's experience practically all of the many cysts he has encountered in relation to the testicle have been situated near its lower extremity. They are placed outside of the tunica vaginalis, and often project into this membrane and occasionally come to simulate to some degree a collection of fluid in the tunica vaginalis. The cysts may be single or they may be multiple, small or large. They are frequently thin-walled, are translucent and have a watery contents and are so tense that it

is difficult or almost impossible to differentiate them from solid growths. There may be a single cyst situated between the epididymis and testicle, or there may be a conglomeration of cysts, a half dozen or more in close juxtaposition and in con-

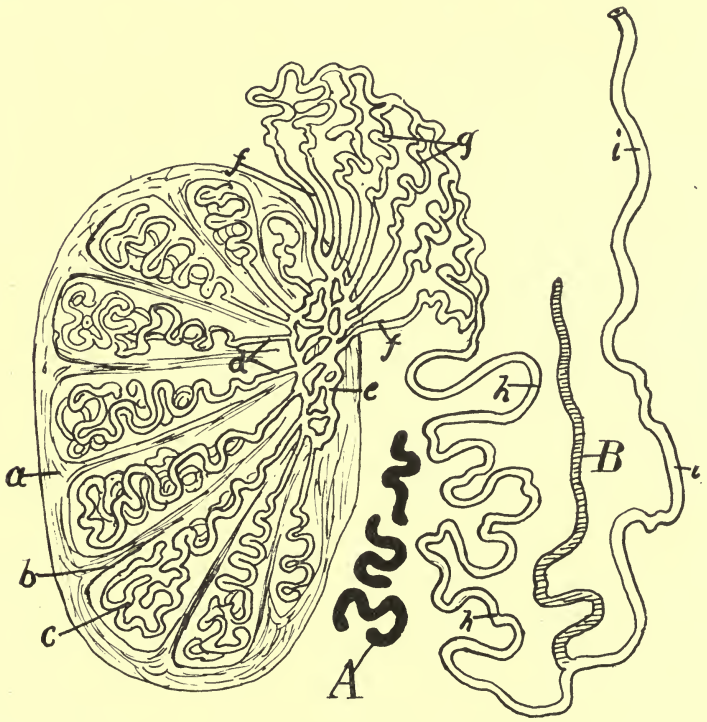


FIG. 136.

Plan of vertical section of the testicle, showing the arrangement of the ducts.

A. Paradidymis. B. Vas aberrans.

a. tunica albuginea. b. Fibrous processes running between the lobules. c. Convoluted seminiferous tubules. d. Straight portions of seminiferous tubules. e. Rete testis. f. Vasa efferentia. g. Coni vasculosi. h. Convoluted canal of epididymis. i. Vas deferens.

sequence of their close relationship may produce a tumor of considerable size which is irrregular, nodular, immovably attached to the epididymis or testicle and which seems as hard as a solid growth. They may be situated either in the para-

didymis, that is between the epididymis and the testicle or between the vas deferens and the epididymis. They may extend for a very considerable distance along the cord producing a large, irregular, nodular, fixed, and very hard tumor. The condition may affect but one side or both may be implicated. In a case recently under the writer's care there were two or three of these cysts upon the left side in close relationship to each other, while upon the right was a conglomerate mass considerably larger than a hen's egg which extended a very considerable distance up the cord. Upon incision the growths were seen to be made up of a number of perfectly clear, very tense, closely aggregated, hard cysts each of about the size of a hazel-nut, although they varied somewhat in size.

Symptoms and Course.—The condition is usually associated with more or less distress, heaviness, and dragging or even pain, although in one of the writer's cases where both testicles were involved the patient experienced no distress whatsoever. These cysts may make their appearance at any time after adult age. The writer has occasionally encountered them in persons past fifty, and in one case at the age of sixty-six years. They are, however, most frequently found in young adults and in middle-aged persons. They may be situated at either extremity of the testicle but undoubtedly are much more frequent at the lower portion in direct connection with the epididymis. They are not especially sensitive upon manipulation. When immovably fixed to the epididymis they are extremely hard, quite nodular, and make their appearance without apparent cause and have a reasonably rapid growth. They very seldom reach any considerable size, rarely producing a growth larger than a hen's egg, which size however may be attained in a few weeks. They are to be differentiated, if possible, from tubercular diseases, hydrocele, syphilitic epididymitis and from sarcomatous growths. Tubercular nodules situated at the lower end of the epididymis may be difficult of differentiation. They, however,

have a less rapid growth, are attended with more pain, and show symptoms of inflammation, such as local soreness, tenderness, thickening of the tissue, an increase of heat, and an increased blood supply to the part. In doubtful cases it may be necessary to resort to incision in order to establish a diagnosis. Syphilitic epididymitis is an inflammation, will usually give a history of syphilis and will yield to anti-syphilitic treatment. The condition is very frequently associated with hydrocele. Whether this be the result of pressure or irritation of the tunica vaginalis resulting from their growth or be due to the disturbance of the circulation, may be difficult to state, but the fact remains nevertheless, that in the majority of cases of cystic diseases an accumulation of two or more drachms of fluid is to be found in the tunica vaginalis.

In hydrocele of considerable size there should be no difficulty in making a diagnosis. In cystic conditions of the testicles the individual cysts seldom reach any considerable size and usually present such a tension of the cyst wall that fluctuation is not readily made out. These cysts are situated upon the posterior surface near the epididymis, while hydrocele occupies the anterior portion of the testicle. In cystic conditions there are ordinarily numerous cysts; in hydrocele there is but one. In hydrocele the testicle is not easily made out. In sarcomatous diseases there would ordinarily be little difficulty in making a diagnosis if one is able at least to watch the condition for any considerable time. Sarcoma frequently occurs in children and in young adults, and is often the result of injury. In sarcomata the tumors are of much greater size than those which ordinarily occur in cystic disease. The condition furthermore is not often confined to the epididymis. The growth is more sensitive, produces greater pain in consequence of the destruction of tissue, does not fluctuate, is not translucent and soon causes a systemic infection and loss of flesh.

Sarcomatous growths occurring in this situation, are usually extremely malignant, quickly affecting the constitution and well being of the patient, and may produce a characteris-

tic cachexia, none of which conditions prevail in cystic disease. It should also be remembered that these cysts are nearly always translucent while the inflammatory growths are not. The condition of cystic disease, however, if it does not cause much distress or pain seemingly affects the peace and comfort of the individual.

TREATMENT.—These cysts should be removed both in consequence of the liability of pressure upon the secretory portions of the testicles and in consequence of the effects upon the mind of the individual. This may be done under antiseptic precautions by simply incising the scrotum over the cysts when they may be punctured and then cut away. It is impossible ordinarily to enucleate them, but the entire cyst wall should be gotten rid of. If there are many cysts each one must be removed, and in this removal it is ordinarily unnecessary to interfere with the tunica vaginalis or seriously interfere with the vas deferens or epididymis. After the removal of the cyst the cavity may be closed by tier suture or drained.

Cysts of Muller's Duct.—Muller's ducts make their appearance in fœtal life shortly after the development of the Wolffian bodies. They are situated upon either side of the vertebral column in close relationship to the Wolffian bodies and Wolffian ducts, and produce in the female the Fallopian tubes and by their coalescence in the median line the uterus and vagina. (Fig. 135 A, B, C.) In the male they occur in embryonal life as small epithelial cords which extend from the sides of the Wolffian bodies downwards where they join the uro-genital tract. At their lower extremity they form what is known as the uterus masculinis which later is converted into a tube which opens into the prostatic urethra in the sinus prostaticus. The upper ends of the ducts may form in the male small sessile hydatid cysts situated upon the epididymis at the site of the globus major. There seems to be in the minds of many embryologists some doubt as to whether the hydatid of Morgagni is formed from the tubules of the Wolffian body or from the anterior end of the duct of Muller. The hydatid of

Morgagni if situated in the female has no pathological significance. If occurring in the region of the epididymis and producing a cyst of sufficient size so as to cause functional disturbance it may be readily exposed by incision and excised.

Hydrocele.—A hydrocele may be defined as a tumor composed of a fibrous sac lined with endothelial cells and containing fluid. Under ordinary conditions, unless otherwise stated, a hydrocele is understood as meaning an accumulation of fluid in the tunica vaginalis testis. The accumulation of fluid may, however, occur in the unobliterated pouch of peritoneum which descends into the scrotum with the testicle, or it may occur in the canal of Nuck. In order to better understand the method of formation of the various hydroceles it is well to briefly consider the descent of the testicle and the method of formation of the peritoneal pouches which accompany its descent. Up to the fifth month of fœtal life the testicle is situated below and anterior to the kidney and is covered in front and upon the sides by the peritoneum. Between the fifth and sixth months it descends to the iliac fossa and during the seventh month enters the internal abdominal ring. A small process of the peritoneum known as the processus vaginalis precedes the testicle in its descent into the scrotum. This explains why in some cases a patient may suffer from hydrocele in whom the testicle has not descended into the scrotum. Under ordinary conditions the peritoneal pouch which has descended from the abdomen with the testicle into the scrotum becomes closed at the internal abdominal ring just before birth. This obliteration of the pouch continues gradually downwards until it reaches a point just above the testicle where it ceases and the unobliterated portion of the pouch situated about the testicle becomes the tunica vaginalis and is the usual site of a hydrocele. (Fig. 137.)

Congenital Hydrocele.—Occasionally the pouch of peritoneum which accompanies the testicle into the scrotum remains open at the inguinal canal and in direct communication with the abdominal cavity, allowing fluid to enter this

pouch from the abdomen and thus producing what is known as a congenital hydrocele. (Fig. 138.) Again the pouch may become closed at the site of the internal abdominal ring and remain open throughout the remainder of its course creating what is known as an infantile hydrocele. (Fig. 139 A.) Hydrocele of the cord may occur in consequence of the lower portion

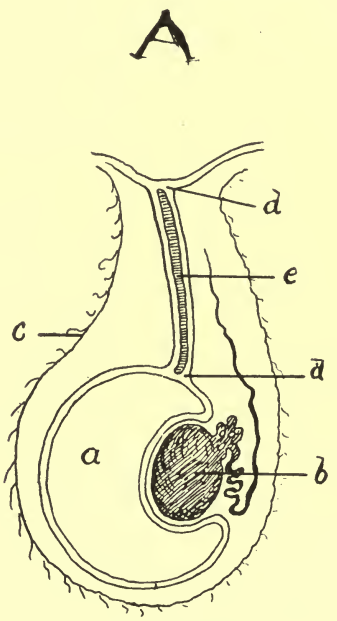


FIG. 137.

Vaginal Hydrocele.

a. Hydrocele of tunica vaginalis. b. Testicle.
c. Scrotum. d. Upper and lower constriction.
e. Obliterated peritoneal pouch.

of the pouch being shut off from the tunica vaginalis and the upper part from the abdomen. (Fig. 139 B.) Another condition which is more rare is that in which the funicular process remains open down to the tunica vaginalis and through this canal a hydrocele of the tunica vaginalis is projected to the external abdominal ring and even through the inguinal canal

into the abdomen producing it may be an abdominal tumor of very considerable size.

A hydrocele may be either acute or chronic. The acute may follow a traumatism or acute inflammation of the testicle or epididymis. The amount of fluid accumulated in the tunic in these cases is not great and may be successfully treated ordinarily by attention to the disease or the condition causing the trouble.

Chronic hydrocele may occur at any age, be unilateral or bilateral, but it is most frequent in the two extremes of

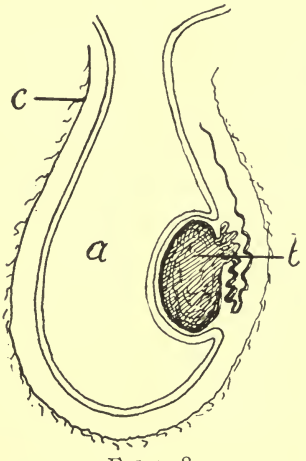


FIG. 138.

a. Congenital hydrocele. b. testicle. c. Scrotum.

life and more often upon one than both sides. Its ætiology is perhaps not well understood, but it seemingly occurs most frequently in hot climates in consequence of the heat relaxing the tissues of the scrotum. It may be secondary to chronic processes occurring in the testicle or epididymis as the result of syphilis, tuberculosis, or injury. In the ordinary case there is undoubtedly some chronic process going on in the endothelial cells lining the tunica vaginalis.

SYMPTOMATOLOGY.—The symptoms and course of a collection of fluid in the tunica vaginalis are reasonably distinc-

tive. The process comes on gradually. A rounded, pear-shaped tumor makes its appearance in the lower part of the scrotum enclosing the testicle. The tumor grows gradually from below upwards, is very tense, elastic, dull on percussion and translucent. If the left hand grasp the growth from behind, a sharp tap with one finger of the right upon its anterior

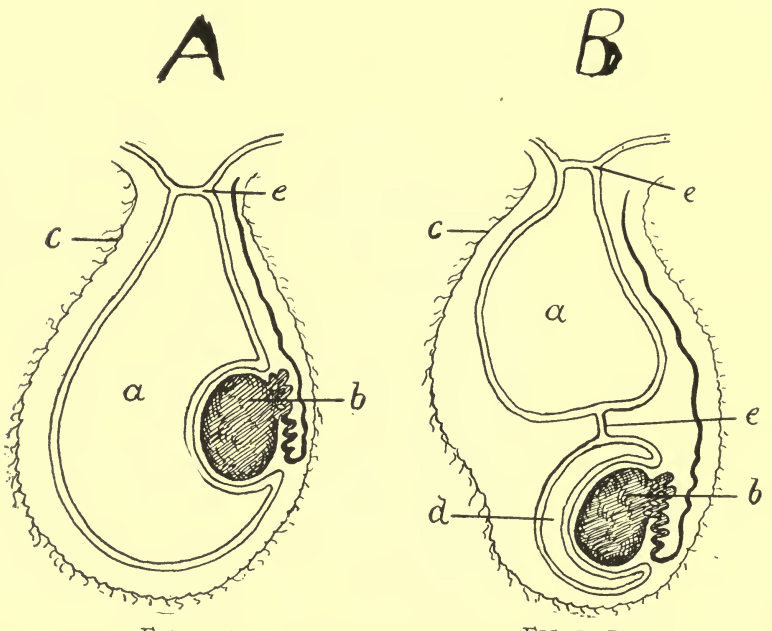


FIG. 139A.

a. Infantile hydrocele.
b. Testicle.
c. Scrotum.
e. Constriction at outer ring,

FIG. 139B.

a. Encysted hydrocele of cord.
b. Testicle.
c. Scrotum.
d. Cavity of tunica vaginalis.
e. Upper and lower constrictions.

surface will elicit fluctuation. The translucency already spoken of depends upon a clear fluid and a reasonably thin sac, which conditions do not, however, always prevail. The fluid may be tinged with blood in consequence of the rupture of some vessels, or the sac may as the result of age or irritation be extremely thick, both of which conditions will prevent the ready transmission of light. The tumor so surrounds and

encloses the testicle that it cannot be felt. The fluid contained in the hydrocele is usually of light straw color and has a specific gravity of about 1020. It occasionally happens that the sac of a hydrocele in consequence of adhesive inflammation becomes converted into two or more separate sacks, or as the result of some inflammatory process bands may be formed extending across from one wall to the other.

Diagnosis and Differential Diagnosis.—A hydrocele should be differentiated from a hernia and from a hæmatocele. Its primary situation at the lower portion of the scrotum, its dullness upon percussion, translucency, freedom from pain, and the fact that it does not impart an impulse upon coughing are reasonably distinctive. A hernia makes its appearance from above downwards, usually suddenly, ordinarily presents an impulse upon coughing, is likely to disappear when the patient lies down, is often attended with pain, may be dull upon percussion or tympanitic depending upon the presence or absence of intestine, and presents a more or less hard, sensitive cord extending through the inguinal canal from the tumor. In hernia the testicle is distinctly outside of, behind, and completely separated from the tumor. It is quite true that in some cases of congenital hernia the intestine may completely surround the testicle. It should not be forgotten that a hydrocele and a hernia may exist in the same case and upon the same side, in which case each will present more or less distinctive and characteristic symptoms. In hæmatocele the tumor usually makes its appearance suddenly and often as the result of an injury, its appearance is usually attended with very decided pain and even faintness from loss of blood. The tumor is opaque, dull upon percussion, doughy, and sensitive. The subcutaneous or cutaneous tissues not unfrequently show discoloration from hæmorrhage. On account of the symptoms and mode of onset a hæmatocele is more likely to be mistaken for hernia than it is for a hydrocele. A hydrocele should be differentiated from diseases of the testicle and from epididymitis. (Fig. 140.)

TREATMENT.—The treatment of hydrocele of the tunica vaginalis may be divided into palliative and curative. In acute cases the recumbent position, elevation of the scrotum, and the application of cooling lotions, the lead and opium wash, or a mixture of guaiacol and glycerine are indicated. In chronic cases the palliative treatment consists in drawing off the fluid from the sac. For this purpose the anterior portion of the

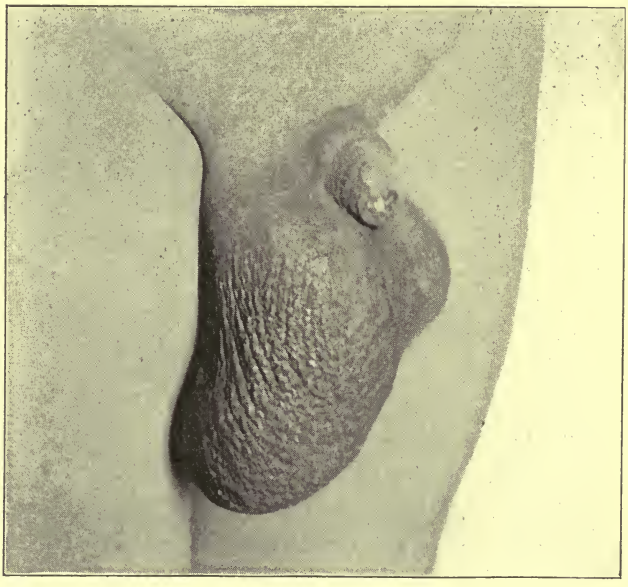


FIG. 140.
Hydrocele right side.

scrotum is rendered aseptic and if the patient is very sensitive a local anæsthetic may be used. The sac is then seized from behind with the left hand and a small, sharp, aseptic trocar thrust into the hydrocele from the front and near the lower portion, the trocar taking a direction upwards and backwards. Care must be exercised that the testicle, which is usually situated at the lower and posterior portion, be not punctured, else serious damage may be done and a hydrocele converted

into a hæmatocele. After drawing off the fluid the cannula is withdrawn and a bit of adhesive plaster or absorbent cotton with collodion placed over the opening. The sac will ordinarily refill in the course of six to twelve months and require a repetition of the operation.

In the radical treatment the injection method is perhaps most frequently employed. The sac is punctured as before, the fluid allowed to flow off, while care is taken that the end of the cannula does not escape from the cavity of the sac. Some irritating fluid is now injected into the sac for the purpose of converting the chronic into an acute inflammation. This acute inflammation, by causing a plastic exudate, may obliterate the cavity of the sac, the two surfaces becoming adherent. Valentine Mott was in the habit, after the withdrawal of the fluid, of injecting into the sac a solution of sulphate of zinc, having the strength of one grain to the ounce. The amount injected about equaled that withdrawn. The scrotum was kneaded and the fluid retained until it caused considerable pain, when it was allowed to flow off through the cannula. The writer has used this injection in a great many cases during the past twenty years and can testify to its efficacy. It causes considerable pain, and occasionally some faintness, which, however, even in the severest cases, disappears in a short time. The results, except in the oldest and most obstinate hydroceles, are all that could be desired. Tincture of iodine is used by a great number of surgeons for this purpose, injecting one or two drachms into the sac after the withdrawal of the fluid, where it is allowed to remain. Another substance used by many is carbolic acid, 30 to 60 minims of a 95% solution being injected and the scrotum kneaded for a few moments, when the acid is allowed to make its escape through the cannula.

The Open Method.—This treatment consists of making a reasonably free incision through the anterior portion of the sac, allowing the fluid to drain off and then either stitching the sac to the skin to prevent its closure, and placing in a

drainage tube, or packing the sac with iodoform gauze and alloiwng it gradually to contract.

Removal of the Sac.—This procedure, so much practised in Von Bergmann's clinic, and bearing his name, consists in making a free incision down to and through the sac, when it is seized with forceps and its connections to the adjacent tissue snipped with scissors until one reaches the border of the testicle, when the redundant and separated portion is cut away leaving the peritoneal covering of the testicle intact. There is usually some oozing following the removal, and a few cat-gut ligatures may be found necessary as well as a cat-gut drain in the lower angle of the wound. The method is absolutely curative and is deserving of a more extended adoption. The writer confines his treatment in these cases almost entirely to either the injection of a sulphate of zinc solution or to the Von Bergmann method.

Congenital Hydrocele.—As already stated, this is caused by a non-obliteration of the peritoneal pouch which precedes and follows the testicle into the scrotum. In this form there is no tunica vaginalis. The opening from the scrotum into the abdomen is free and the fluid readily enters the sac from the abdomen when the patient stands, and flows back when the patient resumes the recumbent position. The condition is to be differentiated from hydrocele of the tunica vaginalis and from hernia. From a hydrocele of the tunica vaginalis the differentiation is easy, as the latter condition cannot be made to disappear when the patient lies down, but the fluid, on the contrary, is retained in a tense, more or less immovable sac. Congenital hydrocele is often associated with congenital hernia, but the conditions, even if associated, should not be mistaken the one for the other. In hydrocele the tumor forms slowly when the patient stands, from below upwards, and in hernia rapidly from above downwards. The former is translucent and the latter opaque. Hydrocele is dull upon percussion, hernia tympanitic, at least if made up of intestines. A hernia returns with a gurgling sound and

hydrocele without palpable sensation. The treatment of this form of hydrocele is that of infantile hernia, and consists of the application of a truss for the purpose of establishing, as the result of pressure, an adhesive inflammation between the two opposed peritoneal surfaces and thus obliterating the space. If this does not succeed and if the condition is troublesome, and especially if associated with a hernia, it should be treated by operation, adopting the same technique that is used in the radical treatment of congenital hernia.

Infantile Hydrocele.—In this species the pouch of peritoneum, which is carried down into the scrotum with the testicle, becomes obliterated at the site of the inguinal canal, while the remaining portion, including that which normally makes up the tunica vaginalis, remains open and constitutes the sac of the hydrocele. In this form there is a collection of fluid surrounding and enclosing the testicle and producing a tumor which may extend from the bottom of the scrotum to the external inguinal ring. The growth has practically the same characteristics and presents the same symptoms as hydrocele of the tunica vaginalis, excepting that it is not confined within the limits of the tunica vaginalis, and is more likely to extend upwards along the cord to the external inguinal ring. It may be treated by the same method and with the same results as a hydrocele of the tunica vaginalis.

Hydrocele of the Cord.—It occasionally happens that the pouch of peritoneum, which extends from the external abdominal ring to the tunica vaginalis, becomes only in part obliterated. In this case the open portion forms a sac within the cord, which becomes filled with fluid and is known as a hydrocele of the cord. In these cases there appears within the substance of the cord a slowly growing, tense, fluctuating, it may be transparent, oblong tumor, which is dull upon percussion, which cannot be made to disappear by pressure, does not reach any great size, and which receives no impulse upon coughing. If causing disturbance, it may be treated by injection or incision.

Hydrocele En Bissac.—The pouch of peritoneum, which has descended into the scrotum with the testicle, becomes occluded just above the testicle forming the tunica vaginalis, and from there on into the abdomen the pouch remains open, forming what is known as a funicular process. In these cases it is possible for a hydrocele to form in the tunica vaginalis and press its way through the funicular process up to the external abdominal ring and even through the inguinal canal into the abdomen. (Fig. 141.)

The following is a short resumé of a most interesting case which presented itself, and was operated upon in the writer's clinic, at St. Joseph's Hospital: Carl L., aged thirty-five. German. Family and previous history good. In May, 1901, while carrying a heavy weight, patient sustained a severe fall, striking lower abdomen across a board. The following summer he experienced occasional pain in the right iliac region and noticed swelling in the right side of the scrotum. Shortly before Christmas, while carrying a hod of mortar up a ladder, one of the rounds broke, precipitating him to the ground. Shortly after this a decided swelling made its appearance in the right side above Poupart's ligament. The pain was now considerable. On February 27, 1902, the pain in the right iliac region became so severe that the patient was obliged to take to his bed. Upon examination February 28th, a large fluctuating tumor about the size of a fœtal head was found in the right iliac region and from this a large, tense cord extended through the inguinal canal and connected with a fluctuating tumor in the scrotum, the size of a cocoanut. A wave of fluctuation was readily transmitted from the tumor in the abdomen to the one in the scrotum. An incision was made in the scrotum down to the sac, which was opened and found to be the tunica vaginalis, containing the testicle and extending up into the abdomen. After emptying the sac of its contents, it was gradually drawn upon and shelled out of the abdominal cavity through the inguinal canal. After the removal of this sac with the testicle, it was found that there was a thick pouch of peri-

toneum, a funicular process, which had completely enclosed that portion of the sac within the scrotum and was in direct communication with the peritoneum of the abdominal cavity. This sac was dissected out, ligated, and removed. Patient made an excellent recovery. (Fig. 142.)

Hydrocele of the Canal of Nuck.—In the female the round ligaments of the uterus are projected through the

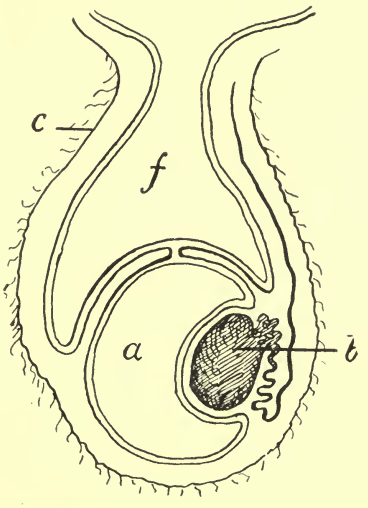


FIG. 141.

Author's Case.

Vaginal hydrocele with funicular process communicating with cavity.

a. Hydrocele of tunica vaginalis. b. Testicle.
c. Scrotum. f. Funicular process of peritoneum.

inguinal canals to the labia majora. They carry with them processes of peritoneum which ordinarily become obliterated, but which may remain open like those descending with the testicle, and produce what are known as the canals of Nuck. If these peritoneal processes remain entirely open they correspond to a congenital hydrocele in the male, with this excep-

tion: the sac is either confined to the inguinal canal or extends to a labium majus. These pouches are not unfrequently the site of an inguinal hernia. A case of double inguinal hernia in the canals of Nuck was recently operated upon by the writer. The treatment in these cases is practically the same as in congenital hydrocele of the male. If the peritoneal

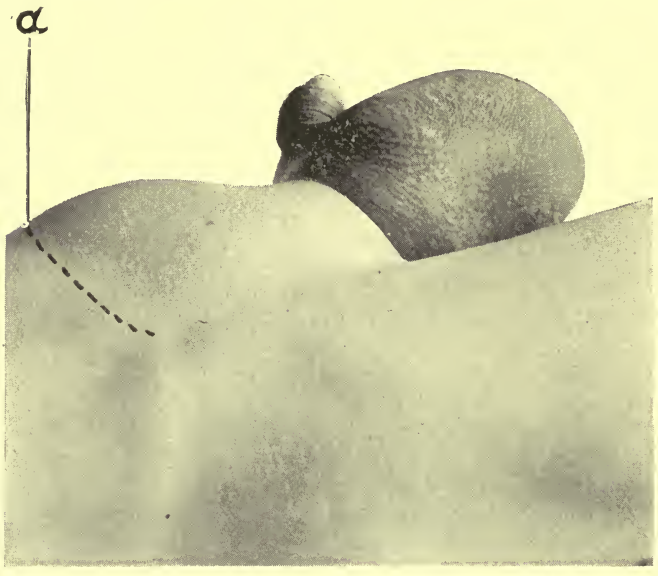


FIG. 142.

Hydrocele of the tunica vaginalis which has passed through the funicular process and inguinal canal producing a large tumor in the abdomen.

a. Upper limit of tumor in abdomen.

process becomes closed only at the site of the internal inguinal ring, then, and in that case, an encysted hydrocele of the canal of Nuck is formed, which has practically the same appearance and requires the same treatment as an infantile hydrocele in the male.

Cysts of the Ovary. Cysto-Adenomata. Cysts of the Graafian Follicles and of the Corpus Luteum.—The ovary is

situated upon the posterior surface of the broad ligament and is covered by the peritoneum. The ovary is divided by histologists into two parts: the cortex, which is placed superficially and makes up about one-third of the gland, and the medulla which is situated centrally. In order to understand the cysts and cysto-adenomata which occur in the ovary it is necessary to have a clear conception of the histology and embryology of the organ. As has already been stated cysts are often really cysto-adenomata, and take their origin from glandular structures, from epithelial cells occurring either in solid columns or in those which have a distinct lumen.

Histology of the Ovarian Cortex.—The ovary is covered, except at the hilus, by peritoneum. The cortex is made up of stroma and Graafian follicles, the latter in various stages of development. The stroma consists largely of spindle cells, which, near the periphery, become much condensed and form a sort of capsule, the tunica albuginea. Within this stroma are to be found the Graafian follicles. The immature follicle is lined by a single layer of low columnar cells, while in those more mature the epithelial lining consists of many layers of small polyhedral cells. Each follicle contains an ova. The medullary portion of the ovary is made up of fibrous tissue, involuntary muscular tissue, blood vessels, lymphatics, nerves and groups of epithelial cells.

Embryology of the Ovary.—This has been already discussed to some extent, but there are a few points which I desire to emphasize in order to make clear the conditions which lead to the formation of adenomatous cysts of the ovary. During the first few days of fœtal life the endothelial cells of the peritoneum at the site of the ovary become changed in character and converted into low columnar cells, and are known as the germinal epithelia of the ovary. These cells occur in a single layer and subsequently grow into the ovarian stroma at innumerable points as solid columns of cells, out of which a certain number become converted into Graafian follicles. These sequestered columns or pegs of epi-

thelial cells known as Pfluger's tubes have apparently no function other than the formation of Graafian follicles which process is about completed at birth. They then remain sequestered in the tissues as embryonal rests, or undergo degeneration and absorption. (Fig. 143 b.) Coincident with this growth of germinal epithelium into the cortex a similar process takes place from the adjacent Wolffian body into the medulla. Innumerable small epithelial strands may be seen to reach the hilus of the ovary from the Wolffian body where they anastomose and then grow into the ovarian medulla as medullary or sexual cords. They may penetrate the medulla as far as the cortex and come in contact with Pfluger's tubes before mentioned. The function or purpose of these outgrowths from the Wolffian body is not well understood. It is held by some embryologists that they take an active part in the formation of the Graafian follicles, while Pfluger's tubes are active in the formation of the ova, and like the latter they become embryonal rests without apparent function. (Fig. 143ee.) With the ripening of a Graafian follicle it approaches the surface of the ovary, ruptures, and the ovum is discharged. The follicle now called the corpus luteum becomes filled with blood, the rent heals, the polyhedral cells lining the cavity proliferate, and with the clot forms quite a prominence. After a time under ordinary conditions the blood exudate and the cells undergo absorption or organization into fibrous tissue. It is easily to be seen then that there are four epithelial structures within the ovary which are capable of producing cysts or cysto-adenomata. The one, if Pfluger's tubes, taking origin from the germinal epithelium, another is the medullary tubes coming from the Wolffian body. The former is placed in the cortical, the latter in the medullary portion of the ovary and from these two sources unquestionably come the large multi and monolocular ovarian cysts. The Graafian follicles instead of rupturing may continue to increase in size producing cysts as large as a walnut or even much larger. The epithelial cells of the corpus

luteum may, instead of undergoing degeneration, proliferate, this growth resulting in the formation of a cyst.

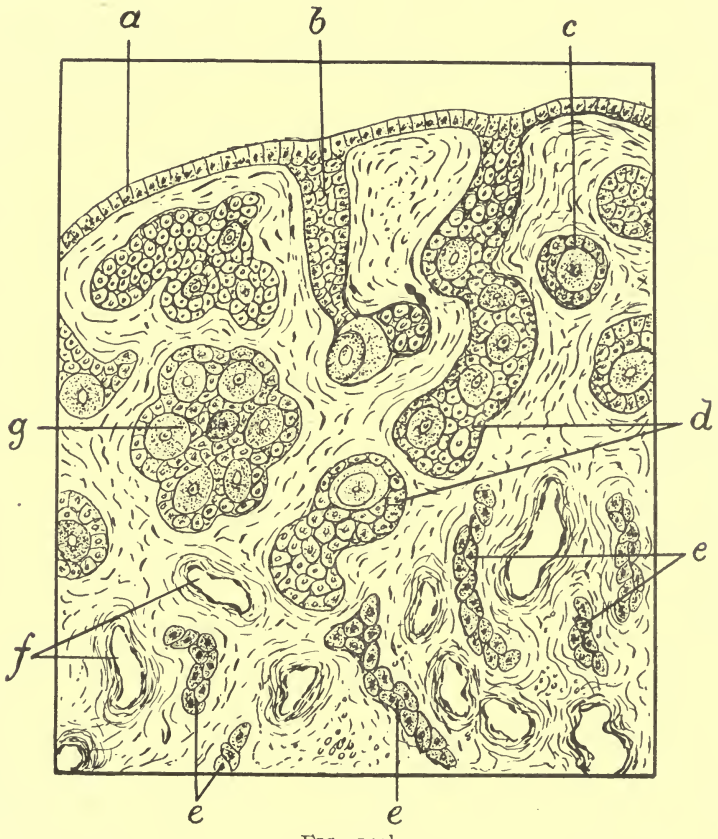


FIG. 143b.

a. Germinal epithelium.
b. Formation of Pflügerian egg-tube.
c. Young, newly-formed follicle.
d. Constriction of longer egg-tube to form nests.
e. Groups of interstitial cells, derived from Wolffian body; the so-called medullary cords.
f. f. Blood vessels.
g. Large nest.

Cysts of Graafian Follicles. — As has been already stated Graafian follicles, instead of approaching the surface and rupturing, may take on cystic growth and form single or

multiple tumors upon the convex surface of the ovary. They produce small, soft, somewhat pointed, thin-walled growths beneath the peritoneum which are easily ruptured in handling. In size they may not be larger than a pea or cherry, but when many are in juxtaposition they may produce a tumor the size of an orange or even larger. They contain a thin, serous fluid or one mixed with blood and epithelial cells, the latter in a more or less advanced stage of fatty degeneration. In many of these cases the patients present the symptoms ordinarily ascribed to a chronic ovaritis from which they are really suffering. They have more or less continuous pain in the region of the ovary implicated which is increased upon standing, and attended with soreness upon pressure in the corresponding iliac region and often also a pre-menstrual pain lasting for several days. Upon bimanual examination the ovary can be readily palpated and is recognized as being much enlarged, soft, semi-fluctuant, and tender upon pressure. In some cases, however, where the cysts are small or few in number there may be no very marked symptoms.

TREATMENT.—It is recommended by some writers that these cysts when small be ruptured by bimanual pressure or when large that they may be punctured through the vagina by means of a long trocar. It is absolutely necessary if these methods are to be practised that these tumors be differentiated from pyosalpinx, abscess of the ovary, or other infectious or inflammatory conditions which, however, are always accompanied by symptoms of inflammation. It is probably the better method, in the majority of cases where the symptoms are pronounced, to open the abdomen either through the linea alba or vagina, and remove by incision and enucleation, the cysts which present themselves. The rent in the ovary can then be closed by continuous or interrupted suture. If there is or has been pronounced ovaritis, the ovary had better be removed. A method practised by many is to puncture these cysts, either with a scalpel or with the point of a Paquelin cautery. It is probably true that the great majority

of cysts which are punctured and the contents allowed to discharge, will, when the rent is healed, readily refill, consequently it is thought best to enucleate or excise them.

Cysts of the Corpus Luteum.—After the rupture of a Graafian follicle, the sac, in consequence of the hæmorrhage, becomes filled with blood, while the polyhedral cells lining the same proliferate vigorously, and then, in the natural course of events, are absorbed, and their place taken by connective tissue. In some cases, however, the process continues active, the cells lining the sac proliferate, the rent closes, and a cyst forms which may be filled with a comparatively clear fluid or one tinged with blood. These cysts are lined by several layers of polyhedral cells and may reach the size of a walnut, or even an orange. They cannot be differentiated readily, even with the aid of a microscope, from unruptured Graafian follicles, except that the sac may be more or less filled with blood and in the former an ovum may be found. Clinically, they present practically the same symptoms as do cysts of the Graafian follicles. The ovary is enlarged, more or less fluctuant and sensitive. The patient is likely to have pain in the side. If the condition is producing serious disturbance the cyst may, after exposure, be enucleated and the rent closed with continuous cat-gut suture.

Ovarian Tumors, Proper. Cysto-Adenomata. — The classical descriptions which have been given with so much accuracy and detail by McDowell, Peasley, Atlee, Spencer Wells, and others, applies to the large multilocular or unilocular ovarian cyst. There has been, and probably is yet, some considerable confusion as to the exact origin of these growths. With many they are held to be cysts of the Graafian follicle, while others hold that they come from the glandular structure of the ovary. They undoubtedly take their origin from two sources. One is the columns of epithelial cells which are projected into the ovary from its surface and which produce the Graafian follicles and are then left within the tissues as embryonal rests. The other source is the medullary,

or sexual cords, from the Wolffian body, which pass into the medulla of the ovary at the hilus. These ovarian tumors may have a single cavity, unilocular, or they may have a large number, multilocular. This condition is apparently due to two causes. An ovarian tumor may not only have but a single cavity, but it may remain as a single cyst throughout its existence. A compound cyst, having a considerable number of cavities, may be converted into a single cyst in consequence of the destruction of the partitions by pressure and absorption. A single cyst may be converted into many in consequence of the active proliferation of the epithelial cells lining the cavity by means of which epithelial buds are formed upon its interior. Later these buds, by reason of central absorption, the secretion of the cells themselves, or as a result of a serous exudate from the blood, are converted into active cysts. A typical ovarian cyst has a beautiful, pearly, grayish white, glistening appearance, which is made up of a fibrous stroma of greater or less thickness, being at times as thin as tissue paper and again thicker than binder's board. It may also be the site of cartilaginous or osseous plates. The cysts are lined by cuboidal or low columnar epithelium. The cyst contents is represented by a thin, clear, pale, straw-colored serum, having the specific gravity of about 1025, or it may present a light muddy appearance or be a very dark chocolate. This dark color is the result of hæmorrhage into the cyst cavity. The contents of these cysts, instead of being serous or watery, may have a mucilaginous or jelly-like consistency. The contained fluid contains fat droplets, desquamated epithelium, pseudo-mucin, and detritus. Pseudo-mucin is reasonably characteristic of an ovarian tumor, as it does not occur in Graafian follicle cysts or in parovarian cysts.

Ovarian tumors are situated primarily within the ovary and are attached to the broad ligament by the mesovarium, and to the uterus by the broad and utero-ovarian ligaments. In the cyst's growth these structures are drawn upon, producing with the ovarian vessels what is known as the pedicle,

which may be quite long, measuring two or three inches, or extremely short, scarcely affording a place for a ligature. Again, the pedicle may be very thin and fragile, or thick and tough. These cysts may implicate but one or both ovaries. In about six per cent. of the cases both ovaries are affected. Taking origin from the ovary, they grow into the free abdominal cavity, or they may, and in exceptional cases do, penetrate the folds of the broad ligament and become partially or wholly intra-ligamentous.

Symptoms and Diagnosis.—Ovarian tumors occur most frequently in middle life, being comparatively unfrequent at the two extremes. While of slow growth they increase more rapidly in size than does the parovarian cyst, and much more rapidly than the uterine myoma. Ordinarily, however, it takes some years to produce a tumor of large dimensions. Being primarily situated to the right or left of the uterus, they push this organ to the opposite side and partially fill the pelvis. Later they may become impacted in the pelvis, causing serious pressure upon the bladder, with retention of urine, or pressure upon the ureters producing hydroureter, or pressure upon the rectum with more or less of obstruction of the bowels, or pressure upon the nerve trunks, with resulting severe pain. When impacted in the pelvis the pedicle is occasionally drawn over the top of the cyst like a hood, simulating a broad ligament cyst. Such a case was recently operated upon in which the pedicle could not be defined and the diagnosis was only established after the cyst was tapped. Rising in part out of the pelvis, they are likely to drag the uterus to some extent to the side upon which they are situated, or, getting behind the uterus, to press it against or above the symphysis, or if in front of the uterus to crowd it into the hollow of the sacrum. Passing into the abdomen if the growth is a single cyst it will present a round, hard, tense, fluctuant surface, be dull upon percussion, movable, free from pain, and situated to some extent upon the side from which it took its origin. A multilocular cyst may pre-

sent beneath the abdominal wall a single cyst, and consequently have a smooth surface, the other cysts being situated posteriorly, or, and as is often the case, the anterior surface may be irregular and present the surface of several cysts. As these cysts reach the position of the navel the intestines float upwards beneath the ribs, and laterally to the flanks; the central portion of the abdomen being occupied by the growth. If they reach great size they are likely to produce serious pressure upon the stomach, interfering thereby with digestion and causing emaciation. They may press the diaphragm upwards, thus compressing the lungs and interfering with respiration and often with the heart's action. They may cause œdema of the lower limbs, shortness of breath, albuminuria, abdominal pain, and pronounced general weakness. These growths must be differentiated from myomata, which are directly connected with the uterus, much harder, do not present fluctuation, and cause menstrual disturbances. They should be differentiated from growths of the kidney, which usually lie beneath the colon and present a tympanitic note. The greatest difficulty, in a diagnostic sense, may occur in cases of ascites. In marked ascites, when unassociated with a growth, the fluid seeks the flanks, forcing the intestines beneath the ribs while the central abdomen is occupied by the tumor. If there is only ascites, the umbilical region will be tympanitic, and the dull area will depend upon the position of the patient. In ascites, and this is most important, we cannot feel a dense, resisting sac. One may have an encysted dropsy, as tubercular, or one due to adhesions, but here there will have been symptoms of inflammation and more or less pain and induration.

PROGNOSIS.—The prognosis of ovarian tumors may be said to be bad, as they all tend towards death, if not subjected to surgical interference.

COMPLICATIONS.—Among the more important complications which may arise during the growth of an ovarian tumor, are adhesions to the abdominal wall and adjacent viscera,

caused by a local peritonitis and attended with pain, fever, soreness, and colic, and followed by disturbance of the bowels and perhaps obstruction. Infection of the sac may occur from the adjacent bowel and cause the formation of pus, the occurrence of fever, chills, and general prostration. Twisting of the pedicle may take place, especially in cases where it is long and the tumor unusually movable. If the twisting is sufficient so as seriously to interfere with the venous circulation, there is likely to be excruciating pain with more or less of shock and collapse, the latter due not only to the pain but also to the hæmorrhage which occurs in these cases into the cavity of the cyst. The pain may be so severe and the loss of blood so great, that the patient succumbs in a very short time. In the severest cases, the circulation may be entirely arrested, leading to gangrene of the cyst wall, with its attendant evils. The vitality of the cyst wall may, in such a case, be sustained by the formation of numerous adhesions to the adjacent structures. Again, interference of the circulation may be only such as to give rise to recurring attacks of inflammation of the sac, with severe pain, pronounced fever, and great abdominal tenderness.

Rupture of the Cyst.—This occasionally occurs as the result of injury or violent muscular exertion in cases where the cyst wall is thin and fragile. If the contents of the cyst be aseptic, which is usually the case, there may be a sudden severe pain with rapid disappearance of the hard cyst wall, followed by one or two days of excessive polyuria. Following the rupture the rent is closed by adhesions to the abdominal wall, adjacent viscera, or by plastic exudate, and then in a few weeks or months the cyst again fills and becomes as large and tense as before. With the cyst contents septic, a violent peritonitis becomes established following rupture, leading, under ordinary conditions, to an early death. If the cyst contain papillomatous products these will not only be disseminated upon the peritoneum, but will also form innumer-

able adhesions and new papillomatous growths situated at various points within the abdomen.

TREATMENT.—The method by tapping which was so much practised twenty years ago has given way almost entirely to the more rational and scientific treatment of removal. When knowing, as we do, that these tumors are always pro-

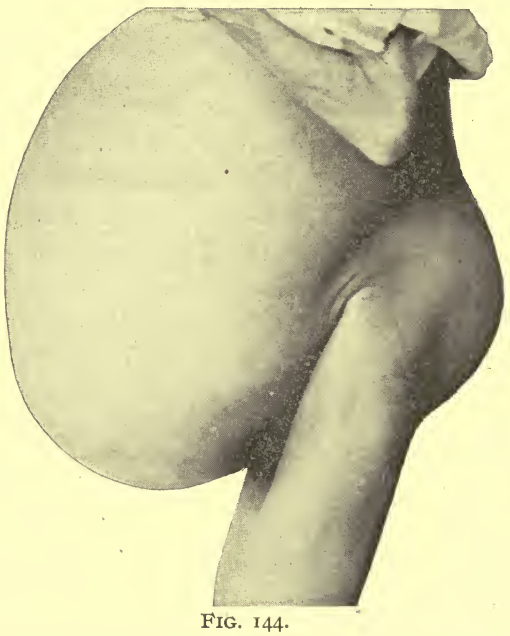


FIG. 144.

Mrs. M., age sixty-eight. Operated September 15, 1900, at St. Joseph's Hospital. Recovery. Weight of patient before operation 208 pounds. Weight of patient after operation 83 pounds. Weight of tumor 125 pounds. Abdominal girt, 58 inches, from ensiform to pubis 40 inches.

gressive, constantly increasing in size, associated in their growth by serious complications, reaching dimensions which in a few months, or, at most, years, are incompatible with health and necessarily leading to serious and even alarming conditions, they should unhesitatingly be removed as soon as discovered unless there are serious contra-indications to this treatment. Age, disturbances of circulation and respiration,

valvular heart disease and chronic nephritis are not contra-indications for operation. Great weakness, exhaustion and severe intercurrent complications might cause one to hesitate, especially if the patient is very much advanced in years. Disturbances of the circulation and respiration, albumen in the urine with casts, œdema of the lower extremities, inability to take food, mental disturbances and loss of sleep are likely to

FIG. 145.

disappear as if by magic during the first few days after the removal of a large ovarian tumor. The classical ovarian tumor of such enormous size as to fill and greatly distend the abdomen producing serious pressure upon the diaphragm and outward pressure upon the lower ribs with great emaciation and facies ovariana, is seldom encountered at the present time. The removal of a small ovarian tumor which is free

from complications is one of the easiest operations in surgery. It is also one which should have almost no mortality. (Figs. 144 and 145 show an enormous ovarian cyst which was successfully removed by Dr. Thos. Fitzgibbon, of Milwaukee).

FIG. 146.

Multilocular ovarian cyst removed from young married woman aged eighteen. Had noticed growth, which at time of operation filled pelvis and lower abdomen, for one year.

A short incision, not more than two or three inches long, is made in the linea alba midway between the symphysis and

umbilicus. The great distention of the abdomen, with the thinning of the abdominal walls and the separation of the recti muscles, makes it necessary for the beginner to be cautious lest he open the abdomen unexpectedly. It is also necessary for one to be on his guard not to wound the bladder, which possibly may be drawn high into the abdomen, or an adjacent coil of intestine which may be adherent near the median line. In large ovarian tumors there is usually more or less ascites which escapes as soon as the peritoneum is opened. The cyst then presents itself as a tense, glistening, pearly-white or grayish membrane. (Fig. 146.) Two fingers may be passed into the wound and swept around the presenting portion of the cyst in order to determine the presence or absence of adhesions. If one is doubtful in regard to the aseptic condition of the cyst contents every precaution should be taken to avoid infecting the peritoneal cavity. For this purpose the abdominal wall may be lifted and iodoform gauze snugly packed about the site of the proposed puncture. For the purpose of withdrawing the fluid the writer is in the habit of using a long curved trocar without hose attachment and having a diameter of about one-quarter of an inch. This trocar allows almost no fluid to escape by its side. The fluid as it escapes is caught in a dish or pail. In making the puncture one should avoid wounding any vessels of size which may be situated in the cyst wall. As soon as the fluid commences to flow the cyst should be seized with a tenaculum or forceps and the abdomen supported and compressed upon each side by the hands of an assistant. As the sac gradually empties itself it may e dragged out of the wound by means of heavy, flat-jawed cyst forceps. In multilocular cysts while the largest cyst is often in front, others of considerable size may lie to the side of or behind this and require puncturing and the withdrawal of the fluid before the cyst can be entirely delivered. If the trocar is witbdrawn for the purpose of puncturing secondary cysts the trocar opening should be quickly closed with heavy forceps. In a great many cases portions

of the tumor impart a sensation to the touch of great hardness and these are readily mistaken for fibroids. They are, however, usually conglomerate cysts with reasonably thick walls which are under great tension. In consequence of the small size of the individual cysts, and the considerable size of the mass the wound has often to be enlarged that the hard portion may be delivered. The pedicle is then tied in sections with silk and the tumor removed. The other ovary should always be examined, as in a considerable number of cases both are implicated. If this is also found to be affected the cysts should be removed and then the wound closed.

CYSTS OF CONGENITAL ORIGIN—DERMOIDS.

Dermoids are innocent, slow-growing cystic tumors which take their origin from embyronal inclusions of either the epi- or hypoblast. Coming from the epiblast they have the characteristic structure of the skin, but are found where this tissue does not normally exist. The cyst wall is made up externally of connective tissue and has a lining of stratified epithelium supported by papillæ, corium, subcutaneous tissue and fat. Within this structure are to be found sebaceous glands, sweat glands, and hair bulbs; in fact all of the structures which are normally found within the skin. The cyst wall is often quite thick and resistant and may contain a considerable quantity of calcareous matter. If the dermoid is due to inclusions of portions of the hypoblast the cyst wall will correspond in structure to a mucous membrane. The teeth as they occur within the mouth are the product of a stratified epithelium and a submucous connective tissue, while those which occur in dermoids are the product of a stratified epithelium and a subcutaneous connective tissue, Many embryologists consider the teeth but outgrowths of specialized papillæ similar to those of the skin.

Dermoid tumors may be unilocular or multilocular. A single cyst only of a multilocular growth may have the char-

acteristic lining of a dermoid, or only a portion of the cyst may be so lined, while in others the entire lining membrane comes either from the epi-or hypoblast. Dermoid tumors, if multilocular, are often bossed, the surface being irregular and presenting only a semi-fluctuant sensation. If unilocular they are smooth, often quite tense, and may also present a semi-fluctuant feel. They also often present a doughy sensation upon pressure or palpation.

These tumors are very variable in size, depending largely upon their location and immediate cause. Some are not larger than a pea or hazel-nut, while others attain the size of an adult head or are even much larger. The contents of these cysts at the temperature of the body is usually fluid, but if the sac be removed and the temperature allowed to fall the contents often become semi-solid and even solid in consequence of the large amount of fluid fatty material, which the sac contains, undergoing solidification. Upon the interior of the cyst wall may be found cysts coming from either the sebaceous or sudoriferous glands. The semi-fluid contents is made up largely of sebaceous material containing quantities of epithelial cells, cholesterine, fatty material, hairs and detritus. A higher type of glandular structure than the sebaceous or sweat glands occasionally occurs in the ovarian dermoids in the form of mammæ, with or without nipples. The nipples often contain ducts and the mammæ glandular tissue. These glands may secrete colostrum.

Histogenesis.—There seems to be some considerable confusion regarding the formation and growth of dermoid tumors, many writers making no clear distinction between these and the teratomata. It is pretty generally held that the dermoid is due to some disturbance of embryonic development in consequence of which some portion of the skin or mucous membrane or a nest of embryonal cells, becomes included within the mesoblast along one of the natural fissures of the embryo. Dermoids may be divided into four genera: Implantation

dermoids, Sequestration dermoids, Tubulo dermoids, and Ovarian dermoids.

Implantation Dermoids.—These tumors do not correspond to the definition given of a dermoid in that they are not congenital growths but are the result of a traumatism in consequence of which some portion of the skin is detached and carried into the subcutaneous tissue, where it retains its vitality, takes on growth, and produces a cyst lined with characteristic structures in which are all the constituents of the skin, including hairs, sebaceous cysts and sweat glands. In the contents of these cysts there are to be found hairs, epithelial cells, and sebaceous material. These cysts usually occur upon such portions of the body as are the most frequent sites of traumatisms, such as lacerations, punctures and incisions of the skin. This is usually upon the palmar surface of the fingers and hands. The persons who most frequently suffer from this condition are needle-women, carpenters, shoemakers and butchers. Implantation dermoids also occur subcutaneously in such animals as sheep, cattle and horses, and with especial frequency in animals which are driven with, or urged on by, prods or long sticks having nails in the ends. In the lower animals, dermoids, whether they be implantation growths or not, represent in their contents the natural outgrowth of the animal's skin. In hogs, dermoids contain bristles; in birds, feathers; in sheep, wool, and in horses and cattle, short hairs.

The implantation dermoids upon the fingers or hands of laboring people are of slow growth, seldom reaching any considerable size, being ordinarily not larger than a pea or hazelnut. They are round, somewhat elastic, soft tumors which are situated in the subcutaneous tissue and consequently have no connection with the skin. It may perhaps be necessary to differentiate them from ganglia, which are in direct connection with tendon sheaths and are affected in their position and made more tense by the contraction of the corresponding muscles. The ganglia are also more tense on palpation and

show greater elasticity and sense of fluctuation than do the small implantation cysts. In the case of a ganglion there is as well a condition of weakness and even pain in the tendon implicated, which is also characteristic. Implantation dermoids may also be found upon other portions of the body and perhaps with especial frequency upon the scalp. In this situation they have reached a greater size. If these implantation dermoids, in consequence of their position, are easily injured or give rise to irritation, unsightliness, or pressure symptoms, they may be removed by incision and enucleation.

Implantation Cysts of the Cornea and Iris.—Ophthalmologists have described with considerable detail these cysts as they exist both upon the iris and within the cornea. They are caused by injuries like those which produce implantation cysts upon the hands. An incision or laceration of the cornea may carry some portion of its epithelial covering into the deeper structures and implant them upon the iris or within the corneal tissue where they take on active growth and produce implantation cysts, or implantation dermoids. Those situated upon the iris are usually in the form of transparent vesicles and are found upon its anterior surface. In some cases the contents of the cyst is made up of sebaceous material and is then opaque. Mr. Hulke reports nineteen cases, fifteen of which were the result of mechanical injury.

Implantation cysts in the cornea may be single or multiple. They have been the sequence not unfrequently of operations for cataract or the result of accidental injuries in consequence of which some of the epithelial cells covering the cornea have been carried into the deeper tissues where they have taken on growth and produced cysts usually of small size.

Epidermoid or Atheromatous Cysts.—These are usually small growths situated beneath the skin and caused by the detachment of epithelial cells lining the cutaneous surface, which being carried into the subcutaneous structures, take on growth and produce a cyst or cysts. These cysts may

present a stratified arrangement internally, while outside of this epithelial lining is the connective tissue capsule. They differ from the ordinary dermoids in that the cyst wall does not contain all the structures of the skin. It has no hair follicles and consequently the cyst does not contain hair. It does not contain either sebaceous or sudoriferous glands, consequently the cyst is not filled with sebaceous material. The contents is made up largely of degenerated epithelial cells. These small cysts are frequently situated upon the scalp and have been mistaken for sebaceous cysts, but they are easily distinguished from them in consequence of their being situated beneath and not in direct connection with the skin, and also in consequence of their presenting no opening upon the cutaneous surface, as is the case with sebaceous cysts. They may be single, but are often multiple. If causing disturbance they may be readily enucleated following incision.

Sequestration Dermoids.—In embryonic development the lateral halves of the body coalesce along a median line which extends from the base of the skull down the back through the perineum and genital organs up the abdomen, thorax, and neck to the chin. Along any portion of this line of coalescence the cellular elements making up the skin may become sequestered in the deeper tissues and take on growth, producing a dermoid which will be of congenital origin. It is quite true that many of these growths at the time of birth may not be tangible or apparent, but the tissues from which they subsequently grew were implanted or sequestered during embryonic development. Dermoids along this line are of less frequent occurrence upon the posterior aspect of the body, barring the region of the sacrum and coccyx, than they are upon or within the anterior region. Above the region of the sacrum they seldom reach any very considerable size. When occurring along the region of the spine these growths, in consequence of their cystic character, their congenital origin, and their situation in the median line are extremely likely to

be mistaken for cases of spina-bifida, with which they may even be associated.

During the past two years two cases of sequestration dermoids, one in the cervical and the other in the upper dorsal region, have been operated on in the writer's clinic at St. Joseph's Hospital. In each case the growth was present at birth, was of small size, situated in the median line beneath the skin, presented distinct fluctuation and had no connection with the membrane of the spinal cord. After removal the microscopical examination of the cyst walls showed them to be lined with tissue which corresponded in structure to that of the skin. In cases of dermoids in this situation the differentiation from spina-bifida where the neck of the sac, as occasionally occurs, has been obliterated, would be difficult or impossible without an operation and a microscopical examination of the sac wall. This differentiation would not be material as the treatment would be practically the same. Spina-bifida, however, in direct communication with the membranes of the cord and with the cerebro-spinal fluid, whether it be a meningocele, a meningo-myelocele, or a syringo-myelocele, will present distinctive symptoms either of translucency, increased tension upon straining or crying, cerebral pressure symptoms upon compression, absence of skin covering or other congenital defects which will render the diagnosis ordinarily easy. The spina-bifida is also likely to be much larger than a dermoid in this situation. Dermoids along this line when causing disturbance may be readily removed by incision and enucleation.

Dermoids in the Sacro-coccygeal Region.—Dermoids occur much more frequently here and are much larger than upon any other portion of the back. In the embryological construction of the anus and rectum the epiblast is invaginated for one inch or one and one-half inches to form the anus, while the rectum comes down from above and is an outgrowth of the hypoblast. The ingrowth of the epiblast and down growth of the hypoblast do not, however, make an accurate

junction. The epiblastic tube comes in contact with the hypoblastic upon its anterior surface at some little distance above its lower extremity. In their coalescence there remains a blind portion of the hypoblast which has no function and which ordinarily undergoes degeneration and absorption. (Fig, 147.) Some of the sequestered epithelial cells, however, may remain dormant within the tissues and be the cause of a subsequently appearing dermoid growth. Occasionally at the time of birth these growths have been very large weighing as

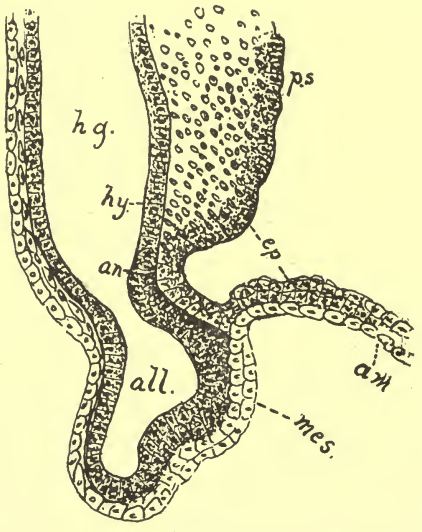


FIG. 147.

hg. Hind gut. an. Anal membrane. ep. Epiblast.
hy. Hypoblast. am. Ammion. mes. Mesoblast.
all. Allantois-rudimen. p. s. Primitive streak.

much as six or eight pounds and have caused serious difficulty in delivery. Infants with these large growths seldom live more than a few days and are often still born.

Dermoids are encountered in the sacro-coccygeal region as the result of the sequestration or snarring off of portions of the skin. Dermoids also occur in this region within the rectum as polypoid growths, due to inclusions of portions of the mu-

cous membrane, in which case they will be lined by tissue corresponding to the mucosa, containing mucous glands and likely filled with a mucilaginous fluid. The polypoid growth may be snared off or removed after ligation of the pedicle. The small growths due to the inclusions of the skin may be enucleated. The large sacral dermoid has been but seldom successfully removed.

Dermoids of the Scrotum.—These occasionally occur in the raphe as the result of inclusions or sequestrations of portions of the skin. They seldom reach any pronounced size and have the characteristics of subcutaneous dermoids situated elsewhere. Bland Sutton thinks that many of the dermoids which have ordinarily been thought to take origin from the testicle, really have their origin in the scrotum. Sequestration dermoids also occur in the penis, but they are extremely rare.

Dermoids of the Abdomen.—Dermoids have not unfrequently been observed within the abdominal cavity exclusive of the ovary. They have been found upon the peritoneum, within the mesentery or omentum, and associated with the spleen or kidneys. In these situations they may possibly be explained by inclusions of skin or by inclusions of embryonal dermal cells.

Dermoids of the Thorax.—These may occur as small, well circumscribed, movable cysts, situated beneath the skin and over the sternum. They seldom reach any considerable size and are comparatively rare. Dermoids due to inclusions of portions of the skin may be situated within the thorax, being behind the sternum in the anterior mediastinum, or be connected with the pleural cavity or possibly an open bronchus. It occasionally has happened in these cases that the sebaceous material and hairs contained within the cysts have been coughed up by the patient, rendering a diagnosis easy. In either case they may produce serious pressure upon the corresponding lung. They have also been found in connection with the pericardium and producing pressure upon the heart.

DIAGNOSIS.—Growths situated in the median line over the sternum, disconnected with the skin, of congenital origin, or occurring soon after birth and having a pseudo-fluctuant or doughy feel, may reasonably be suspected of being dermoids. If causing disturbance they may be readily enucleated. Dermoids situated within the thorax, unless they communicate with a bronchus and the characteristic contents is expectorated, will be impossible ordinarily of diagnosis from other intra-thoracic growths, such as sarcomata or echinococcus cysts. If the diagnosis is possible and they are situated in the anterior mediastinum or in connection with the pleural cavity and causing severe pressure symptoms, they may possibly be removed or incised, following excision of one or more ribs or a portion of the sternum.

Dermoids of the Scalp and Dura.—These growths occur over the fontanelles and especially over the anterior fontanelle, and at or near the occipital protuberance. It has occasionally been observed that these growths, by means of a slender pedicle, are connected with the dura through an opening in the overlying bone. They are usually small, but in some instances they have reached the size of a large orange or even that of a cocoanut. They are to be differentiated from sebaceous cysts and from meningoceles. The fact that they are not directly connected with the skin and are not possessed of an opening by the side of a hair, as are sebaceous cysts, is sufficient to differentiate them from the former. Meningoceles whose cavities are closed sacs, will be difficult of differentiation. Meningoceles which are in direct connection with the cerebro-spinal fluid, will show increased tension on coughing or straining, symptoms of cerebral compression on attempts to reduce the tumor and often translucency or skin defects. In the removal of these growths one should remember their possible connection with the dura.

Dermoids of the Face and Neck.—In the development of the face during embryonic life, the large cavity which represents the mouth, has connected with it five fissures. (Fig. 148.)

The upper pair are known as the orbito-nasal and project outwards to and include the region of the eye. The two lower are known as the mandibular fissures and project outwards through the cheek towards the ear. The fifth is the inter-mandibular fissure and projects downwards at the symphysis between the still separated portions of the lower jaw. In the construction of the face and the closure of these fissures, portions of the skin occasionally become implanted or sequestered in the sub-

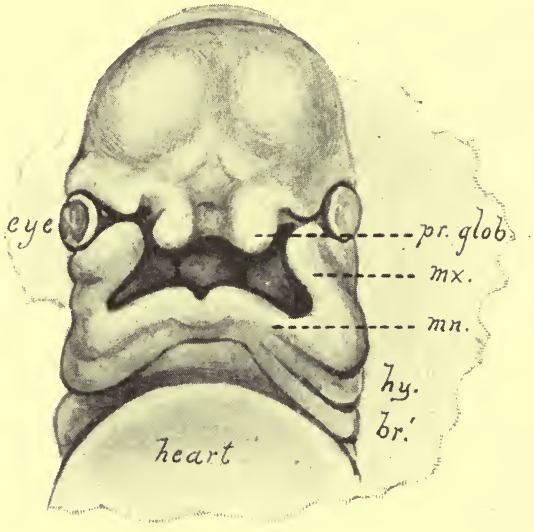


FIG. 148.

Head of embryo more advanced. (After His.)

pr. glob. Globular extremity of the mesial nasal process.
mx. Maxillary process.
mn. Mandibular arch.
hy. Hyoidean arch.
br'. First branchial arch.

cutaneous tissue, where they take on active growth and produce cysts dermoid in character. These cysts may be situated at the root of the nose, at the inner or outer angle of the eye, along the center line of the cheeks or at the median line of the lower lip. They present in these situations the charac-

teristics of ordinary subcutaneous dermoid growths, being of congenital origin but occasionally of post-natal appearance. They are of slow growth, painless, subcutaneous, slightly movable tumors which fluctuate, are globular, and seldom reach any very considerable size. If causing disfigurement or producing serious pressure upon adjacent structures, they may be enucleated.

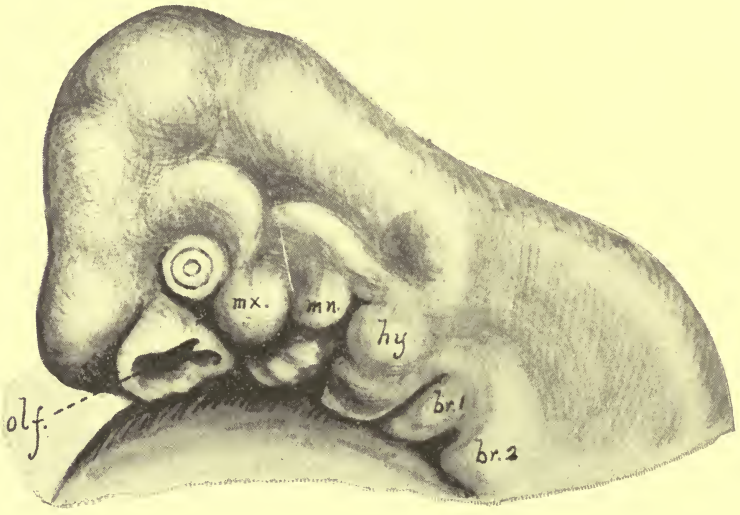


FIG. 149.
Human embryo about four weeks. (After His.)
olf. Olfactory depression. mx. Maxillary process.
mn. Mandibular arch. hy. Hyoidean arch.
br.1, br.2. First and second branchial arches.

Branchial Clefts.—In the formation of the pharynx there occur five arches and four clefts, known ordinarily as branchial arches and branchial clefts. The first arch is the mandibular, which produces the lower jaw. The second is the hyoid, from which the hyoid bone is formed. The third is the thyro-hyoid, which is known as the first branchial arch, and below this there are two others known as the second and third branchial arches. Between the five arches there are four cephalic visceral or branchial clefts. (Fig. 149.) Ac-

cording to His, the lower clefts do not ordinarily in man present absolute fissures, in that the epithelium of the hypo- and epi-blast extends from arch to arch. In any of these branchial clefts portions of the epiblast may, during the closure, become sequestered and lie dormant for a time in the subcutaneous tissues and then take on active growth and produce a dermoid cyst. Branchial dermoids of the neck are not of frequent occurrence. They are situated ordinarily upon the side of the neck, above or below the hyoid bone, and usually beneath the deep cervical fascia. They present ordinarily the characteristics of deep-seated cysts, and in this situation occasionally reach considerable size. They are not unfrequently in close relation with the deep cervical vessels. Occasionally, instead of taking origin from cutaneous structures, they are the result of inclusions of portions of the mucous membrane lining the pharynx, in which case they may project into the pharynx or beneath the skin and will have a lining characteristic of the mucosa enclosing mucous glands and a contents made up of exfoliated epithelial cells and the secretion of the mucous glands. These growths, if causing unsightliness or reaching any considerable size, may be exposed by incision and then enucleated, care being taken to avoid injury to important structures situated deeply within the tissues of the neck, with which they may be intimately associated.

Tubulo-Dermoids.—The dermoids of this genus take their origin from the thyro-glossal duct. In the embryo this duct is found extending from each lateral lobe of the thyroid gland up the anterior portion of the neck to the dorsum of the tongue, where it terminates. The mouth of the duct is to be found in the median line, a short distance anterior to the posterior border of the tongue. With the development of the hyoid bone the duct at this point often becomes obliterated, leaving a lingual portion above and a thyroid portion below. In the ordinary course of events coincident with the development of the fœtus the duct, which is made up largely of a

strand of epithelial cells, looses its lumen and then disappears by degeneration and absorption. The upper portion within the tongue remains for a considerable period as a short, small opening or canal known as the foramen cæcum. This opening may be of sufficient size to admit a small probe. It occasionally happens that the duct, even from the dorsum of the tongue to the lateral lobes of the thyroid, remains open as a patulous canal. If this is the case, or if the portions of the

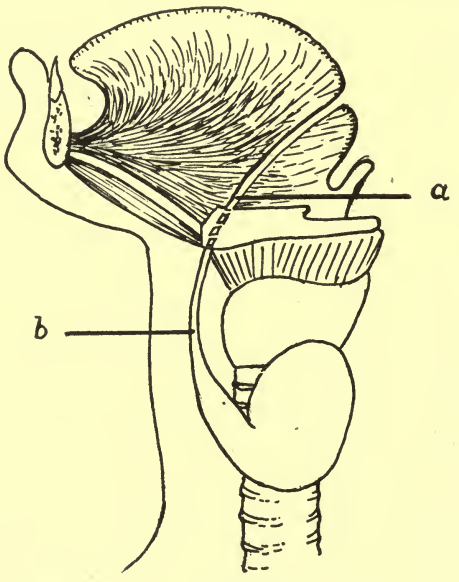


FIG. 150.
Thyro-glossal Duct.
a. Lingual portion. b. Thyroid portion,

epithelium making up the tube do not disappear by degeneration and absorption, then, and in that case, the tube or epithelial cells may be the site of the formation of dermoids. (Fig. 150.) These may be situated in one of three positions: in the tongue, near the hyoid bone, or over the thyroid cartilage. In the first instance they occur in that portion of the tube which passes through the tongue. They are situated in the median line and may project from the base of the tongue

upwards into the mouth as sessile or more or less pedunculated growths, or downwards beneath the tongue, elevating it and pressing it towards the roof of the mouth. In some of these cases the tumor is said to have reached the size of a cocoanut, projecting from the mouth as a large growth and deforming the jaws and teeth. In these cases deglutition has been impossible except for liquids, respiration was greatly interfered with, and speech held practically in abeyance. Dermoids in this situation are soft, cystic, semi-fluctuant, painless, slowly-growing tumors which are most troublesome, but which produce disturbance only by pressure. They frequently are mistaken for sebaceous cysts in consequence of their being lined by a stratified epithelium and filled with sebaceous material. They frequently are of congenital origin, although not in appearance, being first observed perhaps during childhood or at adult age.

TREATMENT.—They may ordinarily be enucleated without great difficulty after an incision which is carried around the base. When situated at or below the base of the tongue they distend and elevate the floor of the mouth, in which case they have frequently been mistaken for ranula, or they project downwards beneath the jaws to the region of the hyoid bone. Dermoids in this situation, taking origin from the lingual duct, are also often connected with one or more of the branchial or cephalic clefts. The latter growths are situated either in the median line between the genio-hyo-glossi muscles or between the mylo-hyoid and genio-hyo-glossus muscle. It may be difficult in some instances to differentiate cysts connected with or taking origin from the lingual duct from those which take their origin from inclusions in cephalic or branchial clefts. As a rule those connected with the lingual duct will be situated exactly in the median line, while those connected with the branchial or cephalic clefts will be situated to one side. It is the writer's observation that the former are of more frequent occurrence than the latter, several cases having come under his observation. If causing disturbance or producing deform-

ity an incision may be made down to the capsule through the floor of the mouth, if the growth project strongly there, or from the chin to the hyoid if the projection is in this situation, when the growth is reached it ordinarily is readily enucleated. Dermoids of the thyroid duct may be situated anywhere between the isthmus of the thyroid and the hyoid bone. They are usually placed in the middle line and beneath the deep cervical fascia and the sterno-hyoid muscles. They are deeply seated, painless, cystic, slowly-growing, congenital tumors, which, as they increase in size, project upwards and may pass behind the hyoid bone at the thyro-hyoid membrane into the pharynx. If of any considerable size their pressure upon the trachea or larynx is likely to produce something of hoarseness, difficulty of respiration, or even a harassing cough. They are likely to be mistaken for cysts of the thyroid gland, but may be differentiated by the fact that they are above and not within the gland. The writer, during the past few years, has removed several dermoid cysts from the thyro-glossal duct, which had reached the size of a hen's egg or even larger. They are ordinarily easily enucleated by blunt dissection.

Dermoids of the Ovary.—The ovarian dermoid is of much less frequent occurrence than the ovarian cyst, the proportion being about 1 to 14. They are most often met with at or about puberty, although they may occur in childhood or in old age. The growth while most frequently unilocular may be multilocular. In multilocular growths but a single cyst may show the characteristic lining and possess a contents which would indicate its dermoid nature. The cyst wall in some cases is thin, friable, and almost translucent, while in others it is thick, tough, and resistant. The cyst wall that presents to the abdomen has a peritoneal covering and the grayish-white appearance of the ordinary ovarian tumor. Within this is a fibrous layer and then comes the lining peculiar to dermoids, namely, skin or mucous membrane. The contents is like that of dermoids elsewhere, sebaceous ma-

terial from the sebaceous glands, water from the sweat glands, hair from the hair bulbs, and teeth which are also outgrowths from the epiblast. In the ovarian dermoid are also to be found structures representing the highest type of gland found in dermoid growths, namely mammæ, nipples and milk ducts. The mammæ may contain glandular tissue and secrete colostrum. The nipples may be attached to the mammæ or not. They also have frequently contained ducts. Mammary glands have been found only in ovarian dermoids. Their occurrence should not be a matter of great surprise because they come from the epiblast and are only modified and specialized sebaceous integumentary glands. In size the ovarian dermoid may vary from a small cyst embedded and scarcely observable within the ovary to one which fills and greatly distends the abdomen. They seldom, however, are much larger than the adult head. Dermoids of the ovary are liable to the same accidents which befall the ordinary ovarian cyst, such as rupture, torsion of pedicle, adhesion to adjacent structures, infection and gangrene. Ovarian dermoids seem peculiarly liable to cause attacks of localized peritonitis which are often severe and are followed by numerous adhesions to adjacent viscera. They frequently produce pressure upon the bladder resulting in frequent micturition and even tenesmus. If reaching considerable size they may compress the ureters leading to hydroureter or even inflammation in the pelvis of the kidney following infection. They have been known to cause a perforation into the bladder or intestine with all of the evil effects incident thereto. In cases in which infection has occurred chills, fever, and pain place the patient in great danger unless relief is obtained by surgical interference. (Fig. 151.)

ÆTIOLOGY.—Ovarian dermoids are caused by embryonal inclusions of portions of the epiblast within the ovarian tissue.

DIAGNOSIS.—This ordinarily will be difficult in so far as differentiating them from the ordinary ovarian cyst is concerned. The following conditions are somewhat character-

istic: They are most frequently unilocular, situated at one side of the uterus, often occur in young women, are not so distinctly fluctuant or of so rapid a growth as the ordinary ovarian cyst, but more likely to cause attacks of localized peritonitis. Kastner says that an important sign is that they often or usually float in front of the uterus and that they lie directly beneath the abdominal wall. In consequence of their frequent connection by adhesions to adjacent viscera they are less movable than the ordinary ovarian cyst.

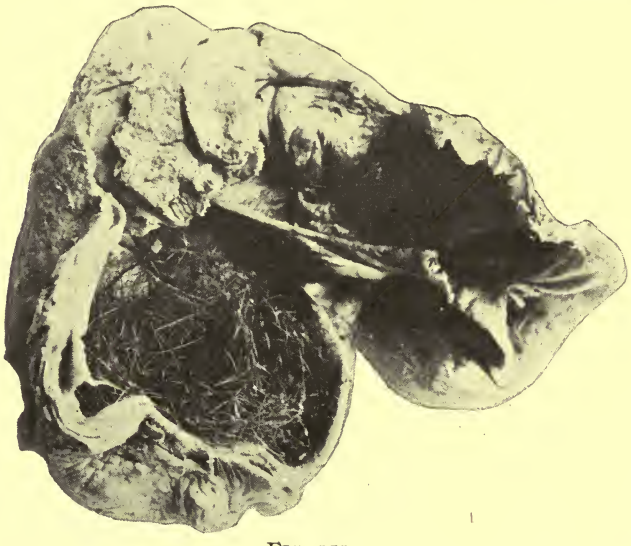


FIG. 151.
Multilocular Ovarian Dermoid.

TREATMENT.—Dermoids of the ovary, if allowed to go without surgical intervention, will eventually destroy the life of the individual. The treatment therefore should be early removal. By this means may the accidents already enumerated be avoided, but what also is of very great importance, malignant infection, sarcomatous or carcinomatous, will not occur. It is well known that occasionally all tumors, including dermoids, are the seat of this lamentable complication. Serious complications may also arise during preg-

nancy or delivery. Some few years ago I was asked to see a woman who had been delivered a week previously and who was suffering intensely from septicæmia. It was learned that at the time of her confinement the physician discovered a tense but fluctuating tumor filling the pelvis and blocking the progress of the child. After a consultation the sac was punctured through Douglas' pouch causing it to partially collapse when the child was delivered. The cyst proved to be a dermoid and became infected probably at the time of the puncture or immediately subsequent thereto, with the result that the cyst suppurated and an enormous collection of pus was formed in the pelvis extending up the right side which fortunately for the patient was walled off by omentum from the general peritoneal cavity. This immense collection of pus was drained off through the pelvis above the pubes and in the right lumbar region. After several weeks of energetic treatment we were enabled to open the abdomen in the median line and shell out the dermoid without opening the peritoneal cavity as shut off by the omentum and the adhesions. The patient made a slow but perfect recovery. (While writing this article I encountered during an operation for appendicitis a dermoid of the right ovary as large as a man's fist. It was filled with sebaceous matter and hair.)

Dermoids of the ovary should then be removed at the earliest possible moment in order to avoid the many distressing accidents which may attend their growth. The technic of their removal does not differ from that of the ordinary ovarian cyst.

Dermoids are also found in the eyelids, brain, bowels, mesentery, peritoneum, testicle, kidneys, mammary and parotid glands.

TERATOMATA.

If the position of the dermoid is somewhat unsettled, in the classification of tumors, that of the teratoid growth is still more uncertain. Some writers classify dermoids under the

head of and as a species of, the teratomata. Hektoen says that the teratomata bridge the gap between true tumors and malformations. Some writers group under the head of teratomata, all malformations and monsters. In our definition of dermoids we confined them to growths which were due to inclusions of either portions of the skin or of a mucous membrane, to growths which were lined by either the one or the other of these two structures and whose contents were never more than the products of these structures. The teratomata are something more than this. They represent not only growths from the skin and mucous membrane, epi- and hypoblast, but growths which include the mesoblast as well. In a teratoma one finds, or may find, bone, cartilage, muscle nerves, ganglionic nerve cells, portions of viscera such as kidney, supra-renal capsule, lung and intestine.

A teratoma may be defined as a tumor coming from two, possibly three, of the germ layers and always including mesoblastic tissue. It is not held ordinarily by writers on teratology and pathology that these growths which include viscera or mesoblastic tissue come from inclusions of tissues of two or more of the germ layers, but rather that they are suppressed or undeveloped fœtuses, that instead of coming from the germ layers they come from the ovum or an embryo. Some writers hold that they are the result of some stimulus applied to the ovum in consequence of which it attempts reproduction in a vicarious manner and without fecundation. Bland Sutton says that a teratoma is a suppressed fœtus attached to an otherwise normal individual. Wilms, who has studied this subject carefully, holds that these tumors are the result of an atypical outgrowth of the three layers of the embryo. The subject may be better understood perhaps by studying the formation of twins. A single ovum may possess two or more germinal centers and give rise to two or more embryos. If there are two embryos from an ovum and they are separated, twins are the result, which are always of the same sex. If the embryos are united at some point, conjoined twins are

the result. If one of the embryos going to form conjoined twins is imperfectly nourished it will be imperfectly developed, perhaps represented by a mass of tissue, a tumor attached as a parasite to the healthy fœtus, and will be made up of skin with ill-formed bones and viscera. It will represent then a teratoma. In other cases a teratoma may be the result of excessive or improper cleavage. These tumors

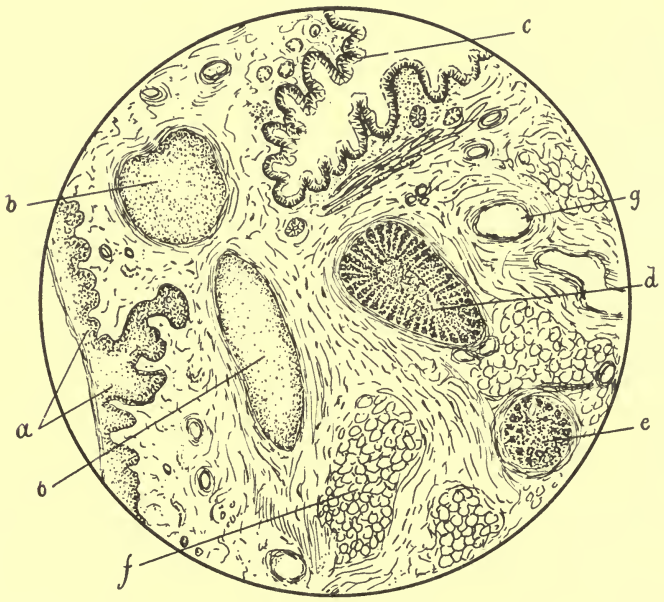


FIG. 152.

a. Epidermal growth. b. Cartilage
c. Intestinal mucous membrane. d. Adrenal body.
e. Kidney. f. Fat.
g. Blood vessel.

are often converted into cysts by the processes of degeneration and absorption. It seems that there should be an effort made to separate tumors, that is teratomata, from malformations and monsters which do not represent what is ordinarily considered a tumor. In so far as surgery is concerned, the subject is only of interest when well-defined tumors are formed. A teratoma growing as a distinct tumor, which may be amena-

ble to surgical interference, is found most frequently connected with the glands of generation, and especially with the ovaries Here they may present tumors which cannot perhaps, macroscopically, be differentiated from dermoids. Kockel believes that the teratomata of the testicle are the result of partial unilateral hermaphroditism, the ovarian portion of the testicle being the site of origin of the growth. Teratomata also occur and thoracic in the sacro-coccygeal region, neck, orbit and in the abdominal cavities. The growth represented in Fig. 152 was removed from the peritoneum. A teratoma in the peritoneal cavity might be the result of the transmigration of an ovum. A very large teratoma situated in the sacral region is not often amenable to surgical interference, both in consequence of its size and the feeble condition of the child. Especially is this the case when they occur in infants. When occurring elsewhere and in adults they will be subject to the same surgical rules and require the same technic in their removal which appertains to the removal of other benign gorwths in the same locality.

CYSTS OF PARASITIC ORIGIN.

There occurs in man two forms or genera of cysts due to the growth of parasites. One of these is the *cysticercus cellulosæ* and the other the *tænia echinococcus*, or hytatid cyst. The cysticercus is comparatively rare and is the larval form of the tænia solium, or tapeworm. This tænia is frequently found in the intestinal canal of man. The full-grown tænia solium measures ordinarily from six to twelve feet in length and is made up of a head, or scolex, and segments, or proglottides. The head is roundish, the size of a pin head or slightly smaller and has four suckers and a beak, or rostellum, upon which there are two rows of hooklets numbering in all from twenty-six to thirty-two. (Fig. 153.) The neck is extremely small being not much more than a line in size. The segments vary greatly in their dimensions. While those of the

neck are scarcely more than a line in width those segments which are mature have a breadth of about eight milimeters and a length varying from eight to twelve milimeters. In the mature worm there are from 600 to 900 segments. Maturity, however, is not reached until about the three hundred and fiftieth segment is attained. Each mature segment, or proglottidis, contains both male and female sexual organs and innumerable eggs or ova. After the tænia solium has

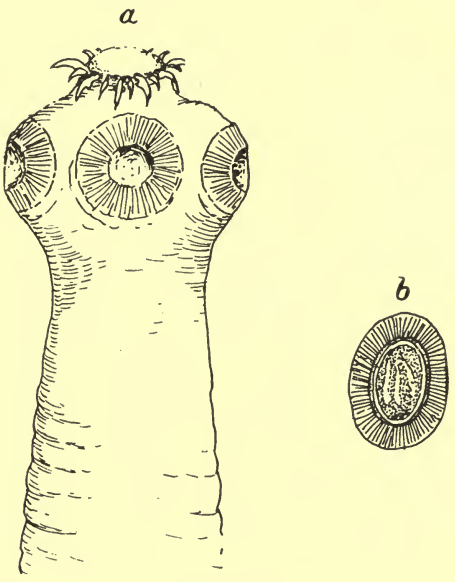


FIG. 153.
a. Head of Tænia Solium.
b. Ovum of Tænia Solium.

reached maturity the segments are broken off either singly or in chains and are discharged with the fæces. The ova which are contained in the segment are set free either by decomposition of the segment or in consequence of their finding their way into the stomach of the pig, sheep, dog, or man where they are digested liberating the contained ova. The individual ovum has a shell or capsule which is brownish in color, elastic, and quite tough. This shell is dissolved by the juices

of the stomach or intestinal canal setting free the embryo within. The embryo has six hooklets arranged in pairs and when freed from its covering is able to penetrate the stomach wall and gain an entrance to blood vessels or adjacent tissues or organs. When it finds itself favorably situated, which in man is frequently in the subcutaneous tissue between the muscular fibres, in the heart structure, in the brain or eye, it undergoes cystic development. The hooklets are thrown off and the embryo is converted into a small, transparent cyst which may have the diameter of a few millimeters or that of an inch or even more. These cysts may be single or multiple.

It is a peculiar fact that man may harbor both the full-grown tænia solium, or tapeworm, and the larval form known as the cysticercus cellulosæ.

In tracing the tænia solium through its various stages of development we find that the mature worm frequently occurs in the intestinal canal of man, that the segments which are shed and discharged with the fæcal matter most frequently gain an entrance into the stomach of the pig as their second host where the proglottidis, or segment, is dissolved, setting free the innumerable ova which it contains and also where the shells of the ova are digested setting free the embryos. These embryos with their hooklets penetrate the walls of the pig's stomach and most frequently find an abiding place in the muscular tissue between the individual muscular fibres of the shoulders, neck and anterior portion of the trunk. Here the embryos lose their hooklets and develop into cysticerci.

If we trace these embryos through a third host we find that they revert to the original condition of tapeworm. Upon the internal surface of each cysticercus or vesicle there develops in the course of a few weeks, a scolex, or head, which may be retracted within or protruded from the vesicle. This scolex has in immature form the rostellum, hooklets, suckers, and head of the mature worm. (Fig. 154.) If the pork containing these vesicles, or cysts, be eaten without proper cooking the vesicles containing the scolices, or immature heads, are

digested by the juices of the stomach or intestinal canal setting the embryos free. One of these embryos may attach itself either to the upper portion of the jejunum or duodenum and there produce a mature tapeworm.

What interests us here is the production and development of the parasitic cyst or cysts from the larval form to such a degree as to require surgical interference.

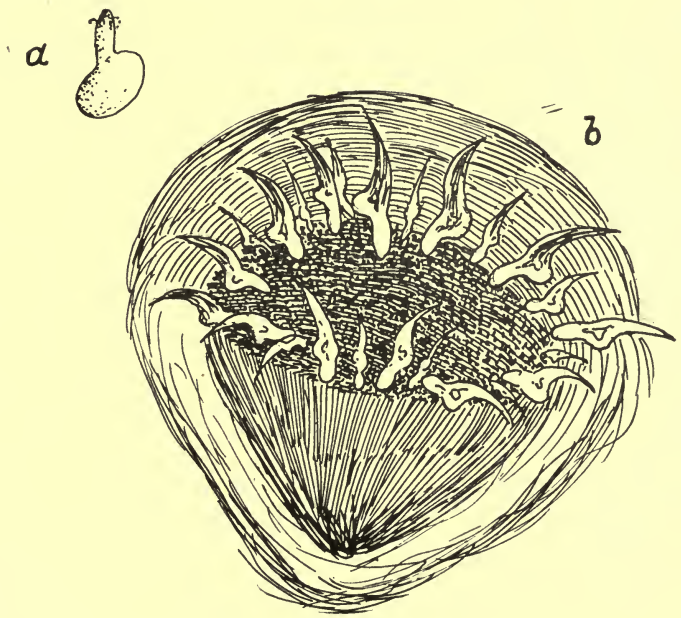


FIG. 154.

a. Cysticercus Cellulosæ.
b. Circle of hooklets of Scolex in Cysticercus Cellulosæ.

As has been already stated, man may harbor both the mature worm and the larval form, the latter being the second stage of development of the former and usually requires a second host for its production. This second host is usually the pig. In man it is thought that when he harbors a full-grown worm the segments when they are cast off may in consequence of their inherent power of motion propel themselves through the duodenum and reach the stomach, or that they

may reach the stomach in consequence of severe and protracted efforts at vomiting, or the ova may after having been discharged with the fæcal matter contaminate the food or water taken and thus gain an entrance into the stomach of man where the embryos are set free, and being provided with hooklets and power to penetrate the walls of the stomach they gain an entrance into the blood current or adjacent tissues or organs, where they produce the cysticercus cellulosæ, or parasitic cyst.

Frequency and Situation.—The cysticercus cellulosus is said to be comparatively frequent in North Germany, being found once in every seventy-six bodies examined. In the United States it is extremely rare. Certain tissues seem to have a predilection for the parasite. Among these may be mentioned the brain, eye, subcutaneous tissue and heart. In 155 cases compiled by Stiles the parasites were found 117 times in the brain, 32 times in the muscles, 9 times in the heart, 3 times in the lungs, 5 times beneath the skin, and twice in the liver.

The Parasite Situated Subcutaneously.—Subcutaneously they occur as small, round, more or less painful, nodular growths, varying in size from that of a pea to that of a walnut. They are in this situation quite movable, without special symptoms of inflammation and do not ordinarily occasion special disturbance. In some cases, however, and especially in a case described by Osler, the patient was very stiff in his muscles and joints, and was only able to move with effort, which movements were attended with such pain that the condition was primarily thought to be due to a neuritis.

The Parasite Situated in the Heart.—When situated in the heart they may produce symptoms of irregularity, functional disturbance, and perhaps valvular insufficiency.

The Parasite in the Eye.—Von Graefe was the first to demonstrate their presence in the eye. They are found here either in the aqueous or vitreous humors. They are most frequently found beneath the retina, half as often in the vitre-

ous humor and more rarely in the anterior chamber. They may be seen as clear vesicles possessing inherent motion in consequence of which they may readily be diagnosticated. When occurring in the eye they are likely to cause irritation, inflammation and even destruction of the eye and possibly sympathetic inflammation of the second eye. (Fig. 155.)

The Parasite Situated in the Brain.—They are frequently found within the brain and also in the spinal cord. In the brain they may have their situation within the membranes, upon the surface, or within the cortex or ganglia at the base. They are frequently situated within the meshes of the arachnoid and in the ventricles.

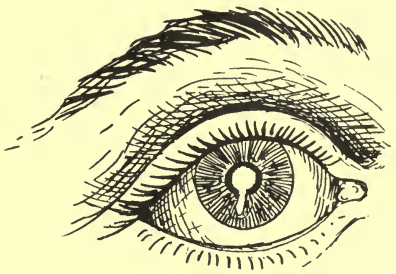


FIG. 155.
Cysticercus Cellulosæ of Eye.

In 88 cases reported by Kuchenmuster the muscles were implicated in 49, the brain cortex in 39, the ganglia at the base in 36, central substance in 19 and the ventricles in 18. A few cysts may occur in these situations or many thousand may be found. If situated in the silent regions of the brain they may cause few or no symptoms, but if occuring in the motor or sensory areas or within the ventricles they are likely to produce such symptoms as ordinarily occur from the growth of tumors in these positions. Headache, cramps, epileptic attacks, and optic neuritis are conditions resulting from the growth of these cysts upon or within the brain structure. With the increase of intracranial pressure due to these cysts comes irritation, inflammation, and softening of

the brain structures. Hirt reported four cases, in all of which the patients suffered from epileptic attacks, while between the seizures they showed more or less mental confusion. Each of the four patients suffered from headache and vertigo. Vomiting and optic neuritis are also common symptoms of brain tumors. Hydrocephalus is occasionally the result of the growth of a parasitic cyst within the ventricles of the brain. In 43 cases of cysticerci situated within the ventricles sixty-one per cent. occurred in the fourth ventricle. Matignon reports a case of a patient found in the street in a state of collapse. On admission to the hospital it was seen that she was aphasic. She was soon taken with general convulsions and became hemiplegic. At the autopsy in the first and third left frontal convolutions tænia cysts were found, and on the inferior surface of the cerebellum a third cyst was discovered. The right temporal lobe also contained a degenerated cyst the size of a walnut. Herdman reports a case of a tænia solium cyst at the base of the brain which had caused symptoms of paresis of both upper and lower extremities, exaggeration of the knee jerks and other sensory, motor, and ocular disturbances. A succession of chills in this case was followed by unconsciousness and death. At the autopsy a cysticercus at the base of the brain in the middle region was found which extended from the chiasm to the pons and laterally on each side to the temporal lobes. A case came under the writer's observation of a tænia cyst as large as a hen's egg attached by a slender pedicle to the dura mater. The patient, a man, had suffered from cramps and paresis in the opposite arm, headache, and general convulsions. His mind was also considerably disturbed.

Symptoms.—The symptoms which will occur in any given case in consequence of the growth of one of these tumors within the brain will depend very largely upon its situation. The symptoms, like those resulting from other intracranial growths, will be general and special. The general symptoms will be such as arise from an increase of the intra-

cranial pressure and they are likely to be headache, vomiting, vertigo, and optic neuritis. The special symptoms will depend upon the situation of the growth. There may be cramps, paresis, or paralysis in any given set of muscles, or general convulsions. Disturbances of sensation, speech or hearing, or hemiplegia, may occur. In making a differential diagnosis of tænia solium cysts of the brain or elsewhere, the existence or absence of a cysticercus of the eye or subcutaneously, as well as the habits of the patient in regard to the eating of uncooked pork, and his general surroundings, should be taken into consideration.

The tænia cysts also occur, although rarely, in the lungs, producing symptoms not unlike those of asthma. They very rarely occur in the lymphatic glands or the bones. But two cases have thus far been reported of these cysts occurring in each of these situations. They also occur in the spinal cord, where they produce the symptoms ordinarily ascribed to spinal growths, such as localized pain, cramps in the muscles, paresis, and it may be finally paralysis of one or even both lower extremities.

TREATMENT.—When the condition occurs subcutaneously the cyst may be readily excised and subjected to a microscopic examination for positive diagnosis. If occurring in the eye the cyst should be removed by making an incision through the sclera down to the parasite, when it can be extracted with forceps. If occurring within the skull, it is all important to determine its location and also the fact as to whether the cysts are confined to a single area or multiple areas. If they are scattered over the surface or within the cortex or ventricles or in the ganglia or at the base, the condition is beyond surgical relief. If there is a single cyst and it is situated within the arachnoid or membranes, or within the cortex, and can be located by the localizing symptoms, it may be removed, following the technic which is applicable to operations upon the head. If situated within the lungs they are not likely to be correctly diagnosed. If infection occurs, leading to an ab-

scess of the lungs or to empyema, the treatment would be that of incision and drainage.

HYDATID CYSTS.

Hydatid cysts are the larval form of the tænia echinococcus, the latter being frequently found in the intestinal canal

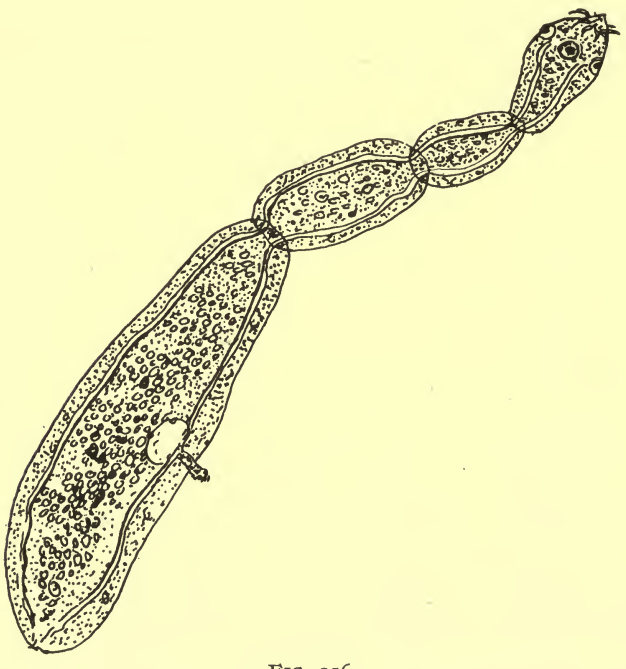


FIG. 156.
Tænia Echinococcus, sexually mature, showing water vascular system.

of the dog. The mature tænia echinococcus is a white, thread-like worm, not more than four or five millimeters in length. It is difficult of detection in the intestinal canal of the dog both in consequence of its small size and also because it clings among the villi to the intestinal mucosa. It unquestionably, for these reasons, frequently escapes detection.

The mature worm is composed ordinarily of four segments, the anterior one or head being possessed of four suck-

ing disks and a rostellum carrying two rows of hooklets. The head or first segment as well as the second and third segments are extremely small, while the fourth is the only one which is mature and this one measures one-half as much as the entire worm. The fourth segment contains the ova, which ordinarily number about 5,000. (Fig. 156.) This segment, or its ova, gains an entrance to the stomach of man with food or water, where the shell is digested, setting free the eggs. The egg shell is

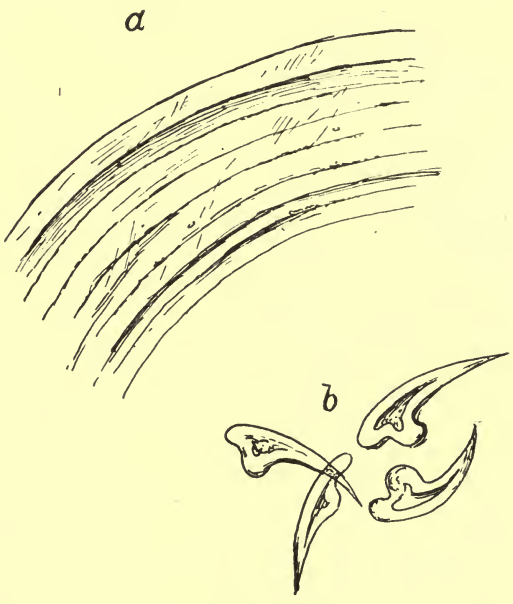


FIG. 157.
a. Cuticula of Echinococcus Cyst.
b. Hooklets from Scolex, highly magnified.

also disintegrated by the juices of the stomach or intestines setting free the embryo, which is extremely small and contains upon its anterior extremity six hooklets in pairs. These embryos make their way through the wall of the stomach or intestines to the peritoneal cavity, or they may enter the venous radicles of the portal system or the adjacent lymphatics and be carried to the liver. They may gain an entrance to the

tributaries of the inferior venæ cavæ and be carried to the right side of the heart and from there they are sent to the lungs, and being protoplasmic bodies they may pass the capillary system of the lungs and gain the left side of the heart and from there reach any of the tissues or organs of the body. They are, however, much more frequently carried to the liver than to any other organ, not that they find this tissue a more favorable habitat in which to grow, but they more readily gain an entrance to the radicles or lymphatics of the portal circulation and thus more frequently are found in the liver. Once

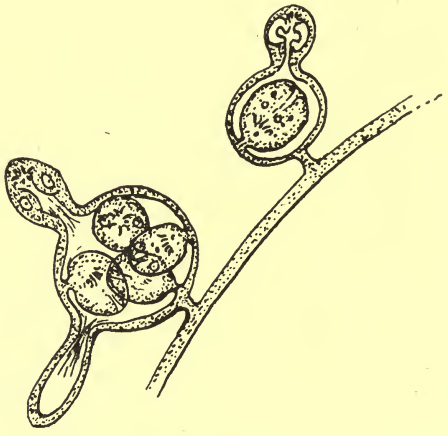


FIG. 158.
Brood-Capsules of Echinococcus in connection with parenchymatous layer of cyst wall.

finding a resting place the embryo looses its hooklets and is converted into a cyst which has two distinct layers, an outer cuticular layer made up of many laminæ, and an inner parenchymatous layer composed of granules, cells, and a water vascular system. (Fig. 157.) When this capsule, known as the parent or mother cyst, reaches the size of a walnut, which it does at about the fourth month, there appears upon its internal surface, springing from its parenchymatous layer, buds which have a granular appearance, which are converted into cysts having a clear fluid and which are known as brood capsules. (Fig. 158.)

These brood capsules have their cuticular layer upon the inside, consequently they are probably formed by an invagination of both layers of the mother cyst. From the external surface of these cysts or brood capsules slight elevations may be seen which mark the origin of the scolices. These scolices are extremely minute, measuring not more than 0.3 of a millimeter in length. They have, nevertheless, four sucking disks, a row of hooklets and a rostellum upon their anterior ex-

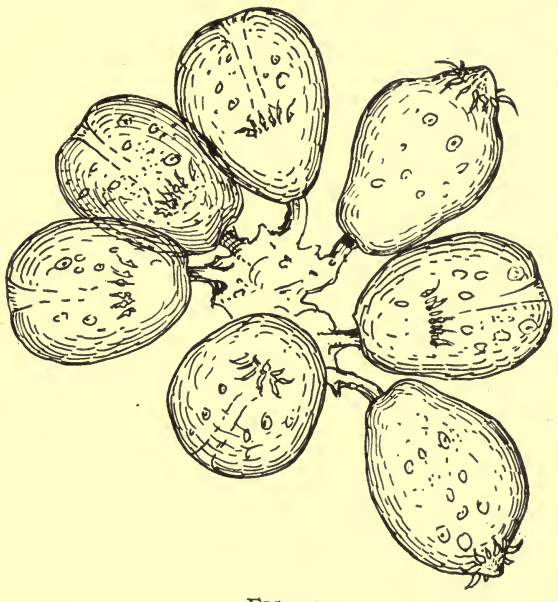


FIG. 159.
Scolices of Tænia Echinococcus attached by their pedicles to part of collapsed wall of "brood-capsule."

tremity. (Fig. 159.) As they develop they come to project from fhe brood capsule and later are invaginated into it and are attached thereto by a slender pedicle. With the detachment of the pedicle and the bursting of the brood capsule they are found swimming free in the fluid of the parent cyst. From the internal surface of the parent cyst or from the brood capsules daughter cysts are produced which may number but a few or many hundreds. These daughter cysts have the same char-

acteristic structure as does the parent cyst, and upon the internal surface of the daughter cysts grand-daughter cysts may also be developed. The scolices are capable, if taken into the stomach of a second host, of developing into a mature tænia echinococcus. With the appearance of the primary buds upon the internal surface of the parent cyst, and largely due to the growth of the daughter and grand-daughter cysts, the primary or parent cyst gradually increases in size until it may reach very large dimensions, containing in some cases daughter and grand-daughter cysts to the number of thousands, and from sixteen to twenty pints of fluid. The fluid is clear lymph, alkaline, and has the specific gravity of from 1005 to 1015. The daughter cysts vary in size from that of a pigeon's egg to that of a hen's egg and are translucent, oval, flattened, extremely elastic and most beautiful. It is held by some that the daughter and grand-daughter cysts are produced from the scolices and brood capsules, while others hold that they have a separate origin from the inner layer of the mother cyst. Surrounding an echinococcus cyst there is produced in the adjacent tissue a fibrous capsule or cyst, which is the result of the irritation set up by the growth of this foreign body. This is a beautiful illustration of the fact that irritation, the result of some foreign body implanted within tissue, may cause a proliferation of the adjacent cells to such an extent as to produce an entirely new cyst wall. Cysts which contain daughter and grand-daughter cysts, and which usually are of large size, are classified as *echincoccus hydatidosus*. When a hydatid does not contain daughter cysts or scolices it is said to be sterile.

Echinococcus Multilocularis.—This species of hydatid may be found in any tissue, but occurs more frequently in the liver than in any other organ. In it there is no typical parent cyst but an innumerable multitude of very small cysts, some of these being not larger than a millet seed. These cysts in the liver have a connective tissue stroma and an alveolar arrangement. In this situation they were formerly thought to be the result

of colloid degeneration of a carcinomatous growth. This form is also found in bone, where it occurs in the medulla and by pressure produces absorption of both the cancellated and compact bone, leading often to fracture. The long bones are those most frequently affected.

PRESSURE EFFECTS.—These depend largely upon the situation and size of the cyst. Those which reach very considerable size produce not only serious pressure upon, but also more or less of destruction of adjacent tissues or organs. Situated in the upper portion of the liver they may produce such pressure upwards against the diaphragm and adjacent pleura as to interfere with respiration. If situated in the left lobe, they may, as the result of pressure, interfere with the heart's action. If growing downwards into the abdomen from the lower portion of the liver they not unfrequently disturb the action of the stomach and intestines. Hydatids occurring in the bones produce marked absorption, leading frequently to fracture. If situated upon or within the brain or spinal cord, they are likely to seriously interfere with their functions. In fact they may interfere with the function of any organ in which, or near which, they may be placed.

COMPLICATIONS.—Hydatid cysts not unfrequently rupture. This may be into the right pleural cavity, if situated within or projecting from the upper portion of the liver, causing an infection of or setting up a traumatic pleurisy. If the lung becomes attached to the pleural surface they may open into a bronchus and be discharged with the expectoration. They may rupture into the peritoneal cavity, producing sudden death or infection of this cavity, the latter leading to the growth of innumerable hydatid cysts upon the surface of the peritoneum. They may rupture into the stomach and the cystic contents be discharged with the contents of this organ by vomiting. They may open into the colon, to be carried off with the fæcal matter. They have also been known to rupture into the bile ducts or gall bladder, or externally through the skin. When situated within the ventricles of the brain they not unfrequently

have caused hydrocephalus. In consequence of infection from an adjacent hollow organ, such as the stomach or intestines, they may suppurate, producing symptoms of septicæmia or pyæmia. If a hydatid of the liver or other organ rupture into the peritoneal cavity a hydatid urticaria appears within a few hours, which is supposed to be due to the irritation or absorption of some ptomain present in the fluid of the cyst.

Geography of Hydatid Cysts.—The statement has been made that hydatids are to be found over as wide an extent of country as is the domestic dog. They are found, however, much more frequently in some countries than in others. They seem to be specially frequent in Iceland, in which country they are the cause of a very considerable mortality. Next to Iceland they are said to be more frequent in Silesia and then in Australia. In the latter country they are of very frequent occurrence. In North America they are comparatively rare. According to Bland Sutton they have been found not only in man, but also in monkeys, cows, sheep, goats, deer, camels, antelopes, horses, hogs, squirrels. and in the giraffe and kangaroo. In man the hydatid cysts may be found in almost every organ and tissue of the body. In 1,862 cases collected by Davaine, Cobbald, and Neiser the parasite existed in the liver in 953 cases, in the abdomen in 63, in the brain and spinal cord in 157, bones 61, heart and blood vessels 61, and in other organs 158 times. Of the 85 cases occurring in the United States 50 developed in the liver. In Greifswald clinic in 56 cases 36 were in the liver, 10 in the lungs, 9 in the right kidney, and one in the spleen. It is, however, of more frequent occurrence in the liver than in all other tissues and organs combined. They have also been found in the breast, thyroid gland, kidney, bones, suprarenal capsules, scrotum, heart, orbit, and subcutaneously. They may occur singly or be found scattered over the surface of the body, or any organ, in great numbers.

Hydatids in the Liver.—Symptoms and Course.—When occurring in the liver they produce a slowly-growing, painless

tumor which may be situated within the substance of the organ producing a uniform enlargement, or a growth, which projects from any one of its surfaces. Hydatids of the liver may be of such size as to fill much of the abdomen and produce symptoms of pressure upon the adjacent lung, stomach, intestines, or heart. Ordinarily the cyst is characterized by its slow, painless, non-sensitive growth; a growth which may consume years in reaching large dimensions; a growth which does not interfere under ordinary conditions with the health or well-being of the individual and which produces no loss of flesh or strength. The cyst if near the surface may show indications of fluctuation or the hydatid fremitus may be demonstrated. This, however, is more frequently absent than present. It is determined by placing the left hand upon the surface of the swelling when one of the fingers is struck sharply by a finger of the right hand. If the fremitus is present a distinct thrill or vibration is imparted to the hand struck. If infection occurs in a hydatid cyst of the liver the symptoms will change to those of a hepatic abscess and the process will be attended with chills, fever, pain, sensitiveness of the surface, swelling, and even œdema. In making a diagnosis of hydatid cyst of the liver the surroundings and the habits of the patient should be taken into consideration with the foregoing symptoms.

Echinococcus Cysts in Bone.—The multilocular form is the one which most frequently occurs in bone. Hydatids in bone lead to more or less pain, absorption of bone structure and, it may be, fracture. They occasionally present the symptoms of a cystic tumor of bone which has a very slow, indolent growth, often running into years. They may follow an injury. The cysts vary in size from that of a millet seed to that of a hen's egg. They may break through the bone and invade the surrounding parts. They occur more frequently in the long bones than in the flat. In 52 cases, 26 were in the hollow bones, 11 in the humerus, 8 in the tibia, 6 in the femur, 1 in the phalanges. Eighteen times they

were in the flat bones, eleven times in the pelvis, four times each in the skull, scapula and sternum, and once in the ribs. Suppuration is a frequent accompaniment of hydatid disease in bone. The tibia seems to be frequently affected. In it the medulla and compact bone are often encroached upon until there is but a mere shell of the latter remaining, in the cavity of which there will be hundreds of small vesicles. A diagnosis would be impossible under ordinary conditions without incision or direct inspection of the broken bone when the true condition either macroscopically or microscopically may be determined.

Hydatids in the Heart.—Hydatid cysts occasionally occur in the heart either in the muscular tissue or in the auricles or ventricles. When occurring in the cavities of the heart they usually are the result of the embryos being brought there in an embolus. In these situations they usually cause irregularity of the heart's action and often lead to the death of the patient, either as the direct result of functional disturbance from pressure or in consequence of the cysts rupturing into the heart cavities. A positive diagnosis in these cases would be practically impossible.

Hydatids in the Kidneys.—A large number of cases have been reported. The cyst is usually situated in the substance of the kidney, often projecting into the pelvis. It produces an innocent, very slowly-growing tumor which is covered in front by the colon and consequently is tympanitic and moves freely with deep inspiration. If of considerable size there may be fluctuation. The cyst not unfrequently ruptures into the pelvis of the kidney and its contents is then discharged with the urine. A positive diagnosis is then possible by making a microscopical examination of the urine. A hydatid cyst in this situation will produce the symptoms usually ascribed to a very slowly-growing cyst of the kidney.

Hydatids of the Thyroid Gland.—Hydatids in this situation are extremely rare. When occurring they produce painless, somewhat fluctuant, slowly-growing tumors. The diag-

nosis would be impossible without incision, puncture, or rupture.

Hydatids of the Appendix.—Birch Hirschfeld found a hydatid in the lumen of the appendix, which had produced a small tumor.

Hydatids of the Mammary Gland.—More than twenty cases of hydatid cysts in the mammary gland have thus far been reported. Most of these have occurred in adult women. They make their appearance as painless, slowly-growing, perhaps slightly fluctuant swellings which are ordinarily well circumscribed and which grow so slowly that they require from ten to fourteen years to reach any considerable size. There is nothing in the history of these growths which would differentiate them from other cysts in the same situation. An incision showing the beautiful daughter cysts, or a puncture and a microscopical examination of the fluid showing hooklets, would establish the diagnosis.

Hydatids of the Lung.—Hydatids occur comparatively seldom in this situation. In 2,137 cases of hydatids they were found in the lung in ten per cent. of the cases. From 1890 to 1900, in two hospitals in Amsterdam, there were 48 cases of echinococcus observed, in which the parasite was 42 times in the liver, 4 times in the kidney, once in the spleen, and once in the lungs. Echinococcus of the lungs occurs, as might be expected, much more frequently in those countries where the disease is most prevalent. It is stated that Finsen, in a very large experience in Iceland, saw seven cases in which the parasite affected the lungs. It is stated by Duncan Burg that in Australia, during a period of ten years, 150 cases of echinococcus of the lung were observed. Hearn, in 1875, was able to record up to that date 147 cases of echinococcus of the lungs, the great majority of which came from Australia.

The condition in the lungs seems very difficult of diagnosis. It occasionally presents the symptoms of tuberculosis and then again of pleurisy, or of a tumor of the lung. Occasionally there are few or almost no symptoms, but as a rule

there is a severe, dry, distressing cough, pain in the breast, some dyspnœa and often a bloody expectoration, which has in some cases been very profuse. There is usually a well circumscribed area of dullness, depending for its size upon the dimensions of the cyst and its nearness to the pleural surface. The general health, as a rule, is not seriously interfered with. There is no fever, loss of flesh, or debility. Not unfrequently the parasitic condition has been unexpectedly discovered at the autopsy or during an operation carried out for the purpose of draining the pleural cavity or an abscess of the lung, or the cyst has opened through a bronchus and its contents discharged through the mouth, making the diagnosis easy. Should infection occur the symptoms of pus formation such as chills, fever, pain, with perhaps œdema of the chest wall will occur. The symptoms most likely to be observed are frequent and distressing cough, often with bloody expectoration, some dyspnœa, dullness upon percussion over a circumscribed area, enlargement of the corresponding side of the chest, enfeeblement of respiration, with perhaps symptoms of fluctuation. Unless, however, infection takes place the general health and well being of the patient are not seriously interfered with.

Echinococcus of the Brain.—Gowers states that hydatid cysts occur more frequently in the skull than does the cysticercus, and that its most frequent situation is in the hemispheres and within the white substance, although it may be found outside of the dura within the arachnoid, in the ventricles, or at the base of the brain. If the cysts reach any considerable size the symptoms which they produce will be those of irritation and pressure. As has been already stated, tumors of the brain are extremely likely to produce headache, vomiting, giddiness, and optic neuritis as general symptoms. Aside from these the localizing symptoms which they may produce will depend upon the situation of the growth. Echinococcus of the brain may also produce hydrocephalus, especially if the cyst is situated in or near the base. The cere-

bro-spinal fluid comes largely from the choroid plexuses of the lateral ventricles and passes by the third ventricle and the aqueduct of Sylvius and the fourth ventricle to the cord. A tumor situated at the base in the pons, within the corpora quadrigemina, in the third ventricle or in the middle lobe of the cerebellum may so obstruct the outflow of this fluid as to produce hydrocephalus through an accumulation in the lateral ventricles. The symptoms of echinococcus in this situation are not characteristic. They are only those of a tumor. A positive diagnosis would be, therefore, impossible, but a probable diagnosis perhaps might be made if one took into account the habits and surroundings of the patient.

Echinococcus in the Spinal Canal.—In this situation they may take their origin from the vertebræ or in the space between the vertebræ and the dura, or from the membranes. In their growth they may so press upon the laminæ as to produce absorption, or project forwards between the transverse processes into the thorax or abdomen. Pressing upon the cord they are very likely to produce the symptoms of traumatic inflammation, as well as motor and sensory paralysis, radiating pains along the course of the nerves and cramps in the muscles supplied by the nerves, which take origin at the seat of the disease. The process comes on very slowly and should be unattended with fever. A differential diagnosis from other growths would be impossible.

Diagnosis and Differentiation.—Hydatids of the Liver.—The characteristics or differential symptoms of hydatids of the liver from other pathological processes may be summed up in a comparatively few words. They are especially to be differentiated from carcinoma, abscess, gummata, and from an enlarged gall bladder. Hydatids in this situation, as elsewhere, are characterized primarily, perhaps principally, by the fact that they are benign cysts which do not necessarily, except by pressure, interfere with the health or well being of the patient. They are of extremely slow growth, requiring ten or even twenty years to reach any

considerable size. Situated within the liver those containing daughter cysts or fluid are fluctuant, elastic, painless growths which may present a hydatid fremitus upon percussion. The multilocular hydatid is also to be seen in the liver and is characterized by its extreme hardness, slow and usually painless growth, during which it produces a well circumscribed tumor. Malignant growths affect the health and constitution, and are of a few months or at most of one or two years' duration. The gummata are round, circumscribed growths, also indolent, of small size, and the patient will present symptoms of or a history of syphilis. An abscess is sensitive, painful, attended with chills and fever, and often with œdema of the skin and a severe throbbing pain. The symptoms are progressive. Enlarged gall bladder may be mistaken for a hydatid cyst projecting from the lower surface of the liver, but an enlarged gall bladder will ordinarily have been preceded by jaundice and other symptoms of hepatic disturbance. Hydatid cysts in other situations such as the lungs, bones, brain, spinal cord, mammary and thyroid glands present the physical characteristics of a very slowly growing cyst or cysts. The diagnosis would be difficult and probably impossible without incision, puncture, or drainage, in either of which instances the presence of daughter cysts or the appearance of hooklets will absolutely demonstrate the diagnosis. In hydatids of the kidney a differential diagnosis will usually be possible from cases of hydro- or pyonephrosis. In the former there usually are symptoms of severe, excruciating pain, radiating from the lumbar region to the bladder, coming on suddenly and lasting with slight remissions for hours or days, these attacks being attended with acute enlargement of the kidney. Pyonephrosis will give the characteristic symptoms of pus formation and usually pus will be present in the urine. It may also be necessary to differentiate the process from sarcoma of the kidney, which, however, often occurs in young patients and is of more rapid growth.

Spontaneous Cure.—The life history of the hydatid

parasite seems quite variable. It is held that it may live anywhere from ten to twenty years. A goodly number of cases undergo spontaneous cure. The parasite dies, the cyst shrivels up and is converted into a whitish, mortar-like substance containing, it may be, hooklets, fat, calcareous particles and general debris, the fluid being absorbed. This condition of spontaneous cure is usually only discovered post-mortem.

METHODS OF TREATMENT.—The removal of an echinococcus cyst of the brain will not differ in its technic from that required in the removal of any other form of cyst whether it be parasitic or non-parasitic in origin. The same is true of an echinococcus cyst of the spinal cord or spinal canal. Cysts situated in the kidney will require drainage, removal of the cyst, or excision of the kidney. Cysts in bone are usually of multilocular form and are often associated with infection and suppuration. Here it is most desirable that the condition be treated early before destruction of the bone has progressed so far that repair is impossible. Experience has demonstrated that in these cases the periosteum makes little or no effort to form new bone around that which is being destroyed. A free incision, or if necessary more than one, should be made down to and through the periosteum into the interior of the bone when the cysts and affected structures should be curetted away, the wound then being treated antiseptically. The treatment of hydatids of the lungs will correspond with the usual treatment of empyema or abscess of the lung. This will usually be drainage. After removing one or more ribs and determining the area to be incised by an aspirating needle the pleural cavity is shut off with iodoform gauze packing and the cyst cavity incised and drained.

In the treatment of hydatids of the liver, which is of the greatest importance in consequence of their frequency, three methods are in vogue.

First, the operation of Volkman which has been in pretty general use. Following this method the operation is divided

into two stages. The first stage consists in is cutting down to the cyst wall, usually below the lower border of the ribs, then packing the incision with iodoform gauze until the liver has formed adhesions to the parietal peritoneum. This process usually requires two or three days. Then the second operation is done by freely incising the cyst, clearing out the contents and establishing drainage.

The writer not long ago observed an operation for an immense hydatid cyst of the liver by von Bergman who followed the Volkman method. At the second sitting after freely incising the parent cyst he took a very large tablespoon and with this cleared out the daughter cysts from the cavity. They numbered hundreds or perhaps thousands and certainly would have filled a large basket. They were nearly as large as hen's eggs, as elastic as a rubber ball, translucent, and very beautiful. The operation now is usually done in one stage, cutting down upon the cyst the area is dammed off with iodoform gauze or the peritoneal surfaces sutured, when the cyst is incised cleaned out and drained.

The Operation of Bond, of Leicester. His operation differs from the others in that he attempts to remove the parent cyst. An incision is made down to and into the parent cyst which is evacuated, when by gentle means he endeavors to separate the parent cyst from its surrounding fibrous capsule. This is usually not very difficult, nor is it attended with severe hæmorrhage. It has the advantage of clearing out all of the hydatid material at one sitting. The cavity usually readily collapses and a cure is insured. In these cases there should be no effort made to remove the fibrous capsule which is strongly adherent to the liver tissue. All that should be done is simply to remove the parent cyst entire and then drain the cavity.

MISCELLANEOUS CYSTS.

In making up the classification of cysts, one of the subdivisions put down was that of miscellaneous cysts. It was

intended at that time to include under this head Adventitious Bursæ, Simple and Compound Ganglia and Neural Cysts, the latter including Hydrocephalus of the various ventricles of the brain, as well as the Meningoceles of the head and Spina Bifida. After a more careful consideration of the subject it has been thought to be more in keeping with the scope of this work to exclude the consideration of these pathological conditions from its pages. It is admitted that these subjects are of great interest and importance, but their consideration probably more strictly belongs to a work on general surgery than it does to one devoted exclusively to tumors.

CHAPTER XXII.

MALIGNANT TUMORS.

Malignant tumors may be defined as those which in their growth tend towards the destruction of the lives of their hosts. They may be divided into three genera, namely, the sarcomata, endotheliomata, and the carcinomata. Each one of these genera is composed of two or more species.

General Characteristics of Malignant Growths.—These have been considered to some extent in a previous chapter, but we will recapitulate them here, and enter more fully into some of the phases of the subject. The growth of malignant tumors differs very materially from that of benign, in that the former tend to destroy the life of the patient. The malignant tumors also are not encapsulated, having no distinct boundary line, but insinuate themselves, in consequence of their cellular growth, into the adjacent tissues. They produce metastases; the carcinomata most frequently through the lymphatics and the sarcomata through the veins. They are also likely to return after removal. This is in consequence of their having no distinct boundary line and because islands of cells remain outside the lines of the incisions, and also in consequence of infection of the wound at the time of operation with the specific elements of the malignant growth. They are extremely likely to undergo degeneration. This is largely the result of the cellular elements of which they are composed not being properly nourished. Caseation and liquefaction frequently occur as degenerative changes, while absorption of the disintegrated products of the tumor is of common occurrence. Hæmorrhage frequently occurs into the tumor, largely as the result of degeneration and liquefaction. As the result of pres-

sure, infection, and destruction of tissue, ulceration and sloughing are frequent.

Malignant growths lead to what is known as a cancerous cachexia, which is the result of a variety of conditions, among which are the following: First. The patient's inability to take and assimilate food. Second. Rapid and numerous metastases. Third. Ulceration and sloughing of the tissue. Fourth. Pain, loss of sleep and mental anguish. Fifth. Toxic infection.

The most pronounced characteristics, then, of a malignant tumor are that it tends to destroy the patient's life, is not encapsulated, consequently inseparable from adjacent tissues and often fixed, it returns after removal, produces metastases, destroys adjacent tissue by pressure and infection, and that it produces a cachexia.

ÆTIOLOGY.—It must be apparent that the various predisposing or exciting causes of benign tumors are not sufficient to account for the formation and growth of the malignant neoplasms. The theory of Cohnheim, that tumors are due to embryonal inclusions, may be held to be sufficient for the causation of some of the benign growths, but no one will scarcely hold that this theory accounts for the excessive cellular proliferation and the destructive tendencies of malignant or cancerous growths. Everyone who has studied the subject or watched the progress of these tumors must have been impressed with the thought that there is in them something which is unique and characteristic; that they are not governed by the same laws or due to the same causative conditions as are the benign tumors.

Ribbert has modified and developed somewhat the theory of Cohnheim and holds that carcinoma has its origin in a vigorous proliferation of the sub-epithelial connective tissue, that in consequence of this sub-epithelial growth the epithelial cells become separated from their organic connections and displaced into the connective tissue where they take on independent and rapid growth. He holds that this separation of the

epithelial cells from their normal connections and their transplantation into the adjacent connective tissue is the real and active primal cause of the carcinomatous tumor. This he believes is the result usually of a slow inflammatory process. In consequence of this separation and displacement, the character and function of the cells are entirely changed, and they become able to proliferate enormously. In opposition to this theory it is held by many students of pathology that in the early stages of many of the carcinomata the sub-epithelial connective tissue cells are not interfered with and do not show unusual proliferation. We are also all cognizant of the fact that epithelial tissues are very frequently transplanted into subcutaneous tissue where they undergo degeneration and absorption, remain sequestered, or produce dermoids without the growth taking on the characteristics of malignancy. Schleich considers that tumors are due to a certain form of infection originating within an organ. The cells of this organ, at a certain stage of its normal development, become, as the result of irritations of various sorts, infectious and take on rapid proliferation much the same as an impregnated ovum. Tumors are considered by Schleich to be the result of a pathological impregnation and conception. The pathological germs are represented by the cells that have become infectious.

Germ Theory of Carcinomata.—Dr. Harvey R. Gaylord in a classical article published in the *American Journal of Medical Sciences*, May, 1901, gives the report of the investigations thus far undertaken at the Buffalo University laboratory, for the purpose of determining, if possible, the cause of cancer. In this article he claims that certain round bodies resembling fat in the fresh state are to be found in every case of cancer, also that in persons who die from sarcoma, carcinoma, or endothelioma, all organs, including the blood taken from all regions, contain a very large number of these organisms, also that in cases of sarcoma and carcinoma in which a cachexia was well marked these organisms could be detected in the peripheral blood, and further, that animals could be infected

by inoculating them with the peripheral blood from cachectic cancer cases. Russell was the first to interpret these spherical bodies found in cancer as blasto-mycetes. They are ordinarily known as Russell's fuchsin bodies. He was of the opinion that they belonged to the yeast group. Russell's article describing these bodies was published in 1890. Sanfelice, an Italian, published some interesting articles in 1898 in regard to parasitic inclusions found in cancer cells. He considered these bodies identical, in appearance at least, with yeast organisms. Plimmer, in an article which appeared in the *Practitioner* for 1899, also describes organisms found in carcinomatous tissue. During a period of six years Plimmer examined 1,278 cases and found in 1,130 these parasitic bodies. He describes them as round bodies varying from 0.004 to 0.04 millimeters in diameter. The central portain contained seemingly a nucleus and around this was a layer of protoplasm and outside a capsule. Leopold, of Dresden, in 1896, described cells which he had found in carcinomatous tissue which were round and filled with yellowish, angular or oval granules of a glistening appearance. The granules appeared to move about and even to escape from the cells. In a later communication he claims to have obtained pure cultures of blastomycetes from human carcinoma.

Gaylord claims that the organism which he has found is a protozoon and is the cause of cancer. Roswell Park holds that the bodies which Gaylord has seen and described and the Russell and Plimmer bodies are one and the same, and that they are not yeast fungi but animal parasites and the probable cause of cancer. Gaylord believes that Plimmer's bodies and Russell's fuchsin bodies and the forms described by Sjobriny, Eisen and others, are identical with the organisms which he claims are the cause of cancer. Schiller, in some articles which have attracted a great deal of attention, claims that he obtained pure cultures of parasites from both carcinoma and sarcoma. This was done by cutting a piece from the growing tumor and placing it in an air-tight vessel under antiseptic pre-

cautions, where it is allowed to remain at the temperature of the body. This, however, is not a sub-culture. These organisms have a double capsule and have pores through which cilia pass out. He holds that there are but minor differences from the parasites obtained from carcinomata and from sarcomata.

The committee of bacteriologists and pathologists from the Harvard Medical School has recently made its report covering a year's work, during which it endeavored to solve the claims of the adherents to the theory of the parasitic origin of cancer. These claims were, first, that the proliferation of epithelial cells analogous to the lesions seen in cancerous tumors can be produced by certain well-known protozoa (the coccidium oviforme); second, certain skin lesions characterized by epithelial cell proliferation are due to the action of a so-called protozoon (molluscum contagiosum); third, blastomycetes are constantly present in human cancers and are the cause of the lesion; fourth, by experimental inoculation of animals with blastomycetes true epithelial or cancerous nodules can be produced; fifth, the endocellular bodies seen in the protoplasm of cancer cells have a definite morphology, are "parasites" and the cause of cancer.

The conclusions this committee reached after a year of research are the following: first, the lesion produced by the coccidium oviforme is essentially a process of chronic inflammation and is not analogous to the lesion seen in cancer; second, the lesion in molluscum contagiosum is characterized by certain changes in the epidermis, is not due to the action of a protozoon and is not analogous to cancer; third, the so-called "blastomycetes" (saccharomycetes) of Sanfelice and Plimmer are torulæ; fourth, the lesions produced by these "blastomycetes" (torulæ) are essentially nodules of peculiar granulation tissue, are not cancerous, nor in any sense true "tumors"; fifth, blastomycetes are not constantly present in human cancers; sixth, the peculiar bodies seen in the protoplasm of cancer cells are not parasites, nor the cause of the lesions, but

probably are in part at least atypical stages of the process of secretion by glandular epithelium.

In the production of malignant growths it must be conceded that there is some agent or some substance which in some way, perhaps in consequence of its irritation, is capable of producing an enormous cell proliferation, but rapid cell proliferation is not differential, nor all there is in malignancy. A myoma, a myxoma, or almost any other benign growth may be the site of rapid cell proliferation, but they do not possess that peculiar characteristic known as malignancy, an ingredient which separates the benign from the malignant class of tumors. There is not only in malignant growths rapid and seemingly uncontrollable proliferation of cells, but there is something more, something which is not possessed by the cells of any of the benign growths something which is capable of giving these cells unusual characteristics or powers by which they are capable of permeating the adjacent glands, tissues and distant organs, and as a result of which conditions or powers nutrition is disturbed and a cachexia produced and finally the death of the patient is effected. It seems unreasonable for a moment to assume that there is not in malignant growths a pronounced factor which is entirely distinctive and separate from anything contained in benign tumors. A theory, or theories, such as Cohnheim's or Ribbert's, or such conditions as injuries, inflammations, age, sex, occupation and heredity may be and often are sufficient to account for, and are the probable causes of many, perhaps the great majority, of benign tumors, but no one of them or all combined are sufficient to explain the origin and course of malignant tumors.

In the writer's opinion nothing that has thus far been offered as a causative condition for malignant growths is at all reasonable or explanatory of their development and course except that they are of parasitic origin. Each cell in a malignant growth seems endowed with the malignancy of the tumor and when separated from the mother growth

and transplanted to distant organs or tissues is capable of producing a growth which has the same characteristics of structure and malignancy as did the primary tumor.

There are many correlated conditions which seem to prove or make reasonable the theory of the parasitic origin of cancer. Behla found one hundred and eighteen cases in which cancer had been transmitted from husband to wife, or from wife to husband. Forty-three cases have also been recorded where cancer has occurred in the penis and uterus of man and wife. Six cases have been recorded in which cancer has seemingly been transmitted by the use of a syringe. Behla has recorded eight cases in which doctors in their work have been inoculated with cancer juice and have subsequently died of cancer. He injected the fluid from a mammary carcinoma into the jugular vein of a dog and found in three months carcinomatous nodules in the liver. Eberth has collected twenty-two cases in which there was a direct transmission of cancer from lip to lip or from tongue to cheek or palate. The fact that a malignant growth can be transmitted from one part of the body to another is presumptive at least of its germ origin. Jurgens showed that some of the sarcomata are infectious and can be inoculated into the lower animals. He found sporozoa both in tumors and in the blood of animals affected. In his experiments there were within two or three weeks following an inoculation of a melanoma a melano-sarcoma formed in the periosteum and metastasis in the different organs. Eiselsberg inoculated white rats with a fibro-sarcoma. Frothingham was able to isolate a torula from a myxo-sarcoma found in the lung of a horse. Inoculations of rabbits and guinea-pigs with pure cultures of the torula and with material obtained from the original tumor produced lesions in the animals inoculated identical with the original lesion and which were attended by metastases. The fact that cancers frequently occur in families or are seemingly hereditary; that there are certain districts or foci in which malignant tumors are especially prevalent; that there are

cancer houses in which one or more members of every family living therein, even if the ancestry be entirely changed, become infected; and also the seemingly well-established fact that malignant disease is rapidly on the increase and is of greater prevalence where the population is most dense (Czerny) all tend to favor the theory of the germ origin of malignant diseases. Many scientists of the present believe that in the chemistry of the cells may be found the cause of cancer.

The disease through organisms, or by some influence or condition of the system or its cells may be carried from parent to child. The seeming fact that there are certain houses which are known as "cancer houses" and certain districts in which malignant disease is especially prevalent, would appear to indicate at least that there was some process or influence or organism which was indigenous to certain localities and which has produced infection of certain houses or districts. It is probably well established at the present time that there are certain portions of cities or states or even countries in which malignant disease is especially prevalent. In a city of 8,000 inhabitants in the vicinity of Milwaukee there have been within the last few years fourteen deaths from cancer within a radius of a few blocks. Of these fourteen cases three had cancer of the rectum, in six the carcinomata were situated in the breast, in two in the stomach and in three in the uterus. These cases have occurred within the past few years and, as stated, within the radius of a few blocks. It is unquestionably true that many pathologists, perhaps the majority, do not look upon this theory as to the cause of malignant growths with favor, probably largely because they thus far have been unable to discover anything peculiar or specific in the cancer cell itself. They, however, are unable to offer any other satisfactory explanation of the cause or characteristics of malignancy, but many of the clinicians, and especially the surgeons, who have watched the course of these diseases and have seen them travel through the tissues at times with almost the rapid-

ity of an acute infection and have found it at times as difficult to eradicate them by operative means as it would have been a pyæmic condition, are forced almost from the circumstances to believe in the germ theory as the cause of malignant growths. Even if we believe that a malignant tumor is due to infection there are unquestionably many factors which favor this condition, factors which are predisposing and which produce a soil most suitable for the growth of infected epithelial cells. The carcinomata, sarcomata and endotheliomata are not only malignant growths, but they present peculiarities as to origin. The former come from epithelial structure, either that of the skin or mucous membrane or from glandular epithelium, while the latter, the sarcomata and endotheliomata, have their origin in connective tissue cells. Each of these genera present certain peculiarities which may be due largely to the cells from which they spring.

The Influence of Age.—The carcinomata occur, as a rule, in tissues which are in a state of senility. While it is quite true that cancer is occasionally found in young adults and even before adult age, this occurrence is extremely rare and does not invalidate the rule that carcinomata occurs most frequently during the decline of life, as a rule after forty-five or even fifty. Israel reports cases of carcinoma of the colon in two girls aged seventeen and twenty respectively and a carcinoma of the sigmoid flexure in a boy of thirteen. Age, then, seemingly is a predisposing factor. The sarcomata and the endotheliomata occur, on the contrary, most frequently in young adults and in middle-aged persons. While they may occur in people advanced in years, this is rare. They are also sometmes found in children and occasionally in those not more than a year or two old.

Sex is also a predisposing factor. Women, on the whole, are more prone to malignant growths than are men. Tillmann states that in 7,878 cases of malignant disease 5,017 occurred in women and 2,861 in men. Sex also has a decided influence upon the location of malignant growths. In

men they are most frequently situated upon the skin, lips, tongue, within the mouth and rectum, while in women they are most frequently found in the mammary gland and uterus. In the hollow organs they are frequently found where the lumen of the organ is constricted, as in the œsophagus where it passes through the diaphragm and at the pyloric end of the stomach.

Occupation and Habits.—Occupation, seemingly, is a distinctive factor in the production of carcinomatous growths. Any calling which leads to a more or less continuous irritation of any particular part or organ is extremely likely to lead to the formation of a malignant growth. Paraffine and coal-tar workers as well as chimney sweeps are peculiarly prone to carcinomatous growhs of the skin. Epitheliomata of the lip is peculiarily prevalent in persons who smoke. In 78 cases of carcinomata of the lip 74 occurred in men and 4 in women. The great majority of the men affected were smokers and of the four women three were inveterate smokers. Out of 245 cases of carcinomata of the tongue, 230 occurred in males. Of 100 cases of carcinomata of the tongue observed by Botteni, all occurred in persons addicted to the use of tobacco. Persons who chew tobacco are said to be predisposed to carcinomata of the cheek in the vicinity of the last molar tooth. It is claimed by some that it is not so much the tobacco that is the cause of malignancy as it is some ingredient which is used in the curing or preparation of the tobacco.

Carcinoma of the stomach is most frequent in persons who have suffered from gastric ulcers or who have been drinkers. In fact the great majority of cases are preceded by chronic gastritis. It is claimed that in seventy per cent. of the cases of gastric carcinoma the patients have been previously steady drinkers of spirituous liquors. It is also claimed by some that the irritation incident to frequent shaving with a dull razor in a predisposing factor of carcinomata of the face.

Irritation and Injury.—These conditions have almost from time immemorial been considered as predisposing factors both for the benign and malignant growths. The irritations

are usually chronic or more or less continuous, but a simple traumatism or chemical irritation may be the exciting cause. The irritations of the hot stem of the clay pipe and of the jagged tooth are well recognized. Malignant growths may also, and frequently do, follow a single injury. Sarcomata occasionally follow fractures and malignant growths of all kinds occur occasionally in calluses. According to Rapok sarcomata followed injuries in 128 out of 666 cases. Ziegler states that in eighteen per cent. of his cases of tumors there had been a single traumatism and in twenty-five per cent. a continued traumatic influence. Lowenthal in 934 cases of carcinomata of the mammary gland found that traumatism had seemingly been a factor in 125 cases. In 70 cases of malignant growths Coley found that traumatisms had been an important ætiological factor in 44. It is within the frequent observation and experience of every surgeon to have witnessed malignant growths, both carcinomatous and sarcomatous, apparently following upon one or more injuries.

Woodland believes that the development of neoplasms may be the result of a deficiency of nourishment. He holds that they develop only as the result of irritations such as injuries, chronic catarrhs, inflammations and microbic infections. In consequence of these such an activity in the tissue elements occurs that the food taken into the system is insufficient to supply the demand and the process results in tumor formation.

Predisposition.—Esmarck believes that the sarcomata depend largely upon an inherent predisposition from syphilitic ancestors. Rapok, in one-third of all the cases which he collected, found that they originated from warts. In a case recently under the writer's observation the mother died of carcinoma of the breast, one daughter of carcinoma of the uterus, another of carcinoma of the stomach, and a grandchild was supposed to be suffering from carcinoma. It has been thought for many hundreds of years that carcinoma to a certain extent depends upon inheritance or heredity. It is within the experience of nearly every physician to have noticed families in

which one or more members for many successive generations have been affected. Broca reports the case of a woman who died of cancer of the breast, and of twenty-six of her descendants who had reached the age of thirty-six, fifteen had died of cancer.

The Increase of Carcinoma.—Statistics seem to bear out the statement that malignant disease is distinctly on the increase. The statistics of the city of Milwaukee show that in 1878 the mortality from carcinoma was 25 to every 100,000 population. In 1898 the mortality had increased to 59.3 to every 100,000 population. Wm. T. Whitney, who has studied the subject of the increase of carcinomata in Massachusetts, states that if the deaths from carcinomata should go on at the rate of increase of the past fifty years, in two and a quarter centuries every person over thirty would die from this disease. The statistics of all states and countries practically agree that malignant disease is very markedly on the increase. It is claimed in opposition to this by some writers that this is only apparent and is due to better diagnostic methods and to the possible fact that greater industry is exerted in recording the cases.

Tissue Origin of Malignant Growths.—The sarcomata originate in connective tissue. This may be the connective tissue which grows subcutaneously within the skin or in cartilage, bone, periosteum, fat or that of any organ. The endotheliomata most frequently take origin from the flat connective tissue cells such as line the lymphatic and connective tissue spaces, blood vessels, and serous cavities. It has ordinarily been held that the carcinomata originate in or take their origin only from epithelial cells. Klebs holds that connective tissue cells, in consequence of epithelial infection, may become converted into epithelial carcinoma cells. Thiersch was the first to hold that the epithelioma of the skin took origin from the epithelial cells of the rete Malpighii, and Waldeyer was one of the first to prove that the carcinoma of the glands took origin from the glandular epithelium. This is the ground

taken by the majority of pathologists at the present time, that the sarcomata and endotheliomata take origin only from connective tissue, while the carcinomata take origin from all species and kinds of epithelium. Not only Klebs but Gussenbauer, Rindfleisch and others hold with Virchow that carcinomata may originate by the process of metaplasia from connective tissue cells and especially from endothelial cells.

Permanent Cures.—According to the statistics of Fischer and Meyer in 298 cases of malignant tumors operated upon by Rose in the hospital at Zurich between 1867 and 1878, they were able to obtain reliable returns from 64. Twenty-two were alive in 1887 without recurrence, 10 died without recurrence after a period of exemption varying from one and one-half to sixteen years. In the remaining five patients the cause of death could not be ascertained. Among the cases cured were many difficult ones requiring extensive operations with the removal of recurrent tumors and diseased lymphatic glands. With the sarcomata, the cysto-sarcomata and fibro-sarcomata showed the greatest number of permanent cures, while among the carcinomata were the fewest instances of permanent cure. It is probably true that on the whole sarcomata, including the endotheliomata, are less malignant than are the carcinomata. There is, however, great difference as to the malignancy or curability of the different species. The spindle-celled sarcoma is often only semi-malignant and the same may also be said of the giant-celled sarcoma, while the round-celled sarcomata are usually extremely malignant. Permanent cures following operations upon the spindle-celled and giant-celled sarcomata are within the experience of every surgeon.

The curability of the carcinomata depends to a considerable extent upon the location and upon the species. The epithelioma of the face and lips has a low grade of malignancy, while the soft glandular carcinoma is perhaps the most malignant disease encountered.

Mixed and Multiple Tumors.—Mixed tumors such as

adeno-, fibro-, osteo- and condro-sarcomata and the scirrhus cancer may be due to one of two conditions. It may be said that pure tumors in the sense that they contain only the histological structure or structures characteristic of the growth are extremely rare. A mixed tumor so-called may be caused by the cells of the malignant growth insinuating themselves into, and enveloping thereby, portions of the adjacent tissue, whether this be glandular, fibrous, muscular, or bony; or in consequence of the irritation of adjacent connective tissue incident to the new growth there may be a decided proliferation of connective tissue cells resulting in a growth of new connective tissue which goes to form a part of the tumor. Probably both of these conditions occur to a greater or lesser extent in every new growth. In a scirrhus the epithelial cells insinuate themselves into the surrounding adjacent tissue which goes to make up the stroma of the neoplasm. At the same time these cells in their growth irritate the tissues and produce a new connective tissue growth. It is a curious coincidence, and one but very rarely observed, that different portions of a tumor may not only represent different tissue but one portion may be sarcomatous while the other is carcinomatous. Wells reports the case of a dog with a malignant growth in the thyroid gland. The metastases from this growth were mixed, in part sarcomatous and in part carcinomatous. Wells also found in the literature reports of 17 cases in all of which the individual was simultaneously affected with primary sarcoma and carcinoma.

Malignant tumors are occasionally found in juxtaposition to benign. A few days since the writer did a vaginal hysterectomy for carcinoma of the endometrium of the uterus and found embedded in the fundus two small myomata. Malignant tumors as a rule are single, but there are a few instances on record where they have been primarily multiple. Schimmelbusch has collected several cases. They have been most common in the skin and may develop from the irritation of soot, or tar, in paraffine workers, and in ulcers of the leg. Sar-

comata in skin, periosteum and bone-marrow sometimes appear in multiple form.

DIAGNOSIS.—This subject will be taken up more in detail during the consideration of each individual species of malignant growth. It may be stated, however, that the sarcomata, including the endotheliomata, often occur in childhood, in young adults, or in middle life and that they produce tumors often of rapid growth and those which reach a very considerable size. The spindle-celled sarcoma situated often between the muscles or between fascia has a slow growth and semi-benign nature. The giant-celled sarcomata taking origin often from the medulla of bone also have a slow growth and at times a semi-benign character. The round-celled sarcomata taking origin in almost every kind of connective tissue have often an extremely rapid growth and produce tumors which in a short time reach a large size. These growths are frequently extremely malignant.

In making up a diagnosis it is important to bear in mind the tissues from which a tumor springs. The sarcomata take origin from the connective tissue which is found everywhere throughout the body, while the carcinomata take origin from epithelial cells and may be found on surfaces or in organs or areas which contain these cells. A tumor of bone, muscle, cartilage, nerve or connective tissue cannot be a carcinoma because these structures do not contain epithelial cells, but it may be a sarcoma. The sarcomata do not often, comparatively speaking, take origin within glandular structures such as the liver or mammary gland and they are seldom found growing from the gastro-intestinal canal or skin. The carcinomata, on the other hand, frequently take origin in the epithelial cells of the skin or mucous membrane, as well as from the glands directly connected with these structures. The carcinomata are found with great frequency in the mammary glands, liver, and in the uterus; while both carcinomata and sarcomata are found in the kidneys, testicles and ovaries. With comparatively few exceptions the sarcomata produce

larger and much more rapidly growing tumors than do the carcinomata. In fact in a great many of the carcinomata such as the epitheliomata no distinct tumor is produced, simply an ulcer such as occurs upon the lip, upon the surface of the skin, within the tongue, and often in the gastro-intestinal canal and uterus. Carcinoma of the mammary gland of many years' growth is often not more than a shrivelled node. The medullary carcinoma as it occurs in the breast, liver, kidney, testicle, and intestine may produce a rapidly-growing and large tumor. In the gastro-intestinal canal it is comparatively rare for a growth to reach any considerable size. Situation and size, then, are pronounced characteristics which may be considered in making up a diagnosis. Fever is also present in the majority of rapidly-growing malignant tumors. A fever of a degree, or a degree and a half, is the rule. Metastases, immobility, want of capsule, destruction of tissue, cachexia, pain and loss of flesh are also to be taken into consideration.

PROGNOSIS.—It may be stated that the prognosis of malignant tumors is always unfavorable. This, however, is dependent very largely upon the genus, species, and the situation of the tumor. It is also influenced by the age of the patient and is especially dependent upon the treatment.

TREATMENT.—Every malignant growth should, if its situation will permit, be removed at the earliest possible moment. Believing as we do that malignancy is primarily a local disease if removal can be effected before regional infection or metastases, have occurred the prospects of a cure are excellent. The various methods of treatment have in a previous chapter been considered. It may be well here to state that early removal by the knife of all malignant growths is to be recommended. Those situated superficially, as in the skin, may be destroyed, and perhaps without causing much disfigurement, by the use of the curette and pastes. Richet and Hericourt have inoculated animals with the fluid obtained from malignant growths and then injected

the serum from these animals into persons suffering from cancer and claim that a lessening in the size of the growth has been observed. In carcinomata of the skin, in inoperable carcinomata, and for recurrent carcinomata the X-ray is being used seemingly with gratifying results. In inoperable cases Nussbohn uses the thermo-cautery. It is claimed by this method the pain is relieved, the growth diminished and ulceration and decomposition checked. Massey claims excellent results in the treatment of sarcomata and carcinomata by electric sterilization. The salts of mercury and zinc are introduced into the tissues of the growth by means of electricity passed through fine needles, the process being known as cataphoresis. Adamkiewicz manufactures a substance which he calls cancroin and which he injects directly into the malignant growth. He claims that cures may be effected by this remedy.

CHAPTER XXIII.

THE SARCOMATA.

A sarcoma may be defined as a malignant tumor taking origin from connective tissue. The cells of a sarcoma are immature or not fully developed connective tissue cells. The principal subdivisions according to the form of the cell are the round-, spindle-, and giant-cell sarcomata. The round-cell is still further subdivided into the small and large cell, round-cell sarcoma. The small-cell, round-cell sarcoma is made up of extremely small cells which resemble in size the white blood corpuscles or the cells of adenoid tissue. The growths composed of round cells have as a rule very little stroma or inter-cellular substance, the cells being placed almost directly upon each other. The tumors are soft, richly supplied with blood, grow with great rapidity, may reach a large size, are not encapsulated and are among the most malignant of all the malignant growths. They grow from intermuscular, subcutaneous and submucous tissue, from lymphatic glands and nodes, from the kidney, testicle, and occasionally, but rarely, from the liver. They usually have a pretty uniform consistency, barring degeneration and the formation of cysts, and present on section a grayish-white, yellow, or a faint reddish appearance. (See Plate, Fig. 160.)

The Large-cell, Round-cell Sarcomata.—These tumors, like the small, round-cell, are composed largely of cellular elements having little stroma or inter-cellular substance. The cells are round or oval and contain one or more nuclei. They are often spoken of as epitheloid cells. Both the stroma and intercellular substance, however, vary in different tumors, and may vary in different parts of the same

tumor. They have a rich blood supply, are soft, grow rapidly and form large non-encapsulated tumors. They do not, however, grow as fast as the small, round-cell, and are not ordinarily as malignant in that they do not infiltrate or invade the adjacent tissue as readily or produce in a short time as large and varied metastases. These tumors are found with especial frequency growing from intermuscular connective tissue, from non-striated muscles, and from the uterus or from uterine myomata. (See Plate, Fig. 161.)

The Spindle-cell Sarcomata. — This species is also divided into two subdivisions, the small and large spindle-cell sarcomata. The small-cell, spindle-cell sarcoma is is made up of very small, short, slender cells which are often arranged longitudinally with the blood vessels. There is usually but little inter-cellular substance, the cells being bound together in bundles by a delicate stroma of connective tissue. The tumors are quite hard, resembling closely in consistency an ordinary dense fibroid. They have only an indifferent blood supply and consequently grow slowly. They have usually, at least primarily and before degenerative processes have occurred, a uniform consistency and are the most benign of all malignant growths in that they are frequently distinctly encapsulated, do not invade, at least to any extent, adjacent tissues, but push them to one side, and only rarely and at late periods produce regional or metastatic infection. They seldom reach, unless after some years of growth, any great size. They take origin from fascia, the walls of blood-vessels, from nerve-sheaths, the skin and subcutaneous and submucous tissues. (See Plate, Fig. 162.)

The large-cell, spindle-cell sarcoma is composed of large, spindle, or oatmeal-shaped cells, which have an oval-shaped nucleus and contain a large amount of protoplasm which may be finely granular or finely fibrillated. The stroma and inter-cellular substance varies greatly. They usually have a greater amount of inter-cellular substance than has the small spindle-cell sarcoma and the stroma may be

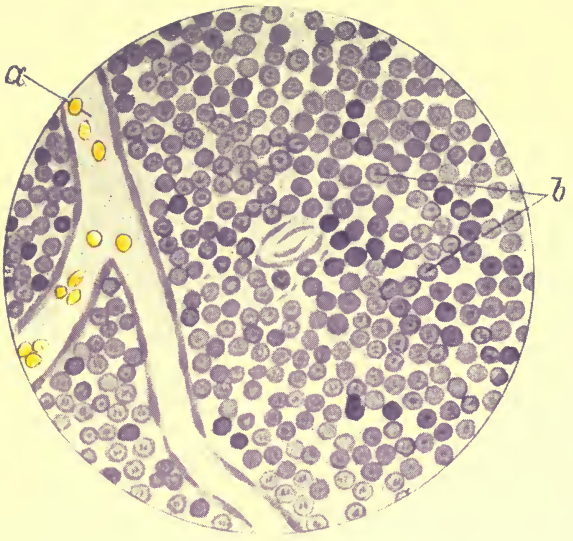


FIG. 160.

Small Round-Celled Sarcoma.

a, Capillary lined by endothelial cells.
b, Round cells.

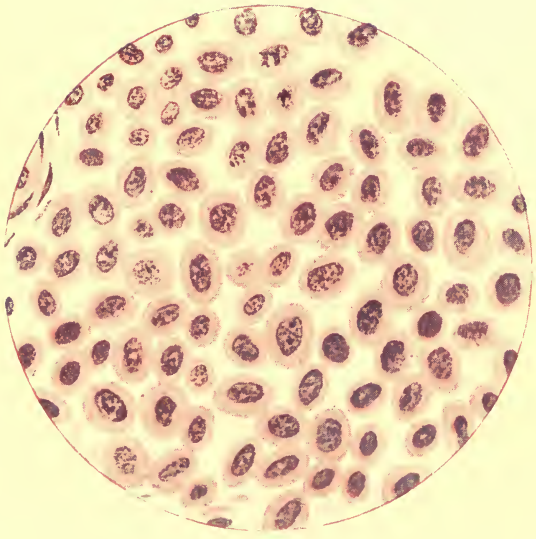


FIG. 161.

Large Round-Celled Sarcoma.

very considerable. They often form large, round, or bossed tumors which may for years be of slow growth and then in consequence of some intercurrent complication take on a rapid increase in size. They are primarily of uniform consistence but like all sarcomatous growths may be the site of cystic formations in consequence of degeneration or hæmorrhage, or both. They are of more rapid growth and also more malignant than the small spindle-celled sarcomata. They are most frequently found growing from fascia, periosteum, subcutaneous connective tissue or from inter-muscular tissue. They seldom take origin from the connective tissue of glands or organs. They are quite frequently encapsulated and may for many years manifest none of the characteristics of malignancy. (See Plate, Fig. 163.)

The Giant-cell Sarcomata.—The cells of this species are very large, usually irregular in form and flat. They contain many nuclei, occasionally as many as 100, the nuclei being arranged often around the circumference of the cells as in a giant cell of tuberculosis. It is seldom in this species that the giant cell is found entirely alone, but it is usually in connection with either the spindle or round-cell or with both, the giant cell simply predominating. They form soft, non-encapsulated tumors, which take origin either from the periosteum or medulla of bone. Being non-encapsulated they invade and destroy adjacent structures and produce regional infection and metastases. They usually grow slowly and are perhaps most often found in connection with the lower jaw, but may be found taking origin from almost any bone in the skeleton, but especially from the ends of the long bones, as the lower end of the femur or upper end of the tibia. They are more malignant than the small spindle-cell, but less malignant than the round-cell sarcomata. (See Plate, Fig. 164.)

The Inter-cellular Substance. — In all sarcomatous growths there is a varying amount of inter-cellular substance. This may be homogeneous, granular, or finely fibrillated. In very rapidly growing tumors, as in many of

the round-cell sarcomata, the inter-cellular substance is extremely limited, the cells seemingly being placed directly one upon the other, while in some of the more slowly-growing tumors, and especially in some of the mixed growths as in the myxo-sarcomata or chondro-sarcomata the inter-cellular substance makes up almost the major portion of the tumor. It must not be held, however, that tumors which contain a considerable amount of inter-cellular substance are necessarily only mildly malignant because many of the myxo- and chondro- sarcomata show in their metastases and effects upon the system characteristics which indicate extreme malignancy.

The Stroma.—The stroma of a sarcomatous growth while differing greatly in amount, forms as a rule but a very small portion of the tumor. It is composed of fibrous or connective tissue in which are more or less of spindle cells. The stroma makes up the capsule, when one is present, from which it permeates to some extent the growth, giving it what little supporting structure it has. The stroma of a sarcoma is largely new-formed, it does not keep pace in growth with the proliferation of the cellular elements, consequently these growths, especially those which increase rapidly in size, have but very little stroma. That which is new formed comes very largely from the blood vessels. The stroma may, however, be in part pre-existant, and this is especially true in tumors which infiltrate adjacent connective tissue, which tissue then comes to form a part at least of the new growth. A stroma may also be formed as the result of the irritation of the growing cells upon the adjacent tissue.

The Blood Vessels.—In a benign growth the blood vessels on reaching the capsule break up into numerous branches which permeate and are supported by the trabecular processes given off from the capsule. In this way they reach every portion of the growth. In a carcinoma they reach the interior of the growth through, and are supported by, the stroma. In a sarcoma there is ordinarily very little stroma, consequently few or almost no trabeculæ. The vessels then,

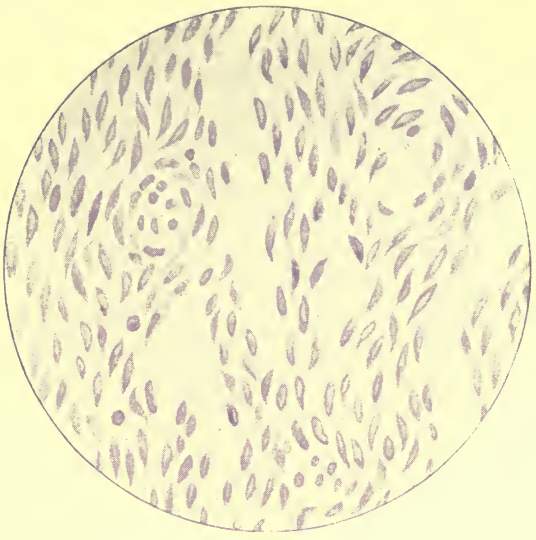


Fig. 162.

Small Spindle-Celled Sarcoma.

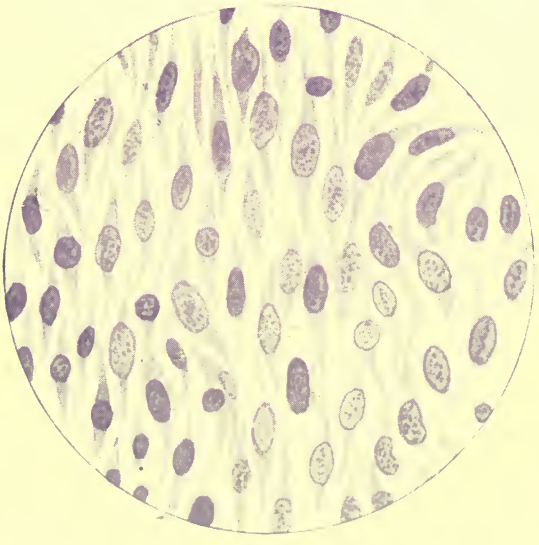


Fig. 163.

Large Spindle-Celled Sarcoma.

instead of being supported by a connective tissue stroma or by trabeculæ, permeate the growth between the individual cells which are placed upon and proliferate directly around the vessels. The only support which the vessels receive is then the soft cells of the part. The vessels are generally new formed and are then made up of a single layer of endothelial cells upon which the sarcomatous structure is built. In many cases the blood courses through channels or canals hollowed out of the growth and which have no distinct coat but are lined simply by the cells of the new growth. In other instances the vessels may be in part at least pre-existant, in which case they possess the three coats of a normal vessel. The fact that the vessels of a sarcoma are not supported by stroma as in other tumors, and the further fact that they usually have but a single coat or often no coat at all, explains the great frequency in these growths of hæmorrhage and cystic formations.

The Lymphatic Vessels.—It is ordinarily held by the majority of pathologists that there are few or no lymphatics in sarcomatous growths. Borst, however, states in his work on tumors that he finds in sarcomatous growths clefts and canals in direct relation with and a part of the lymphatic system. The writer has already expressed himself, and very decidedly, to the same effect. We must also, I think, admit that the not unfrequent implication of lymphatic glands adjacent to, and even distant from, sarcomatous growths, tends very strongly to establish the fact of the presence of lymphatic vessels in these tumors.

Development of Sarcomatous Tissue.—It has been already stated that sarcomatous tissue may take origin wherever connective tissue is to be found, According to the Cohnheim theory this tissue is always embryonal in character and occurs as rests of embryonal cells or as vestiges of congenital structures. Ackerman holds that the sarcomata do not have their origin in embryonal rests, but from the connective tissue cells of the part as occurs in a regenerative process, and that the

commencing of a sarcoma is like that of an inflammatory process. Borst holds largely to the Cohnheim theory. He believes that sarcomatous growths are never produced out of mature connective tissue, by the process of metaplasia, but that the immature embryonal cells which under ordinary conditions might form a fibroma are arrested in their development at a stage higher than embryonal tissue, but lower than fibrous or fatty, or myxomatous tissue, and thus come to be sarcomatous in nature and form a sarcoma. He believes that the round-cell or spindle-cell or giant-cell sarcoma had it not been arrested in its development might have become any one of many benign tumors. It has, however, long been held by many pathologists and embryologists that the cells of a tumor belonging to a particular species might be converted into another species of the same or a different genus by the process of metaplasia. At least three cases have recently been observed in which the mature cells of benign connective tissue tumors have been converted into the cells of a sarcomatous growth. One such case, but a few weeks since, came under the writer's observation. A woman fifty-eight years of age had suffered from gradually increasing myomata of the uterus for the past ten years, but had remained in good flesh and in reasonable health until the last six or eight months when she developed an infiltrating and rapidly growing tumor within an old umbilical hernia and also a soft, rapidly growing and irregular mass filling Douglas' pouch and obliterating in part the vaginal canal and also the rectum. The patient was subjected to a laparotomy and the growth at the site of the umbilical hernia found in direct connection with an outgrowth from the uterus, while the large, soft, cellular mass filling Douglas' pouch and the major portion of the pelvis was also an outgrowth from the uterine myomata. The myomata were of large size and nearly filled the abdomen and by macroscopic and microscopic examination it seemed evident that the cellular elements of the myomata had been converted into sarcomatous

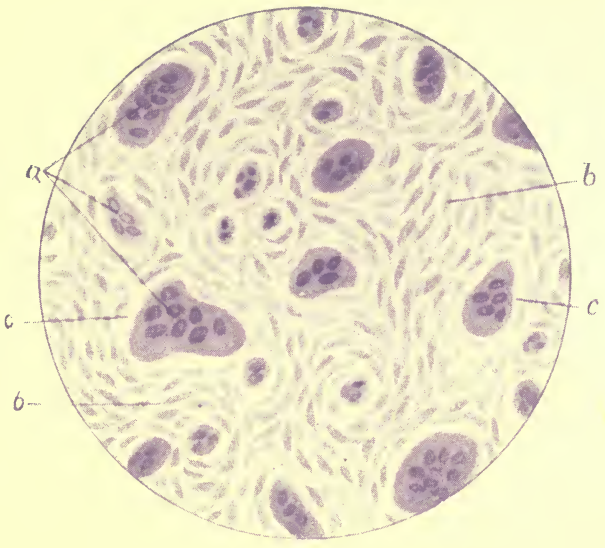


FIG. 164.

Giant-Celled Sarcoma.

a. Giant cells.
b. Small spindle-celled stroma.
c. Peri cellular space.

elements going to make up the umbilical and pelvic masses. In this case there was a gradual transition from normal muscular tissue into atypical muscle cells. (See Plate, Fig. 165.) A case was recently operated by Dr. Fenger and designated by him a myoma sarcomatosum in which a uterine myoma had gone over into a sarcoma. The case in brief was as follows: A woman having reached the menopause and having a uterine myoma of only medium size was advised to wait developments before undergoing operative measures. For ten or twelve years the tumor made no perceptible headway and then at once it commenced to grow rapidly. Dr. Fenger removed the growth and found that the myoma had been converted into a sarcoma.

A case has also recently been reported in the *Journal of Pathology* in which a myoma had gone over into a sarcoma by the process of metaplasia. It is not improbable that in some cases the process corresponds very closely to that which occurs in inflammatory processes in that the connective tissue cells lose their prolongations, are converted into round cells, and form granulation or embryonal tissue and then are, or may be, converted into almost any form of connective tissue, benign or malignant.

Degenerative Processes.—Fatty degeneration of the cellular elements and inter-cellular substance is of frequent occurrence in sarcomatous growths. As a result of this degenerative process and also in consequence of more or less absorption of the products, cavities or cysts are formed within the growth, both large and small, blood vessels or blood channels are opened and hæmorrhage into the cavities or cysts occurs. Hyaline and myxomatous degeneration also occur as well as the building of vacuoles in the cells. Ulceration or necrosis of a considerable portion of the growth may take place in consequence of pressure or infection, and following these processes septicæmia or pyæmia may develop.

Thrombosis and Embolism.—These processes are of frequent occurrence in sarcomatous growths and are the direct

result of the relation between the blood vessels or blood channels and the specific cells of the tumor. Single cells or an aggregation of cells forming a thrombus may frequently be seen in the capillaries or blood channels of these growths. The occasion of this is easily understood when we recall the fact that the capillaries have but a single endothelial lining and upon this the tumor cells are placed, while in other cases the cells of the growth make up the walls of the blood channels. In most instances the sarcomatous cells can readily, as the result of pressure or injury or the force of the blood current, gain an entrance to the circulation and produce a thrombus. Portions of such a thrombus may readily be detached, forming an embolus which is swept away in the current to some distant part where it produces, or may produce, a new growth.

Regional Infection.—Sarcomatous tumors being, as a rule, non-encapsulated, have no distinct limiting border and consequently infiltrate the adjacent structures. They do not, at least to any marked degree, produce regional infection through the lymphatics as do carcinomatous growths. In their growth and in consequence of their rapid cell proliferation they infiltrate the connective tissue spaces and extend along the adjacent anatomical planes. It is not, however, so very unfrequent to find the lymphatic glands, situated in the course of the lymphatic current, enlarged and infiltrated with sarcomatous elements. This is notably the case in sarcomata of the tonsil and of the testicle, and the writer has frequently observed the same infection of the lymphatic glands from sarcomatous growths situated in other tissues. In the case of a large sarcoma of the tibia the inguinal glands upon the same side were enlarged and required removal, and in the case of a very large and rapidly growing endothelial sarcoma of the mammary gland, the axillary glands were implicated. In a lympho-sarcoma the involvement of the adjacent lymphatic glands is the rule.

Metastases.—Metastases in internal organs or in distant tissues very frequently occur in sarcomatous growths and usu-

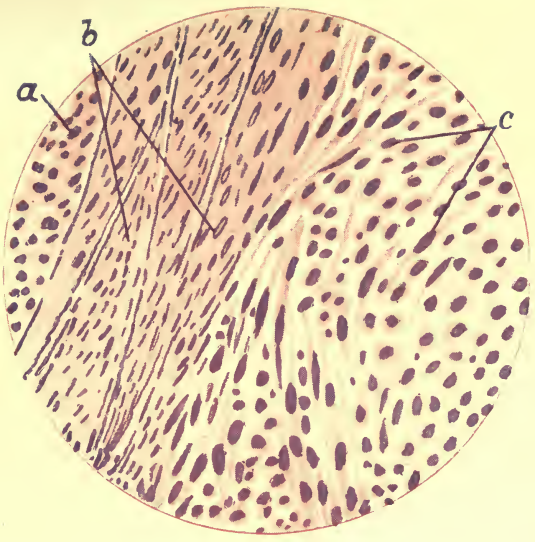


Fig. 165.

Muscular Tissue of a Myoma, going over into Sarcomatous Tissue, by Process of Metaplasia.

a. Muscle fibres cut across.
b. Muscle fibres cut diagonally and longitudinally.
c. Sarcoma cells.

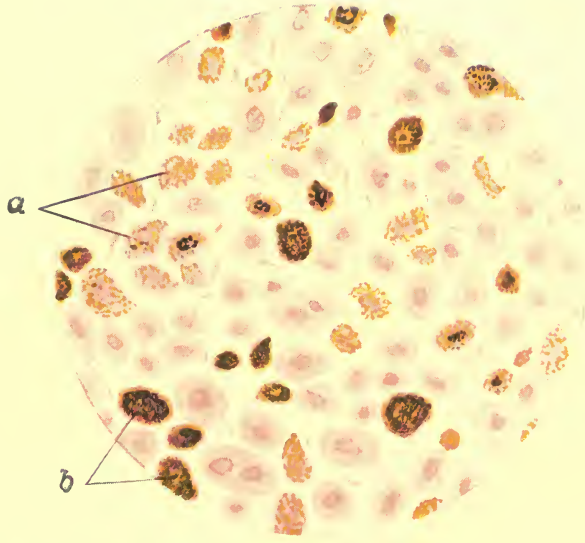


Fig. 166.

Melano–Sarcoma.

a, Slightly pigmented cells.
b. Deeply pigmented cells.

ally through the blood vessels. A number of cells, or groups of cells, gaining an entrance to the venous return current are carried to the right side of the heart and from there sent to the lungs, where they meet the first set of capillary vessels. Experience teaches that they are most often arrested in these capillaries and produce metastatic growths within the lungs. Should they pass, however, the capillaries in this situation they then reach the left heart and the general arterial current, and the distant viscera and tissues of the body. They most frequently, however, after the lungs, find an abiding place in the liver, spleen, kidneys, brain, subcutaneous tissue or medulla of bone. I have seen a dozen or more of these metastatic growths occur subcutaneously in an advanced stage of sarcomatous infection, while at the same time many of the long bones were the site of excessive pain from growths in the medulla. If arrested in any of these situations and finding soil and conditions favorable for growth they produce therein a metastatic tumor which corresponds in all essential particulars, such as structure and malignancy, with the primary growth.

Multiple Primary Growths.—Multiple primary benign growths are of frequent occurrence; multiple primary malignant growths are among the pathological curiosities. Sarcomata, however, occasionally occur as multiple primary growths and when so occurring have been most frequently found in lymphatic glands, in the bones, and in the skin.

Consisteney and Form.—The sarcomata although not encapsulated are nevertheless sufficiently defined so as to produce a distinctive tumor. They present usually a round, globular or somewhat irregular or bossed surface. In consistency they vary greatly. The round-celled, rapidly-growing sarcoma is extremely soft and almost semi-fluctuant, while the spindle-celled sarcoma has ordinarily the hardness of the common fibroid or myoma. The chondro-sarcoma and the osteo-sarcoma, or osteo-chondro-sarcoma, taking origin from bone or periosteum and made up of spindle or mixed cells, in

which there are areas of bone and cartilage, have often almost the hardness and density of cartilage or bone. There is, however, one extremely characteristic point relating to the consistence or hardness of a sarcoma and that is the fact that they are almost never of uniform hardness. At various areas they are quite hard and perhaps somewhat irregular and then one suddenly comes upon a fluctuating cavity or cavities which are scattered over the surface and through the tumor and which vary greatly in size and shape. They are the result of the softening of the constituents of the tumor and of hæmorrhage into the cavities thus formed and are present in nearly every sarcoma of any considerable size or duration of growth.

Rate of Growth.—Round-cell sarcomata often have an extremely rapid or mushroom growth, attaining the size of an infant's or an adult's head within two or three months. On the other hand, the spindle-cell inter-muscular sarcoma may require from two to three years to reach the size of an orange. The sarcomata as a rule, however, grow rapidly and produce large tumors in a short time. On section they may be seen to contain indistinct trabeculæ of fibrous tissue between which are great masses of cells or large and small cavities filled with disintegrated cells and blood.

Color.—This is often on section a dirty grayish-white. It may have a decided yellowish tinge or be of a reddish hue. In the pigmented variety the color may be dead black, brown, or a yellowish brown, while in parts of the growth the color is quite normal.

Mixed Forms.—It often occurs in the formation of a sarcomatous growth that there is a sufficiency of tissue which goes on to full development so as to produce a mixed tumor. One of the most important of these is the lympho-sarcoma first described by Billroth. These tumors occur most frequently in the lymphatic glands and are made up of small, round cells between which there is a fine reticulum of connective tissue. They may also occur in the adenoid tissue of the nose, in the gums, tonsils, spleen, submucous tissue and

in the medulla of bone. They may also be composed in part of large round cells or of spindle cells. This form of growth frequently starts in the glands of the neck and shows a high degree of malignancy in that the lymphatic glands in the immediate vicinity and often those remotely situated are quickly implicated, thereby producing large masses of glandular structure in a short time. There is also as a rule early metastases. The condition commencing on one side soon invades the major portion of the glands of that side and in a short time implicates also the glands of the opposite side. Following this the glands in the axillæ may become infected and then those in distant regions. It would seem as though occasionally a chronic lymphadenitis was converted into lympho-sarcomatodes. I recently operated upon a case in which for many years there had been a few enlarged glands in the lower anterior triangle of the left side of the neck. During this time the patient presented the appearance of excellent health. Some few months since one of these enlarged glands took on an active suppurative process, the pus being discharged through the skin. Following this the enlarged glands which remained were removed by the attending physician partly by enucleation and in part by curettage. The process now became acute and a hard, indurated mass quickly occurred filling and bulging from the lower posterior triangle of the neck and extending beneath the clavicle and from the sterno-cleido-mastoid to near the acromion process. The mass extended backwards filling the supra-scapular fossa and upwards producing a very considerable tumor. Everything in this region, glands, muscles and fascia, were in one solid, inseparable, hard mass. At one point, however, there was fluctuation and this area was filled with pus and blood. Upon the same side of the neck beneath the lower jaw and extending to the mastoid were several entirely separate and much enlarged glands. One as large as an English walnut contained a quantity of purulent material. Upon the opposite side of the neck there was a chain of en-

larged glands extending from the parotid to the clavicle. In the axilla and beneath the pectoral muscles of the left side the glands were also enormously enlarged, requiring for their removal section of the pectoral muscles. The individual glands were enucleated with comparative ease. The mass upon the left side extended so far downwards within the apex of the chest, that its entire removal seemed an anatomical impossibility. All but the deepest portion of the growth, however, was excised. A distinction is made by some pathologists between this form of growth, which they call "generalized lympho-sarcoma" and that form which occurs in single glands and is called "solitary lympho-sarcoma." The hardness in these growths is largely due to a new growth of dense, fibrous tissue.

Several cases of lympho-sarcoma taking origin in the glands of the neck and producing an extensive glandular infection, as in the case narrated, have come under the writer's observation.

The lympho-sarcomata cannot primarily be differentiated from a tubercular process in that for a time the disease produces only an enlargement of the lymphatic glands which is not pathognomonic, but as the condition progresses the infectious material from the glands breaks through the capsule and grows into the adjacent structures infiltrating them, effacing absolutely not only the outlines of the glands, but also the anatomical lines, and converting glands, connective tissue, vessels and muscles into one hard, often immovable mass. In the later stages in consequence of this infiltration and matting together of all the anatomical structures of the part, in consequence also of the excessive hardness of the growth and the enlargement of the glands adjacent thereto, the diagnosis should be readily established.

I have encountered a very considerable number of cases of lympho-sarcomata occurring in persons who have passed the meridian of life, and the majority have been operated

upon during the early stages under the mistaken belief that the condition was one of tuberculosis.

Melano-sarcomata.—The melano-sarcomata occur in tissues which are normally pigmented, as in the skin and the choroid of the eye. It is probably true that in these conditions the connective tissue primarily implicated gets its pigment from the adjacent epithelial cells and thereafter is capable of reproducing this pigment as the cells prolifer ate. The condition often occurs in pigmented nævi and in moles and frequently produces metastatic deposits in the subcutaneous tissue, in lymphatic glands, in the viscera and in the periosteum or medulla of bone.

The cells of a melano-sarcoma are usually spindle-shaped or epitheloid. The stroma often separates or encloses the cells in alveoli. These tumors are usually very soft, grow quite rapidly and are extremely malignant. In color the tissue is often as black as ink. This, however, varies and may be brownish or portions of the growth may be quite colorless. Much of the tumor is in a fluid condition and if a gland is broken in the process of enucleation its black contents will often flow over the adjacent tissues staining them black. (Plate V, Fig. 166.)

Lipo-sarcoma.—This condition is really the result of an nfiltration of fat into the cells of a round-cell sarcoma. The fat may occur in single or multiple separate drops or may fill and distend the cells, so that the nucleus is pressed against the border. The condition must be differentiated from fatty degeneration in which the protoplasm of the cell is converted into fat.

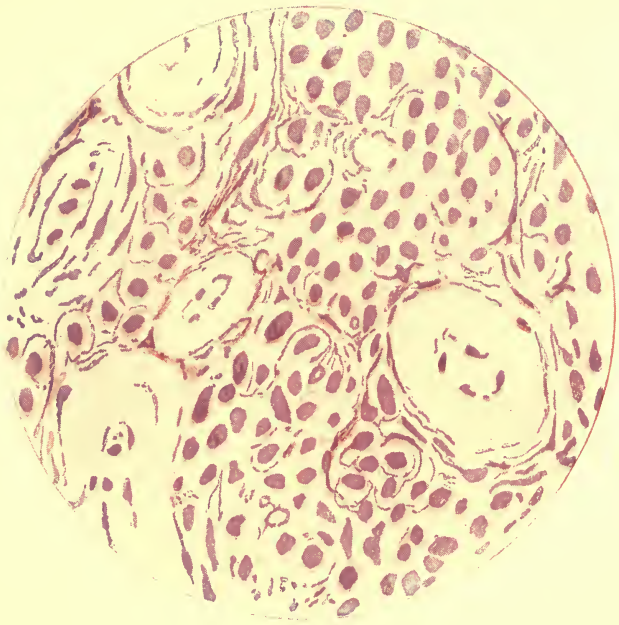
Lipo-sarcomata occur in the subcutaneous and intermuscular tissues and have practically the malignancy of a round-celled sarcoma.

Chondro-sarcomata.—This mixed form of sarcoma is found in connection with bone. The cartilage cells are usually not typical and may be round, spindle, or of various forms. The cartilaginous structure may be so small that it is only capable of detection by the use of the microscope or it may be pres-

ent to such an extent as to form a considerable part of the tumor. The cartilaginous spaces which normally contain one or at most two cells, often hold groups of cells, and the intercellular structures—the trabeculæ—are in some cases more or less absorbed, throwing several cartilaginous spaces into one. These growths are decidedly malignant. They grow rapidly and may produce large tumors within a few months. They occasionally are quite soft, but ordinarily present the hardness of cartilage over certain areas or over the major portion of their surface. They occasion metastases, both in the lymphatic glands and in the inter-muscular spaces.

Osteo-sarcoma.—An osteo-sarcoma is in reality often an osteo-chondro-sarcoma in that both osseous and cartilaginous tissue is present in connection with sarcomatous elements. The sarcoma may be composed of round, spindle or giant cells. The bone in these cases is not typical in that there usually are no lamellæ and only irregular or ill-developed bone or areas of calcified tissue. The production of bone perhaps in some of these cases may be the result of reactionary or inflammatory proliferative processes. These growths also come from periosteum or bone. The color is like that of a chondro-sarcoma, is grayish or reddish white and their consistence, while very much exceeding that of the ordinary fibroid, shows areas of degeneration and cystic formation. Its malignancy is practically the same as the chondro-sarcoma.

Fibro-sarcomata.—These tumors are composed of fibrous tissue and sarcomatous elements in varying amounts. According to Borst this form of growth should have gone on and produced a fibroma, but portions of it were arrested in an undeveloped state and these have resulted in sarcomatous tissue. The fibro-sarcoma represents a richness of cells which is never present in a fibroid growth, and while in the cells of a fibroid the protoplasm is never absent, in the cells of a sarcoma it may be. This form of growth is found taking origin from the cutaneous and subcutaneous tissues, from fascia,



Angio-Sarcoma with Hyaline Degeneration
of Walls of the Blood Vessels.

tendon sheaths, ligaments, and periosteum. It produces growths which correspond in a measure to the spindle-celled sarcomata in that they are quite hard, round, often bossed growths which manifest only mild malignancy and which grow slowly. They are also late in producing metastases.

Myxo-sarcomata.—This again should have been, according to Borst, a myxoma if it had gone on to full development. These growths are made up of fully developed myxomatous tissue and sarcomatous cells. They are soft, more or less translucent, jelly-like masses of tissue in which the sarcomatous elements may be round, spindle, or giant cells. They take their origin from the connective tissue of mucous membranes, from subcutaneous and submucous tissues, from the periosteum, inter-muscular tissue, from nerve sheaths and the marrow of bone. They are richly supplied with blood vessels, grow rapidly, and often bleed freely. They form numerous metastases and are quite malignant in their tendency.

Angio-sarcomata.—Many of the angio-sarcomata come under the head of endothelial growths. A typical angio-sarcoma or a telangiectatic growth is composed of blood vessels or blood spaces, a stroma and round, spindle or mixed cells. They may take origin from the outer wall of the blood vessels. The growths are found most frequently in the subcutaneous and inter-muscular tissue. The tumor grows rapidly, often pulsates vigorously and has an enormous blood supply, in that it is composed largely of blood vessels. They do not possess even the semblance of a capsule and have but little stroma and are soft, often rapidly growing malignant tumors.

Alveolar Sarcoma.—This form of sarcoma is composed of round, spindle or mixed cells enclosed in alveoli. Each alveolus may contain but a few or many cells while between the cells is a faint amount of inter-cellular substance. The wall of the alveolus comes from the stroma and may be composed of but a few delicate strands of connective tissue or of a very considerable band of tissue. They are at times

difficult to differentiate from the alveolar carcinoma, but the carcinoma has no inter-cellular substance, the absence of which can readily be shown by penciling the specimen. They occur in the lymphatic glands and in inter-muscular tissue.

CHAPTER XXIV.

GLIO-SARCOMATA.

These are malignant growths taking origin in the connective tissue of the brain and spinal cord, and while found most frequently within these structures are also found in the pia mater and in the eye. The growths are richly cellular, freely supplied with blood, grow rapidly and are quite malignant. Histologically they are composed of small round cells of various sizes, also spindle cells, giant cells, epitheloid cells and polymorphous cells, the latter having many nuclei and all intermingling with the glia cells of the neuroglia. Tumors taking origin from the pia mater or from the retina are composed, as a rule, of round cells placed in cylinders about the blood vessels. The arrangement is perivascular. In a glio-sarcoma the cells, according to Borst, do not come from the previously existing glia cells but are newformed cells which infiltrate the adjacent neuroglia tissue. In consequence of the many variations in the form of the cells in these growths and their rapid proliferation, the processes which are ordinarily found making up the brush and spider cells in neuroglia tissue are not present to any considerable degree or are entirely absent. The glio-sarcoma in the eye comes, according to Borst, from the pia mater and takes its origin in unused or unripe embryonal tissue.

The sarcomata and glio-sarcomata comprise about thirty per cent. of all the brain tumors.

Chloroma.—This is a rare sarcomatous growth composed of large or small cells having a single nucleus. It has a delicate reticulum resembling that which occurs in a lymphoma and a color which is characteristic, being often light or dark

green, gray, or yellow. The coloring matter situated within the cells, is highly refractive and seemingly combined with fat. The condition in some way resembles leucæmia in that the red blood corpuscles are diminished. The growths are found taking origin from the periosteum and the medulla of bone, most frequently from the periosteum of the skull, but they have been found in connection with the periosteum of the vertebræ, humerus and ribs. They have also been found in the orbit and in the sinuses of the dura-mater as well as in the lymphatic glands. They produce thin, flat growths which extend under the periosteum. Metastases occur in the kidneys, spleen and the liver. In their growth and effects upon the system they present the characteristics of an ordinary round-cell sarcoma.

Diagnosis of Sarcomatous Growths.—There are certain conditions which should be taken into consideration in the diagnosis of a sarcomatous growth. One of these is the age of the patient at which the growth makes its appearance. The sarcomata are of frequent occurrence in childhood and may even occur in infancy, but they are most frequent during young adult life, from fifteen to thirty years of age. It is quite true that they may occur in old age or during the decline of life, that is in senile tissue, but this is rare. One should remember that sarcomatous growths always take origin from some form of connective tissue, and that although this tissue is pretty widely distributed, this fact, nevertheless, aids one very materially in making a diagnosis as well as in differentiating them from the malignant growths which spring from epithelial structures.

Rate of Growth and Size.—While the rate of growth varies seemingly for the different species and again for the same species in different situations and in different individuals, it may unhesitatingly be stated that the sarcomata have a much more rapid growth than do the benign tumors. They also in the extremities when taking origin from bone or periosteum, from intermuscular tissue, fascia or subcutaneous tis-

sue, produce tumors which reach a much greater size than is the case with benign growths taking origin in these same situations. A large tumor then taking origin in an extremity or from a bone and having a reasonably rapid growth, is almost from necessity a sarcoma. The same may be true, although not to quite the same extent, of large tumors in the mammary gland. The rapidly growing tumors of the kidney, testicle, tonsil and even of the uterus, those which attain in a short time a large size, are, with few exceptions, sarcomatous in nature.

Consistence.—The consistence of sarcomatous growths varies greatly. The round-cell, rapidly-growing tumor is so soft that it may seem to be semifluctuant, while the slowly-growing spindle-cell sarcoma is almost, if not quite, as hard as a hard fibroma, and the chondro- and osteo-sarcomata, especially those which contain much cartilage or osseous tissue, are almost as hard as the structure from which they take origin. There is, however, one condition in the consistence of a sarcoma which is peculiar and to a certain extent pathognomonic in that as the result largely of degenerative processes and the peculiar lack of support given the blood vessels or blood channels, hæmorrhage occurs into the softened areas and cysts are produced. In palpating a sarcoma situated near the surface, and especially one which has reached any considerable size, there are to be found areas which are hard, with surfaces perhaps irregular and nodular, and then between these one finds cysts scattered over the surface of irregular size and distinctly fluctuant. While this condition is not present in every growth, it is so generally present and consequently so characteristic of sarcomata that it may be considered peculiar and of great diagnostic importance and even pathognomonic.

Fixity.—The round and giant-cell sarcomata which infiltrate the adjacent tissues, have no distinct border or capsule and are fixed, in the sense that they are inseparable from and immovable in the adjacent healthy tissue. If growing

subcutaneously, they become sooner or later attached to the skin, while they constantly invade and insinuate themselves into the spaces and along the muscular and fascial planes of the adjacent tissue. The spindle-cell sarcomata growing from fascia, intermuscular and subcutaneous tissue and occasionally even when growing from the periosteum, often are distinctly encapsulated and consequently freely movable within their capsule and are only indifferently connected with the adjacent tissue and may be shelled out with comparative ease. Of course it is understood that histologically they are not distinctly encapsulated in that the specific cells of the growth to a limited extent pass through the capsule and invade the adjacent tissue.

The Capsule.—This is only to be found in the spindle-cell sarcoma and may be in part new tissue resulting from the irritation of the rapidly proliferating tumor cells, but it is largely a condensation of the adjacent tissue which has been pushed one side, consolidated and converted into a capsule. It is generally held that the cells of a malignant growth proliferate at their circumference, while those of a benign tumor grow from the center. Borst states that tumors which have a capsule, benign or malignant, grow from the center, while those which are not encapsulated grow from the periphery.

Regional Infection.—Sarcomatous growths as a rule produce regional infection by the cells invading adjacent tissues and spaces in consequence of contiguity of growth or as the result of the mobility of the individual cells. It is quite true that infection may occur through the lymphatics or blood vessels, but the cases in which this condition occurs are exceptional. The involvement of the glands situated along the course of the lymphatics must not, however, be considered to prejudice the existence of a sarcoma as this condition occurs with sufficient frequency, although it is not the rule, so as to render its presence not a contra-indication of sarcomatous growths.

Metastases.—Metastases in the internal organs as the re-

sult of the peculiar arrangement of the cells to the blood vessels is of such frequent occurrence as to probably be the rule. They occur with the greatest frequency in the lungs where the specific elements must pass the first capillary network, and if they pass these capillaries they may be arrested in the kidneys, liver, spleen, brain, bones, or subcutaneously.

Subcutaneous Metastases.—Subcutaneous metastatic deposits occurring through the venous and arterial circulation is of sufficiently frequent occurrence in sarcomatous growths to merit separate consideration. They take, in these situations, the same general characteristics in form of cell, structure, and malignancy as the original growth. They are never encapsulated and often grow with decided rapidity. While these metastatic deposits are most frequently situated subcutaneously, they are often placed between muscles or fascia. In a sarcomatous growth of an extremity the proximal portion of the limb should always be carefully examined for these metastases. They are usually quite sensitive, fixed to the adjacent tissues and more or less irregular. Many of these secondary growths are occasionally found in the later stages of a sarcoma and at a time when the system seems more or less saturated with the infectious material of the neoplasm. I have often found them of varying size, from that of a hickory nut to that of a large orange or even larger, and situated over the back, abdomen, chest, or in the subcutaneous tissue of the extremities.

Infection of the Proximal Lymphatic Glands.—This subject has been dealt with in speaking of the lympho-sarcoma. It should, however, be distinctly understood that sarcomatous growths of every kind, and especially those situated in the testicle and tonsil, may produce infection and enlargement of the adjacent lymphatic glands. The condition, however, excepting in the tonsil and testicle, is the exception and not the rule, and when not occurring or occurring to only a limited extent in rapidly-growing tumors, is of diagnostic value.

Sarcomatous Growths following an Injury.—This seem-

ingly is of such frequent occurrence as to be of diagnostic value. So often has an injury preceded a sarcomatous growth, in my experience, that I consider it one of the most frequent predisposing factors, and when in a young person an injury precedes a rapidly-growing tumor, taking origin especially from periosteum or bone, this fact should be considered of pronounced significance.

Differentiation from Carcinomatous Growths. — In making up a diagnosis one should strive to determine, first, whether the growth is benign or malignant, and if malignant whether it is a sarcoma or a carcinoma. The situation, the want of uniform consistence, the rapidity of growth and want of a distinct capsule, the fixity, the metastatic and possibly glandular complications, the interference often with the health and well being of the individual, ulcerative processes, the pain and often precedent injury are usually sufficient to denote that the tumor is not benign. From a carcinoma the differentiation may be easy or most difficult, depending upon the characteristics of the individual growth. The hard, nodular, slowly-growing scirrhus presents none of the characteristics of the sarcoma. The same is true of an epithelioma. The encephaloid carcinoma, however, when occuring in glandular structures, such as the breast, kidney, testicle, uterus, ovary or parotid gland, presents conditions which upon examination are extremely like those of a sarcoma in that the tumor is very soft, grows rapidly, has no capsule, invades adjacent tissues, and is often of unequal consistency. Primarily it might be extremely difficult to differentiate these growths. There are, however, certain conditions which should be taken into consideration. A sarcoma occurs in childhood, or young adult age; carcinoma seldom before fifty. Sarcomata seldom implicate or produce enlargement of the proximal lymphatic glands; carcinomata always do and at an early stage. It is stated by Borst, and is in the main true, that the sarcomata do not produce a cachexia, while it is a well-known fact that carcinomatous growths, especially when metastatic deposits

have occurred or ulceration has taken place or toxæmia is pronounced, often do cause a cachexia to a most pronounced extent. The differentiation, although important, would not affect the treatment, as both require early removal.

Differentiation from Tubercular Processes.—(Sarcomata in joints.) Sarcomatous growths in these situations are of frequent occurrence. They take origin either in the end of a bone from the synovial membrane or in the capsule and in their growth, especially at the knee, soon produce a large mass of soft tissue which fills the joint and extends to the oppositeb one. The ends of the bones are eaten away and in one or two years a large globular or spindle-shaped tumor is produced. By this time the patient's health is seriously interfered with. The condition is often mistaken for tuberculosis of the joint, but they have little in common. It is true that both processes are chronic, cause pain and disability, and occur in young persons. Tuberculosis, however, may produce a dropsy but never a large solid tumor. The joint, unless there is an accumulation of fluid, remains of about normal size or is only slightly enlarged. There is frequently also a history of tuberculosis. In sarcoma there is often a large tumor which increases the circumference of the joint perhaps two or three times. The surface also is not of uniform consistence; areas of hardness intermingle with those which fluctuate.

Diagnosis of Sarcoma of Bone.—It is of the utmost importance that one be able to make an early diagnosis of sarcoma taking origin from the medulla or periosteum of bone. It is a well recognized fact that a traumatism often precedes and probably acts as an exciting cause of these growths. A sarcoma taking origin from the medulla causes, almost from the beginning, a persistent, dull, heavy, aching pain in the part affected, and this usually is in the epiphysis. This pain is often present for weeks and not unfrequently for many months before any swelling makes its appearance, and is due to the pressure of the growth upon the bone which it finally

disintegrates and destroys. The swelling is caused by the expansion of the bone or in consequence of the growth having permeated the osseous structure and infiltrated the surrounding tissues. Following the destruction of more or less of the bone a fracture may occur. Persistent, long-continued pain, disability of the limb, swelling perhaps of the adjacent joint, enlargement of the affected bone and, it may be, fracture, the condition occurring by preference in young or middle life, are among the most characteristic symptoms of a medullary sarcoma. A sarcoma taking origin from the periosteum also produces pain and swelling, but the swelling is usually coincident with the pain. If the bone be deeply situated in consequence of overlying muscles the swelling may not be readily observed. In endeavoring to make a diagnosis of sarcoma of bone in the early stages when a diagnosis is so important, one may meet with almost insurmountable difficulties. The condition is so easily differentiated from acute inflammations such as acute osteomyelitis, epiphysitis, and arthritis in consequence of the absence of high fever that only mention may be made of these conditions. The chronic inflammations of bone are much more difficult to differentiate. They may be due to injuries, to rheumatism, to tuberculosis, or to syphilis. An inflammation due to a traumatism will afford a history of injury and is likely to subside and disappear in a short time with rest and proper local treatment. Inflammation of rheumatic origin may be extremely persistent, but the rheumatic diathesis, want of swelling, the administration of antirheumatic remedies and the application of dry heat locally, are likely in a short time not only to establish the diagnosis, but to relieve the condition. Tubercular affections occurring in the epiphysis may simulate very closely those of a sarcomatous growth, but frequently the tubercular cases present the appearance or give the history of tuberculosis. They are likely to be attended with fever. The patient is usually a child and the bone will present one or more small, well-circumscribed and sensitive areas. The administration of tubercu-

lin in doubtful cases for diagnostic purposes is to be recommended. Syphilitic inflammation and gummata will give the aching, boring pain of a sarcoma, but they most often affect the tibia or the bones of the skull and should give a history of syphilis and will in part yield to anti-syphilitic treatment. The use of the X-ray is often of the greatest service in bone lesions in consequence of the fact that the Roentgen picture in cases of chronic osteitis shows a bone of perhaps normal outline, and perfect shade, whereas in cases of partial destruction of bone, as in sarcoma, there will be a light instead of a dark shade at the site of the growth.

PROGNOSIS.—The prognosis of sarcomatous growths is always bad, in that they not only interfere with the health and well being of the individual, but also sooner or later destroy the life of their host. The prognosis, however, while always being unfavorable, varies with the situation and with the species. As has been already stated, the small-cell, spindle-cell sarcoma runs an almost benign course and seldom destroys life in less than five years, while the patient may survive ten or even twenty years. A patient of mine with a small spindle-cell sarcoma taking origin from the fascia of the thigh, lived for more than twenty years, and another with an angio-sarcoma taking origin from the muscles of the calf of the leg maintained a fair state of health for more than eighteen years. The same is true, although perhaps to a much less degree, of the giant-cell sarcoma, in which case the patient may live for many years, while the round-cell sarcoma has a prognosis as bad perhaps as the most malignant encephaloid carcinoma and often destroys life in a few months.

TREATMENT.—The treatment of sarcomatous growths is that of early removal, the method depending very largely upon the situation and the species. The recent articles by Kramer and Jenckel, as well as the experience of many surgeons, must convince one that the giant-cell sarcoma is frequently only mildly malignant, and that conservative methods of treatment will often succeed. Kramer reports two cases

of giant-cell medullary sarcoma, one occurring in the lower end of the femur and the other in the upper end of the humerus, both of which were cured by the use of the chisel and curette, the continuity of the bone being preserved. Jenckel reports one case cured for thirteen years by enucleation. These cases correspond with the reports from Johns Hopkins Hospital and with my own experience. There should be then, I think, a conservative treatment adopted for the giant-cell sarcomata which have their origin from the medulla or periosteum of bone. This conservatism may consist in the removal of these growths by knife, chisel and curette, by excision of bone or by amputation. These growths may usually be differentiated from the round- or spindle-cell sarcoma, first, by the fact that they usually grow from the medulla or periosteum of bone, most frequently from the lower jaw or from the epiphysis of the long bones, and, second, that their growth is slow, that they seldom reach any considerable size, are generally well circumscribed and only late, if at all, produce metastases. The round-cell or round- and spindle-cell sarcomata taking origin from periosteum, require in their treatment the removal of the bone from which they have originated. In other words, a patient having such a sarcoma of the tibia should have the leg amputated well above the growth or exarticulated at the knee. One having a round or mixed-celled sarcoma implicating the knee-joint or the shaft of the femur, should have the leg exarticulated at the hip. A round or mixed-cell sarcoma springing from one of the bones of the forearm should be treated by high amputation or an exarticulation at the elbow, and one taking origin such the humerus requires the same treatment at or near the shoulder-joint. It is quite true that the treatment often practiced is less extreme in that the attempt is made to do an enucleation, partial resection of the bone, or an amputation through the bone implicated. The enucleation and partial resection seldom, perhaps never, permanently succeed in this class of cases, and an amputation through the continuity of the bone implicated

.s extremely likely to leave within the bone or adjacent tissues foci of infection, which sooner or later will produce new growths quite as malignant as the one for which the operation was instituted. It has been my experience in operating for sarcomatous growths, that if one is to succeed it must be at the first operation, and that secondary operations are seldom, almost never, permanently successful.

It is far better to sacrifice a little more of the tissue or even a portion or all of the limb and save the patient's life, than to temporize and have the operation a failure. In some instances, as those in which sarcomatous growths take origin from the crest of the ilium or rami of the pubis or ischium it will be impossible, or, as ordinarily considered, inadvisable to remove all of the bone implicated, but so much of it as is anatomically feasible should be removed. Operations in these situations are, in my experience, almost never permanently successful. I very well remember a mixed-cell sarcoma as large as a child's head, taking origin from the periosteum of the descending ramus of the pubis and projecting into the proximal side of the thigh and which seemed at the operation distinctly encapsulated and during which a considerable portion of the periosteum and bone were cut away only to be followed in a few months by a rapid recurrence. A second operation was performed but it was less successful than the first. The same is true of the operative interference of growths springing from the ilium. Fig. 167 shows a photograph of an osteo-chondro-sarcoma of twelve months' duration, taking origin from the periosteum of the tibia in a young girl of nineteen years. The leg was exarticulated at the knee. Shortly after the patient was out of bed a metastatic deposit was noticed in the upper and outer portion of the thigh. About the same time the inguinal glands became enlarged. The thigh was now exarticulated at the hip. The girl made a splendid recovery, gained flesh, but died suddenly four months after the last operation. No autopsy was allowed.

Growths which take origin from fascia, intermuscular or

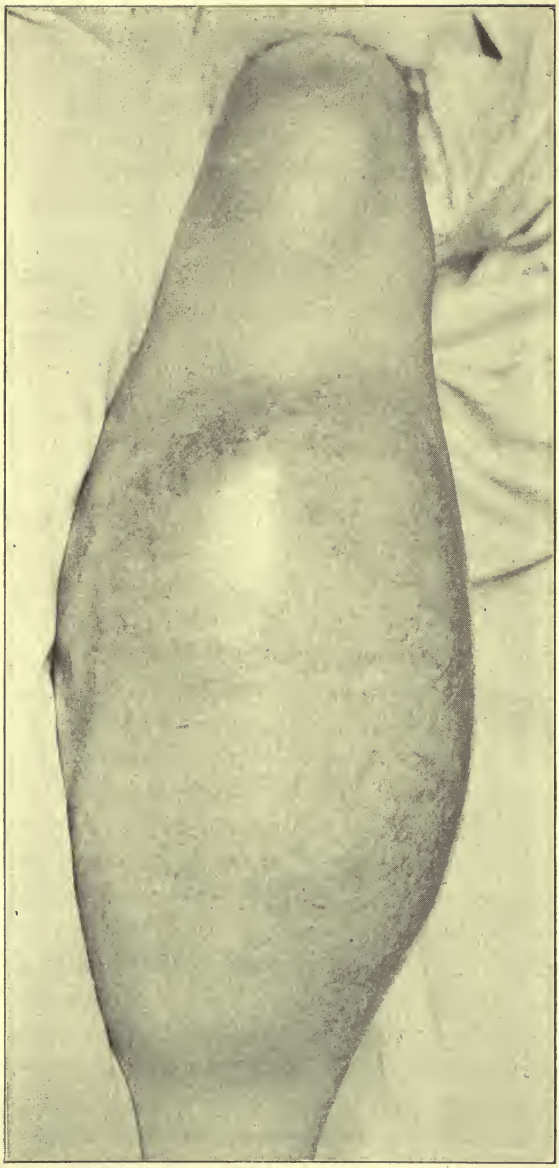


FIG. 167.
Osteo-chondro-sarcoma of Tibia.

subcutaneous tissue, and are composed of spindle-cells and are distinctly encapsulated and quite freely movable, present problems in their treatment perhaps more difficult to decide than do those tumors which spring from the bone. In these cases the tumors grow slowly, often very slowly, and are not only distinctly encapsulated and freely movable but do not interfere with the patient's health, and may be readily shelled

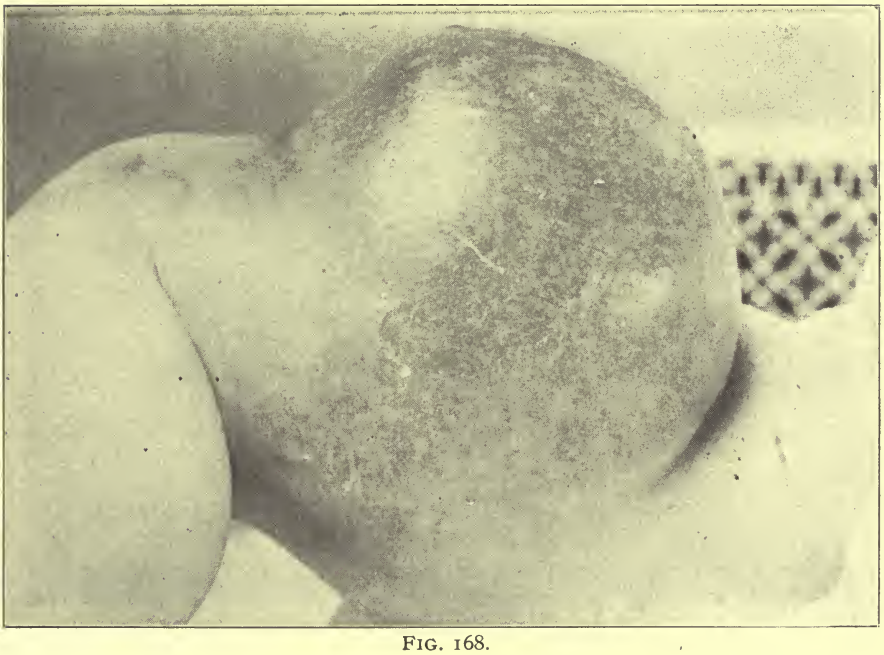


FIG. 168.
Spindle-cell Sarcoma of Thigh.

out, and if recurring after perhaps one or two years, may again be removed and this removal occasionally may be repeated again and again without the patient suffering materially therefrom. I think, however, that the experience of men who have seen a large number of these cases, will be that they almost invariably recur after enucleation and that each recurrence is more rapid in growth and slightly more malignant than was the original tumor, and that enucleation almost

never does or can permanently rid the patient of one of these tumors. For that reason I believe it is the part of conservatism and wisdom, when one of these tumors occurs in an extremity, to do an amputation well above the growth or to exarticulate at the joint above. Fig. 168 shows an intermuscular, spindle-celled sarcoma of the thigh of nearly twenty years' growth. Of late it had given the patient a good deal of trouble. She refused exarticulation at the hip and amputation. The tumor was easily enucleated. There was a rapidly-growing local recurrence in a few months. This was

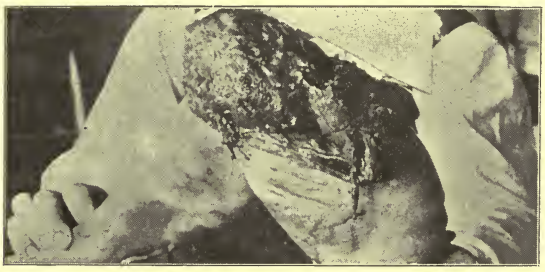


FIG. 169.
Sarcoma of the Knee-joint.
Showing destruction of condyles of femur.

also removed, but recurred again and after about one year and a half the patient died.

It is quite true that the X-ray may completely revolutionize the treatment of these tumors, and even at the present time one might be justified in doing the less radical operation and then follow this with the X-ray treatment.

(Fig. 169.) Sarcoma of lower end of femur; exarticulation at the hip; no recurrence after five years.)

Sarcoma of the Clavicle.—Sarcomatous growths in this situation are of less frequent occurrence than are those implicating the tibia or femur. They do, however, occur and may reach a large size. They may be confined to either extremity, to the middle portion or invade the entire clavicle. They extend in the direction of least resistence, which is up-

wards and outwards. An operation for the removal of the clavicle for this condition may be reasonably simple and attended with but little loss of blood, or it may be very difficult and extremely bloody, depending upon the size, the situation, and the complications. Small growths situated centrally are easily removed. Growths which implicate the entire clavicle, and especially those which extend into the adjacent tissue, are operated with difficulty and their complete removal is in some cases an anatomical impossibility. I have excised the clavicle on two occasions for sarcomatous disease. In the operation an incision should be made from one end of the clavicle to the other. Following this, one or more perpendicular incisions may be added, and then the flaps are reflected. If the skin is implicated, or the tumor very large, a portion of the overlying integument should be excised by making two primal elliptical incisions, including the portion of skin to be left attached to the tumor. The end of the clavicle least implicated and most accessible should be primarily attacked. If this is the sternal end, the first step should be the division upon a grooved director of the clavicular portion of the sterno-cleido-mastoid muscle. The attachment of the pectoralis major is also divided, when the sterno-clavicular joint may be opened by using a short, stout knife, and keeping close to the joint. What is much easier, however, and ordinarily better because it is safer, is to pass a spatula beneath the sternal extremity of the clavicle, when the bone may be divided easily and without risk with a pair of bone forceps. The end of the divided clavicle is then seized with a pair of strong forceps and lifted upwards, while the further attachments of the pectoralis major and subclavius muscle are divided. The clavicular attachments of the deltoid and trapezius should also be divided and preferably upon a grooved director, taking care not to injure the cephalic vein at the anterior border of the deltoid. The coraco-clavicular ligament is divided close to the under surface of the clavicle and following this the acromio-clavicular ligament, the clavicle, and

with it the growth, are then removed. The vessels here of importance, the consideration of which must be kept constantly in mind, are the subclavian, suprascapular, internal mammary, and cephalic.

Sarcoma of the Scapula.—Sarcomatous growths of this bone are of comparatively frequent occurrence. They may have their origin in any portion of the bone or be situated primarily upon its external or internal surface. They are, however, in the majority of instances, situated either in the superior, inferior or in the subscapular fossæ. In any of these situations the growth soon penetrates the thin shell of bone and makes its appearance beneath the periosteum of the opposite surface. There is, under ordinary conditions, some difficulty in making an early diagnosis. The growth, springing from the periosteum and usually beneath the supra- or infra-spinatus or the subscapularis muscles, is well protected from palpation and if situated at a considerable distance from the skin is not easily detected, at least at an early period. The process is, however, attended with a severe grinding pain, with decided sensitiveness upon pressure, often with weakness or lameness in the corresponding arm. It ordinarily is for many months treated for a rheumatic condition. It is only when the tumor has reached such dimensions as to produce a well-defined swelling that a diagnosis is ordinarily made. The fact of a severe, boring, grinding pain occurring in this region in a young person, often subsequent to an injury and being associated with lameness in the corresponding arm, soreness upon palpation, and then with some fullness, the condition not being relieved by internal medication, should early excite suspicion. It may not be possible to make an early positive diagnosis without incision, but should some fullness occur a very probable diagnosis may be made. The Roentgen picture will aid materially in the diagnosis. The great majority of rapidly-growing tumors of the scapula occurring in young people are sarcomatous in nature. They present at times considerable difficulty in the operative technic, this depending

upon the size of the growth and the presence of extensions into the adjacent structures. I have removed the scapula four times for sarcomatous growths. It is perhaps useless to say that the operation should be undertaken at the earliest possible moment following the diagnosis. This is perhaps especially true of sarcomata in this situation because they early invade the muscles attached to the scapula, extend into the root of the neck, onto the arm, into the axilla, complicating the operative technic and very greatly increasing the risk of the operation, and lessening the probability of a permanent recovery.

Before undertaking an operation looking to the removal of the scapula for a malignant growth, one should have clearly in mind the blood supply or vessels which he is sure to encounter in performing an excision. There are three vessels of considerable size which supply the scapula and which freely anastomose with each other, forming almost a complete arterial circuit around the bone. Two of these vessels are indirectly from the thyroid axis, one, the posterior scapular, comes from the transversalis coli. The latter vessel after leaving the thyroid axis crosses the root of the neck to the superior angle of the scapula and then passes down its vertebral border to the inferior angle where it anastomoses with the subscapularis. The suprascapular, a vessel of large size, also comes from the thyroid axis, crosses the root of the neck below the transversalis coli and behind and parallel with the clavicle. It reaches the suprascapular notch upon the superior border of the scapula and passes to the supraspinous fossa, which it supplies. The dorsalis scapulæ, also a vessel of large size, comes from the subscapular and the latter from the axillary artery. It winds around the axillary border of the scapula at about its center and supplies the infraspinous fossa. Before entering this fossa it gives off a branch which passes beneath the scapula and supplies the subscapular fossa, anastomosing with the posterior scapular and with the suprascapular arteries.

Under ordinary conditions a sarcoma confined to the body of the scapula is best reached by making two incisions. One should be placed along the spine extending from the tip of the acromion process to the vertebral border. The other should be placed perpendicular to this and at about two inches from the vertebral border. The incision should be long so as to give plenty of room and should only go through the skin

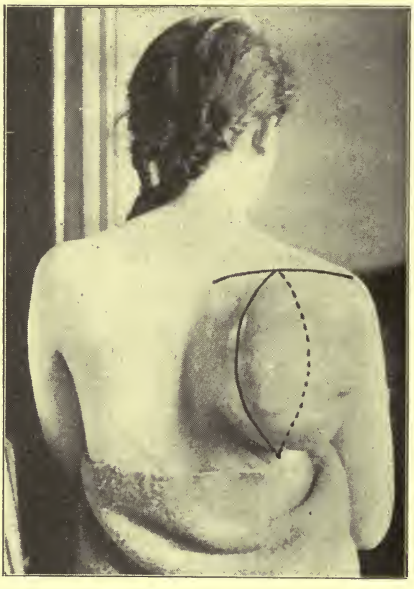


FIG. 170.
Immense Round-cell Sarcoma of Scapula in a girl aged 18.

and subcutaneous tissue. If the overlying tissues are involved, as they frequently are, the perpendicular incision may be converted into a double elliptical, so as to leave attached to the tumor any portion of skin which has become adherent. (Fig. 170.) After making the incision the flaps are reflected, when the trapezius and deltoid are separated from the spine of the scapula. If these muscles can be preserved entire, or in other words cut close to the spine, it will be very advantageous to the subsequent usefulness of the arm, but if they are infil-

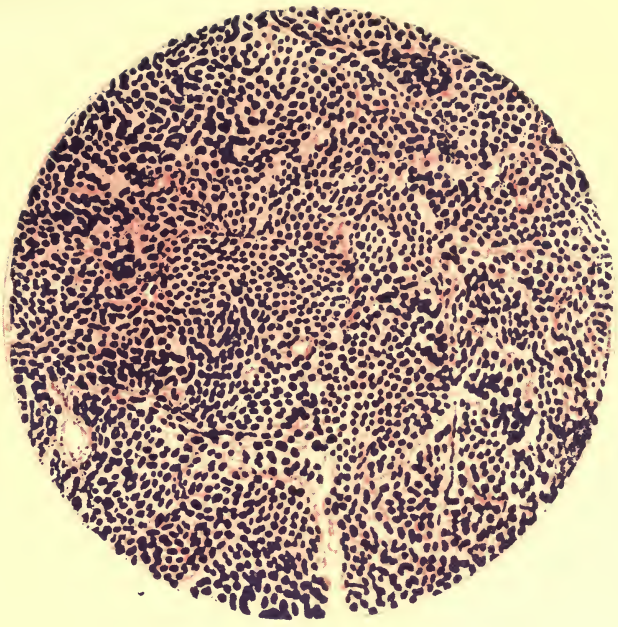


Fig 171.

Small Round-Cell Sarcoma from Scapula.

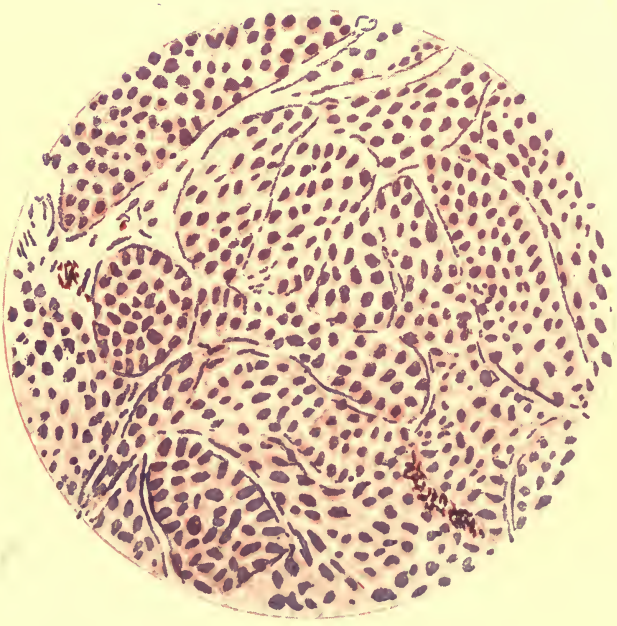


Fig. 173.

Large Round-Cell Sarcoma of Scapula.

trated, as they often are, they should be cut short and such portions as necessary removed. The vertebral border of the scapula should then be freed. This includes a section of the rhomboideus minor and major, the levator anguli scapula and the serratus magnus. No very considerable hæmorrhage is likely to be met with thus far. The posterior scapular artery will have been interfered with, but this is easily put under control. If the acromion process is not implicated it should be preserved and the spine of the scapula cut through with bone forceps. The saving of the acromion and consequently the preservation to some extent of the attachments of the deltoid and trapezius, assists very markedly in holding up the arm after excision of the scapula. If the acromion cannot be preserved the acromio-clavicular joint should be opened, and then the shoulder joint, the ligaments and tendons about the glenoid cavity being divided. The scapula should now be pulled away from the arm and the muscular and ligamentous attachments of the coracoid divided close to the bone. In clearing the upper border of the scapula the suprascapular artery will be divided or exposed. If it is avoided until the attachments to the clavicle have been divided and the glenoid cavity freely opened, it can be readily secured. The scapula is then turned backwards and dragged away from the arm, while the attachments of the teres muscles are served and the dorsalis scapulæ artery secured. The branch of the dorsalis scapulæ going to the subscapularis muscle is secured with the division of that muscle.

Difficulties and Dangers of the Operation.—The difficulties are not great when the growth is confined to the scapula, but if it has invaded the adjacent structures it will require their liberal removal, and then the difficulties may be very considerable. The dangers are largely those from hæmorrhage and shock. The shock is best avoided by having the patient well prepared and supported during the operation, by using a small amount of anæsthetic, completing the operation quickly and avoiding hæmorrhage. Hæmorrhage to any marked

degree may be avoided in tumors which are confined to the scapula by making large incisions, thoroughly exposing the growth, and following the technic already outlined. That is, by first dividing the deltoid and trapezius, and then attacking the muscular attachments at the superior angle and vertebral border of the scapula. The posterior scapular artery will come into view here and may be controlled. Then the the attachments to the clavicle are divided and the humero-

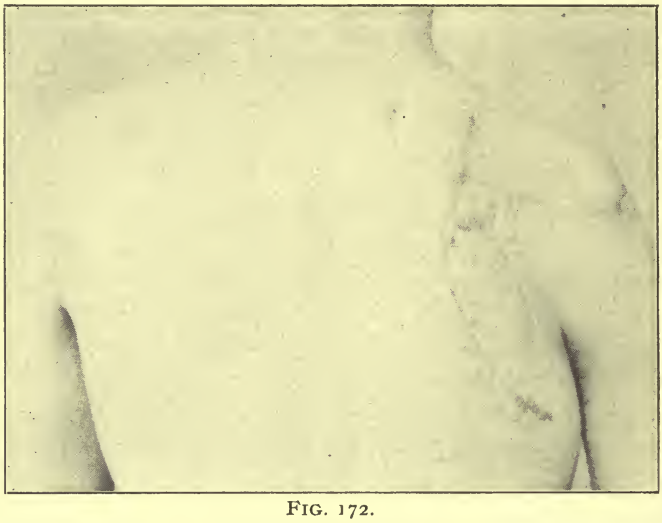


FIG. 172.
Excision of Scapula.

scapular joint opened. The coracoid process is dissected out and the suprascapular artery secured.

The axillary border is left to the last. As has already been stated, it is most desirable, if practicable, to save the acromion process and the attachments of the deltoid and trapezius, as this prevents the subsequent dropping of the arm. If this cannot be done, the severed deltoid and trapezius should, subsequent to the excision, be united by means of many heavy catgut sutures and the arm well supported in a sling so as to take off the weight from the sutures. This,

if successful, will prevent to a very marked degree the falling of the arm and shoulder.

Fig. 172 shows the effect of resection of the scapula for a sarcoma where the acromion end was retained. There is in this case, as readily seen, a comparatively slight falling of the shoulder and arm. This was a young man twenty years of age, who had noticed a fullness over the scapula for several months. There had been an almost constant, dull, heavy, grinding pain in the swollen area. At the operation the bone

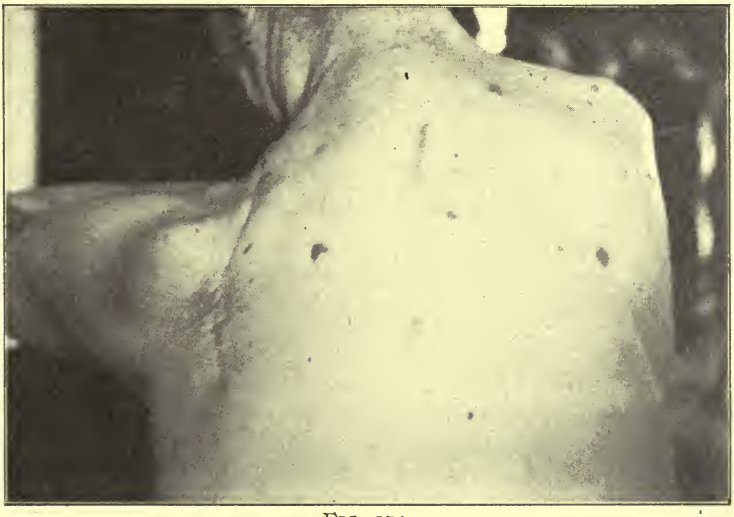


FIG. 174.
Excision of Scapula.

was found to be very much destroyed and the growth extending into both the infraspinatus and subscapularis muscles. Four years after the resection the young man remains entirely free from recurrence.

Fig. 173 shows a microscopical section of the growth.

Fig. 174 shows the photograph of a man fifty-six years of age who had had a gradually progressive, ill-defined, very painful swelling of the scapula for about three years. In this case the large swelling implicated the infra and supraspinatus and subscapular fossa. The infiltration extended out on the

shoulder and down beneath the clavicle. It was hard, of uniform consistency and immovable. Over a considerable area the growth was attached to the skin. Two elliptical perpendicular incisions were made enclosing the attached portion of skin, which was left adherent to the tumor. Then a long incision was made over the clavicle, connecting with the elliptical incisions. The flaps were dissected up and the trapezius, levator anguli scapula and rhomboideus, major and minor, muscles divided at a considerable distance from their attachments to the scapula, that is high on the neck, as their lower portions were found infiltrated. The deltoid was also divided at a distance from the spine, on account of the infiltration. The vertebral border of the scapula was then freed, the clavicle divided near the sternum and its muscular attachments separated. The scapula was then disarticulated from the humerus and the attachments at the upper border divided, the suprascapular artery secured, and then the axillary border dealt with, when the scapula and the major portion of the clavicle were removed. There was at the time of the operation a node as large as a hen's egg in the right axillary space and one as large as a hickory nut in the left. A few months after the operation enlargement of the glands in the groins occurred and metastases made their appearance subcutaneously in various portions of the body and after about a year the patient died. There was, however, no recurrence at the site of the operation. In this case, in consequence of the long delay and the infiltration of the trapezius and upper portion of the deltoid and the necessary removal of the clavicle, there was a marked loss of support and a decided falling of the arm.

Interscapulo-Thoracic Amputation.—Unfortunately, in a considerable number of the sarcomatous growths of the scapula the process will have extended so widely into the adjacent tissues of the neck, shoulder, axilla, and perhaps clavicle, as to demand the removal not only of the scapula but also of the upper extremity. In cases in which it is nec-

essary to remove the extremity entire, the technic of the operation must be altered. The first step here should be the ligation of the subclavian artery. A long incision is made over the clavicle, and the tissues separated from the bone near the sterno-clavicular joint. A spatula is now passed beneath the internal portion, when the bone is divided with bone forceps. The clavicle being separated from the adjacent tissues is again divided in the vicinity of the attachments of the coraco-clavicular ligament and this portion of the clavicle removed. At the outer end of the wound more space may be gained by making a perpendicular incision and the wound gradually deepened. The hyoid muscls and brachial plexus of nerves are drawn to one side and the subclavian artery ligated in the third part of its course. This cuts off all of the circulation except that coming from the transversalis coli and the suprascapular, and these vessels may usually also be ligated in the wound. An incision is then made to pass from the center of the one through which the clavicle was removed, down over the scapula to the lower angle. A second incision starts at the center of the perpendicular one or farther out on the clavicular incision and is carried around to the center of the axilla. If a portion of the skin over the tumor is infiltrated it should be surrounded by incisions and left attached to the growth. The flaps are dissected up and the scapula attacked as before. The only fear of hæmorrhage now is from the posterior and suprascapular vessels, if these have not been ligated in the clavicular incision. After separating the scapula from its attachments, an incision is carried around the anterior portion of the chest from the clavicular incision to the middle of the axilla and made to meet the previous incision. The pectoral muscles are now divided, the axilla freely opened, and the axillary vein seized before division and secured. The vein is not interfered with until the last step of the operation. In Figs. 175 and 176, is shown a case in which I did an interscapulo-thoracic amputation, the greatest difficulty was experienced in consequence of an infiltration of the posterior

triangle of the neck. In this case the subclavian vein was torn in an effort to ligate it and a very considerable amount of blood lost and a great deal of time spent with nothing gained. In fact it would seem a more scientific procedure to leave the vein until the last, that it may empty the extremity of blood, when it may be secured and divided with the brachial plexus.

Sarcomata of the Lower Jaw.—These are usually giant-cell sarcomata and occur in one of two common positions,

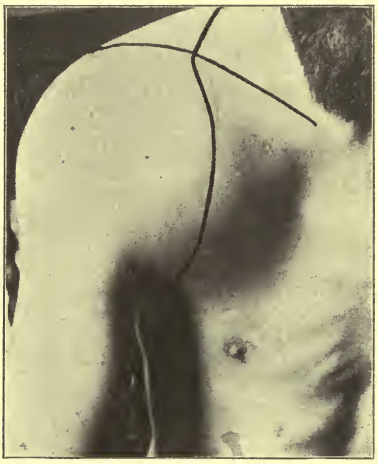
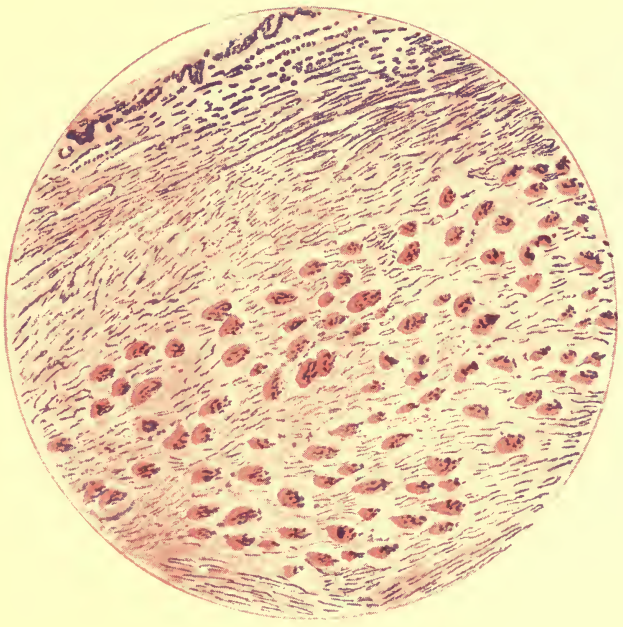


FIG. 175.

either as a periosteal outgrowth, often as an epulis, or as a growth from the medulla of bone. An epulis takes its origin from the periosteum covering the alveolar border adjacent to the teeth, or from the periosteum lining the alveoli. It is seen as a soft, fleshy tumor, having the appearance almost of granulation tissue and springing seemingly from the gum, and projecting upward at the side of the teeth. It is softer than a fibroid epulis, grows more rapidly and bleeds readily. It has nothing absolutely distinctive about its general appearance, and in some cases a microscopic section is requisite for a diagnosis. A sarcomatous epulis is only mildly malignant, and may be successfully treated by extracting the teeth



Epulis of Jaw. Giant Cell.

(To face p. 593)

adjacent thereto and then freely excising the epulis and the alveolar border of the jaw. The latter may be done by pinching off a small portion of the alveolar surface with bone cutting forceps. I have cured many of these cases simply by extracting the adjacent teeth, cutting the epulis away freely and then curetting the bone. I have yet to see the first one return after this treatment.

Sarcomatous Growths Taking Origin from the Medulla of the Inferior Maxillary.—These occur at almost any age, but preferably in young adults. The first indication is usually a toothache which makes its appearance in spite of the fact that the tooth, or teeth, are entirely sound. The pain persists and becomes more severe. The teeth become loosened and perhaps are extracted. The bone gradually expands, the pain if anything increases, the alveoli after the extraction of the teeth do not heal but become infected and are the site of suppuration. A probe introduced shows denuded, often necrosed, bone and its introduction is followed by a bloody discharge which amounts at times to a slight hæmorrhage. The growth is progressive, the bone becomes thin and crackles on pressure and can be indented with the fingers. Finally its continuity gives way, the adjacent tissues are infected, and enlargement of the lymphatic glands beneath the jaw occur. The condition must be differentiated from benign growths taking origin within the alveolar process, such as the odontomes and cysts. The former, almost without exception, occur in childhood and are usually associated with the non-eruption of a tooth, or teeth. The cystic tumors grow more rapidly than the myeloid sarcomata and may occur without the failure of tooth eruption. Fibroids and osteomata occur within the interior of the lower jaw, but they are extremely rare growths. If there is considerable doubt about the diagnosis, this may usually be established by an incision into the tumor through the mouth.

The treatment of a sarcomatous growth taking origin from the medulla of the inferior maxillary bone should be conserva-

tive, provided the case is seen early. Too often when the adjacent tissues and glands are infected, no treatment, however heroic, is of permanent avail. The conservative treatment may consist in extracting the loose teeth and in cutting away all of the corresponding alveolar border; (this preserves the continuity of the bone); in opening or curretting the cavity or in more advanced cases in resecting the implicated portion of bone, while only in exceptional cases need the entire bone be removed. When the latter seems necessary it may be carried

FIG. 176.

out as follows: Before commencing the incision, however, forceps may be placed on each side of the lower lip for the purpose of controling the coronary vessels. An incision may then be made through the lower lip down the symphysis and then carried along the lower border of the jaw and behind the ramus to within about one-half an inch of the lobe of the ear. This incision will cross the facial artery, but it need not be carried deep enough primarily to injure this vessel. It is well not to carry the incision higher than is absolutely necessary, for the purpose of avoiding injury to the cervico-facial branch of the facial nerve and also to Stenson's duct. The central incisor tooth on the diseased side is extracted and the bone sawed through at this point. This leaves the attachments of the

genio-hyo-glossus and is of advantage in the control of the tongue. The end of the sawed bone is then seized with forceps and the soft tissues separated with the knife, being cautious to control the circulation through the facial artery, or seize this vessel as soon as cut. On reaching the ramus the knife should hug the bone for fear of wounding the internal maxillary artery. Upon reaching the upper portion of the incision a strong retractor forcibly drags the tissues at the end of the incision upward and assists in uncovering the condyle and coronoid process. If the jaw be carried forcibly outwards the temporal muscle may be separated by blunt dissection from the coronoid process, then the articulation is opened and the bone by blunt dissection and force is twisted from its socket. (Fig. 177.) In this case there was a sarcoma which took origin from the medulla of the inferior maxillary bone just in front of the ramus. The patient had suffered for many months with severe pain in the jaw and teeth. The teeth had been extracted and finally the alveoli were being treated under the belief that the case was one of necrosis. About one-half of the body of the jaw implicated was excised. Patient has remained perfectly well now for three years.

Melano-Sarcoma. — Fig. 178 represents a melano-sarcoma in a man sixty-three years of age. The history makes it doubtful whether the primary situation of the growth was in the derma, the subcutaneous tissue or in the periosteum. Six years previous to the operation the man noticed a small induration directly over the chin, which soon disappeared. Shortly after this a swelling came upon the left side of the jaw and about midway between the ramus and the symphysis. This induration slowly increased in size and soon became attached both to the skin and to the periosteum. Shortly after this the glands beneath the jaw and those posterior to the sterno-cleido-mastoid became enlarged. The growth about this time softened and sloughed out and the wound rapidly healed. Following this an induration again made its appearance directly over the symphysis. Another occurred

just anterior to the cicatrix at the side of the jaw. They both grew rapidly. At the time of the operation the submaxillary and sublingual glands were enlarged upon the left side, as well as a row of glands posterior to the internal jugular vein. The man's physical condition seemed good. He was suffering no pain, kept his flesh and slept and ate well. At the operation a long incision was made, it commenced near the chin and extended along the jaw, crossing the sterno-cleido-mastoid

FIG. 177.
Sarcoma of Jaw.

and was then carried downwards along its posterior border to the clavicle. The enlarged glands were readily exposed and removed. They were very black, and in their exposure many circular, tortuous canals were cut across which seemed to be lymphatic vessels and which contained a black, gelatinous, tar-like substance. The contents of the glands was also of this same tar-like material. These seeming vessels containing this black substance extended into the tissues in almost every direction and for a considerable distance. Some of the glands were not larger than a hickory nut, while others were the size

of a hen's egg. They extended from the clavicle to the parotid. Incisions were then made through the lip skirting the tumor at the symphysis and that portion of the jaw excised. The patient stood the operation well and the microscopical examination showed the growth to be a melano sarcoma.

Sarcomatous Growths of the Superior Maxillary Bone.—These may take origin from any portion of the bone surface but are most frequently found within the antrum of Highmore and taking origin from the muco-periosteal covering of the bone. They are often composed of giant cells and then may be only mildly malignant. The growth is attended with decided pain, especially when the antrum has become filled and distended. Continued growth will produce pressure upon the orbital cavity and bulging of the eye; it may produce pressure upon the nasal wall and interference with respiration as well as pressure upon the anterior wall and decided prominence of the cheek and also pressure downwards upon the roof of the mouth, convexing the palate process of the superior maxillary bone and causing loosening and perhaps falling of the teeth. They may also grow into the nasal fossa, obstructing the air passage and causing hæmorrhage. They may, as the result of pressure, produce absorption of one or more of the walls of the antrum and appear upon the corresponding surface or surfaces. These growths generally occur in young adults. The diagnosis is approximated by considering the age of the patient, the rate of growth, the severe pain, the expansion of bone, and finally the absorption of bone and the infiltration of adjacent structures. If necessary an osteoplastic flap of the anterior wall of the antrum may be made for diagnostic purposes.

TREATMENT.—The treatment of a sarcoma springing from the antrum is ordinarily excision of the corresponding maxillary bone. One of the best external incisions used for this purpose is Ferguson's, slightly modified, and which commences near the external angle of the orbit and passes along the

lower border to near the internal angle and then follows the groove down the side of the nose, passing the alæ to the center of the lip, which it divides. The flap is reflected from the bone and the periosteum divided throughout the upper extent of the incision and that which covers the lower and outer border of the orbit slightly reflected. A few light strokes of the mallet upon a sharp chisel will divide the nasal process of the superior maxillary, the lachrymal, ethmoid and the floor of the orbit. Then the malar process of the superior maxillary is divided with a chain saw, cutting from within outwards. The soft palate is separated from the horizontal plate of the palate bone and the periosteal covering of the roof of the mouth divided in the median line. The palate process of the superior maxillary and the horizontal plate of the palate bone are divided with a chain saw from behind forwards, as well as the alveolar process of the inferior maxillary bone. The bone is then wrenched out, and the soft tissues brought into position with a few stitches. By this incision no important structures are crossed and the only vessels from which any considerable hæmorrhage may be expected are the branches of the facial and the internal maxillary, and these are readily controlled by the use of forceps or sponge pressure. If the sarcomatous growth has not extended outside of the bony wall the chances of a permanent cure are good.

Sarcomatons Growths of the Tonsils.—These are among the most malignant of all the sarcomatous growths, in that they very early lead to regional and lymphatic infection, internal metastases, ulceration and sloughing and even serious hæmorrhage from the infected tissue. Although these growths may make their appearance at almost any age they are most frequent in middle life and occur as soft, rapidly-growing tumors situated within the structures of the tonsil. They are usually composed, in part at least, of round cells. They are readily differentiated from infectious processes in consequence of the absence of marked fever and a less abruptness of the course. They also may be differentiated from benign

tumors in consequence of their more rapid growth, softer consistence, the fact that they are not encapsulated, as well as the occurrence of metastases.

TREATMENT.—The treatment should be that of early removal, if possible before regional or distant infection has occurred. If glandular involvement has taken place, including the glands beneath the jaws and those in the anterior triangle of the neck, a permanent cure is practically impossible. The operation for their removal may be carried out through the mouth or through an external incision. For a malignant growth, especially one of any considerable size, it is best to attack the tumor through an external incision. This may be carried along the anterior border of the ramus of the jaw, commencing just below Stenson's duct, crossing the jaw anterior to the ramus, where the bone is divided with a saw, and the upper portion turned forcibly outwards. The mucous membrane covering the cheek is divided and the tonsil made readily accessible. It may then be thoroughly excised without severe hæmorrhage or difficulty. The maxillary bone is then brought into position and wired and the soft tissues united with silk worm gut. In a case which recently presented itself in which there was a large, quite rapidly-growing sarcoma of the left tonsil this method of procedure was followed with the greatest satisfaction.

Sarcomatous Growths of the Kidney.—Eighty per cent. of these growths are said to occur during the first four years of life while some are of congenital origin. The tumors primarily are confined to the kidney; later they may become diffused. They may take origin from the capsule or from any portion of the kidney. For a considerable time the growths may produce no marked symptoms, then hæmorrhage is likely to occur. This may be intermittent or continuous, slight or profuse. It is said to be absent in about one-half of the cases. It is often, however, very severe. It is greater in amount than in cases of stone in the kidney, or in cases of tuberculosis. Sooner or later a tumor makes its appearance,

coming out from below the ribs. It is round, somewhat irregular, easily depressed on inspiration and plainly to be felt in the loin below the ribs on palpation. It is covered in part at least by the colon, and consequently its anterior surface is often tympanitic. The condition is to be differentiated from tubercular processes, from nephro-lithiasis, hydro-nephrosis, and tumors of the spleen, ovary and intestine. If tubercular processes produce tumors of considerable size it is in consequence of the formation of pus within the kidney. In this case there is fluctuation, high fever, and quantities of pus in the urine. In nephro-lithiasis there is usually severe pain, increased by active or violent exercise. The hæmorrhage is often of insignificant amount requiring, it may be, the microscope for its detection. Hydro-nephrosis is often attended with severe colicky or excruciating pain and produces a tumor which is fluctuant. It is sudden in its occurrence and often disappears as quickly as it came. Tumors of the spleen, in consequence of their shape and situation, and tumors of the ovary in consequence of their position, may easily be differentiated.

TREATMENT.—The treatment is that of excision, which ordinarily, unless the tumor be very large, is carried out through the lumbar region, the incision if necessary being carried well onto the side of the abdomen. If the tumor is very large it may be removed by a transperitoneal incision. An early operation in these cases is most desirable in consequence of the fact that the adjacent structures easily become infected, and when this condition is present to the extent that the tumor cannot be shelled out of healthy tissue, an operation is not advisable, and if undertaken it may be terminated and the wound closed. The operation even in well-selected cases has a considerable mortality, averaging at the present time about nineteen per cent. The duration of life in non-operable cases ranges from one to four years.

Sarcomata of the Bladder.—These are comparatively rare growths. They are found with about equal frequency in

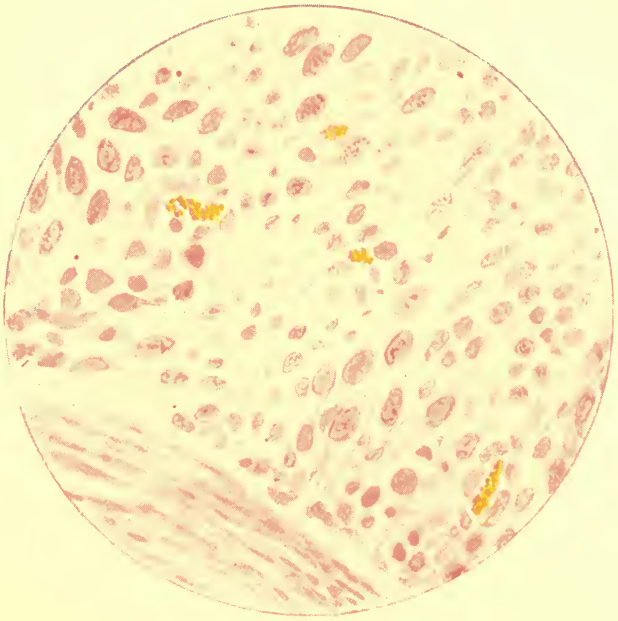
the two sexes and thirty-three per cent. are said to occur before the tenth year of age. Any portion of the bladder may be implicated. The base, the trigone and the posterior

FIG. 178.
Melano-sarcoma of the Chin.

wall are seemingly most frequently affected. The growths may be single or multiple, sessile or pedunculated. They are, however, most frequently sessile and tend to infiltrate the

bladder walls at the base, which becomes more or less indurated. Their surface is often smooth, although it may be lobulated and may be covered with villous growths. Their consistence conforms to that of sarcomatous growths in other situations in that they not unfrequently contain hæmorrhagic areas. In their growth they may implicate the peritoneum, extend into the urethra, while they occasionally reach the symphysis pubis or rectum. Secondary growths have been found in the lungs, liver, and spleen. In their histology they are composed largely of small and large round cells, spindle and giant cells. They are frequently mixed tumors in that they are composed to a considerable extent of blood vessels, fibrous, mucous or cartilaginous tissue, making angio-, fibro-, myxo- or chondro-sarcomata. The cells are also arranged occasionally in the form of alveoli. There are certain secondary lesions which result from these growths. The tumor may be so situated as to produce retention of urine and with this, dilatation of the bladder, and as a sequence to these conditions muscular hypertrophy, infection, cystitis, hydro-ureter, hydro-nephrosis or pyo-nephrosis may occur.

Symptomatology.—Hæmaturia is perhaps the most frequent symptom and is said to occur in eighty per cent. of the cases as the first indication. The amount of blood lost varies greatly. The bleeding may be very profuse and long continued, scarcely ceasing, or there may be long intervals of cessation. It is apt to follow injury, excessive exertion, fatigue or straining. It is the result of the excessive vascularity of the growth, the unsupported or delicate blood vessels or to ulceration. Pedunculated growths are said to bleed more freely than those which are sessile. Pain is another frequent symptom and especially if the growth is situated in the vesical neck. Where hæmorrhage has occurred or is taking place clots are likely to form and these may not only cause retention, but they may cause excessive pain. Frequent urination is another symptom of importance in that nearly every patient is obliged to urinate from ten to twenty times a day.



Large Spindle-Cell Sarcoma of Bladder.

(To face p. 603)

Constitutional Symptoms.—For a considerable time there may be no constitutional symptoms. If hæmorrhage is severe, anæmia is likely to be the first symptom. If cystitis in an aggravated form is present chills and fever, increase of pain, infection of the ureters and often of the kidneys, with nephritis, may occur. Later there is likely to be a low state of vitality with septic intoxication.

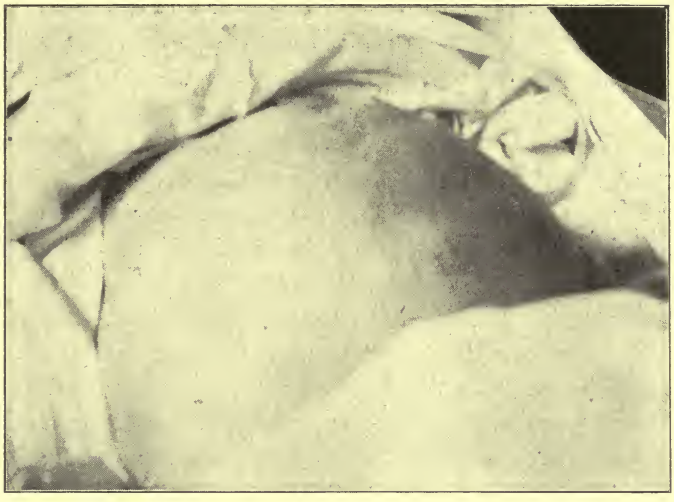


Fig. 179.
Sarcoma of the Uterus.

Prognosis.—The prognosis is always bad, the majority of cases terminating in death by the end of the first year. The round-cell growth may lead to death in six months. Death is caused in these cases by excessive hæmorrhage, septic infection and debility.

Diagnosis.—Sudden, severe, and causeless hæmorrhage occurring with increased frequency and attended with coagula, is indicative of a tumor in the bladder. A positive diagnosis of a tumor may perhaps be established by bimanual palpation either through the vagina or rectum. This at least will establish the fact of the presence of a neoplasm if it be very

large. If this be not sufficient, cystoscopic examination is likely to be absolutely conclusive, at least if the urine can be rendered clear, or a clear fluid injected in the bladder. The cystoscope cannot be used with success if the fluid in the bladder is not reasonably clear. A still further means of diagnosis is the suprapubic incision.

TREATMENT.—The symptoms often call for relief. The hæmorrhage has to be put under control and often may be by the internal administration of ergot and washing the bladder with a hot boric acid solution. Acetanilid, two drams to the pint; hydrastis two ounces to the pint; or a solution of alum may be used for the same purpose. Large clots, if giving disturbance and causing spasm of the bladder, should be evacuated by introducing a large catheter and attaching to this an exhaust syringe. They may also be extracted through the evacuator employed in litholapaxy. In severe cases of hæmorrhage a suprapubic incision may be made and the bladder packed. The pain is controlled by suppositories of opium, belladonna or cocaine. Surgical treatment is that of removal when this is practicable and it may be accomplished either through a suprapubic or perineal incision, preferably a suprapubic one. The tumor is exposed and the mucous membrane and bladder wall at the base of the growth excised. The parts are then readjusted with one or two layers of catgut suture. In the upper and anterior wall the peritoneum may be readily separated with the finger before the bladder wall is excised. If the growth invades the posterior portion Clado, after making a suprapubic incision, divides the mucous membrane about the base of the tumor and endeavors as much as possible to form a pedicle for the tumor with the fingers, this is then clamped with a pair of long forceps and the suprapubic wound partially closed. The abdomen is then opened and the approximating peritoneal surfaces stitched together with two rows of Lembert sutures. The abdomen is then closed, the suprapubic wound reopened and the tumor cut away. The

wound caused by the excision is then united with rows of catgut sutures and the bladder drained suprapubically.

Sarcomatous Growths of the Testicle.—These usually occur in childhood or early manhood. They often follow an injury. Histologically they are usually composed of round cells. They have a rapid growth, producing at an early stage metastatic deposits within the abdomen and in the retroperitoneal glands. An effusion in the tunica vaginalis often complicates the condition. A probable diagnosis may be made by considering the age of the patient, the rapidity of the growth, the absence of definite outlines, early metastases and also the fact that these tumors are usually soft and of variable consistence.

TREATMENT.—The testicle should be removed with the growth at the earliest possible moment, excising the cord well up into the external abdominal ring.

Sarcomatous Growths of the Uterus.—These are comparatively rare. They have been met with in childhood as early as the thirteenth year, but are more frequent between the fortieth and fiftieth years. They take their origin from the mucous membrane or parenchyma and are diffused or more or less circumscribed. The cervix is usually exempt. There is no doubt but that they frequently have their origin in myomata. The symptoms are not unlike those which occur in myomata. Hæmorrhage is frequent. In some cases a more or less continuous watery discharge is present. The uterus gradually enlarges, but has not the hardness of an ordinary myoma. Implication of adjacent structures is frequent in that the tumor cells perforate the uterine wall and attach themselves to any portion of the adjacent peritoneum with which they may come in contact.

TREATMENT.—The treatment is that of complete removal of the uterus, which should be done at the earliest possible moment consistent with the diagnosis. Fig. 179 shows the photograph of the abdomen of a woman aged sixty-three who had a rapidly-growing, round-cell sarcoma,

springing from the uterus, which had broken through the uterine wall, filled the pelvis and was causing a progressive obstruction of the bowels, attended with severe vomiting. The case was non-operable when it came under observation. The patient finally died from exhaustion and metastases.

Sarcoma of the Skin.—Sarcomatous growths situated in the derma have been recently studied and classified by a number of dermatologists. Among those who have been especially identified with this work may be mentioned Unna, Kaposi, Neuman, Piffard, Fink, and Hyde. These growths take origin from the connective tissue of the derma and may be hard or soft, multiple or single. They are composed largely of round or spindle cells. The hard sarcomata occur as single nodules often not larger than a pea or cherry and are situated upon and project from the skin. They are for a time very slow in their growth. In some cases they may grow rapidly. They occur most frequently upon the face, hands and feet. The primary, multiple tumors may be symmetrical upon the extremities. They also occur upon the face. The multiple may be hard or soft. The soft grow rapidly, reach a considerable size and ulcerate and discharge a thick semi-solid material. The wound then cicatrizes. They usually reappear again in the immediate vicinity of the cicatrix. These dermal growths have been classified by Unna into the multiple, white and hard sarcomata, the multiple, hard, pigmented sarcomata, the multiple soft, and the multiple gummatoid sarcomata. A fifth classification was added by Kaposi. In this the growths consist of very dark blue nodules occurring most frequently upon the hands and feet, especially upon the fingers and toes, as well as on the soles of the feet. The fingers become thickened and deformed. The nodules often run together and form a painful and quite diffused infiltration.

TREATMENT.—In circumscribed single growths the treatment should be early and complete removal, and in those

which are multiple if this treatment can be practised it is advisable.

Sarcomata of the Brain.—Sarcomata comprise, according to the tables of Von Bergman, which correspond pretty accurately with those of other writers, about fifteen per cent. of all tumors of the brain. In this situation they are without a capsule, infiltrate the adjacent tissues and produce metastases. The symptoms, which are those of a tumor, have been sufficiently dwelt upon in the article on gliomata. It is impossible to differentiate them without operating. The diagnosis of a tumor can only be made. The growths are often non-operable in consequence of their situation, size and want of limitation. If reasonably circumscribed and favorably situated the treatment should be that of excision, the technic of which has already been dwelt upon in the above-named article.

CHAPTER XXV.

ENDOTHELIOMATA.

These growths have excited very general interest among surgeons, clinicians and pathologists during the past few years. Their frequency and importance, however, is still scarcely appreciated. Many excellent articles have appeared in the journals, and some in the text books, but the exact status, histological structure and classification of these growths has not been as yet very well defined. There is also scarcely a doubt but what the endotheliomata are every day mistaken for the sarcomata and perhaps especially for the carcinomata.

The endotheliomata have been classed as a subdivision of the sarcomata. They are like the sarcomata in their clinical course and in that they take origin from connective tissue, but the microscopic picture is usually distinctive both in the form and in the arrangement of the cells. Many cases, however, occur in which there is great difficulty in differentiating these growths from the sarcomata and also from the carcinomata.

The endotheliomata come from endothelial cells, the form or species depending upon the situation and structure from which these cells take their origin. Endothelial cells are capable of readily changing their form and appearance, and are frequently converted into tissue of a higher order especially into connective tissue. The endothelial cells, as found lining the serous and synovial membranes, blood and lymph vessels and lymph spaces are thin and flat, presenting distinctive characteristics of form and appearance. When these cells proliferate rapidly they become polymorphous, assuming at one time an

epitheloid form, and then again a cuboid, low cuboid or cylindrical form. The cuboid cell is perhaps the most frequent. Then again they may be spindle-shaped or assume the form of giant cells. Their shape in a tumor depends largely upon their arrangement and the compression to which they are subjected. The endothelial cells when proliferating have the power of motion. In tubercular processes they are capable of producing epitheloid and giant cells and then tubercles. The thickening of serous membranes in chronic inflammatory processes is largely due to the proliferating endothelial cells. In these processes they often are converted into connective tissue. Primarily in the process a large cell granulation tissue is formed which is converted into spindle cells and then into connective tissue proper. The surface cells in inflammatory and in new growths, in consequence of pressure or the contact with fluids, assume the flat form of endothelial cells. In the inflammatory processes of serous membranes resulting in adhesions, the cells coming from the endothelium as the result of proliferation are usually polymorphous. Such forms are seen as epitheloid, cuboid, branching and spindle cells. In consequence of their proliferation they assist in forming, or do form, a considerable portion of the connective tissues occurring in adhesions.

The endothelial cells have the power of forming their intercellular substance. This is probably the result of the cell's secretion, and in consequence of this function, which they possess to a considerable degree, they are more like epithelial glandular cells than they are connective tissue cells. In the flat cell also, in consequence of the division of the cell body, fibres are formed. In acute inflammations affecting the blood and lymph vessels the endothelial cells lose their outline and are changed into protoplasmic cells. In chronic inflammation the cells proliferate, become polymorphous, form granulation tissue composed of round or spindle cells, and later become converted into connective tissue. In the healing of the wounds of vessels the endothelial cells take

an active part and are converted into connective tissue. Borst saw connective tissue formed in a capillary vessel which had but an endothelial coat. He states that if tincture of iodine be injected into one of these vessels the endothelial cells will proliferate and form connective tissue. In a chronic inflammatory process affecting a vessel these cells may proliferate to such a degree as to close the vessel's lumen, and in cases of thrombosis the endothelial cells take an active part in the organization of the thrombus in that they grow through the thrombus, canalizing it and producing columns of cells which later may be converted into a solid connective tissue thrombus.

In this process the endothelial cells when undergoing rapid proliferation are said to form not only polymorphous cells and intercellular substance but the stroma of the part as well. The endothelial tissue is then but a form of connective tissue into which it is converted by the process of metaplasia. Connective tissue cells when forming the lining of new blood vessels, serous and lymph spaces, as the result of pressure or the influence of fluids passing over them, become flat and take on the characteristics of, and are converted into, endothelial cells.

Endothelial cells have, as has already been stated, many of the characteristics of epithelial cells. They are capable of producing a secretion, and in their arrangement and form in many of the endothelial growths they are extremely like some of the epithelial glandular structures and are only with considerable difficulty and patient study differentiated from the latter.

Diagnosis of Endotheliomata. Degenerative Changes.— Hyaline, amyloid and mucoid degeneration is extremely characteristic of endothelial growths, in that it occurs much more frequently in these tumors than in others. Endotheliomata do not form horny substances. The cells when not proliferating are thin and flat like a membrane, and when occurring in spaces or vessels are to be seen in strands or

columns. These strands may be very narrow, not representing more than two thin cells in juxtaposition, or they may occur in the form of wide columns. They are situated within the blood and lymph vessels in lymph spaces, or are arranged concentrically around them.

The growth of an endothelioma is ordinarily slow, not as rapid as is the growth of a round-celled sarcoma or of an encephaloid carcinoma.

Their metastases are more limited. They produce, however, regional infection and are likely to return after removal. While it is ordinarily held that they grow slowly, produce few metastases, have but slight effect upon the system, seldom implicating the adjacent lymphatic glands, and are only mildly malignant, they occasionally, on the contrary, show most decided malignancy in that they grow rapidly, produce widely distributed metastatic deposits in the internal organs, implicate adjacent glands, produce marked effect upon the system and soon lead to the death of the patient.

The endotheliomata are ordinarily classified according to the structures from which or in which they spring. In this chapter on the endotheliomata I am pleased not only to follow the classification of Borst as given in his recent work, "*Die Lehre von den Geschwulsten*," but also to draw freely from his most excellent work on this subject.

The genus, endotheliomata, may primarily be divided into two important species, 1st, the lymphangio-endotheliomata, or those tumors coming from the lymphatic vessels, spaces and serous membranes; and 2d, the hæmangio-endotheliomata, or those coming from the endothelial cells lining the blood vessels. The second species has a very important subdivision, the perithelioma, which has been called a perivascular hæmangio-endothelioma. As subdivisions of the hæmangio-endotheliomata we also have the ceolom, the cylindrom, the psammome and the cholesteatom.

Ackermann divides the endotheliomata somewhat differently. Those coming from the blood vessels he calls the

endothelioma intravasculare. Those coming from the endothelium of the lymphatic vessels as the endothelioma-lymphangio matosum, and third, the endothelioma interfasiculare, or those coming from the endothelium of the lymph spaces. Amenn makes three divisions, 1st, the lymphatic endotheliomata, or those coming from the endothelium of the lymph vessels; 2nd, the intravascular endotheliomata, or those coming from the endothelium of the blood vessels, and 3rd, the peri-endothelioma, or those coming from the perithelial tissue of the blood vessels.

Tumors of endothelial origin may be solid or cystic, very vascular, or poorly supplied with blood. They may be hard, having the firmness of a dense fibroid, or be a soft, jelly-like mass corresponding in consistency to a myxoma. The growths vary in size, being large or small, well-circumscribed and seemingly encapsulated or more or less diffuse, infiltrating the adjacent structures. An endothelioma may be a fungus mass and very cellular, or an irregular, nodular growth containing a quantity of connective tissue, cartilage or bone. It is ordinarily held that the endotheliomata are only mildly malignant, but that a local recurrence after thorough operative measures may occur. In so far as ulceration and the breaking down of the growths by degenerative processes is concerned they seem less likely to be affected, or less frequently, than are the sarcomata and carcinomata. It is ordinarily stated that the regional lymphatic glands are seldom implicated, and this is probably true. Endotheliomata, however, are to be found which grow rapidly, are extremely destructive of tissue, show marked metastases and early cause the death of the patient.

Again they may for years grow very slowly, scarcely increasing in size, and then at once and without apparent cause, take on a rapid growth and show a decided malignancy. My experience with a very considerable number of endotheliomata has been that some have grown rapidly, quickly infecting the proximal lymphatic glands, producing marked metastases and early leading to the death of the patient.

Some of these tumors have grown as rapidly and produced as widely spread metastases as the most malignant carcinoma or sarcoma. In the face Klebs states that the endotheliomata seemingly are most frequent where the skin passes over the bone, while the carcinomata, as is well known, show a predilection for border lines at which mucous and cutaneous surfaces meet. It is pretty well established, however, that the endotheliomata are quite frequent near the angle of the jaw and in the region of the parotid gland. Hinsberg has seen endotheliomata of the face which were difficult to differentiate from the carcinomata, and this is, I believe, the experience of every microscopist.

In considering the various species we must bear in mind that these tumors are never entirely pure in the sense that they are composed solely of endothelial cells, but that they, like other growths, contain a variety of different tissues. In fact the endothelial cells ordinarily make up but a very small part of the tumor. The cells, as it were, are but an ingrowth into the spaces of connective, fibrous, cartilaginous, osseous and myxomatous tissue. In the skin the endotheliomata may make their appearance as diffused infiltrations or as circumscribed nodular growths.

Histology.—The microscopic structure of the endotheliomata presents a very variable picture, and while this is true of all growths, both benign and malignant, it is especially true of the endotheliomata. Ordinarily one finds a very considerable connective tissue stroma in the spaces of which the cells appear closely set in numerous long strands. These strands often form a very distinct net-work, and when cut across show solid columns of cells. The arrangement of the structure reminds one of the histology of the lymphatic vessels and spaces, and, as Borst states, it seems as though the cells when in a fluid or plastic state had been injected into these vessels or spaces. At places the strands are much wider than at others, giving one the impression as though the lymph vessels had been dilated into distinct sinuses or cysts. Again,

the spaces are so narrow as to contain but a single row of cells or a couple of cells lying in close juxtaposition. This is very often the case where the lymphatic spaces are infiltrated, the wider strands, or columns, appearing like sinuses, and occurring as a rule in the dilated vessels.

Those cases in which the vessels are decidedly dilated have been spoken of as cavernous, lymph-angio-endotheliomata, and those in which the vessels are dilated to a still greater degree, especially if in circumscribed areas, as cystic-lymph-angio-endotheliomata. (Fig. 193.) The growth in this case was situated on the border of the tongue and was about the size of a cherry and ulcerated. The cells which are next the vessel wall resemble in a measure the endothelial cells, while those farther separated are epitheloid or irregular. The strands or columns are not all solid. Many of them have a distinct lumen which is surrounded by several layers of flat or polymorphous epitheloid cells. These cells are very often cuboid or even cylindrical. In those cases in which the strands have a lumen and are composed of cuboid or low cylindrical epitheloid cells the appearance is not unlike that of a glandular carcinoma.

The tubular endotheliomata composed of cuboid cells in tubules with a lumen, are quite like in appearance normal tubular glands. They are to be differentiated, however, by the fact that they have no basement membrane and by the further fact that the cells are in direct relation with the underlying connective tissue.

Klebs also calls attention to the fact that the cuboid and cylindrical cells of an endothelioma do not possess the secretory power or activity of glandular epithelium. Borst examined a cystic thyroid which was due to the growth and dilatation of the lymph vessels. A case of cystic thyroid came under my care fifteen months ago. A young school teacher, aged twenty-four, had noticed an enlargement of the neck for several years. During the past six months the increase in size had been quite rapid and was causing distress in breath-

ing and some cough. Examination showed the tumor to be confined largely to the right lobe of the thyroid gland. The growth was soft, cystic and free from pain. The right half was enucleated. Patient made a good recovery and up to this date there has been no recurrence. A macroscopic and microscopic examination showed numerous cysts large and small, a quantity of stroma, and in places strands of polymorphous endothelial cells in the lymph spaces.

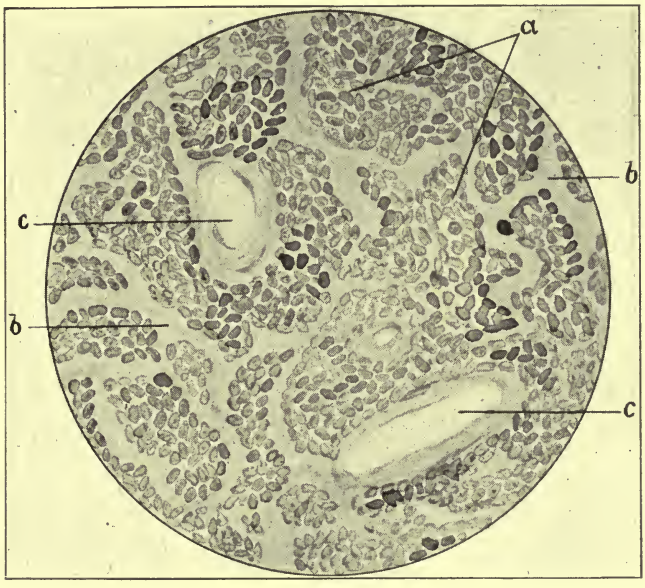


FIG. 180.
Endothelioma of Parotid.
a. Solid endothelial cell strings. b. Hyaline trabeculæ.
c. Vessels with thick hyaline walls.

Fig. 180 shows a microscopic section of an endothelioma of the parotid gland recently removed from a young woman aged thirty. The growth was about the size of an English walnut and was situated in the right side. The growth was enucleated, and the wound healed kindly. The microscopic section shows the growth to be a lymph-angio-endothelioma. The cell strands are situated in the lymph vessels and spaces, and are composed of round, cuboid and slightly elongated

cells surrounding blood vessels which have undergone hyaline degeneration. Between the strands of cells is to be seen the fibrilated connective tissue stroma in a state of hyaline degeneration.

The cystic-lymph-angio-endothelioma also occurs in the parotid and in the ovary. In the latter organ they have been especially frequent, and cannot, macroscopically, be differentiated from ordinary ovarian cysts. Marchand describes a case in which the cyst weighed ninety-three pounds. Burkhardt has seen many of these endothelial cysts of the ovary which were filled with a clear, albuminous fluid or one slightly tinged with blood. Microscopically the cysts are lined with hypertrophied, cuboid, endothelial cells.

In many cases of endotheliomata in consequence of the cell strands growing into the lymph spaces and producing a net-like formation with distinct separation of the cells from the connective tissue an appearance is given upon cross section like that of an alveolar sarcoma. The differentation is made more difficult because the cylindrical or flat epitheloid cells when growing rapidly are pressed together and become polymorphous. In some of the alveolar endotheliomata in consequence of the cells being situated in nests and spaces and surrounded by a connective tissue stroma, the cells being without an intercellular substance, a picture is produced difficult to differentiate from a carcinoma. The cells in some cases are cuboid or low cylindrical and being situated upon a connective tissue structure in the form of alveoli each having a lumen filled with a secretion, the appearance is that of an epithelial glandular tumor. Borst states that the differentiation may ordinarily be made by examining the border of the growth, where the epitheloid cells will be found going over into the flat endothelial cells of the lymph vessels or spaces. Ribbert says that in endotheliomata the tendency is for the cells to occur in connective tissue spaces, which they fill in every direction so that the stroma forming the spaces and containing the vessels is surrounded in every direction by cells.

Volkmann and Hansemann also coincide with this view and agree with Borst that if the periphera of the growth be carefully examined the epitheloid cells of the tumor will be found going over into the flat endothelial cells of the lymph spaces.

Differential Diagnostic Marks Between Carcinoma and Endothelioma.—In endotheliomata Borst says there is a direct connection between stroma and cell nests, in that the fine cell processes of the nests are connected directly with the surrounding stroma, or the fine fibrillæ penetrate between the cells as an intercellular substance from the stroma, making it difficult in a microscopical section to shake or pencil the cells out of their nests. In carcinoma there is no such connection and the cells may be readily shaken from the surrounding stroma. Borst also states that alcohol, in consequence of its shrinking power, shrivels or contracts the cell nests in carcinoma, separating them from the surrounding connective tissue so that a distinct space is left between the nests and the stroma, while in endothelioma, in consequence of the connection of the cell nests by strands to the stroma, no such shrinking is possible. Waldyer adds that in carcinoma the blood vessels are always separated from the cells by connective tissue, while in endothelioma the strands of cells or cell nests often lie directly upon the vessels. Not unfrequently the difficulties of differentiation are so great that one must learn the tissue from which the growth originally sprang in order to make a positive differentation. Lubarsch says that where growths occur in lymphatic glands or in bone, simulating carcinoma, that we must know if there was a primary growth somewhere in the body and if these are not possibly metastatic in origin.

Fascicular Endotheliomata.—In the membranes of the brain endotheliomata occur which on account of their structure are known as fasicular endotheliomata. They are found as diffuse, infiltrating, plate-like thickenings, flat nodes or nodules, or as tubular structures. In the dura they have their origin in the endothelial cells of the lymph spaces and are

surrounded by fibrous tissue. The cells retain in a large measure their flat characteristics. Narrow and wide strands of cells are to be seen surrounded by a considerable quantity of fibrous tissue which is rich in cells, the growth often being called an endothelial fibroid. These growths not unfrequently undergo degenerative change, such as hyaline and calcareous, so that they resemble in a measure the psammomæ.

Fasicular Endotheliomata of the Pia.—Here the original tissue consists of two endothelial plates with numerous cross trabeculæ, between which the blood vessels course, all being lined by endothelial cells. The endothelial cells in proliferating follow the blood vessels. The stroma is considerable. The cells in bundles are pressed about the vessels, producing a fasicular or plexiform arrangement. The cells may be arranged concentrically or parallel with the blood vessels. In a microscopical section the strands when cut lengthwise give the appearance of being composed of spindle cells. When cut crosswise the cells look flat. These tumors have often been called flat or spindle-cell sarcomata. Borst says they look like perithelioma and that it is difficult to say whether they are from the perithelial cells of the blood vessels or from the endothelium covering the trabeculæ. The cells of the plexiform endothelioma are often arranged in layers and frequently undergo hyaline degeneration. They are occasionally to be found growing from the under surface of the dura as round, sessile, fungus tumors which correspond closely to the growths taking origin from the pia. Borst saw an endothelioma of the pia the size of a hen's egg. Microscopically it appeared like a fibro-sarcoma. The perivascular arrangement was distinct. By long and cross sections the vessels were seen to have an endothelial lining and outside of this an indistinct connective tissue coat. The tumor cells were arranged as a mantle about the vessels. The growth was made up of elements composed of small spindle cells poor in protoplasm but with long, tapering ends, and of flat, polymorphous and endothelial like cells. These endotheliomata

often possess a large amount of fibrous tissue and are frequently called fibro-endotheliomata. They often also contain fine strands of intercellular substance. Not unfrequently the connective tissue spaces in the fibro-endotheliomata are filled with epitheloid cells, producing the appearance of a scirrhous tumor.

A Case of Endothelioma of the Pia with Numerous Metastases. — (I am indebted to Dr. John M. Beffel for the report of the following case):

James R. Laborer. Age, forty. Native of Germany. Father of two children. Wife living and well. Always healthy. Denies venereal infection. Was married at twenty-three.

Patient was in usual health until eight weeks ago when he was taken with severe pain in the left side of chest. At first the pain was worse on taking a deep breath, but gradually become less and during the last three weeks he has not suffered much. No cough or sputum at any time. No head symptoms. No abdominal pain or gastric symptoms. Bowels move regularly every day. At onset of attack patient noticed a lump over left scapular region posteriorly. Tumor painful on pressure and interferes with his lying on his back. Numerous small nodules have appeared under the skin of trunk and upper extremities at varying intervals since trouble began. Nodules are tender and painful and rapidly increase in size. They vary in size from that of a pea to that of a small walnut. Patient says he never noticed any similar nodules before. Complains of pains in calves of legs, but there is no pain in any of the joints. Has lost over fifteen pounds, he thinks, since onset of illness. He feels weak and has no appetite. Urine negative.

Autopsy.—Body—That of a man about forty years of age. Markedly cachectic. Small subcutaneous nodules on arms, abdomen and back. Tumor completely covering left scapula, apparently adhering to the periosteum. Entirely subcutaneous, and at its thickest point about $1\frac{1}{2}$ inches in

depth. Tumor substance dense, seemingly well supplied with blood vessels. Axillary glands greatly enlarged, especially those of the left axilla. Sub-clavicular and supra-clavicular glands also greatly enlarged.

Internal Examination.—Pericardium and pleuræ were adherent to the sternum. Pleural cavities contained bloody fluid.

Lungs.—Right pleura adherent to chest wall. Lower part of inferior lobe adherent to diaphragm. In removing this part because of adhesion a portion remained in pleural cavity. The left lung is everywhere filled with nodules varying in size from that of a millet seed to that of a walnut. On section these growths appear somewhat glistening and are of a steel-gray color.

Right Lung shows same large number of tumors as left. In the inferior lobe was found the largest tumor. This was about the size of a large hen's egg.

Heart.—Heart was displaced to the right. Apex being slightly to the left of middle line. Heart removed. Showed small tumors in the auricular walls. Right ventricle opened showed a nodule about the size of small pea developing in endocardium.

Auriculo-ventricular valves, normal. Left heart opened showed valves normal. Endocardium normal. Walls of left ventricle greatly hypertrophied. Incision in myocardium showed a nodule about the size of a pea.

Liver.—Right lobe appeared about three finger's breadth below the costal border. Somewhat enlarged. Sections across liver showed numerous tumors varying in size from that of a millet-seed to that of a walnut. Some of these were white, soft, and exuded a milky fluid on incision. Others were discolored by considerable quantities of blood.

Spleen.—Sectioning through spleen from left to right showed a solitary tumor about the size of an orange almost completely surrounded by splenic tissue. This tumor presented same appearance as tumors in other organs.

Intestines. — The large intestine was normal. The mesentery of small intestine contained numerous whitish nodules about the size of a filbert. The lower part of the duodenum was lost in a tumor mass apparently developing in the head of the pancreas. The tumor had grown into the intestinal canal and in this place was bile-stained. The body of the pancreas was normal.

Kidneys.—Small growths on surface of both. Cut section showed tumors throughout kidney substance.

Œsophagus was normal. The right and left lobes of the thyroid gland were considerably enlarged. Left lobe contained two or three small nodules. In the right lobe was a tumor about the size of a hen's egg. This growth was necrotic.

Brain.—There were a great many nodules beneath the pia mater. One the size of an English walnut was situated in the right temporo-sphenoidal lobe. Many were found in the fissure of Sylvius and some in the internal capsule. The nodes which took origin from the pia often grew into the brain substance. Sections were made from all the internal organs as well as from the skin, scapular and axillary growths. All showed practically the same characteristics. It was difficult to say which was the primary growth although it seemed probable that the large tumor taking origin in the pia and at the site of the temporo-sphenoidal lobe was the primal one. This conclusion was reached largely because these growths were more highly specialized than the others. The cells which were polymorphous occurred as mantles about the blood vessels producing a fasicular appearance, or one which was difficult to differentiate from the perithelioma.

Sections of the largest axillary tumor showed the cells to be arranged in strata about open spaces, lymph spaces. In some fields the cells are arranged in alveoli. The cells are polymorphous and the stroma quite dense. In the duodenal tumor which has developed almost entirely in the inner muscular and submucous coats the cells are found in columns be-

tween the bundles of circular muscular fibres. The cells in the submucous layer occur in alveoli, but at no point is the continuity of the mucosa interrupted. Fig. 181 shows a microscopical section of the tumor situated in the pia.

Hansemann believes that many scirrhous growths of the stomach, œsophagus and uterus are of endothelial origin.

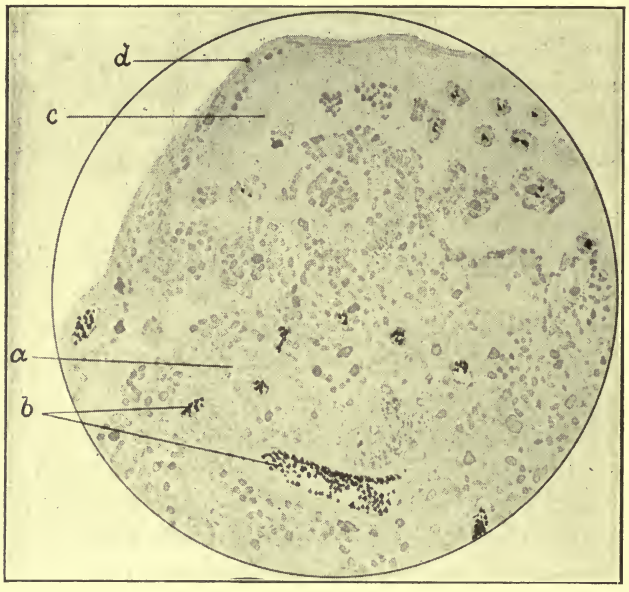


FIG. 181.

Endothelioma of Pia Mater.

a. Endothelial cells
b. Blood vessels.
c. Cerebral cortex.
d. Pia Mater.

Borst saw a case of ulcer of the stomach in which the endothelial cells had grown into the lymph spaces like a scirrhous and had also produced metastases. He believes that in many of these cases the growths are endotheliomata.

The endothelioma which occurs upon a serous membrane is of special interest. It may occur as a more or less diffused

growth extending over a considerable portion of the membrane or as innumerable small and distinct or confluent nodules. The growths may be light or dark, in the form of wheels or nodules, simple thickenings or flat, swelling-like pads. They are usually confined to the surface, not extending into the deeper tissues. They may reach a very considerable size. Although confined to the surface they are at times as destructive in their growth as the carcinomata and produce metastases in the lymphatic glands, liver, kidneys, muscles, in the suprarenal glands and in the bladder. The endothelial growths in these situations are usually attended with chronic inflammation in which there is a serous or fibrous exudate.

HISTOLOGY.—Especially characteristic of the growths of the serous membranes is the net-like arrangement of the cells occurring as they do in narrow or broad strands. Their appearance reminds one of the lymph spaces and lymph cavities. The connective tissue of the part is often considerable as the result of proliferation. The cells are often polymorphous. The protoplasm is rich and granular. Cuboid and cylindrical cells occur. In endothelial growths taking origin from the serous surfaces it is a question whether they come from the surface endothelium or from the endothelial cells of the lymph vessels and lymph spaces. The cells of the former may grow into the subendothelial lymph spaces and lymph vessels. The cells from these spaces by proliferation may produce cell masses of considerable size.

Borst had a case of endothelioma of the peritoneum, commencing seemingly in the left ovary. The peritoneum was covered with nodules, flat thick wheels and soft papillæ. The growths were confined to the surface. They did not invade the organs. The serous membrane was covered with smooth cysts of varying sizes which contained a colloid or mucoid material. This material seemed to be due to the secretion of the cells. The cysts filled the pelvis, were found in the meso-colon and produced a thickening and contraction

of the omentum. They were found everywhere between the nodular and papillary growths. The process had also affected the pleura and the lymphatic glands generally. The cysts were lined with cuboid or flat cells in a single layer and were seemingly formed by constrictions and foldings of the cell masses. The cells were arranged in the lymph vessels and spaces like an alveolar carcinoma and were flat, cuboid and cylindrical. At places the appearance seemed fasicular. At times the cells were epitheloid in appearance.

Endotheliomata of the Pleura.— These growths taking origin in this situation often reach the lungs and spread out from the hylus as a diffuse infiltration. Borst believes many of the so-called flat cell carcinomata are really endotheliomata. He had a case of large, plate-like swelling of the pleura with diffuse infiltration of the hylus of the lung. Secondary nodes were to be found on the ribs and in the skin. It is unquestionably true that growths of this character and in this situation have very often in the past failed of correct recognition. They have been mistaken for cases of acute or chronic pleurisy or for new growths of undetermined origin. Dr. Francis Delafield reports in the November number of the *Medical Record* for 1902 four cases of primary endotheliomata of the pleura. In these cases there is primarily, according to Delafield, a new growth of cells from the endothelium of the lymphatics. Coincidently the pleura is split up by an extensive new growth of cells and there collects within the pleural cavity a quantity of bloody serum. In the early stages the pleura is only thickened, but in this thickened membrane there are tubules or irregular cavities filled with polygonal cells. In the early stages the condition may readily be ascribed to an inflammatory process. In a later stage white nodules, more or less distinct or confluent make their appearance. These growths may be not larger than a pea or as large as the end of the finger. Delafield says that during the first weeks it is scarcely possible to distinguish endothelioma of the pleura from pleurisy with effusion, that the invasion, the behavior of

the patient and the physical signs are all the same. The temperature remains, however, practically normal and the fluid within the pleural cavity is bloody. As the case goes on the loss of strength and flesh, the progressive weakness, makes one think of malignant disease. In three of Delafield's cases the disease apparently came on after a cold. All had pain in the side, effusion, slight cough, expectoration, dyspnœa, loss of flesh and great weakness. One of the patients died four and one-half months after the onset, a second in four months, a third in two and the fourth in one month. The autopsy findings in these four cases were much the same:—bloody serum in pleural cavity, adhesions, and either whitish nodules scattered over the surface of pleura or a thickening of the pleura. In one case the liver beneath the capsule contained several large, white nodules. There was also a large nodule in the spleen. The peritoneal cavity contained bloody serum and there were nodules in the omentum aud mesentery. In another case the peritoneal cavity contained bloody serum, while the peritoneum was studded with small white nodules.

A case of endothelioma of the pleura recently came under my observation the history was as follows:—A man aged forty-eight had an attack of pleurisy on the left side. This was attended with a large effusion. After three months two quarts of bloody serum were withdrawn. The man steadily grew worse, had a severe cough with dyspnœa, lost flesh and strength and died at the end of the seventh month.

Autopsy.—Left pleural cavity almost obliterated by adhesions. Costal surface covered with confluent whitish nodules the size of the end of a finger. Right pleura thickened and partially adherent, Many small white nodules varying in size from that of a wheat kernel to that of a pea were found beneath the capsule of the liver. The other organs were healthy.

Histology.—Fig. 182 shows a microscopical section of the growth. In this case the cells were cuboid or polymorphous and arranged in long, slender, interlacing strands

which conformed to the lymph spaces. At places the strands are quite wide like columns. The tissue showed myxomatous degeneration with vacuoles between the cells. The lymph spaces may be those normal to the part or they may be new-formed. In Borst's case the cells of the lymph spaces were composed of small and large flat cells. They were polymorphous. Degeneration had also taken place.

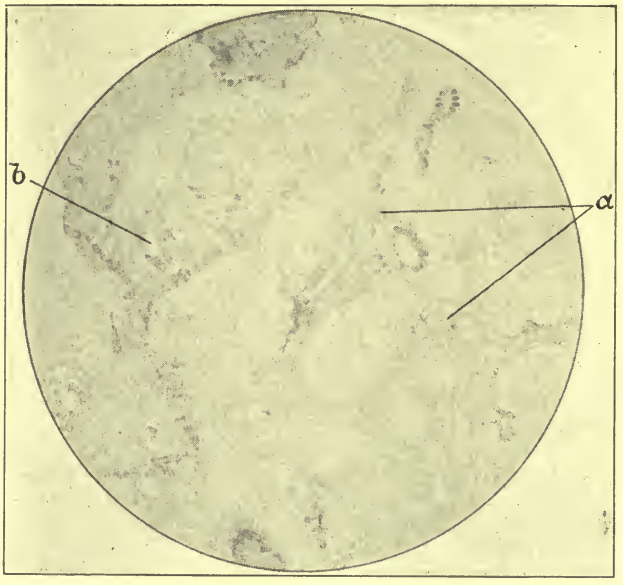


FIG. 182.
Endothelioma of Pleura.
a. Endothelial cell strings. b. Vacuoles.

Shrunken nuclei had appeared and it seemed as though the nuclei were broken into fragments.

Papillary Lymph-angio-endothelioma.— These growths are of unfrequent occurrence and are found in those endotheliomata which invade the large lymph spaces. Merchand and also Mueller saw cases of cystic papillary endotheliomata of the ovary. Borst had a papillary lymph-endothelioma of the subcutaneous tissue with an alveolar structure. At places

there were wide cell growths in the lymph spaces. At others cysts were formed with papillary outgrowths. The cysts are the result of dilatation of the lymph spaces from the borders of which there is a cellular outgrowth.

A large number of lymph-angio-endotheliomata are of interest on account of the complicated structure of the stroma. In a considerable number of those which have their origin in lymph spaces the connective tissue surrounding them takes on such an active growth as to present the appearance of a scirrhous. The stroma surrounds strands of epitheloid cells usually closely pressed together. Hansemann is of the opinion that many cases of so-called scirrhous of the stomach, and also perhaps of the mammary gland and uterus and even of other organs, do not have their origin from epithelial structures but from the endothelium of the lymph spaces. Von Rindfleisch examined the stomach of a woman who died in her sixty-seventh year of what had been diagnosed as a carcinoma of the stomach. On the small curvature of this organ was an ulcer, the base or border of which presented a milk-white, hard infiltration. The ulcer completely surrounded the region of the pylorus and had caused an extreme degree of stenosis. The base of the ulcer was irregular and nodular. The growth had invaded all the coats of the stomach as well as the retro-peritoneal connective tissue. Behind the stomach the lymphatic glands were enlarged and formed a mass as large as a man's fist. Metastases in distant organs had occurred. Sections of the infiltrated stomach walls showed a characteristic carcinomatous structure in that epitheloid cells invaded the connective tissue spaces, where they were closely pressed together in nests. The cells did not correspond to the cylindrical carcinomatous cells, but had enlongated nuclei and the long axis was without regular order. The cells were also enlongated. As the cells did not correspond to those of a carcinoma in this region the growth was held to be of endothelial origin. Often in cases where there is a resemblance

to scirrhous the growth really is a lymph-angio-endothelioma only the stroma is over-developed.

Mixed Growths.—In these tumors there may be found hyaline, fatty, myxomatous, sarcomatous, cartilaginous and even osseous tissue. This is especially true of endotheliomata occurring in the parotid and submaxillary glands and in the gums. In the metamorphosis the individual fibres are said to swell up, run together and form a homogeneous mass. There is much dispute as to how the mixed tissue is formed, whether by the process of metaplasia or by the development of sequestered embryonal cells. The process of metaplasia, or the changing of one tissue into another, especially where the tissues are of like character, is of frequent occurrence. Borst says that connective tissue may liquefy, the cells, taking a star-shape and from this homogeneous mass with star-shaped cells cartilage may be produced in that the stroma is converted into a cartilaginous substance, while the cells take on a capsule forming a tissue in all respects like cartilage. Cartilage may be converted into mucous tissue. It is a matter of dispute whether the long, flat, endothelial cells can produce the intercellular tissue of myxomatous and cartilagnious tissue, while the endothelial cells themselves become converted into mucous or cartilaginous cells. Wartmann believes that this is possible. J. Volkmann holds that out of myxomatous and cartilaginous cells endothelial tissue may be produced. Borst states that he has never seen endothelial cells going over into cartilaginous tissue or into cartilaginous cells. He also thinks that the mucoid tissue cannot build endothelial strands. The endothelial strands can and do grow into mucous and cartilaginous tissue. A tumor of the submaxillary gland, a hyaline chondro-endothelioma the size of a hazel-nut was described by Von Rindfleisch. In this case the endothelial cells grew as strands into the tumor, canalizing it and changing it into an endothelioma. The cartilaginous tissue in part was converted into connective tissue, while the endothelial cells grew into and filled the lymph spaces.

The lymph-angio-endotheliomata are found in many regions and organs of the body. They are especially frequent in the parotid and in the salivary glands. They are also found in the skin, especially that of the face, in the serous membranes and perhaps most frequently in those of the central nervous system, also in the kidneys, testicles, ovaries and in the lymphatic glands. Ziegler found an endothelioma in the mammary gland. Many have reported these growths in the stomach. They have frequently occurred in the lymphatic glands of the neck and in the gums.

A Case of Lymph-angio-endothelioma of the Mammary Gland.—Fig. 183. A girl nineteen years of age consulted me in November, 1902, concerning an enlargement of the right breast. The family history was negative. In the personal history the girl stated that she had never been very strong, always thin in flesh, but never had been seriously ill. Six months before she had noticed a small, somewhat sensitive lump in the upper part of the right breast. In so far as she could remember there had never been any injury to the breast. The tumor had grown rapidly and at the time she came under observation was as large as a fœtal head. The growth was round, globular, had a smooth surface and projected directly forwards from the chest wall. The growth was of uniform consistence and gave about the resistance to pressure of a soft fibroid. The growth was freely movable from the chest wall, but had completely enveloped the mammary gland so that it was no longer possible to differentiate the one from the other. In fact the entire breast seemed of new formation. The axillary glands were enlarged. The girl, naturally thin in flesh, had lost several pounds since the growth made its appearance and now was anæmic, very thin, with sunken eyes and a haggard expression of the face. A diagnosis was made, in consequence of the age of the patient and the rapidity of the growth, of a round-cell sarcoma. The breast was removed and the axilla cleaned out. The wound healed kindly and now, four months after the operation, there is no sign

of recurrence, while the girl has gained several pounds in flesh and has improved in strength and in appearance in every way. A microscopic section is shown in Fig. 184. In this section are seen large strands or columns of endothelial cells. The center of these strands in places show hyaline degeneration.

FIG. 183.

Lymph-angio-endothelioma of Tonsil.—John S., a clerk aged thirty-two, married, came under my observation in the fall of 1900. His family history was negative. Personally he had no serious illness preceding the present one. He was, however, addicted to the excessive use of alcohol. Six months

previously he had noticed a small, hard nodule growing out from the center of the left tonsil. He consulted a throat specialist who, after a few weeks of observation and treatment, removed the growth, which was then about the size of a small hazel-nut. The growth quickly recurred, and was again removed without in either case removing the tonsil. It recurred again, and when he came under my observation the

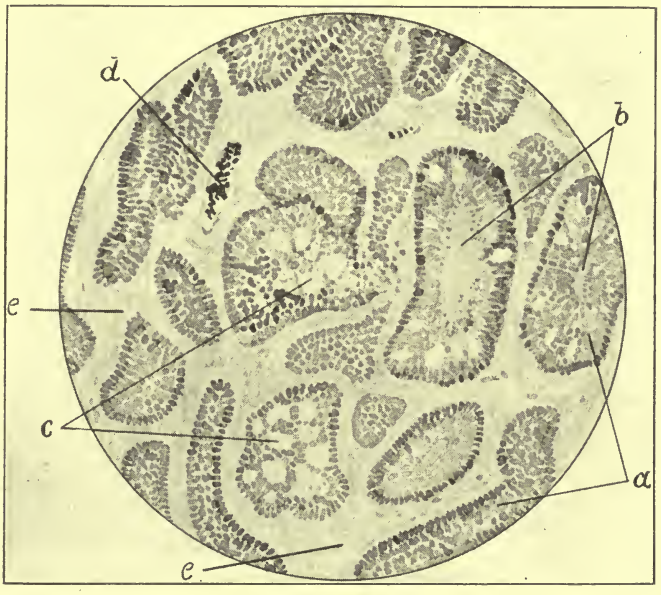


FIG. 184.

Hyaline Endothelioma (Cylindroma) of Breast.

a. Endothelial cell strings. b. Mucoid degeneration.
c. Hyaline masses. d. Blood vessel.

tonsil, including the growth, pressed well over against the uvula and was much larger than an English walnut. The soft palate upon the left side and its two pillars down to the tongue were infiltrated. The glands under the jaw were enlarged. The patient was suffering considerable pain in his throat, found it difficult to take much nourishment, did not sleep well and was losing flesh.

An incision was made from just below Stenson's duct down along the front border of the ramus, crossing the body and then carried along beneath the jaw to near the symphysis. The bone at the junction of the ramus and body was sawn through, the cheek opened, when the soft palate, including the pillars and tumor, were removed. The enlarged glands beneath the jaw, including the submaxillary, were exposed and removed. The bone was re-united with silver wire, the soft tissues with catgut and silk worm gut. The patient made a good recovery, but after three months there was a recurrence at the site of the cicatrix in the mouth, while a row of enlarged glands made their appearance along the entire length of the internal jugular vein. The man died ten months after the operation from general cachexia and with symptoms of cerebral metastases. In the microscopic section as shown in Fig. 185, the columns of endothelial cells are mostly cut crosswise and look like nests of polymorphous cells imbedded in a quantity of connective tissue. The center of the strands in places is undergoing hyaline degeneration. In one part of the section shown there is an area of lymphoid tissue which is also undergoing degenerative change.

Lymph-angio-endothelioma of the Sacrum.—Samuel W., German, aged fifty-six, consulted me on account of severe pain with some swelling over the sacrum. His family history was negative. In his personal history he stated that during the previous January while walking on a slippery sidewalk his feet suddenly went out from under him and he fell with great force, striking the region of the sacrum. He was severely stunned for a time, but soon was able to resume his work in a tannery. Following the fall a swelling appeared over the sacrum which never quite disappeared. There was also great tenderness and some pain in the swelling and these remained. After two or three months the swelling and pain increased. When he came under my observation the pain was constant and so severe that he was unable longer to work. There was at this time directly over the sacrum a hard, smooth, sensi-

tive slightly elevated and immovable growth about the size of a sauce-dish. Per rectum nothing abnormal could be felt. The patient did not return after this examination for more than four months, but when he did the growth was seen to have increased greatly in size. It was still circumscribed, very hard, of uniform consistence and implicated the major portion of the sacrum. Per rectum a large, hard, circum-

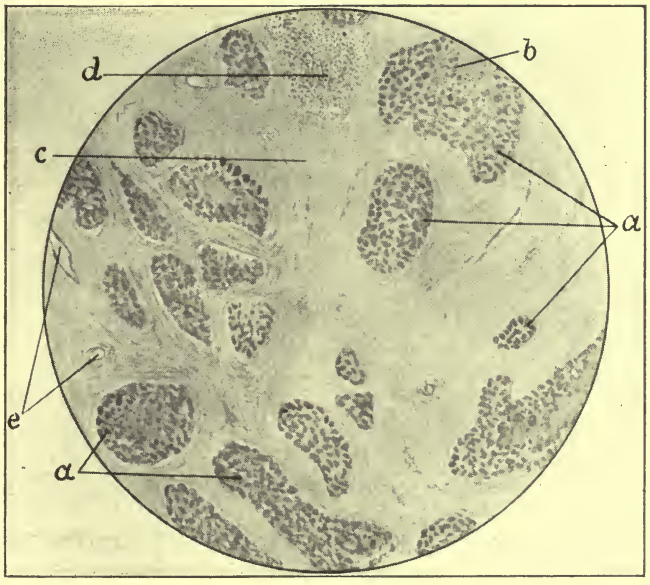


FIG. 185.
Endothelioma of Tonsil.
a. Endothelial cell strings and nests. b. Mucoid degeneration.
c. Stroma. d. Lymph follicle. e. Vessels.

scribed, bulging mass could be felt attached to the sacrum. Operation. The tumor was surrounded by two eliptical incisions which went down to the bone. The mass, which was quite hard and consisted of bone, cartilage, a dense stroma, and a soft cellular tissue, was cut and curetted away. The borders of the adjacent bone surfaces were also removed. This left an opening through the sacrum some three or four inches in

diameter, exposing the lower portion of the sigmoid and the upper end of the rectum. The wound was packed with iodoform gauze, no effort being made to close it. The patient was relieved of his pain at once and in a few weeks, from the formation of granulation tissue, contraction and cicatrization, the wound had closed. The man was also able in a short time to return to his work and up to this time, now five months

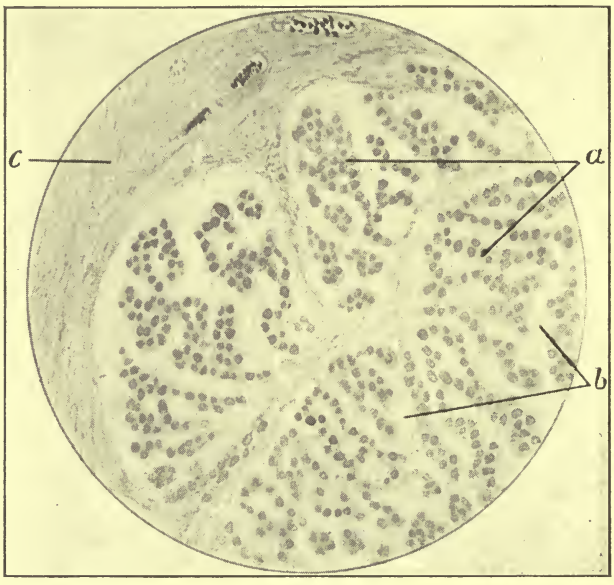


FIG. 186.
Endothelioma of Sacrum.
a. Endothelial cell strings. b. Hyaline Matrix.
Connective-tissue Stroma.

after the operation, there has been no return. Fig. 186 shows a microscopical section. Here are to be seen beautiful narrow endothelial cell strands which are largely composed of but a single row of cells or of strands composed of two or three cells in close juxtaposition; the matrix is hyaline; at one part is shown a large connective tissue stroma.

Lymph-angio-endothelioma of the Testicle.—A boy five

and one-half years old, of healthy parents, was noticed to have a swelling of the right testicle which increased rapidly in size. The growth while not especially painful, was of uniform consistence, smooth and rather soft. At the end of the fourth month it was as large as a large orange. The growth was then removed and with it as much of the cord as seemed practicable. The boy seemed well for four months when

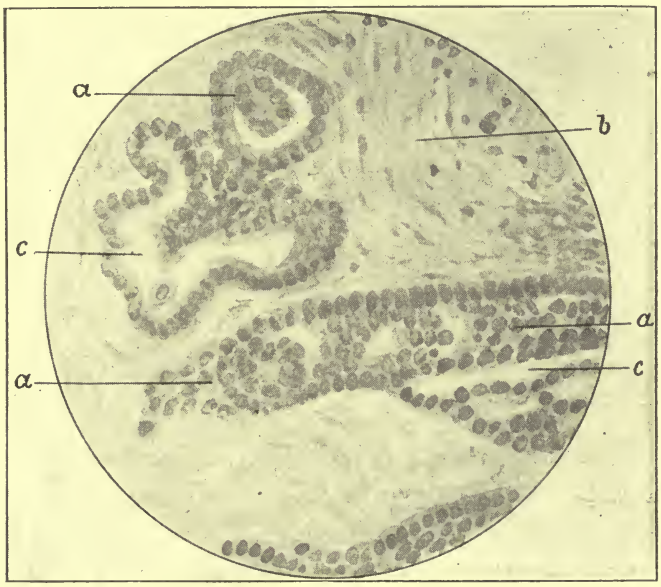


FIG. 187.
Endothelioma of Omentum (Metastasis from Testicle).
a. Endothelial cell strings in longitudinal and cross section.
b. Fibroma stroma. c. Lumen.

a tumor was noticed in the right iliac fossa, which grew rapidly. The growth was sensitive, somewhat irregular and fixed. The abdomen was opened and the growth found to implicate the omentum, cecum, and a small portion of the ileum. A large portion of the omentum was resected and with this the cecum and several inches of the ileum. The boy died from shock. Fig. 187 shows a microscopic section

of the growth. In it are to be seen the strands or cords of endothelial cells. These are composed largely of cuboid cells, some, however, are polymorphous. The strands are cut longitudinally and cross-wise. In the latter a lumen is to be observed.

Lymph-angio-endothelioma of the Right Iliac Bone.— Mrs. M., aged thirty-one, of good family and personal history,

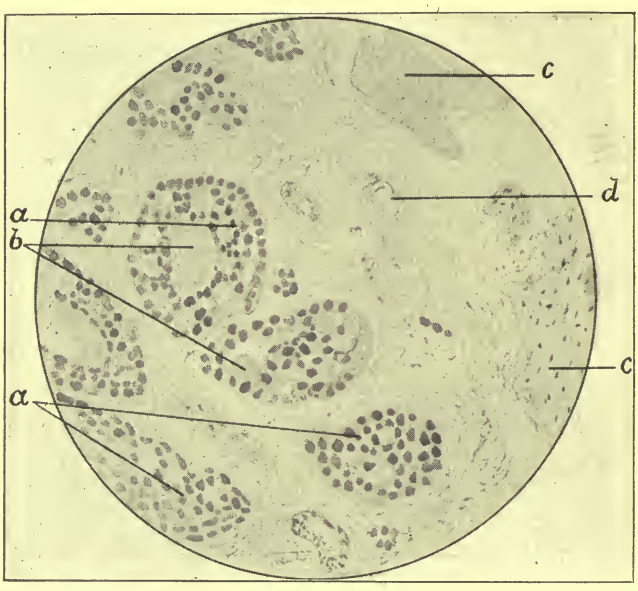


FIG. 188.
Endothelioma of crest of Ilium.
a. Endothelial cell nests. b. Hyaline masses in cell nests.
c. Osteoid spiculæ. d. Blood vessels in fibrous stroma.

first noticed in Jan., 1900, a swelling about the center of the crest of the ilium. This was sensitive, smooth, hard, reasonably well circumscribed, fixed and grew slowly. After six months, the growth, having steadily increased in size, was removed by an excision of a considerable part of the ilium. The wound healed kindly and the patient made a good operative recovery. Four months thereafter, however, an induration was noticed

in the structures adjacent to the cicatrix both soft and hard. These were nodular, in places, subcutaneous and then again seemingly springing from the periosteum of the bone. Some were distinct, others more or less confluent. The condition was progressive and the patient died fifteen months after the first appearance of the growth in a general cachectic condition. Fig. 188 shows a microscopic section of the tumor. In the growth both bone and cartilage were to be found. The connective tissue stroma made up a considerable part of the tumor. In this are round and oblong cavities or cysts more or less filled with flat, cuboid endothelial cells, The cells are at times polymorphous and show in places especially in the cyst-like cavities hyaline degeneration. In some places only the nuclei are to be seen, the cells apparently having undergone degenerative change. The connective tissue stroma has also in places undergone hyaline degeneration.

ENDOTHELIOMATA TAKING ORIGIN FROM THE BLOOD VESSELS.

It has been held by a goodly number of pathologists and clinicians that endothelial tumors take origin only from the endothelial cells lining lymph vessels, lymph spaces and serous membranes. The opinion seems to be gaining ground, however, and it is undoubtedly the correct one, that endotheliomata under certain conditions take origin from the endothelial cells lining the capillary blood vessels and from the adventitial cells known as perithelial cells which form a membrane just outside the capillary vessels. The former have been called by Borst hæmangio-endothelioma intravasculare, or hæmangio-endothelioma simplex. Here the primal condition is an excessive outgrowth of capillary vessels. Following this as a second important factor there is a rapid proliferation of the endothelial cells lining the capillaries. The capillary vessels become more or less completely filled with cells in consequence of the rapid proliferation of their endothelium, thus producing more or less solid strands or columns of cells. The cells here are within the vessels and

cell strands or cords or columns consequently take much of the form and arrangement of the original capillaries. In the second species the hæmangio-endothelioma perivasculare, or, as it is usually called, perithelioma, the endothelial cells are outside of the vessel as a thick mantle of large cells. The stroma in both of these species is often deficient and may disappear so that in a microscopic cross section the cell strands or cylinders are pressed close together, while there is but little stroma or perhaps none to be seen. The tumor often presents the appearance of a sarcoma or of an angio-sarcoma. In fact the endotheliomata taking origin from the blood vessels have ordinarily been classed as angio-sarcomata. There are, however, certain pretty well defined and distinctive differences.

Thoma looks upon an angio-sarcoma as a cellular variety of angioma. Many writers describe an angio-sarcoma as a sarcoma in which the blood vessels have been unusually developed. Paltauf thinks that an angio-sarcoma is an atypical outgrowth from connective tissue. Ziegler looks upon an angio-sarcoma as a growth composed of blood vessels and cells, the latter surrounding the former. Borst thinks that when a sarcoma is rich in blood vessels it may be called a telangiectatic sarcoma.

When a tumor takes its origin from the endothelial or perithelial cells either of lymph vessels, lymph spaces, serous membranes or blood vessels it should be called an endothelioma. In the hæmangio-endothelioma simplex the original tissue consists almost entirely of capillary vessels, the stroma usually being insignificant in amount. The arrangement of these vessels is very various. Some times they are seen as a plexiform mass, then again in loops and then in the process of budding. It is ordinarily held that in this species only capillaries are to be found, that it is not determined that vessels of large size make up any considerable portion of the growth. These tumors may usually be differentiated from ordinary capillary growths by the proliferation and metamor-

phosis of the lining cell layers. In the normal capillaries of an angio-sarcoma the vessels are lined by flat, endothelial cells while in the hæmangio-endothelioma simplex the vessels show degenerative changes, and the cells are often in a state of active proliferation and instead of being flat, normal endothelial cells assume the appearance of epitheloid, cuboid or cylindrical cells. The cells are frequently rich in protoplasm and often present the appearance of a glandular structure when cut across, and are only differentiated by the occasional occurrence of blood in the lumen of the columns. In those cases assuming a glandular-like structure in which the capillaries are widely dilated and the amount of stroma small, the vessels being pressed as it were directly against each other, there is produced a spongy mass having the appearance of a cavernous angioma. Occasionally in consequence of the lumen of the vessels being lined by cuboid cells an appearance is produced not unlike that of an adenoma or an adeno-carcinoma.

Borst states that many of the hæmangio-endotheliomata of bone have been thought to be carcinomata. The same is also true of the endotheliomata of the kidney and testicle. The glandular form of the intravascular endothelioma is very rare. It is a pure form of endothelioma, but borders upon the angioma. The proliferation of cells may become irregular the cells growing in bunches. These cells are polymorphous, grow rapidly and may fill the vessels displacing the blood. Markwald found a hæmangio-endothelioma affecting nearly all the bones of the skeleton. In this case the growths appeared as solid strands of epitheloid cells, and as tubes, lined by cylindrical cells and filled with blood. At times the vessels were dilated into spaces resembling caverns. The intravascular hæmangio-endothelioma of bone and of kidney often contains quantities of fat and glycogen. The protoplasm of the cell is often scarcely to be seen. The hæmangio-endothelioma may take the form of a papillary growth. Most and Boormann examined a case of hæmangio-endothelioma

simplex of the testicle in which there had been many metastases. The capillaries of the tumor were widened, contained blood corpuscles and were lined with endothelial cells. In the widened capillaries papillary growths were to be seen. These were due in part to the growth of the stroma which projected into the lumen of the widened vessels, as many branching processes, and in part to the proliferation of the endothelial cells. The intravascular hæmangio-endotheliomata have been observed in the penis, nose, bones, scrotum, thyroid gland, spleen, kidney and liver. Plate 189 shows an intra-vascular hæmangio endothelioma of hepatic vein. The proliferating endothelial cells have nearly filled the lumen of the vessel.

Hæmangio-Endothelioma Perivasculare, or Perithelioma.—There seems to be some uncertainty as regards the histology and origin of the perithelial cells, the perithelial membrane and of the so-called perithelial tumors. Some writers hold that these growths are only a variety of angiomata or angio-sarcomata, while others, and perhaps the majority, believe that they take origin from certain distinctive endothelial cells. It is claimed that these growths are related on the one hand to the angioma and on the other to the alveolar sarcoma. Some writers seem disinclined to differentiate an angio-sarcoma from a hæmangio-endothelioma. In histology the perithelium has no recognized position. So far as I am aware histologists do not describe any particular class of cells as of perithelial origin. Aamann holds that the perithelium is that adventitious connective tissue which immediately surrounds the blood vessels. Borst holds that the perithelial cells are those which line the vascular side of the perivascular lymph spaces. Arnold defines the perithelial membrane as that part of the connective tissue which shuts itself off on the one hand from the lymph channels and on the other from the blood vessels. By this means it is held that a perivascular space is formed which cannot be injected from

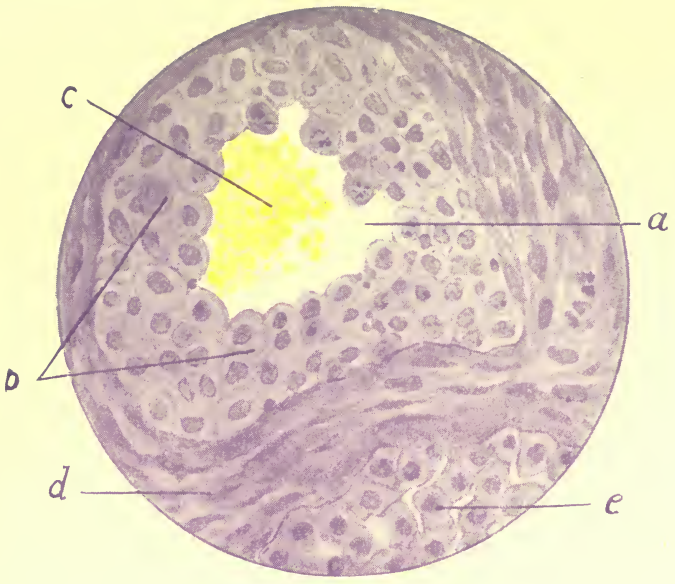


Fig. 189.

Intravascular Hæmangio-endothelioma of Hepatic Vein.

a. Lumen of vein.
b. Proliferated endothelial cells.
c. Red blood cells.
d. Capsule of Glisson.
e. Liver cells

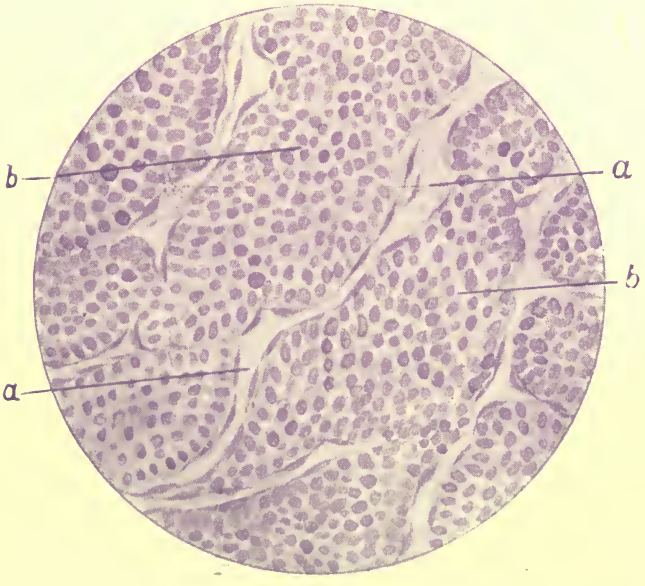


Fig. 190.

Perithelioma of Mamma.

a. Capillary blood-vessels.
b. Endothelial cell masses.

the lymph or blood vessels. This space is lined by endothelial cells, the so-called perithelium.

Tumors taking origin from the perithelial cells are not widely distributed or of frequent occurrence. They have been called in the literature angio-sarcoma, plexiform sarcoma, and myxoma. The tumor is made up primarily of proliferating capillaries. Around these the cells grow as a thick mantle and produce a plexiform arrangement. The cells are large, flat, cuboid, cylindrical or polygonal. This mantle of cells is placed directly upon the endothelial cells making up the wall of the capillary. This endothelial lining separates the vessel contents from the adventitial cell masses. The cells composing the mantle either lie close together without a stroma or there is a fine fibrillary structure with occasional long spindle cells making up an intercellular structure. Inside of this stroma Borst says the cells are arranged, when polygonal, quite irregularly. When flat they lie in close parallel or concentric layers around the blood vessels, or the cells may radiate in slender columns from the vessels. The inner layer next the endothelial lining is often cuboidal or cylindrical. If the stroma is very sparse the tumor will consist of blood vessels pressed close together, each vessel having its mantle of cells. In some cases the walls of the older vessels become thickened in consequence of a quantity of connective tissue being deposited around them. In these cases the growths take on an alveolar structure and bunches of tumor cells are to be seen lying within the meshes of the walls of the blood vessels. If the stroma between the vessels is more highly developed, then a structure like a carcinoma is produced. A rare form of perithelioma presents in place of these thick mantles, a single regular layer of epitheloid, cuboid, or cylindrical cells.

Degenerations.—Hyaline swelling of the wall of the blood vessel leading practically to its obliteration, is a frequent occurrence in this class of tumors, and the perithelioma in which the vessel wall has undergone hyaline degeneration,

forms a considerable part of the cylindroma. This hyaline degeneration may extend to the stroma in which there are to be seen bunches, strands and nests of epitheloid cells joined in a network, thus making the original character of the tissue difficult of recognition.

These growths are situated most frequently in the membranes of the brain and in the brain itself. They also occur in the serous membranes, in the parotid glands, in the bones, gums, subcutaneous connective tissue, kidneys, ovaries, mammary glands, muscles and eye-lids.

The perithelioma is to be differentiated from the hæmangio-endothelioma intravasculare by the fact that in the latter the proliferation of the endothelial cells is within the blood vessels, while in the former the cells which proliferate are outside of the vessels, leaving the lumen intact and forming a mantle of polymorphous, cuboid or cylindrical cells surrounding the capillaries. In the membranes of the brain and in the brain itself these growths occur as circumscribed hæmorrhagic nodules rich in blood vessels and of a soft medullary or gelatinous consistence. The growths are occasionally multiple infiltrations. If the growths take origin in the dura they may extend to the vessels of the pia, as well as to those of the brain itself. These growths also occasionally assume the papillary form. Borst states that the outer surface of the vessels of the brain is covered by a delicate membrane forming a mosaic of endothelial cells. This is the perithelium and this perithelium lines the outer surface of the brain and extends to the under surface of the pia. The sub-arachnoid lymphatic spaces embed loosely the blood vessels. This is the so-called perivascular lymph space. The circumscribed growths occurring upon the membranes of the brain are composed almost entirely of capillary vessels. These capillaries are interwoven so as to present varicose branches, all of which are filled with blood and lined by endothelial cells. Directly upon this endothelial lining are many layers of epitheloid polymorphous cells occasionally in a radiating arrangement.

Not unfrequently the cells are flat and then are in layers. In these growths there is very little of stroma, the thick mantles covering the vessels usually touching each other. V. Rindfleisch says the first process in the formation of a perithelioma of the brain is a rapid proliferation of perithelial cells of a blood vessel forming a bunch. These cells are large, protoplasmic, nucleated cells which occur in distinct layers or in balls. The large vessels always have a lumen, while the smaller ones may shrink and finally be converted into a solid strand of cells. The diffuse endothelial growths of the pia often occur as multiple thickenings with extensions to the adjacent structures. They produce infiltrating areas which present very much the appearance of a glandular structure in consequence of the vessels being surrounded by low cylindrical or cuboid cells. These cellular outgrowths come entirely from the proliferation of the perithelial cells.

The papillary form of the perithelioma also occurs, but not frequently, in the pia.

It is stated by Borst that a perithelioma of the carotid gland situated at the bifurcation of the common carotid artery and possessing only mild malignancy is occasionally to be found. Hanke described a perithelioma taking origin from the under eye-lid. It was made up of cylindrical cells arranged concentrically and in a radiating manner. There was scarcely any stroma. The growth of a hæmangio-endothelioma is the result of the proliferation of its own cells and not due to the irritation of neighboring cells. In the hæmangio-endothelioma and in the perithelioma the tumors are formed by irregular proliferated cell masses and by the sending out of new processes. In the latter in the first stages there may be seen long chains of cells either in single, double or multiple layers or rows.

In the perithelioma the proliferating endothelial cells grow into the spaces of the tissues as long cell strands. The network may be formed of single or double strands. The intervascular tumors show atypical growth by the cells assum-

ing a cuboid or cylindrical form and by their growing into the lumen of the vessels instead of forming a normal endothelial lining. They may later assume a plexiform or an alveolar structure. There are intravascular endotheliomata which take on a typical growth, and form real blood vessels having a lumen which can be filled with blood.

The peritheliomata also grow by capillary proliferation, but following this there is a proliferation of the perithelial cells surrounding the vessel, producing for the vessel a mantle. The perithelium proliferates much faster than the endothelium and forms the greater part of the growth and the cell mantles for the vessels. Boormann has been able to demonstrate this sprouting of the hæmangio-endothelium perivascalure. He thought that probably the first process was a proliferation of the perithelial cells instead of a sprouting of the vessels. Plate 190 represents a section from a perithelioma of the mamma. The capillaries are cut lengthwise consequently the cells appear as large columns between the vessels. The cells are placed directly upon the endothelial lining of the vessels. The tumor was removed from a young woman aged twenty-four, was the size of an orange and of quite rapid growth.

The Mixed Endothelial Tumors.—The mixed tumors are formed by a considerable growth of connective tissue in connection with the endothelial cells. Occasionally these tumors have a rapid growth like the sarcomata. The amount of stroma in any given tumor is largely dependent upon the rate of growth of the specific cells of the part. These cells may proliferate so rapidly that there is little time for the formation of a connective tissue stroma. Tumors which grow with less rapidity usually contain more of stroma and this may come, at least in part, from the adjacent structure. Occasionally there occurs a combination of sarcomatous and an endotheliomatous tissue in the same tumor. Endothelial proliferation may in fact occur in almost any new growth. In certain large spindle-cell sarcomata there occurs marked proliferation of endothelial cells.

In these there may be cell nests or cell strands coming from the endothelium of the blood vessels.

Bundles of epitheloid cells formed into alveoli and occurring in a sarcoma may present the appearance of a carcinoma. There seems to be at times a close connection between an endothelioma and a sarcoma. The endothelial strands of cells are often closely related to sarcomatous tissue. In fact no very sharp line seems to separate the two forms of growth. J. Volkmann and Nasse saw in combination a spindle-celled sarcoma and a lymph-angio-endothelioma. Borst had two cases in which a hæmangio-endothelioma was combined with a sarcoma. In both there were cavernous spaces and large spindle cells. The tumors grew rapidly, were rich in blood and the site of frequent hæmorrhages.

A lymph-angio-endothelioma and a hæmangio-endothelioma are frequently found in combination. It is said that the lymphatic portion of these tumors comes from the lymph spaces and not from the lymph vessels. J. Volkmann found an endothelioma of the gums in which there was a proliferation of the interfasicular endothelium combined with the adventitial cells of the vessels. Borst thinks that this is a common occurrence for an endothelial tumor to take origin from the lymphatic spaces. It is ordinarily held that multiple endotheliomata are rare. Klebs demonstrated a case of multiple endothelioma of the pia. This occurred in the form of small white nodules. Ssobelew reported a multiple lymph-angio-endothelioma in the gastro-intestinal canal. Multiple endotheliomata are the rule when these growths occur upon a serous membrane. The endotheliomata of bone are often soft, hæmorrhagic, pulsating tumors which may be partly covered by a thin plate of bone and which should be differentiated from aneurism.

Cylindroma.—They may be defined as a sub-variety of the endothelioma in which the walls of the blood vessels, and also at times the endothelial cell strands and stroma, have undergone hyaline degeneration. Degenerative processes, hya-

line, myxomatous, colloid, and chalked occur so frequently in endotheliomatous growths as to become almost pathognomonic.

In a cylindroma one usually finds the growth to be made up in part of gelatinous tissue which occurs in globules, balls, or cylinders. This tissue may be translucent or even transparent. In consequence of hyaline, colloid and myxomatous degeneration occurring occasionally in carcinoma, sarcoma, and adenoma, these have been by some writers, especially Ziegler and Lubarsch, classed as cylindomata. In sarcoma, carcinoma and adenoma, however, the hyaline degeneration almost never proceeds so far that the specific cells characteristic of the tumor cannot be distinctly made out.

The cylindromata may be divided into several subdivisions according to the particular tissue or the situation of this tissue which has undergone degenerative change. Thus they take origin in the endothelial or perithelial cells of the blood vessels. The tissue undergoing degeneration is variable. It may be confined to the blood vessels both in the hæmangio-endothelioma and the lymph-angio-endothelioma, or the vessels and the stroma may undergo hyaline degeneration, or the process may be confined to the cell strands. In the hæmangio-endothelioma simplex there is microscopically a central strand of cells around which a hyaline mantle or vessel wall is to be seen. In the perithelioma we have a central vessel with a normal, or, more often, altered lumen, the vessel wall having undergone hyaline degeneration, while surrounding this and outside of it is the endothelial cells. In the lymph-angio-endothelioma the hyaline changes may be confined to the blood vessels or they may invade the stroma as well. If the perivascular lymphatic vessels are the site of the endothelial growth then, and in that case, there are to be seen hyaline cylinders which are the blood vessel walls surrounded by the cells of the growth. Koester, Friedlander and Tommase have demonstrated the endothelial nature of cylindroma. Koester believes that the degenerative process begins in the axis of the

cell strands, that these undergo liquefaction and then the hyaline masses become confluent. The degenerative process may involve a part of, or the entire, cell strands. When this process is not complete there are often to be seen vacuoles in the cells. The cell bodies represent tubules and in these tubules there is a transparent gelatinous substance. (Plates 184 and 188.)

In the lymph-angio-endotheliomata not only the walls of the blood vessels but also the cell strands and stroma may undergo hyaline degeneration.

The two principal forms of cylindroma, which are perhaps also the most frequent, are first, the perithelioma with hyaline degeneration of the vessels, and second, lymph-angio-endothelioma with degeneration, in part at least, of the cells, vessels and stroma. The hyaline lymph-angio-endothelioma or cylindroma has been considered under a variety of names by different writers. Billroth was one of the first to examine these growths and give them the name of cylindromata. Macroscopically they are nodular growths in which an indistinct alveolar structure is to be seen in cross section. The gelatinous body is surrounded by connective tissue strands. The periphera is enclosed usually by a fibrous capsule except in cases showing decided malignancy, and in these there is only a very indistinct capsule, the growth being more or less diffuse. Microscopically there are to be seen transparent, glass-like cylindrical and hyaline bodies extending in every direction. Inside of these cylinders varicose swellings, club-like excrescencies, and nodular protuberances, presenting a gelatinous appearance, are present. There are also fine, delicate or coarse hyaline threads ending in colloid enlargement. The hyaline bodies are usually homogeneous or they are very faintly striated. Occasionally the fibres contain spindle-shaped nuclei. On section a cylindroma, or a lymph-angio-endothelioma, shows a very complicated stroma containing in many forms and situations endothelial bodies. These appear as small, fine cell strands or tubules. They

occasionally occur in twisted form or as solid cell cylinders, or they seem like cavities or balls.

The origin of the hyaline material evidently is varied. It has been held by many writers that it was a product of the cells' secretion, and while these endothelial cells in the normal condition possess little secretory function they may, when undergoing rapid proliferation, and when forming endothelial tumors, acquire the power of secreting hyaline material in considerable quantity. This view is perhaps especially held by Jansen, Friedreick and Zahn. Boormann and others believe that the hyaline material is the result of the degeneration of the cell's protoplasm, the cells becoming softened, confluent and form hyaline globules, balls or strands. Lubarsch holds to two methods of production, the secretory and degenerative, and believes that in the secretory the hyaline material is formed within the cells, while in the degenerative it is formed outside of the cells by coagulation. Volkmann holds that it may be due first to degeneration of the stroma or the vessel wall and second be the result of the secretory function of the cells. In hyaline degeneration the part becomes swollen and glossy, the cells merging into or being converted into a regular glistening mass. Toward the outside of the balls the cells are flat and may be without a nucleus and in a state of partial hyaline degeneration. The process of secretory hyaline change at times appears much like the secretion which takes place in glandular epithelium in that a clear hyaline drop appears in the cell which finally, in consequence of its increase in size, forces the nucleus to the periphera while the protoplasm becomes only a thin wall. Volkmann thinks that the cells which contain a clear hyaline material may burst and deposit this material between the neighboring cells. Apparently the nucleus and a part of the protoplasm in this case remains intact. In some cells several separate drops may be seen which may unite into one considerable mass. The hyaline swelling of the connective tissue stroma is in the layers next the tumor cells and may

progress until the entire connective tissue structure is changed into a homogeneous mass and the cell nuclei disappear. The vessels inside of these connective tissue strands may remain intact. The vessel wall often remains normal, for a time, after the connective tissue surrounding it has undergone hyaline change. Later the lumen of the vessel is not unfrequently obliterated in consequence of the swelling of the connective tissue. When this occurs the obliterated vessel appears as a central axis in the connective tissue strand. The endothelial cells lining the vessel are often preserved intact. The hyaline substance which makes its appearance in these cases is coagulated by acetic acid and in consequence has been thought to contain mucein. Lubarsch thinks that mucoid, hyaline and amyloid material may be converted the one into the other, or that the amyloid may be developed out of the mucoid and hyaline tissue.

In cylindromata these three forms of degeneration often occur in the same case. The endothelial cells of the part may be destroyed or undergo degeneration in consequence of their own secretion. If this secretion is not so great as to cause the cells to undergo retrograde change it may be deposited between the cells or be converted into a hyaline substance. The first step following secretion is coagulation of the material as a result of loss of fluid. It then becomes converted into a hyaline substance. Occasionally a seeming hyaline capsule is formed around the endothelial cell mass. The capsules may be filled with hyaline globules which were formed from the included cells. Volkmann asks the question whether the capsule is formed by the degeneration of the stroma or by the secretion of the cells themselves.

Hyaline Peritheliomata.—These growths are found especially upon the serous membranes and more especially upon those of the brain. They have often been called papillomata, on account of their appearance. Upon the peritoneum they are characterized by a diffuse plexiform arrangement. Borst had a case of hyaline perithelioma of the peritoneum which in

one and one-half years' growth filled the abdomen, pressing the diaphragm upwards. The abdomen was found filled with gelatinous, transparent globules, the size varying from that of a cherry stone to that of an adult fist. Their color was varied. Their surface was smooth and glassy. All the organs in the abdomen were covered with tumors and were compressed. There were no metastases in the glands. Microscopically there was a plexiform arrangement of the blood vessels showing many in the process of sprouting.

Cylindromata, both endothelial and perithelial, are found with special frequency in the orbit, the parotid, submaxillary region, gums, membranes of the brain and cord, serous membranes and especially in the peritoneum. They are also found in the skin, the bones, the antrum of Highmore, mammary gland muscles and lungs. Their course of growth is usually slow. They seldom produce metastases, but recurrence locally after removal is the rule. Birch-Hirschfeld saw a peritoneal cylindroma with numerous metastases in the serosa of the abdominal organs. Numerous mestatases have been observed also in other cases. In the orbit they have spread into the frontal and nasal sinuses and into the antrum of Highmore. The endothelial cylindromata are often mixed. This is especially true of those occurring in the parotid gland. The admixture may consist of cartilaginous, myxomatous, sarcomatous or carcinomatous tissue. Muscular tissue has also been found as a part of the endothelial cylindroma. The glycogen which is found in cylindroma is said to be identical with that which occurs in the liver. If the cells contain any considerable amount of glycogen they appear like epitheloid cells and have a sharp contour and a contents light, glassy and highly refractive. It is thought by some that the hyaline and colloid change may be mistaken for the degeneration due to glycogen.

Psammomata.—This is not a specific growth in that sand is found in a variety of tumors. In many kinds of growths calcareous degeneration of the elements of the tumor occurs.

This is true of the myoma, fibroma, carcinoma, sarcoma and adenoma. In these, however, sand is a secondary condition. According to most writers there is but one species of tumor which should be called a psammoma, namely that coming from the meninges and consisting of a new growth of endothelial cells. Virchow described the psammomata as whitish, chalk-like bodies which take the form of globules or egg-shaped concretions. These, according to Virchow, are not connective tissue tumors but epithelial. These sand bodies are globular and egg-shaped. They are in the form of elongated clubs, needles, thorns, spears and splinters. The globular sand bodies under pressure break into radiating pieces. The varied forms of these chalky bodies indicate various origins. All of those excepting the round and egg-shaped find their origin in calcareous degeneration of the connective tissue bundles and of the walls of vessels, especially when these have undergone hyaline degeneration. The round and egg-shaped are of cellular origin; that is, of endothelial origin and in them are found irregular and beautiful layers of endothelial cells. The layers are often arranged concentrically around the cell elements which have undergone hyaline degeneration. If one of these hyaline layers becomes calcified we have a typical psammoma tumor. Virchow says that these bodies have developed from connective tissue bundles and from the intercellular substance of the connective tissue. Cornil and Ranvier think the psammomata are formed in the lumen of the vessels. J. Arnold thinks they come from petrification of the vessel contents or are due to local petrification of the vessel wall, or to both.

Engert found the development of a psammoma to be in close relation with a hyaline vessel and to be either with or without a perivascular concentrical cell mantle. In the center of the chalk bodies he saw traces of blood, pigment and traces of the lumen of the vessels. He believes they originated from vessels. Ernst demonstrated the relationship between hyaline and calcareous degeneration. J.

Arnold believes that the colloid metamorphosis of the concentrically arranged endothelial cells, and especially of the vessels, precedes the process of petrification. Borst believes that in order to have petrification one must have a deficient blood supply and a deficient metabolism. In all of these degenerative products, impregnation of sand molecules were seen in large or small deposits. In this way sand bodies were produced of various forms. The greater the calcification the more these become foreign bodies. Borst saw psammomata in vessels and in endothelial cells and cell layers. He was able to trace all the stages between hyaline and calcareous degeneration of the vessels. He often saw a hyaline thrombus in a vessel undergo calcification. A hyaline mantle often surrounds a sand kernel and later both vessel wall and contents become calcified. Borst says he has determined beyond a doubt that sand bodies may be developed from hyaline endothelial cells and endothelial cell layers. Sand bodies may occur in consequence of the piling up of hyaline endothelial cells in layers, these subsequently becoming calcified. Outside of the characteristic sand bodies the psammomata often contain a varied system of endothelial cell-proliferations. The connective tissue may be so well developed in these tumors that the growth resembles a fibroma. Then the endothelial cell strands are forced into the background or form dense fasciculi. These fasciculi are closely woven and not easily distinguished from an intercellular substance. These tumors have been divided into three classes.

In the first the connective tissue may be so abundant that the tumor has the appearance of a fibroma. In the second the vessels may be so numerous and lie so close together that only a delicate strand of endothelial cells is to be seen between the vessels. In the third the cells are most numerous, the structure becoming alveolar with fine nests or strands of alveolar cells. Inside of the cell nests the layers undergo hyaline degeneration or secondary calcification.

Ernst had four cases of psammomata of the dura which he

studied carefully. One was a plexiform endothelial growth having a large number of vessels. In the second there was a great number of cells. In the third the connective tissue was greatly increased. The fourth was a typical fascicular structure. Borst thinks that the endothelial structure in psammomata come from a proliferation of the endothelial cells in the lymphatic spaces and in part from the perithelial elements of the adventitia of the proliferated vessels. The real psammomata occur as solitary or multiple nodules. Most frequently they are found in the dura, then in the pia, and next in the pineal gland. They occur in the choroid plexus. One was seen in the vessels at the base of the brain, another as a small, egg-shaped growth in the peritoneum. On the dura they usually have a broad base and occur as a hard, superficially-situated mass which is covered by a vascular capsule. Virchow saw a chronic inflammation cause the formation of sand bodies. Borst saw a psammoma of the peritoneum in a woman sixty-nine years of age in which there were numerous adhesions. The growths were flat, round or oval. In color they were white or grayish-white. In cutting through these, the sand bodies could be removed with a spoon.

The first step in the formation of calcareous bodies is the swelling of the cells' protoplasm, the cells then become homogeneous. Then hyaline metamorphosis, accumulation of endothelial cells around the sand bodies, and then calcification occurs. The process is seemingly on a line between chronic inflammation and true tumor formations. Marchand and others have described a psammoma-cyst-adenoma and psammoma-carcinoma of the female genital organs in which the chalk concretions took on the same form as in the typical psammoma. In these cases degenerated, desquamated epithelial cells form the nucleus of the growth. A calcareous incrustation of these masses of cells followed.

An endothelial psammoma taking its origin from the dura came under the writer's observation and was removed a short time since. The microscopic section showed the growth to

contain a great many small, beautifully laminated sand bodies. Around these bodies the connective tissue was concentrically arranged. The sand bodies had a central area which looked not unlike a nucleus. The remainder of the growth was composed largely of connective tissue, resembling in this respect a fibroma. Plate 191. Psammoma of dura mater. There are large and small round calcareous balls which are beautifully laminated and show a central nucleus. The major portion of the growth is made up of fibrous tissue.

Cholesteatomata. Pearl Tumors.—These are partly inflammatory growths and partly real tumors. They have a distinct relationship to the endotheliomata and occur in endothelial cells. Under the cholesteatomata are to be found white, silk-like, glistening, dry, brittle, characteristic structures having concentric layers of cells. Macroscopically such bodies are usually globular and are seen as bullet-like bodies, either occurring as simple or as multiple growths. When multiple they are joined by connective tissue strands into one tumor or are silk-like pearls of various sizes and with short pedicles. Microscopically the layers are made up largely of flat, desquamated cells which are like epidermis elements, some having a nucleus and some not. Outside of the layers of cell elements one finds glistening cholesterine bodies. There is also found in varying amount a fatty detritus of cells. Cholesterine may not be present in every case. These growths are found in the auditory canal and are probably, in this situation, the result of chronic inflammation, with scaling and piling up of epithelial cells. The nucleus of the growth may be an inspissated, purulent secretion which has been retained in the auditory canal. They may be of such a size as to press upon and rupture the tympanum and even do injury to the bone. The cholesteatomata have also been found in the middle ear, either with or without rupture of the drumhead. It is thought by some that they may have their origin in inflammation of the tympanum. Mikulicz and Kuster think that they have their origin in the embryonal

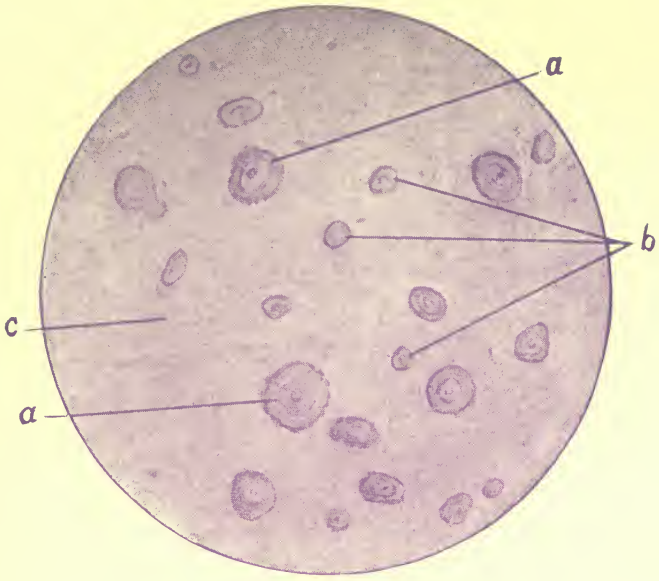


Fig. 191.

Psammoma of Dura Mater.

a. Large and (*b*) small calcarious masses.
c. Fibrous stroma.

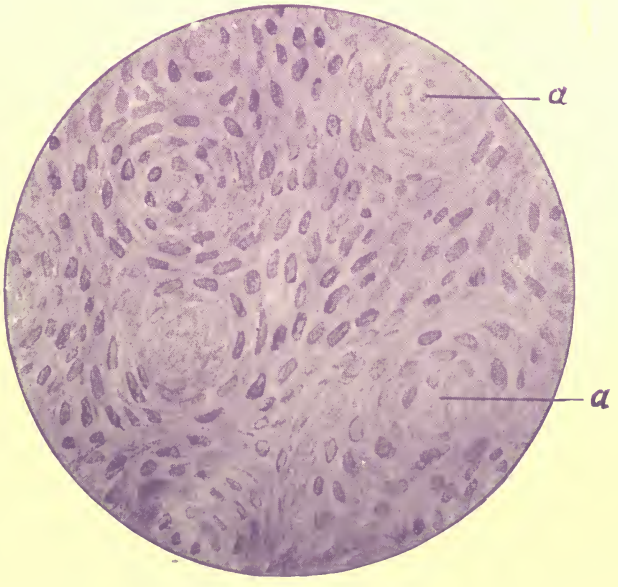


Fig. 192.

Cholesteatoma of Dura Mater.

a. Transparent cell-nests.

cells of the epidermis. Others believe that they have their origin in a traumatic displacement of the epithelium. Borst believes that a chronic inflammatory process with metaplasia of the middle ear epithelium converts these cells into epidermoid epithelium and is the cause of the peculiar tumor. By this metaplasia a horny, scaly, flat epithelium is formed. These inflammatory processes alone are not enough to cause the condition. According to Wendt a cholesteatoma of the middle ear may be formed by proliferation of the endothelial cells covering the connective tissue strands.

In consequence of this process typical endotheliomata occur in the auditory canal. The ureters and urethra are occasionally the site of these growths and also the bladder when in a condition of chronic cystitis. In rare instances the entire mucous membrane from the kidney to the urethra inclusive have been affected. They have also been found on the under surface of the diaphragm, and in the epidermis of the skin. In the latter position they have often been mistaken for dermoids, for traumatic epithelial cysts and for atheromata. Their covering is composed of layers of connective tissue which often shows papillomatous growths. Cholesteatoma are also found in the testicle, ovary and mammary gland. They are found in bone where they are held to be due to displaced cells. The real cholesteatoma as a rule develops in the pia. The typical white, shiny, solitary or multiple pearl tumors of the brain are to be differentiated from the so-called cholesteatomata which are really dermoids.

The cholesteatoma often have their situation at the base and grow into and are developed in the pia. They are often covered upon both surfaces by the arachnoid membrane. Occasionally these tumors are to be found in the cerebellum and cerebrum. In the temporal lobes they are quite frequent and here they may be entirely imbedded in the brain substance. Occasionally they are found in the ventricles of the brain and take origin from the choroid plexus. They are also found in the spinal cord. Microscopically, when occurring in

the meninges, they are seen as pearly, shining, conglomerate tumors having many systems of layers. The bodies of the center layer are surrounded by connective tissue carrying blood vessels. The layers may be concentrically arranged but irregularly, and are composed largely of desquamated cells without nuclei. The younger layers have the appearance of epidermis scales with large nuclei. On section these elements show thin, spindle, flat cells which have the characteristics of a mosaic of endothelium. Beneke and Nehrkorn have, through silver staining and careful study, become acquainted with the endothelial arrangement of these tumors. It has been rendered certain through histological examinations that the commencement of these pearly tumors is due to proliferation and bunching of endothelial cells. The lining endothelial cells of the subarachnoid trabeculæ and the perithelium of the pia vessels proliferate and produce small bodies in irregular layers. It is true that the proliferation of endothelial cells covering the trabeculæ in the pia and the adventitial or perithelial cells of the pia vessels can cause a diffuse thickening of the meninges or multiple small tumors.

The growth of the cholesteatoma is very slow. The adjacent brain substance, however, is often atrophied as the result of pressure. Occasionally hæmorrhage occurs within the tumor. It is held that the typical cholesteatoma of the meninges is an endothelial tumor. Klebs holds that the cholesteatoma of the pia is the purest cellular form of an endothelioma. On the other hand, in the brain and meninges of the cord tumors are met with which resemble the true cholesteatoma. The growths in the cord in many instances are dermoid in character and have an epithelial origin, so that between meningocele dermoids and meningocele endothelioma a sharp distinction should be made. Bostroem holds that the cholesteatomata are not necessarily endothelial tumors. In the meninges dermoid and epidermoid cholesteatomata are met with. In the first there exists a more or less complete embryonal skin in the meninges. In the last

there is only epidermis transplanted. Outside of this germ displacement there is without a doubt a true endothelial tumor and for this the term "Cholesteatoma" should be reserved. Piate 192 shows a cholesteatoma of the dura mater with transparent cell nests.

The Tissue Origin and Location of Endothelial Growths.—These growths take origin from the endothelial and perithelial cells of connective tissue. They are consequently connective tissue growths. The endothelial cells from which they arise may be those lining the lymphatic vessels or spaces and it is probably true that a very considerable proportion of endothelial tumors have their origin from these cells. They frequently take origin from serous membranes such as the pleura, peritoneum, pericardium, from those covering the brain and spinal cord, also from the serous membranes lining the joint cavities and bursæ and from the tendon sheaths. From the blood vessel they take origin from the endothelial cells lining the capillaries and from the perithelial cells which separate the wall of the capilliary vessel from the lymph channels. This wide area of possible origin makes it possible for an endothelial tumor to make its appearance in every tissue which contains an endothelial cell, a lymph space or vessel or a capillary blood vessel. Their distribution then may be very wide and they are found in almost every tissue, organ and region of the body.

Malignancy of Endothelial Growths.—They are held to be less malignant than the sarcoma and carcinoma in that systemic metastases are less frequent. It is, however, seemingly true that local or regional infections are the rule. In my own experience with endotheliomata they have seemed to me to be far more amenable to operative interference than are the sarcomata or carcinomata. It is quite true that some endotheliomata are extremely malignant and many again are almost benign. An endothelioma of the tongue removed by excision one and one-half years ago has, up to the present time, shown no recurrence. An endothelioma of the thy-

roid removed by excision more than a year ago has shown no recurrence. An endothelioma of the parotid removed six months ago by enucleation has shown no recurrence. Two endotheliomata of the breast removed four and ten months ago have not recurred. An endothelioma of the sacrum removed five months since has not recurred. The only recurrences which I have met with in endotheliomata, after removal, which have led to the death of the patients have been a growth in the tonsil, one in the testicle, and one in the innominate bone and in these the operations were done late. The malignancy of the pleural growths I believe are always extreme, and usually lead to the patient's death in a few months. The sarcomata and carcinomata of the tonsils and testicle usually show decided malignancy, and this is also trueof the endotheliomata. It would seem that the operative results in cases of endotheliomata were better than in either the sarcomata or carcinomata.

Diagnosis.—They must first be differentiated from benign tumors, and the endotheliomata may ordinarily be easily differentiated from these in consequence of the facts that they have no capsule nor well defined border; they infiltrate rather than push aside the adjacent structures; their growth is rapid, often causing great destruction of tissue; they usually produce metastases observable before operation; and they not unfrequently affect the health and well being of the individual. In other words they possess the characteristics of malignancy. From carcinoma they may ordinarily readily be differentiated by the fact that the endothelioma comes from the endothelial connective tissue cells, while the carcinoma always takes origin from epithelial cells such as the epidermis covering the skin, the epithelium of mucous membranes, and from the glands connected with these structures, and from the epithelium of glandular organs. From sarcoma the difficulties of a clinical diagnosis will unquestionably be very great. The two classes of growths take origin from the connective tissue and run practically a uniform course.

In my experience the endotheliomata are usually of a uniform consistence, seldom containing the cystic cavities which are so characteristic of the sarcomata. I am inclined to believe that this is an important differential diagnostic symptom. At the present time, however, it is only by a careful microscopic examination and study that one is able to draw a line between a sarcoma and an endothelioma. The fact is, however, of no great importance clinically as the two growths require the same kind of treatment.

PROGNOSIS.—I think it may safely be said that the prognosis of the endothelioma is better than that of either the sarcoma or carcinoma. It may not be better than some of the species of the sarcoma, but I think it is far better than the sarcomata taken as a class, in that systemic metastases are seemingly not the rule and these only occur, if occurring at all, late in the course of the growth. Local recurrence may take place and probably will in a large number of the cases if an operation be not early performed. In my own experience the operative results have certainly been better in endotheliomata than they have in sarcomata and carcinomata.

TREATMENT.—The treatment of endotheliomata corresponds exactly with that of the sarcomata and consists of an early removal, taking into consideration the facts that these growths not having a capsule infiltrate the adjacent structures. Consequently in their removal one should go, if possible, wide of the growth taking something of the healthy tissue. The X-ray is seemingly being used with some success in many of the superficial sarcomata, and this success will probably also hold good with the endotheliomata.

CHAPTER XXVI.

CARCINOMATA.

This genus is one of the most important as well as one of the most frequent which occurs in the classification of tumors. The general subject of cancer having been already considered we will confine ourselves to some of its special characteristics.

The genus, carcinoma, is divided into a number of species depending upon the characteristics of the cells from which they arise, their situation, function, or histological structure. While the cells of these various species usually have certain characteristics, it should be understood that there are no typical carcinomatous cells. The cells of the individual species correspond quite closely with those of the epithelial structures from which they spring, but it may be very difficult by simply examining the cells themselves to determine the tissue or tissues from which these cells have had their origin.

Epithelial cells under different conditions, such as situation, function, rate of growth, pressure and varying states of nutrition, may be cuboidal, cylindrical, columnar, squamous, round or polyhedral. In consequence of these and other varying conditions it may be difficult to determine whether a particular group of cells has had its origin from epithelial or connective tissue structures. It is only by studying the cells in connection with their surroundings that one will be able to determine the source from which the cells have had their origin.

The carcinomata may be conveniently divided for the purpose of histological and clinical study into three species.

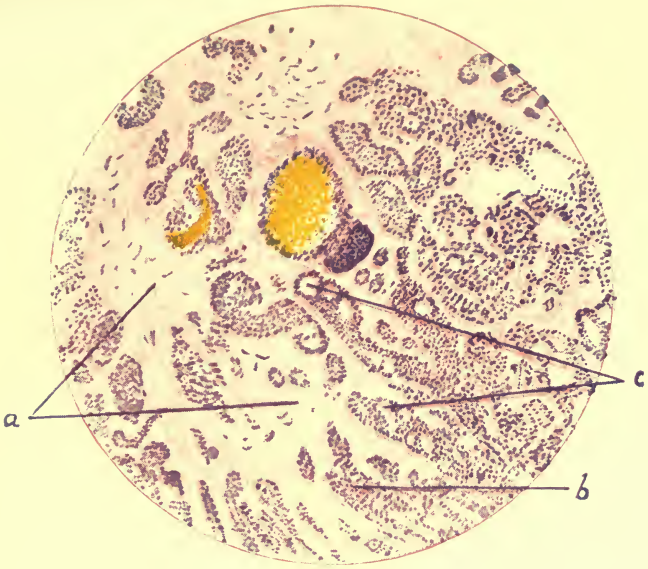


FIG. 193.

Endothelioma Cylindromatosum of Nose.

a. Connective-tissue stroma.
b. Endothelial cell strands.
c. Hyaline areas in cell strands.

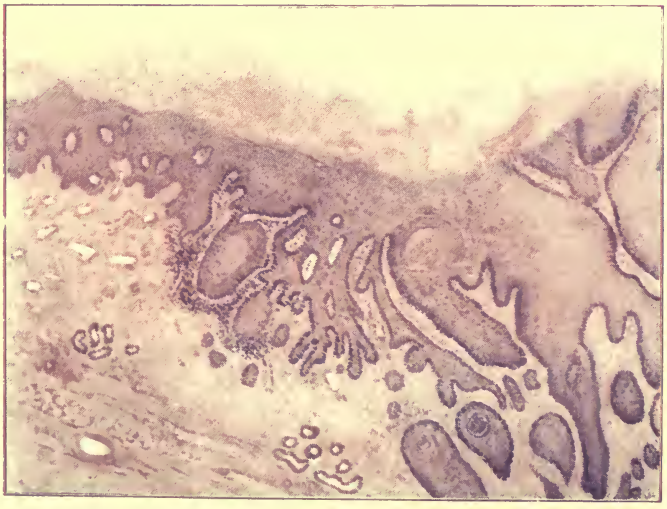


FIG. 194.

Epithelioma of hand showing hypertrophy of papillæ of the skin at the edge of the tumor; also round-cell infiltration. Commencing ulceration at surface.

First, the growths having flat or squamous cells and known as epitheliomata; 2nd, those having cylindrical cells known as carcinomata and found most frequently in the gastro-intestinal canal or the interior of the uterus; and 3rd, those whose cells have no typical form, but take the characteristics largely

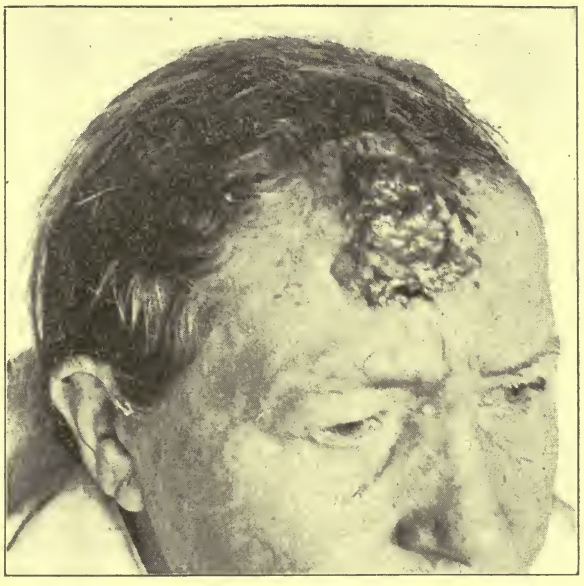


Fig. 195.

Woman, aged sixty-seven. In 1887 was struck on forehead with sling-shot, which broke the skin. Wound never healed, always covered with a crust, under which was an ulcer. Six months ago ulcer commenced to grow rapidly, has hard borders and a hard indurated base, and is attached to bone. Ulcer surrounded by elliptical incisions and outer layers of bone chiseled away. Defect closed by skin grafting. A cure resulted.

of the cells from which they spring and are known as carcinoma simplex or glandular carcinoma. A carcinoma is made up of two principal constituents. One of these, the stroma, is composed of connective tissue cells. These cells often are in varying stages of development. Some may be immature, embryonal cells while others are fully developed into connective

tissue. The stroma may form the major portion or only a very small part of the growth. It may be pre-formed and be a part of the original tissue into which the epithelial cells have grown or it may be a new formation. The second and most important structure in a carcinoma is the parenchyma, which

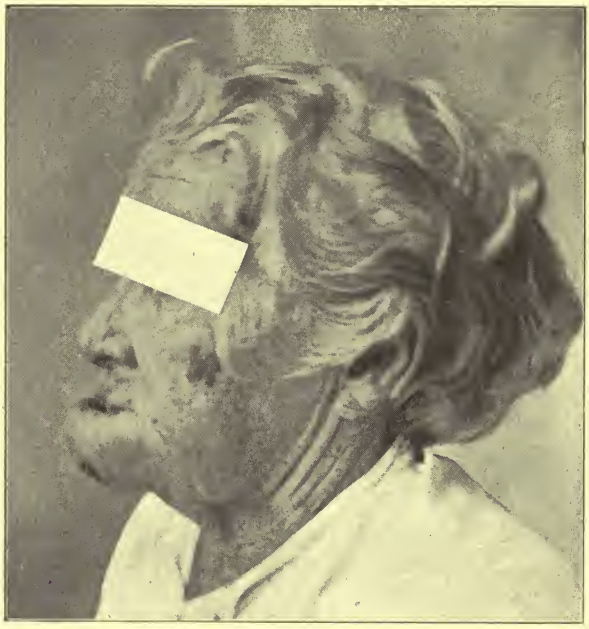


Fig. 196.

Woman, aged seventy-four. Seven months previously an epithelioma made its appearance on inside of lower lip. It extended rapidly and invaded chin, jaw and floor of mouth. Excision of chin, central portion of lower jaw and floor of mouth. Death from shock.

is composed of epithelial cells. These cells are placed in alveoli, form a reticular structure, assume an atypical glandular form, or the cells may produce characteristic whorls, pearls, and nests.

The epitheliomata are those growths which are composed largely of pavement or squamous cells, and which come

from surfaces having a stratified squamous epithelium. The cells of these growths are not always flat or pavement-like but may present the characteristics of any of the cell layers of the skin. They may be composed in part or largely of columnar, cuboidal or polyhedral cells, or the growth may be in part made up of prickle cells. As a rule, however, the dry, horny, squamous epithelium makes up a considerable part of the growth. These tumors take origin from the skin and mucous membranes having a squamous epithelium. Their cells are not confined by the basement membrane but invade the connective tissue spaces of the deeper structures as nests, large or small columns, or as more or less diffused infiltration. The cells are often dry and horny and the part infiltrated feels to the touch very hard and indurated. The epithelial cells in their growth may not only invade the deeper structure, but project outward and accumulate upon the surface of the skin or mucous membrane as a node or nodes, as an excressence or wart, or as a cauliflower growth. An epithelioma as the result of irritation or injury, or a poor blood supply, usually undergoes ulceration and this process may about equal or exceed the growth of that portion which projects above the surface, so that while the ulceration extends there is little or no apparent increase in the size of the tumor.

Epithelioma.—The epitheliomata occur frequently upon the skin and especially at those points where the skin becomes continuous with a mucous membrane, as upon the lips, the labia and the glans penis. They also occur in the mouth, larynx, œsophagus, bladder, vagina and upon the cervix uteri. (Figs. 195, 196 and 197.)

ÆTIOLOGY. *Predisposing Causes.*—Age is unquestionably the greatest factor in the production of epitheliomata as they occur with few exceptions only after middle life. Traumatisms or long-continued irritation with chronic inflammation are unquestionably important factors. The smoker's cancer of the lip, the cancer of the tongue due to the irritation of a sharp, jagged tooth, and the scrotal cancer occurring in

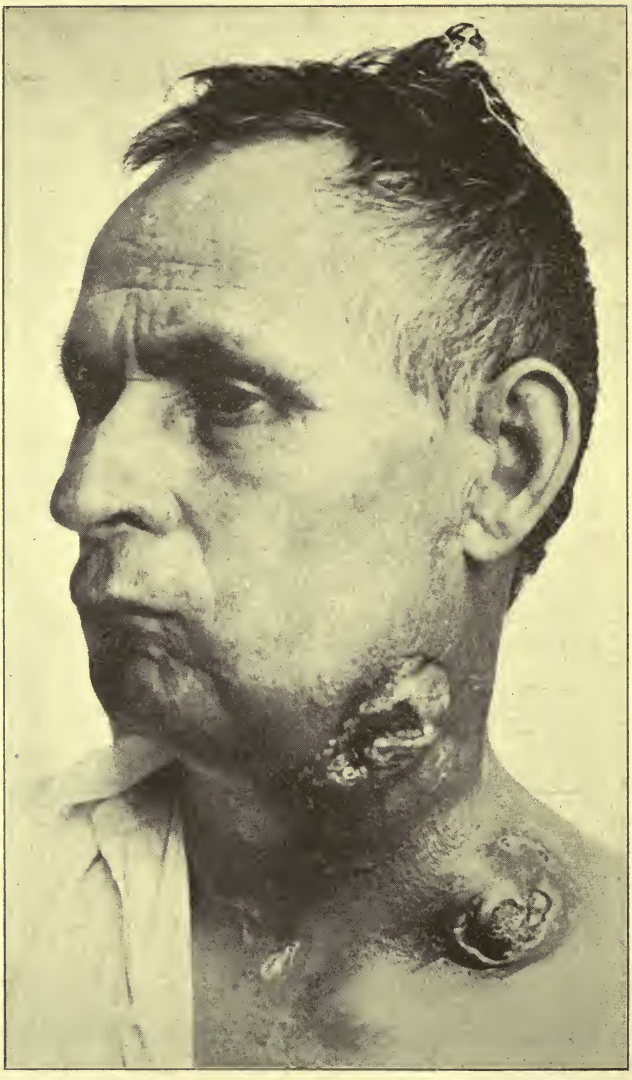


Fig. 197.

Epitheliomata of the neck, secondary to an epithelioma of the lip.

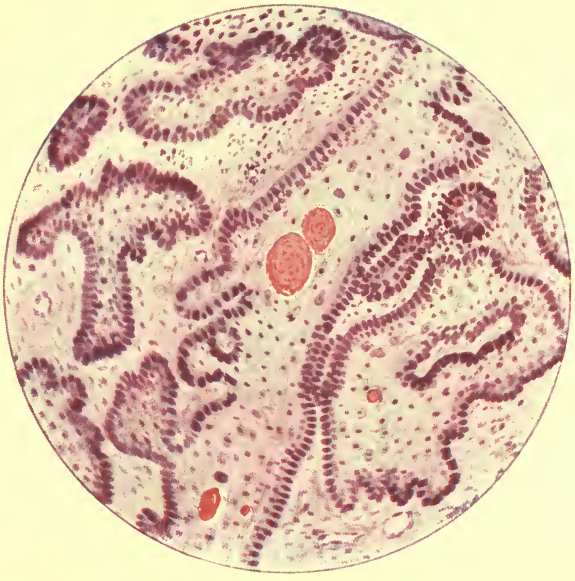


Fig. 198.

Epithelioma of Finger.

the chimney-sweep are too well known to require elaboration.

Epitheliomata of the Skin or Lips.—The first manifestation of an epithelioma when occurring upon the lower lip or surface of the skin is a slight accumulation, a piling up or thickening, of the epidermis, the appearance of a small, indurated fissure, an ulcer, a hard node or wart. If an ulcer exists it is usually cup-shaped, has a few small granulations, or the

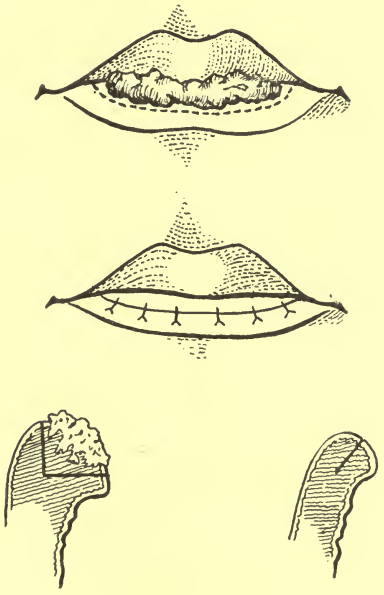


Fig. 199.

surface may be covered with a slight amount of necrotic tissue. The base of the ulcer is very decidedly indurated and when picked up between the thumb and fingers for the purpose of examination feels as though a small piece of pasteboard might have been implanted within the superficial tissues. This condition is extremely characteristic and should always be sought for. An epithelioma of the skin or lip is of slow growth, often apparently standing still for months and it may be almost for

years. It frequently becomes covered with a crust during which time the patient may think the ulcer has healed, but upon the removal of the crust the original ulcer is apparent.

DIAGNOSIS.—The diagnosis will be established largely by the age of the patient, the chronicity of the process, the fact that the ulcer cannot be made to heal by any of the ordinary means of treatment, that it slowly but gradually extends; and especially by the further fact that the base of the ulcer is extremely hard and indurated. Implication of the adjacent lymphatic glands only occurs at a late date and never should

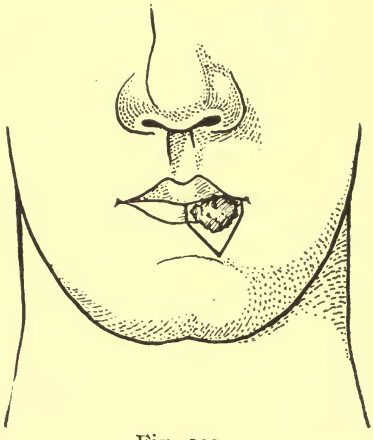


Fig. 200.

be considered necessary in order to establish a diagnosis. (Plate, Fig. 198.)

PROGNOSIS.—Epitheliomata of the skin and lips often run an almost benign course remaining localized for months and it may be for years. The fact, however, that they invade adjacent and deeper structures, and in time the lymphatics makes it advisable that they be removed at the earliest practical moment.

TREATMENT.—In the treatment of cutaneous epitheliomata the Roentgen ray may often be used with success. A case of enormous epitheliomatous ulcer upon the face, which came under my observation and which was not amena-

ble to operative measures in consequence of its situation and size, was remarkably improved and practically cured in a short time by the use of the Roentgen ray. Just what the exact

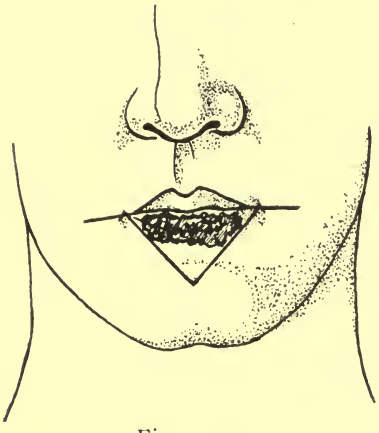


Fig. 201 a.

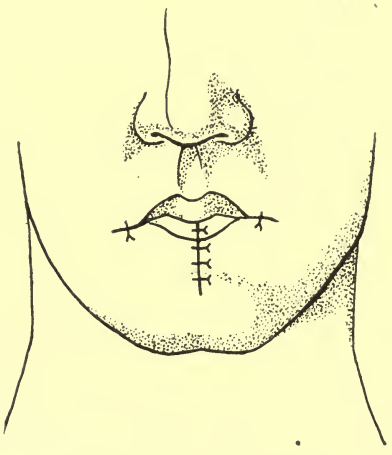


Fig. 201 b.

position of the medical profession will be in the future in regard to the use of the X-ray in the treatment of these cutaneous growths it is difficult or impossible now to state, but at the present time the treatment in many cases seems to hold out great encouragement. These growths

may also be destroyed by the use of an arsenical or other paste, by the vigorous application of nitrate of silver in stick,

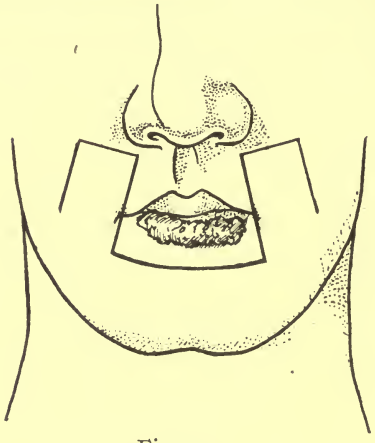


Fig. 202 a.

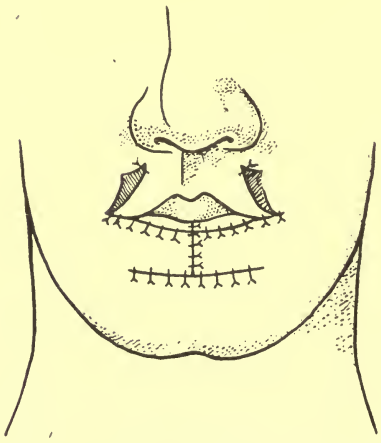


Fig. 202 b.

Cheiloplasty after v. Bruns.

or of other caustics. This treatment, however. gives no very decided assurance of success, is tedious and scarcely to be recommended. Their treatment, when small and favorably situated, by excision is perhaps best.

Epitheliomata of the Lips.—The removal of these growths, as they occur upon the lips, by clean incisions is still to be recommended. The possible infection of the submax-

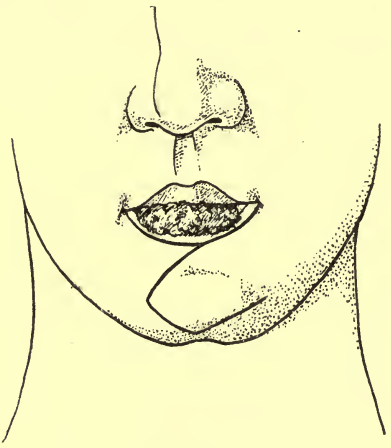


Fig. 203 a.

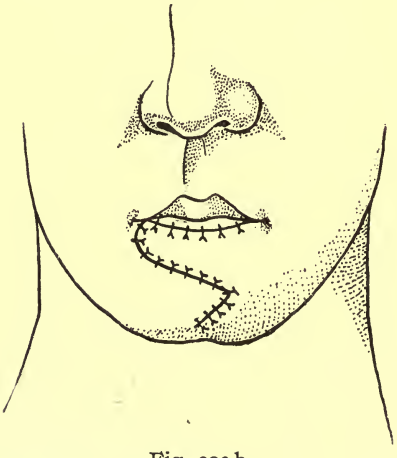


Fig. 203 b.

V. Langenbeck's Method.

illary or adjacent glands is especially to be remembered and when this has occurred these glands should be uncovered and removed. If the growth be superficial and confined to the vermilion border of the lip, it may be removed, by including

it in two transverse incisions, leaving scarcely an observable cicatrix or deformity. The surfaces after the excision are nicely coapted with sutures. (Fig. 199.)

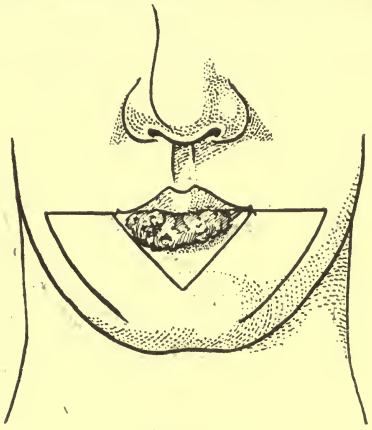


Fig. 204.
Diefenbach's Method.

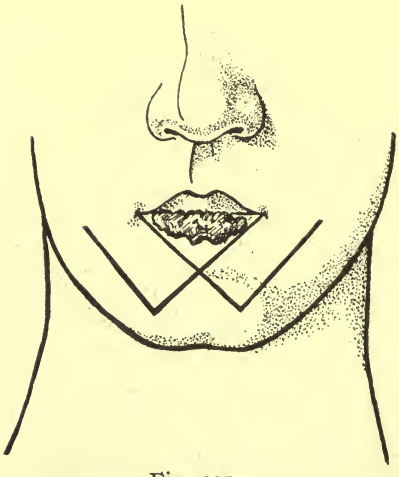


Fig. 205.
Symes' Method.

An epithelioma of the lower lip invading the cutaneous border and of any considerable size is best removed by a V-shaped excision, always being careful to go slightly out-

side of the induration so as to include all of the infiltrated tissue. Before making the incisions one should have the coronary artery upon each side controlled by the thumbs and fingers of an assistant, or perhaps better by two pairs of hæmostatic forceps. These should not close too tightly, and be placed near the angles of the mouth. The incisions are closed by interrupted sutures which include all of the lip excepting the mucosa, which should be separately united by catgut sutures. (Fig. 200.) In the technic for excision of an epi-

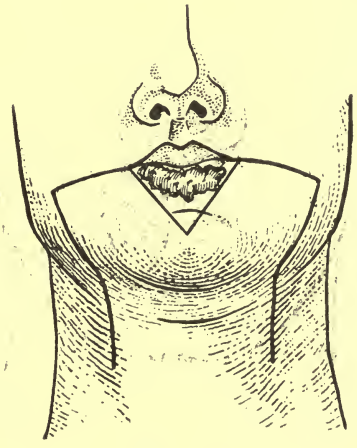


Fig. 206.

Von Bergmann's Method.

thelioma of the lower lip, which requires the removal of one-half of more of the lip, transverse incisions should be made upon each side from the angles of the mouth into the cheeks for one-half an inch or more for the purpose of relieving tension upon and enlarging the lower lip. Following these incisions the mucous membrane of the mouth at the site of the incisions should be stitched to the cutaneous border for the purpose of covering the raw surfaces and aiding in the healing. (Fig. 201, a b.)

Where the entire lower lip is involved in an epitheliomatous growth, as is not unfrequently the case, a great variety of

incisions and plastic operations have been resorted to. Fig. 202 a and b represents the incisions recommended by V. Bruns. In this operation the defect is closed by taking two flaps from the upper lip. Fig. 203 represents the lines of incision as practised by V. Langenbeck. In this operation the lower lip is removed by a curvilinear incision while the flap is taken from the chin to close the defect.

Malgaigne and Szyanowski, for the purpose of closing the defect caused by the complete removal of either lip, take flaps from the cheeks by making two transverse incisions on

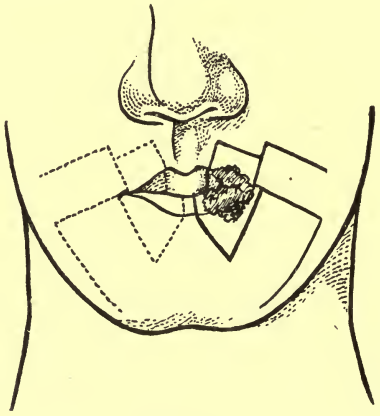


Fig. 207.

each side and then sliding the tissues into place. In cases in which the entire lower lip is involved and requires excision this may be done by making the usual V-shaped incisions, removing the growth, and then filling the defect by making transverse incisions from the angles of the mouth out upon the cheeks for an inch or an inch and a quarter and supplementing these by two incisions as represented in Fig. 204, The flaps being loosened are slid into place and united in the center line, the defects, barring the upper angles, are closed by suture. These angles may be closed by skin grafting or allowed to heal by granulation. The method of Syme is practiced as shown in Fig. 205 by taking two flaps from

the chin after resection of the entire lower lip. Von Bergmann in his treatment of epitheliomata which have invaded the entire lower lip makes transverse incisions from the angles of the mouth out upon the cheeks for an inch and a half or more and then from the outer extremities of the transverse incisions he carries incisions down over the lower maxillary bone to the neck. This entire flap is turned down, exposing the submaxillary regions in which the affected glands are removed. A V-shaped excision is then made of the involved

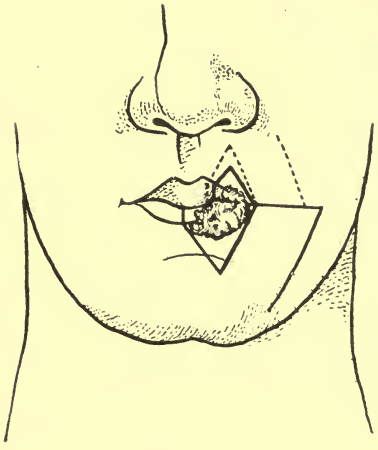
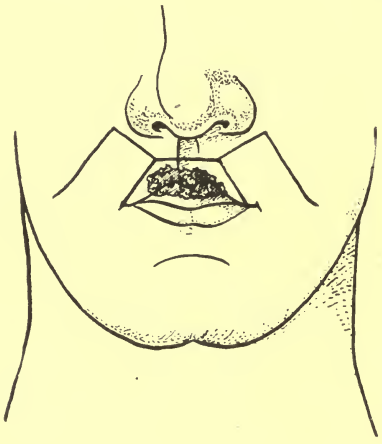


Fig. 208.

Leving's Method.

area of the lower lip when the flaps are united in the median line, stitched at the angles of the mouth and the defects as far as possible closed by suture. The operation is a very thorough one and where the submaxillary regions are involved is to be recommended. (Fig. 206.) It occasionally happens that a carcinoma not only invades the lower lip but extends to the angle of the mouth and implicates a considerable portion also of the upper lip. In these cases the technic must be changed. In the removal of the implicated portion of the upper lip a perpendicular incision may be made through the lip of sufficient distance from the epithelioma so as to in-

sure its complete removal. (Fig. 207.) This incision is supplemented by a transverse one which is carried out on the cheek for an inch and one-half or more. From the trans-



Fig, 209 a.

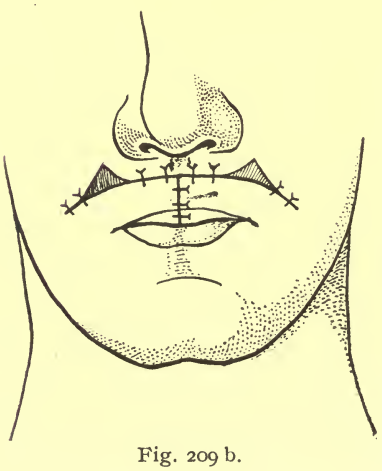


Fig. 209 b.

verse incision just outside of the epitheliomatous growth a perpendicular one is carried down to the region of the angle of the mouth, but outside of the growth. This is supplemented by a V-shaped excision below which removes the

growth by going down upon the chin. For the purpose of closing the defect in the upper lip a second transverse incision is made upon the cheek sufficiently above the first so as to give proper depth to the lip, and this flap is loosened, slid into position and united by sutures. If one-half or more of the lower lip be excised the defect may be closed with a flap from the cheek by making an incision downwards and inwards over the jaw from the outer extremity of the lower transverse incision in the cheek, loosening up this flap and sliding it into the gap. The same effect may be accomplished by making V-shaped excisions of portions of both the upper and lower lips and then, if the defect caused is not too great, simply uniting the structures by suture as in the ordinary case of a V-shaped excision of the lower lip. If the amount excised be too great for closure without plastic work flaps may be slid into the defects in both the upper and lower lips, as represented in Fig. 208. Fig. 209 represents Bruns' method of closing the defect after excision of upper lip.

Epitheliomata of the Tongue.—These growths, or more often ulcerations, have many of the characteristics of epitheliomata situated upon the lips and face. The process is much more frequent in men than in women. The condition is primarily seen as an infiltrated, hard area, a small nodule, a slight fissure or an ulcer. In the first process there may be either a growth of epithelial cells into the submucous connective tissue or upon the surface, In either case, disintegration of cells soon occurs and an ulcer is produced. The ulcer is most frequently situated upon the side or tip of the tongue. It is at first superficial, well circumscribed and has a hard, indurated base. The ulcer is often the site of a profuse discharge. It is covered with small granulations or at times by a mass of necrotic tissue. It causes severe, lancinating pains which often extend toward the ear. The ulcer enlarges, sloughs form, the discharge increases, the process not only nvades the adjacent portions of the tongue, but also in time the tonsils, palate, and floor of the mouth. These tissues

become hard and indurated. The tongue is fixed. The submaxillary, submental, carotid, parotid, as well as the lymphatic glands in the neck become involved. The patient in consequence of excruciating pain, excessive discharge, invasion of adjacent parts, immobility of the tongue and difficulty in taking nourishment, with hæmorrhage and systemic

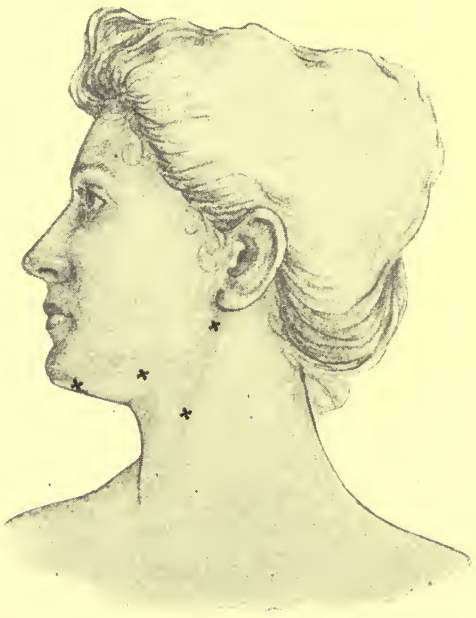


Fig. A.

Showing position of submental, submaxillary, parotid and carotid glands.

poisoning, is excessively prostrated, greatly reduced in flesh and finally succumbs to the disease. Death usually occurs within one year. (Fig. A.)

PREDISPOSING CAUSES.—Chronic glossitis and lingual psoriasis, the result of inveterate smoking, are supposed to be predisposing causes. Any injury or chronic inflammation, such as occurs from a jagged tooth, or follows the accidental but frequent biting of the tongue, may be a predisposing cause.

DIAGNOSIS.—An epitheliomatous ulcer of the tongue must be told from a simple, a syphilitic and a tubercular ulcer. With these conditions it not unfrequently and most unfortunately is mistaken. In this connection it should be kept in mind that an epithelioma of the tongue occurs only in very rare instances before middle life. A simple ulcer due to traumatism and infection will heal within a week or ten days if properly protected and subjected to mild antiseptic treatment. Syphilitic fissures often occur at the borders of the tongue during the second or tertiary stage, but they are without inflammatory indurations and are associated with other symptoms of syphilis, while the history will be that of a syphilitic patient. Syphilitic ulcers are often mistaken for epitheliomatous ulcers. In syphilis there may be a single ulcer or multiple ulcers of the tongue and these may be superficial or deep. They are usually the result of the breaking down of one or more gummata and occur upon the dorsum of the tongue. They are preceded by one or more hard areas, which soften and then discharge their contents, much as does a furuncle. They have a deeply-excavated cavity with jagged edges often covered with a considerable amount of necrotic tissue which is the site of a profuse discharge.

The history of the case, with the facts that the ulcers are often multiple, that they occur upon the dorsum of the tongue, that the induration precedes the ulceration, and the further fact that they occur following a discharge like that which takes place upon the breaking of a boil, will aid materially in the diagnosis.

Tubercular ulcers are unquestionably more difficult to differentiate from carcinomatous than are the syphilitic. The tubercular ulcer of the tongue is usually secondary to a tubercular process in the lungs or throat, but in three cases of tubercular ulcers of the tongue, which came under my care, in so far as could be determined they were primary. The ulcer is situated at the border or tip of the tongue, is chronic, often quite painful and superficial. The surface is often covered

with small, indolent granulations which produce but a slight discharge. The base is only moderately indurated. The absence of anything more than a slight inflammatory induration of the base of the ulcer, with its chronicity, are perhaps the most characteristic differential symptoms.

TREATMENT.—The treatment of an epithelioma of the tongue should be that of excision, the lines of which are carried one-third of an inch outside of any appreciable hardness or ulceration. If the ulcer is small and confined to the border or tip of the tongue it may be excised by making a curvilinear incision around the ulcer. If the ulcer is of any considerable size it is undoubtedly best to remove one-half of the tongue. Perhaps the best operation for this purpose is that known as Whitehead's. The patient is anæsthetized, and placed in a good light, usually in a semi-sitting position or slightly upon his side. The jaws held well open with a gag, while the cheek upon the opposite side is held back with a retractor. The tongue is drawn out by passing a strong silk thread through the unaffected side, when with a pair of curved shears the mucous membrane and muscular tissues beneath the tongue and upon the side affected are divided, catching, if one can, the lingual artery before it is cut. The tongue may then be split down the center line and removed at the base near its attachments to the epiglottis. The lingual artery is then ligated. Butlin dusts the wound with iodoform powder and packs it with iodoform gauze. Whitehead swabs the wound with a one to one thousand biniodide of mercury solution and then paints it over with a varnish made of a saturated solution of iodoform in ether, to which one volume in ten of turpentine is added. The wound may be left without any dressing, the patient simply having the mouth frequently syringed out with a mild antiseptic solution.

If the ulcer implicates a considerable part of the tongue the entire member should be removed, following the same technic as before, barring the splitting of the tongue. When one-half has been divided, however, a silk ligature should be passed through the glosso-epiglottidean fold for the purpose

of controlling hæmorrhage and preventing, when the tongue has been entirely removed, the base falling back upon the epiglottis and causing suffocation.

It is scarcely necessary in these cases, as recommended by Treves, to tie the lingual artery in the digastric triangle, before removing the tongue, in order to prevent hæmorrhage.

If the glands beneath the jaw are implicated, which unfortunately is often the case, they should be removed. It is taught by Butlin and others that these glands are frequently enlarged and infected in carcinoma of the tongue without the enlargement being capable of demonstration. For this reason it very properly should be the practise in all cases in which an epithelioma of the tongue is of considerable duration to open the submaxillary region and remove the implicated glands. The glands most frequently involved are the submaxillary and carotid, but if the ulcer is situated at or near the tip of the tongue the submental gland is likely to be affected, and if situated near the root of the tongue, the parotid. Experience has shown also that the lymphatics are often affected across the tongue so that the corresponding glands upon the opposite side of the neck may be implicated. The lymphatic glands in the anterior triangle of the neck may also be invaded. Kocher's operation contemplates the exposure of the affected glands beneath the jaw. This procedure is carried out by making an incision from near the ear and anterior to the sterno-cleido-mastoid muscle downwards for three inches and then forwards to the hyoid bone when it is carried upwards to the symphysis. This flap is dissected upwards, all of the enlarged glands removed, and the lingual artery ligated. The same process is carried out upon the opposite side if the glands are affected and the entire tongue is to be removed. The mouth is then opened beneath the jaw, the tongue dragged out through this opening, divided at its base and removed. This operation gives access to the glands in both sides of the neck and affords excellent drainage. In the treatment of carcinoma of the tongue implicating the

floor of the mouth one may do a Sedillot operation. An incision is made through the lower lip down over the chin, the bone divided in the median line and its ends widely separated, when the tongue is drawn out and removed with the tissues making up the floor of the mouth. The operation is best modified by carrying the central incision down over the hyoid bone and then out over the sides of the neck and up along the sterno-cleido-mastoid muscle, so that when the flaps are reflected all of the submaxillary regions will be exposed. The enlarged glands are dissected out, the arteries ligated, the bone divided in the median line, and the ends widely separated when all of the tissues implicated, including the tongue, as well as some healthy tissue at the floor of the mouth, are removed. (Plate, Figs. 211 and 212.)

Epithelioma of Tonsil.—This condition, as is the case with the tongue, is much more frequent in men than in women. It occurs primarily as a node, an indurated area or as a chronic ulcer. The process is at first superficial and of small extent, but the tendency is towards rapid growth with the formation of a foul, deeply excavated cavity. The tendency is towards early involvement of adjacent structures, such as the palate, tongue, pharynx, and submaxillary and cervical glands.

The diagnosis is made by considering the age and history of the patient and noting the characteristics and progress of the ulcer. The patient is usually over fifty years of age. The ulcer will have an indurated base, an abrupt, everted edge, will extend rapidly, be covered more or less with necrotic tissue, and be the site usually of excruciating pain. The adjacent structures become involved early.

PROGNOSIS.—The prognosis in carcinoma of the tonsil is extremely grave, the condition often ending in the patient's death in a few months.

TREATMENT.—The treatment, if anything more than palliative, must be undertaken early and consists of a complete excision of the growth, before involvement of adjacent struc-

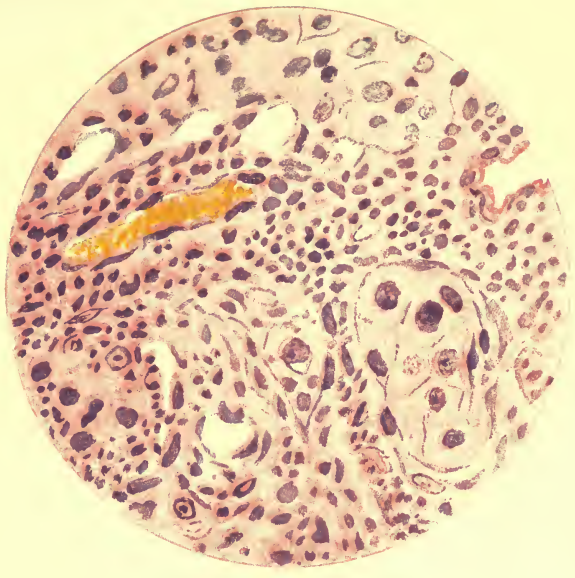


Fig. 210.

Exudative inflammation in epithelioma of angle of mouth showing leucocytes in the stroma and in the epithelium.

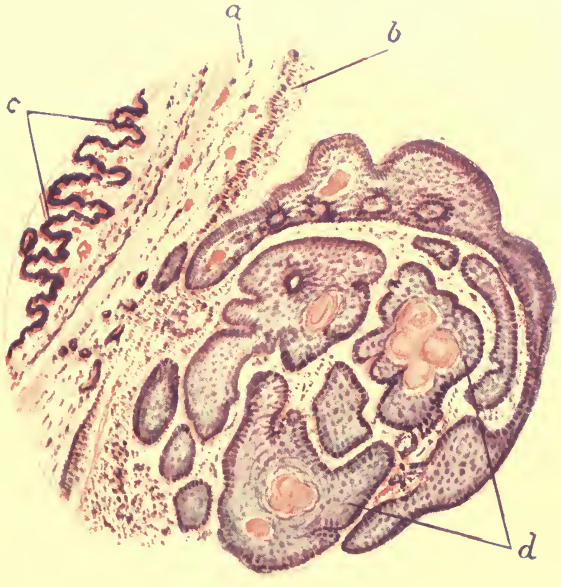


Fig. 211.

Epithelioma of Conjunctiva.

a. Sclera.
b. Conjunctiva.
c. Ciliary body covered with pigment layer.
d. Epithelial cell-nests.

tures or neighboring glands has occurred. The tonsil may be removed, and should be, if possible, through the mouth. This may be carried out by an incision through the mucous membrane, when the gland is shelled out, or it may be cut away with curved shears. It is recommended by Butlin that the growth be removed by the galvano-cautery or ecraseur. In cases in which the pillars of the palate and the base of the tongue are involved it is recommended that the diseased processes be removed, but the hope of anything more than a palliation is scarcely to be expected. If the condition is far advanced, and especially if the submaxillary and cervical glands are implicated, the submaxillary region should be invaded. Cheever makes an incision for this purpose about four inches in length along the anterior border of the sterno-cleido-mastoid muscle from the level of the ear to below the level of the tumor. A second incision is made at an angle to the first along the border of the inferior maxillary bone. The flap is reflected, the affected glands removed, the vessels and nerves separated beneath the jaw until the tonsil is reached, when it is removed with as little cutting as possible. An operation described under the head of sarcoma of the tonsil has proven very advantageous in my hands for the purpose of exposing the tonsil in malignant disease. In these cases an incision is made along the anterior border of the ramus of the inferior maxillary bone crossing the body and extending below the jaw anteriorly and posteriorly as the case may require for the purpose of exposing and removing the enlarged lymphatic glands. The inferior maxillary is sawn through just in front of the ramus which is held strongly upwards and backwards. The mouth is opened when the tonsil is freely exposed and the diseased structures readily removed. After their removal the divided bone is sutured with silver wire and the soft parts brought together with catgut and silkworm gut.

An operation practised by Mickulicz appeals to me for this class of cases. An incision is made from near the mastoid downwards and forwards as far as the great horn of the

hyoid bone. The flap is raised and the enlarged glands removed. The lower jaw just above the angle is divided and the ramus resected. Drawing the masseter, internal pterygoid, digastric and stylo-hyoid to one side the lateral wall of the pharynx is divided and the diseased structures made accessible.

Mortality of Operative Measures.—Butlin in his work on *Operative Surgery of Malignant Disease*, 3rd Edition, states that one patient in twenty-eight died where the operation was carried out through the mouth. Of forty-five cases subjected to the external operations, or to a combination of the external and internal, thirteen died. It is to be presumed, however, that those cases in which the external operation was practised were much more serious than were those in which the operation was carried out through the mouth. It has seemed to me, however, that in operations for carcinoma situated within the mouth the section of the jaw, although often most desirable, is followed by a very great increase in the mortality. (Plate, Fig. 213.)

Epithelioma of the Larynx.—Butlin divides these cases into the intrinsic or those which take origin from the vocal cords, the ventricles and the parts below the true cords; and the extrinsic, or those which take origin from the epiglottis, the aryepiglottic folds, the inter-arytenoid fold and the parts forming the frame-work of the larynx. An epithelioma of the larynx usually makes its appearance as a papilloma or wart. This may form quite a growth or soon take on ulceration. The disease is likely to infiltrate the adjacent structures of the larynx and may even extend to those outside. The adjacent glands and internal organs, however, are seldom implicated. The progress of the growth is usually slow.

Extrinsic carcinoma of the larynx is a much more serious condition in consequence of it spreading more quickly to the surrounding parts such as the pharynx, tongue, palate and tonsils. The lymphatic glands in extrinsic carcinoma are usually implicated early. The duration of life is scarcely more than eighteen months, while many patients die within a year.

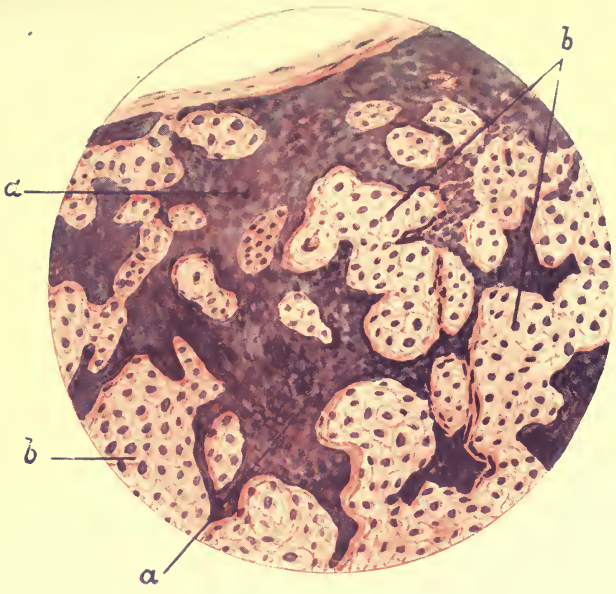


Fig. 212.

Metastatic Epithelioma in Bronchial Lymph-Gland.

a. Cells of lymph-node.
b. Epithelial cell masses.

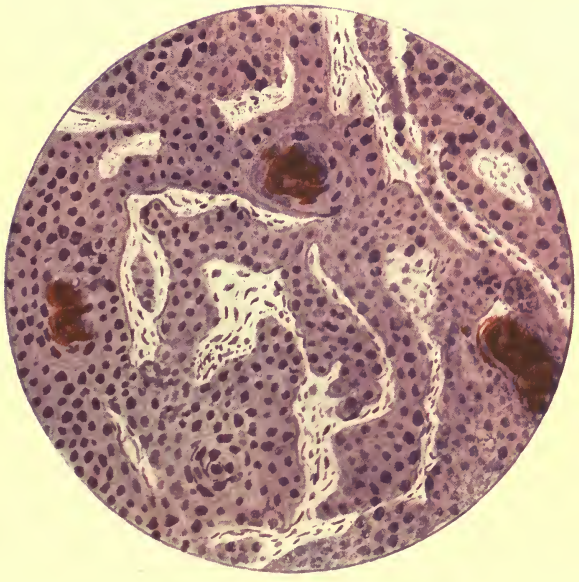


Fig. 213.

Epithelioma of Jaw.

Epitheliomata in both of these situations affect men more frequently than women, while the disease, like that which occurs in the tongue and lip, is essentially one of adult age.

SYMPTOMS.—The primary symptoms are hoarseness, with cough and perhaps dyspnœa. If the action of the vocal cords is interfered with the tone of the voice is likely to be altered and with pronounced interference aphonia may occur. Pain is usually a late symptom. The patient's condition finally becomes most distressing and death may occur from suffocation.

DIAGNOSIS.—An epithelioma of the larynx is to be differentiated from a sphilitic and a tubercular ulceration. Tubercular ulceration is seldom primary, the ulcers are usually multiple and ordinarily follow a chronic laryngitis with thickening of the mucous membrane. In these cases the severe cough, the long-continued hoarseness, the fever and the condition of the lungs will aid materially in establishing the diagnosis.

Syphilitic ulceration is preceded by the formation of gummata and is associated with other manifestations of syphilis. The patient's history will also aid materially in the differentiation of the two diseases.

TREATMENT.—The treatment should be that of complete removal of the growth, with something of healthy tissue. This is seldom possible through the mouth. According to Butlin it is only to be considered when the growth attacks the vocal cords, is accessible, and also when it occurs in a person of extreme old age. Butlin recommends thyrotomy in cases of carcinoma of the larynx and believes that the growth, even when extrinsic, can be more readily and safely removed by this means. The method is as follows: An incision is made from the hyoid bone down nearly to the sternum in the median line. This incision is successively deepened until the thyroid cartilage and trachea, with the isthmus of the thyroid gland, are exposed. The hæmorrhage being arrested the trachea is opened below the cricoid cartilage and Hahn's tube with its

sponge introduced. When the sponge is sufficiently swollen so as to prevent the blood from entering the trachea the thyroid cartilage is split through with bone forceps from below upwards, so as not to injure the vocal cords. The attachment of the epiglottis should also be preserved. The crico-thyroid membrane is also divided and the incision carried upwards beyond the upper border of the thyroid cartilage so as to give as much room as possible. The two alæ of the thyroid cartilage are held widely apart by means of silk threads passed through each. The interior of the larynx is sponged dry and then swabbed with a twenty per cent. solution of cocaine. The interior of the larynx is then examined carefully to note the extent of the malignant process. An incision is then carried around the diseased area with knife or scissors and is made to include at least one-half of an inch of the surrounding apparently healthy tissue. The included area is cut down to the cartilage, which is laid bare and then scraped with a sharp currette. The cavity is packed with iodoform gauze upon which pressure is made for two or three minutes for the purpose of checking the hæmorrhage. After the gauze is removed the surface is dusted with iodoform powder. The alæ of the thyroid cartilage are then approximated with a couple of silk sutures. Hahn's tube is taken out and the remaining portions of the wound approximated down to the site of the tube, which is left open. The wound is covered with iodoform gauze which is kept in place by a bandage. This covering should be changed as often as it becomes soiled. The patient is placed on his side with one flat pillow for the head. The head is inclined well forward so that liquids have a tendency to pass out of the mouth or through the external wound. The day following the operation, the patient leaning far forwards with the head down and with the dressings off the wound, the first effort is made for the patient to swallow water. A portion of this will pass into the stomach and the rest probably escape from the wound in consequence of the patient's position, thus avoiding any probability of its

passing into the lungs. When water can be swallowed readily, milk, beef tea and other liquids may be substituted. The wound, according to Butlin, is generally closed in ten or twelve days.

In cases in which the process is not confined to the soft parts of the larynx, but invades the cartilages or the outlying structures a partial or complete laryngectomy may be done. Billroth, in 1873, was the first to do a complete excision of the larynx. In partial or complete removal of the larynx the original incision is the same as that for thyrotomy. Transverse incisions, however, may be made through the crico-thyroid membrane or even the cricoid cartilage may be divided. Transverse incisions may be necessary at the upper part of the wound through the thyro-hyoid membrane and at times portions of the sterno-hyoid muscles may be divided. In these cases the larynx may then be opened and the extent of the disease determined. If is is necessary to remove one-half of the frame-work of the larynx this may be cut out from below upwards, or from above downwards, keeping knife or scissors close to the structures of the larynx for the purpose of avoiding important vessels or nerves. If it is necessary to remove the cricoid cartilage or some of the rings of the trachea care must be taken not to wound the œsophagus. It should be a cardinal principle only to remove such tissues as are implicated, and if a partial laryngectomy is sufficient this should be practised. If the disease implicates so much of the larynx that total extirpation is necessary this should be done. In cases in which the process has invaded the adjacent structures outside of the larynx these should be removed, if practicable.

The results of the operation of thyrotomy as practised by Butlin and Sir Felix Semen have been extremely gratifying. They are able to report a long series of thyrotomies for malignant disease without a death. Up to 1896 they had done seventeen thyrotomies with two deaths and since that time neither has had a death following an operation for this dis-

ease. These operations, however, were all performed for epitheliomata within the larynx. The process, when extrinsic, is much more difficult to relieve. Butlin thinks that the mortality following thyrotomy for malignant disease should not be above three or four per cent.

Partial extirpation of the larynx for carcinoma has a much greater mortality. Of one hundred and ten cases tabulated by Zendziak the mortality following partial excision was 23.6 per cent. In 188 cases of total extirpation of the larynx, tabulated by the same author, the mortality was 44.7 per cent. The cause of death in a great majority of these cases was pneumonia. Many have died of heart failure and a few of sepsis. Butlin states that sixteen patients upon whom he and Semen had performed thyrotomies for intrinsic carcinoma up to 1896 ten were alive and without manifestation of the disease after three years. Cases operated since that time show a lessened mortality and there is probably quite as good a percentage of permanent cures. In 100 cases of partial laryngectomy there was something like ten cases of apparently permanent cure. In 170 cases of total laryngectomy there were eleven successes claimed. Butlin's conclusions are summed up about as follows: Operations within the larynx are only indicated in cases in which the disease is very limited in extent, superficial, and in which there are urgent reasons for not opening the larynx. Thyrotomy is the operation for intrinsic cases of carcinoma in which the disease is limited to the interior of the larynx. It is in these cases unnecessary to remove any portion of the frame-work of the larynx, and the cartilage, after the removal of the soft parts, should be thoroughly scraped. Where the glands are implicated it is better to remove them by a separate operation. Partial excision of the larynx may be recommended in suitable cases in which the disease is of too great an extent for thyrotomy. It also may be indicated where there are many rapid recurrences following a thyrotomy. Total extirpation of the larynx has a high mortality, is not often followed by permanent success and

should seldom be practised except in very extreme cases. Epitheliomata of extrinsic origin are much less favorable for operation than are those situated within the larynx.

Epithelioma of the Penis.—This condition may make its appearance as an excresence or papillomatous tumor, or as an ulcer. Occasionally the growth is so considerable that it assumes a cauliflower form. The neoplasm may primarily be situated upon the glans penis, the prepuce, or at the junction of the two. The disease very seldom occurs before middle life and it is thought to be much favored by phymosis, the retained secretions in which lead to irritation and an epitheliomatous growth. In its progress the tissues of the body of the penis, including the urethra, may become markedly infiltrated and present a hard, indurated mass in which all of the structures of the organ are more or less cemented together. Occasionally the process not only invades the entire organ but may affect the skin of the scrotum and thigh, with implication of the glands in the groins and also occasionally those in the pelvis. Ulceration is a frequent characteristic and while the ulcer primarily is small and apparently superficial it extends in a few months so as to assume an excavated, or crater-like, appearance with abrupt borders and sloughing surface which has perhaps destroyed a very considerable part of the glans or even of the organ itself. The base of the ulcer, whether small or large and without respect to the destruction which it has caused, always has a very characteristic, hard and indurated base, which with its chronicity, rapid extension and involvement of the glands in the groins, and especially with the absence of any history of syphilitic infection, makes the diagnosis secure. The age of the patient is also a distinct aid in a diagnostic sense. From my experience, however, I am sure there very often is in these cases a failure to make a correct diagnosis, and that the condition is often taken to be one of phagedenic or syphilitic ulceration.

Methods of Operation.—The treatment of these cases should be the excision of the part affected. When the growth

is confined to the prepuce excision may be accomplished by circumcision, or excision of the portion implicated without a mutilation of the organ itself. It is very seldom, however, that this will be practicable. Most frequently the glans itself will be the part primarily affected. When this is the case anything short of amputation at a point one-half to three-fourths of an inch behind the part implicated will prove ineffectual. Following antiseptic preparation the part is enveloped in gauze when traction upon the glans is made while an assistant draws the skin backwards towards the pubis so that too much will not be removed. An incision is then made from the dorsum directly through the corpora cavernosa down to the spongy portion enclosing the urethra, when the incision is carried slightly forwards so that this portion when cut through will be slightly longer than the dorsal. The bleeding, which is usually not excessive, is controlled by catgut ligature. The urethra is then drawn out slightly, incised above and below for one-eighth of an inch, and the two flaps stitched to the skin. This is an extremely simple and very satisfactory method of operating.

Humphrey has described a method as follows: A flap of skin is cut from the dorsum and sides of the organ much as a cutaneous flap is made in an amputation of the thigh. This flap is reflected backwards and the dorsal vessel secured. A narrow-bladed knife is then entered at the base of the flap between the corpora cavernosa and the corpus spongiosum and is made to cut its way out in a forward, outward and downward direction for three-quarters of an inch. From this flap the urethra is dissected out when the corpora cavernosa are divided on a line with the base of the flaps. The urethra is then brought out through an orifice in the two flaps, which are united at their edges. The urethra is split and fastened to the edge of theflap.

In some cases where the entire organ is implicated its complete extirpation is found necessary. This may be done as follows, as described by Mr. Gould. The patient is placed in

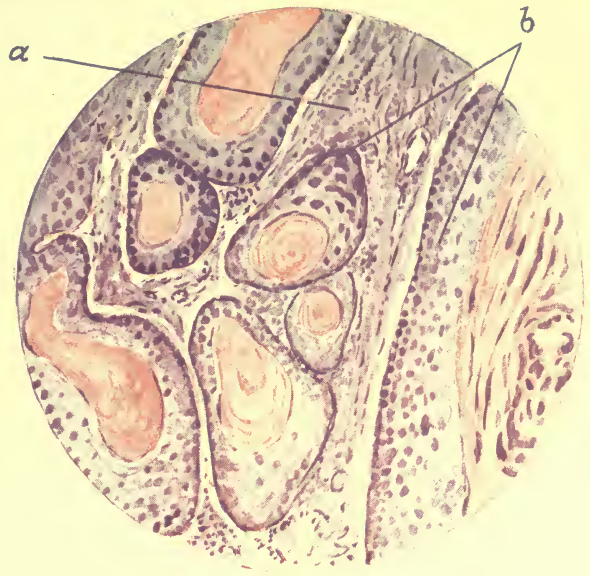


Fig. 214.

Epithelioma of Penis.

a. Connective tissue stroma.
b. Large and Small epithelial "Pearls."

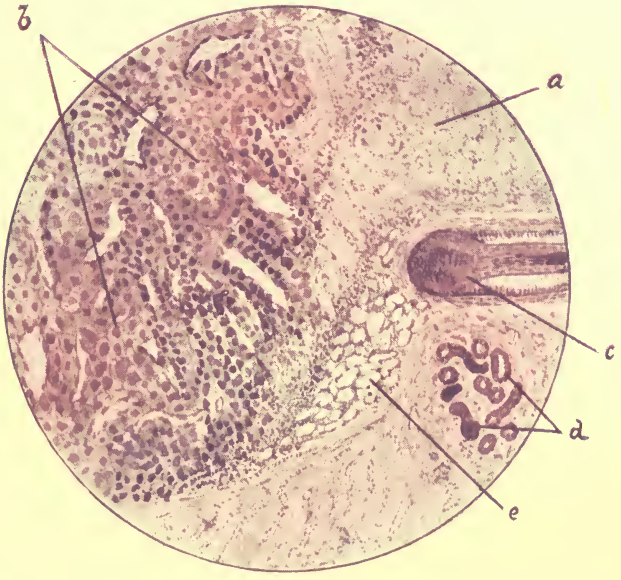


Fig. 215.

Epithelioma of Scrotum.

a. Fibrous connective tissue.
b. Epithelial cell masses.
c. Hair bulb.
d. Sweat-gland.
e. Adipose tissue.

a lithotomy position and the skin of the scrotum excised along the whole length of the raphé. With the finger or handle of the scalpel the scrotum is divided into two halves down to the corpus spongiosum, which is thoroughly exposed. A full-sized catheter is passed along the urethra as far as the triangular ligament and a knife inserted between the corpus spongiosum and the corpora cavernosa, the catheter is withdrawn and the urethra cut across. The deep end of the urethra is detached quite back to the triangular ligament. An incision is then made around the root of the penis, continuous with that in the middle line. The suspensory ligament is exposed and cut through and the penis everywhere separated except at the attachment of the crura. These are separated from the pubic bones by a periosteal elevator. The corpus spongiosum is now slit up about one-half an inch and the edges of the cut stitched to the back part of the edges of the incision in the scrotum. This places the urethra almost in the perineum. The two edges of the scrotum are brought together and a drainage tube placed deep in the wound. A catheter is usually unnecessary.

It is recommended in these cases, especially if the process is at all advanced, to expose the glands in the groins and remove them, even if at the time of the operation they cannot be felt. Scarpa's triangle may be exposed by making an incision from the anterior superior spinous process of the ilium to the pubis and then dividing this area by a second incision along the femoral vessels. The flaps are reflected right and left and all of the glands in the region, with the infected tissues, removed. This may be done at the time of the original operation, or at a second operation when the patient has recovered from the first. (Plate, Fig. 214.)

Epithelioma of the Scrotum.—This condition is rare in this country, but not unfrequent in England where it is known as "chimney-sweep's cancer." It is apparently the result of the irritation incident to the lodgment of soot between the rugæ of the scrotum. It also occurs in persons

who are engaged in coal-tar, gas, or paraffin works. The process may commence at any part of the scrotum, but generally upon its anterior surface, and as a pre-cancerous condition there often occurs one or more cutaneous warts. These break down and ulcerate, the base becomes indurated, they coalesce, become in part covered with a crust and are the site of a considerable discharge. The ulceration slowly but gradually extends in area and depth, infiltrating, it may be, a considerable part of the skin covering the scrotum and extending to the thighs. It has even extended to and invaded the root of the penis, which organ it may finally destroy. In depth the growth often reaches the tunica vaginalis and even the testicles, while the latter are occasionally more or less destroyed by the ulcerative process. The condition, however, for a very considerable time remains local. After some months the inguinal lymphatic glands are likely to become affected and following this the glands in the pelvis.

DIAGNOSIS.—In consequence of the ready exposure of the part, the induration of the base of the ulcer, its gradual extension and chronicity, the age and occupation of the patient, the diagnosis is usually easy.

TREATMENT.—The treatment is that of excision. In carrying this out all of the diseased, and something of healthy tissue should be removed. This may include the testicles and even the penis. The inguinal regions should also be exposed and the glands removed. (Plate, Fig. 215.)

Epithelioma of the Vulva.—This is not a very frequent condition. But five cases were observed among nine hundred women examined in the Basle gynæcological clinic in which there were one hundred cases of malignant disease. The process usually makes its appearance as a wart or a collection of warts. These may be situated upon any portion of the vulva, but are most frequently found upon the large labia or they may be situated between the labia. The warts soon fall into ulceration. The ulcer has the characteristic induration of an epithelioma. It may be superficial and extend

along the surface or become quite deep and crater-like. It seldom extends for any considerable distance into the vagina although occasionally it involves the orifice of the urethra. It may spread outward, involving the skin of the thigh, or extend into the groin. Like other epitheliomatous ulcers it occurs as a rule after middle life. Cancer of the vulva is generally considered to be a decidedly malignant disease, much more so than is an epithelioma of the lip or face. It quite early affects the lymphatic glands in the groin and then the glands in the pelvis. The character of the ulcer, the induration of its base, the age of the patient, and the history, should be sufficient to differentiate an epithelioma from a syphilitic ulcer, with which it has been frequently confounded.

The treatment is that of free excision, taking away, if necessary, a portion of the wall of the vagina or even a portion of the wall of the urethra. The parts are usually sufficiently lax, unless a great quantity of tissue is implicated, to permit of complete union by suture after excision, otherwise the denuded area may be allowed to close by granulation or be covered with skin grafts. If the inguinal glands are enlarged they should be removed, and it is undoubtedly the best treatment to expose the inguinal region in all of these cases, even if the glands are not palpable, and remove them the same as one would clean out the axilla in a case of carcinoma of the breast.

Epithelioma of the Vagina.—This may also be said to be a rare affection. Hecht states that one per cent. of all cancers in women are vaginal. The process may be primary or secondary. It is unquestionably most frequently secondary to an epithelioma of the cervix. Its situation is usually upon the posterior wall. Olshausen states that in eighteen cases fifteen were upon the posterior wall. Like epitheliomata in general it makes its appearance after middle life, although a very few cases have been reported as occurring during childhood. It occurs primarily as a nodular, papillomatous or cauliflower growth, or when first observed there

may be an ulcerated surface. At times the growth projects from the surface and it may fill the upper part of the vagina. In other cases it extends into the mucous membrane and sub-mucous tissue in the form of a flat induration. The process has a hard, indurated base and if not primarily ulcerated soon takes on the characteristics of a progressive ulcerative process the margins of which are always infiltrated and extremely hard. In other cases the vaginal walls may become rigid and contracted as the result of the infiltrating process which affects considerable areas, or the induration may extend around the vaginal walls like a ring. If primarily circumscribed, the process being a progressive one, it soon extends to adjacent tissues involving, it may be, the rectum, the cervix uteri, or, if situated anteriorly, the bladder or urethra. As the result of a deep ulcerative process fistulæ may form between the bladder and vagina, or between rectum and vagina. The process although extending within the vagina and often to the cervix, very seldom implicates the vulva. The lymphatics are often early invaded and especially the glands in the inguinal and pelvic region. Attention is often first called to the condition by the vaginal discharge, which may be watery and of a foul odor, or there may be an unexpected and more or less severe or continuous hæmorrhage. At the same time there is often a dull, aching or burning pain in the part, with perhaps tenesmus in the rectum or bladder. The disease usually extends rapidly, affecting neighboring tissues and lymphatic channels, producing a cachexia and finally causing the patient's death from toxæmia, hæmorrhage and exhaustion.

The diagnosis may be established by inspection and a digital examination of the part implicated, which will show in the early stages an excresence or excresences, a cauliflower growth, an infiltration of the mucous membrane, or an ulceration. The age of the patient, the fact that the condition is a progressive one, that it early leads to ulceration, that the base is extremely hard and board-like, that there is an unu-

sual and foul discharge, and finally that the lymphatic glands become involved and a cachexia occurs, makes the diagnosis clear. This diagnosis, however, to be of any avail to the patient, must be made during the initial stages of the disease, certainly before a condition of cachexia with systemic poisoning, and usually before lymphatic involvement, has occurred and also before the deeper tissues have become involved.

TREATMENT.—Before treatment is undertaken it should be determined by careful vaginal and rectal examination whether or not the area implicated is fixed or movable upon the deeper tissues. If fixed, implicating the rectum, bladder or broad ligaments, operative measures are contra-indicated unless simply for palliative purposes. If the epithelioma is circumscribed, freely movable upon the subjacent tissues and does not cover a large surface, it may be removed by simply lifting up the area affected with a tenaculum or forceps, cutting around its base with a pair of curved shears or a knife, keeping at least half an inch away from the diseased area, and then dissecting out that portion of the vaginal wall involved. The wound may be coapted with catgut or with silkworm-gut sutures.

Another method which is often practised, especially where the growth invades a considerable extent of the upper portion of the vagina, is to make a circular incision entirely around the vaginal wall when the vagina, by a blunt dissection, is separated from the rectum and bladder up to the cervix. The abdomen is then opened, the broad ligaments tied off and the uterus and implicated portion of the vagina removed. It is possible in some cases to carry out this operation through the vagina. In these cases after stripping up the implicated portion of the vaginal wall the cervix is caught, drawn downwards, Douglas' cul-de-sac opened, the broad ligaments tied off and the uterus with the diseased portion of the vagina removed. Olshausen, who has had a large experience with epitheliomata of the vagina, recommends their removal when extensive by making primarily a transverse in-

cision in the perineum, separating the vagina from the rectum up to the cervix; when in the neighborhood of the disease and in a suitable place an incision is made into the vagina and the diseased area excised. If it is thought best the uterus may also be removed. After separating the vaginal wall as before an opening is made into the peritoneum, when the uterus is inverted and the broad ligaments tied off from above downwards towards the cervix.

In cases in which the disease is very extensive, but still superficial, a perineal incision may be made, as advocated by Kelly. The patient having been placed upon the left side an incision is commenced over the sacrum, carried down the side of the coccyx and around the right side of the anus through the perineum to the fourchette. After exposure of the rectum, it is drawn to one side and the posterior vaginal wall freed. The vagina is then split from the fourchette to the cervix and the vaginal wall separated by blunt dissection over an area corresponding to the disease. The diseased portion of the vagina is then excised. The wound, or so much of it as is practicable, is closed by deep and superficial sutures and the vagina packed with iodoform gauze. In this operation care should be taken, by pushing the peritoneum upwards, not to open the peritoneal cavity.

Epitheliomata of the Cervix.—The uterus is thought to be more frequently affected with carcinoma than any other organ. Of the species and situation epithelioma of the cervix is unquestionably the most frequent. That portion of the cervix which projects into the vagina is covered by stratified, squamous epithelium. This usually terminates at the os uteri, but occasionally the squamous epithelium extends into the cervical canal for a variable distance and at times even to the internal os.

An epithelioma of the cervix, following the rule of epitheliomatous growths elsewhere, seldom makes its appearance before middle life. It is quite frequent after the menopause. It occurs both upon the anterior and posterior lips.

Clinically the primal process is represented by a progressive infiltration of the mucous, and submucous tissues, as well as an outgrowth from the free surface. The ingrowth causes the affected area to become elevated above the surrounding surface and gives it a distinct, hard, often irregular and always indurated border and base. Such an induration may be represented by a small, pretty well circumscribed node which gradually extends in circumference, or there may be a large, flat, irregular induration the border of which is gradually extending while the surface may be quite smooth or irregular. Often it has projecting from it numerous small, short, club-like processes, or fingers, which are but an expression of the over-growth of the papillæ. In a very considerable number of the cases as time progresses the hardened area comes to involve a large portion of one or both lips, or practically the entire surface of the cervix. This indurated area may, and not unfrequently does, extend upon the anterior vaginal wall, implicating the bladder, or upon the posterior wall, implicating the rectum. Also quite early in the growth the small, short, club-shaped, finger-like processes increase in number and become elongated. They come to cover the entire indurated surface with a soft cauliflower or spongy mass and may produce a tumor of considerable size filling the upper or even major portion of the vagina.

The growth has a surface which is fissured, streaked and covered with innumerable small, round projections. This represents the first stage of an epithelioma as described by Cullen and others. It is a stage which is not very frequently observed because it gives comparatively few symptoms.

The second stage is represented by an ulcerative process, during which the fungus or cauliflower growth, as the result of injury, infection, suppuration and disintegration, is cast off leaving an ulcer. This ulcer again has an irregular and excavated surface, indurated border and base, and extends in both circumference and depth. It often destroys a considerable portion of, it may be the entire, cervix, and presents in

such cases a crater-like area covered with necrotic tissue and one which bleeds readily on contact. It is true that a considerable number of the epitheliomata of the cervix never produce any very considerable outgrowth of tissue, but that after the primal infiltration of the mucous membrane this area falls into ulceration which gradually extends to the deeper structures.

An epithelioma of the cervix is not a semi-benign growth. On the contrary it has a decided tendency to gradually and continuously, and sometimes quite rapidly, invade the adjacent structures. The submucous lymphatics of the cervix which pass to the iliac glands at the bifurcation of the common iliac vessels are occasionally implicated. The process spreads by preference along the loose cellular planes, but often implicates the vaginal walls or the submucous tissue of the vagina and also occasionally extends through the cervical canal, or through the cervical tissue, into the uterus. It much more frequently, however, invades the loose cellular tissue in the broad ligaments, in the utero-sacral ligaments, at the base of the bladder, and that about the rectum. If this infiltration occurs in the vagina this organ becomes shortened, indurated and more or less fixed. If it occurs in the broad ligaments or in the utero-sacral ligaments a hard node or nodes or a mass of indurated tissue may be felt upon one or both sides of, or behind, the cervix fixing the uterus. If a section be made through such an infected area of the cervix it will often be found extremely hard and to cut with difficulty. It will have a whitish or grayish-white appearance and at times be semi-translucent. The stroma or connective tissue is represented by glistening strands of fibers making up a meshwork in which small or considerably-sized areas of yellowish-white tissue are to be seen. These are the clusters or nests of epithelial cells. (Plate, Fig. 216.)

Microscopically the process commences with a rapid and irregular proliferation of the stratified epithelium covering the cervix. Interlacing columns or finger-like processes are pro-

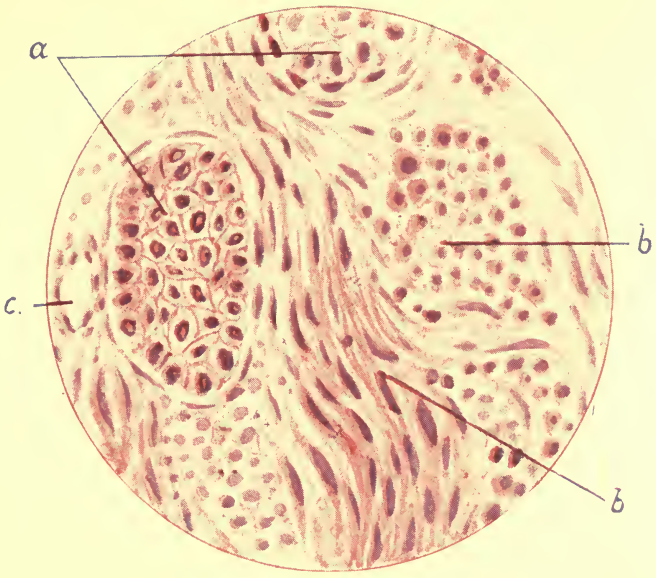


Fig. 216.

Epithelioma of Cervix Uteri.

a. Epithelial cell-nests.
b. Uterine muscle cut in various directions.
c. Capillary blood-vessel.

jected into the subjacent stroma and also above the surface, producing numerous papillæ, or finger-like processes, which consist of a central blood vessel with a small amount of stroma around which is clustered a quantity or a column of epithelial cells. The cells, while conforming in the main to those characteristic of epithelial tissue, are usually pressed closely together, of irregular form, often of large size and contain large nuclei in which there is an excessive amount of chromatin. The nuclei take a large amount of staining material.

SYMPTOMATOLOGY AND DIAGNOSIS.—Often the first symptom which calls the physician's attention to this condition is an irregular hæmorrhage or an offensive sero-purulent vaginal discharge. The backache, pelvic pain, burning or soreness is seldom primarily sufficient to have attracted very much attention. An irregular discharge of blood, however, or one occurring after the menopause, or an offensive, watery discharge, should always be considered of pronounced significance and lead to a thorough investigation. A digital examination will disclose in the first stage either a cauliflower growth, a hard, indurated node or patch having a rough surface and slightly elevated above the surrounding area, or an irregular and indurated ulcer. The age of the patient, the history, the cauliflower excresence or infiltrated area or the excavated and indurated ulcer will usually establish the diagnosis.

TREATMENT.—Before any operative measures are undertaken a most careful inspection and examination of the parts should be made for the purpose of determining the exact limitations of the disease. It is also absolutely essential to determine by vaginal and rectal examination if the uterus is fixed or hindered in its movements, if there is any induration or spanning of the broad ligaments or utero-sacral ligaments.

The treatment of an epithelioma of the cervix should be that of complete removal of the uterus at the earliest possible moment that a diagnosis can be made. If the case is seen early, before any of the adjacent tissues or organs are

involved, the operation may be carried out through the vagina. The operation should be preceded by a thorough curettement of the diseased area and the vigorous application of the paquelin cautery or the sewing together of the cervical lips, for the purpose of preventing any possible infection of the wound at the time of the operation.

In cases which come under observation at a later date it will sometimes be a matter of no little difficulty to determine whether the case is an operable one or not. If the examination shows the uterus to be fixed in consequence of a decided infiltration in one or both of the broad ligaments or utero-sacral ligaments, the case may be dismissed as an inoperable one. In patients in which a considerable portion of the vagina has become invaded, with infiltration of the wall of the bladder or rectum, producing fixation of the vagina, the case ordinarily is an inoperable one. It is difficult enough to eradicate a carcinomatous growth in this situation when it appar ently is of limited extent, and I am not in accord with those who recommend heroic operations, in which the rectum or bladder are implicated, the uterus fixed and the pelvic and lumbar glands involved. It is true one may at times by a process of tedious dissection remove the major portion of the tissues implicated, but there is little or no prospect in this class of cases of attaining more than a slight palliation. It is quite impossible in such a case to prevent a return of the growth and ordinarily the woman will be illy paid for the pain and anxiety which she will have suffered, and for the expense incurred, in consequence of the operative procedures. It is quite true that if only a portion of the wall of the bladder be involved this may be excised, and the same holds good to a certain extent in regard to the rectum; and it is also true that in some cases the infiltration in the broad ligaments is the result of irritation or inflammation; but the rule especially holds true here that epitheliomatous disease of wide extent is not cured by operative measures. The patient may sometimes

be given the benefit of a doubt and an operation undertaken when the limits of the disease are not well-defined.

In this class of cases it is better, after defining the exact limitations of the disease within the vagina, to do an abdominal hysterectomy, as by this means much more of the diseased structures can be removed than is possible by the vaginal route. Vaginal hysterectomy, however, in suitable cases has a much lower rate of mortality and for this reason should be undertaken when practicable. When the abdominal route is adopted in cases of extensive disease the greatest care must be taken not to injure the ureters, as well as to guard most carefully against subsequent hæmorrhage by a careful scrutiny of the entire field of operation, with the ligation of every doubtful point. (Waldstein says that only about ourteen per cent. of the cases are operable and that less than four per cent. are cured by operation.) (Plate. Fig. 216.)

Epithelioma of the Bladder.—This is a rare condition, but is probably the most frequent variety of malignant growth which occurs in this situation. It may take the form of a villous outgrowth on the surface of the mucous membrane and produce a tumor as large as a hen's egg, or even larger; or it may occur as an infiltration of the mucous membrane and produce a hard, irregular area. In either of these processes the pegs or columns of epithelial cells which always infiltrate the deeper structures may invade the muscular, and even the peritoneal, coats of the bladder. This invasion is probably the rule after the first few months of growth.

Ulceration is an early process in epitheliomata of the bladder and has many of the characteristics of epithelial ulceration when situated elsewhere.

The disease while it may implicate any portion of the bladder is most frequently situated at or near the trigonum. The histology of an epithelioma in this situation does not differ materially from that of the ordinary epithelioma except that there are pegs or columns of epithelial cells which invade the deeper structures. The cells and nuclei are of ir-

regular type. Upon the surface, in the papillæ or fringes, there are delicate vessels surrounded by a small quantity of connective tissue and a column of epithelial cells.

The symptoms of epithelioma of the bladder do not differ from those of sarcoma, and have been given in the article upon "Sarcomata." Primarily there is a hæmorrhage which occurs without apparent cause and is intermittent in character, often aggravated by straining, exertion, or constipation, the bleeding being at times profuse and then again insignificant. Frequent micturition, which may reach a dozen or twenty times in twenty-four hours, is also the rule. Cystitis is a late symptom and pain is not at first pronounced. The pain, in part, may be the result of the cystitis. It is usually aggravated very much during the attacks of hæmorrhage in consequence of the force exerted or the difficulty experienced in passing the clots. The pain is often of a burning character, extends through the urethra and is associated with an intense desire to pass urine. The clots may cause retention of urine, partial or complete, and in some cases this retention is carried to such an extent that the bladder reaches an enormous size.

In consequence of hæmorrhage, frequent urination, pain, cystitis, ascending nephritis and septic infection the patient is reduced in flesh and strength and finally succumbs. Death may occur within a few months, or may be postponed a year or a year and a half.

Diagnosis.—The diagnosis is made in consequence of a careful consideration of the symptoms, as the result of bi-manual examination of the bladder region, by the cystoscope and by cystotomy.

Treatment. *Palliative.*—The arrest of hæmorrhage by irrigation with hot, carbolized water and by internal medication. The treatment of the cystitis and the relief of paln.

Radical Treatment.—This should consist of a complete removal of the growth. The patient is placed in the Trendelenburg position and an incision made from the symphysis pubis upwards for three or four inches, care being taken to

avoid wounding the peritoneum, or the Trendelenburg incision may be made, which is a transverse one four inches long with its convexity below. This is placed just above the symphysis and the recti muscles divided sufficiently to freely expose the bladder, which is then opened by an incision corresponding to the superficial one. Helferich in these cases in order to gain more room and more fully expose the bladder practises a resection of the pubis. The growth when situated away from the base may be readily removed. By blunt dissection the peritoneum is separated, when a free excision of that portion of the bladder implicated is made. One should go well into the healthy tissue, controlling the hæmorrhage with forceps and reuniting the bladder walls with two rows of interrupted catgut sutures, one for the mucous membrane and the other for the muscular coat.

Epitheliomatous growths which invade the entire walls of the bladder require a primary approximation of the peritoneal coat, as explained in the article on Sarcomata and as practiced by Clado. Epitheliomatous growths affecting the base of the bladder are often inoperable. Complete extirpation of the bladder in man has been almost without exception fatal. Two successful cases are reported in women, one by Clado and the other by Pawlik. In man the excision of that portion of the bladder which implicates one ureter has been carried out by implanting the divided ureter into the remaining portion of the bladder, or into the other ureter. The ureters have been frequently implanted in the rectum, usually with a fatal result in consequence of an ascending nephritis. An implantation of the ureters into the colon seems to give more promise of success. They have also occasionally been brought out through the external excision. In operations of the bladder the effort should be to make the excision extra-peritoneal, and this may frequently be done by simply stripping up the peritoneum by blunt dissection. It is frequently desirable following excision of some portion of the bladder wall to establish drainage for the viscus. This

may be carried out supra-pubically, by retaining a catheter in the urethra or by placing a drainage tube in the perineum. Under ordinary conditions it is best to close the incision in the bladder wall above the pubis, draining the pre-vesical spaces with a strip of iodoform gauze and retaining a catheter in the urethra. If the hæmorrhage is likely to be of moment drainage may be carried out through the perineum or the wound above the pubis left open and the bladder packed.

CARCINOMA SIMPLEX OR GLANDULAR CARCINOMA.

This species of malignant growth is, for convenience sake, confined to those tumors which take their origin from the epithelium of glandular organs, or from mucous membranes having a glandular epithelium. These growths occur in the mammary gland, pancreas, liver, thyroid and salivary glands, in the kidneys, prostate, testicle, ovaries and in mucous membranes.

The *mammary gland* is a modified or specialized sebaceous gland, is made up, or consists of, from fifteen to twenty lobes, which are supported and held together by connective tissue. Each lobe has its own excretory duct and is separated by fibrous septa into lobules which in turn are composed of groups of acini. The acini are limited by a distinct basement membrane, the membrana propria, and are lined by a single layer of columnar or polyhedral epithelial cells. (Fig. 217.) In the formation of a carcinomatous growth in the mammary gland the columnar cells lining an acinus, or the acini, undergo rapid and irregular proliferation, so that they instead of being lined by a single layer of columnar cells come to have several layers, or the cells partially or completely fill the acini, converting them into solid nests or columns of epithelial cells. These cells are soon not confined by the basement membrane, as in the normal condition, but pass through it into the adjacent lymphatic vessels and spaces and the connective tissue areas which they come to fill. The cells also

change their characteristics. They become polyhedral and are of various shapes and sizes. Giant cells are often to be seen having numerous nuclei. The nuclei are more numerous, larger, have an increased amount of chromatin and stain more deeply with analine dyes.

In the histology, then, of a carcinoma of the *mammary gland* there is an irregular and often rapid proliferation of the epithelial cells lining the alveoli, so that instead of their having a single row of columnar cells they come to have several rows of cells which are of irregular form. The alveoli

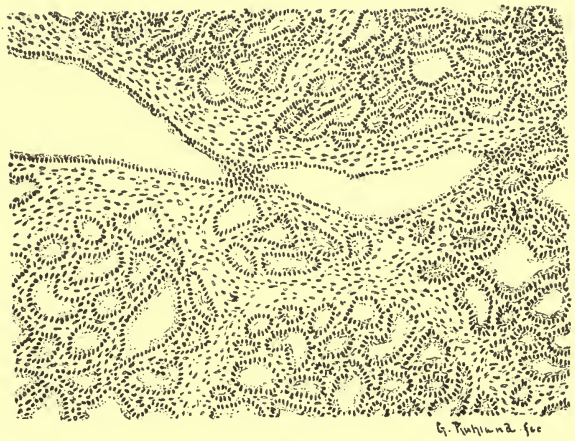


Fig. 217.
Normal Glandular Tissue of Mammary Gland.

are more or less completely filled with these irregular epithelial cells. The alveoli are often markedly dilated in consequence of this overgrowth of epithelium.

A glandular carcinoma is made up of two principal constituents, the epithelial cells, or parenchyma; and the stroma, the latter consisting of connective or fibrous tissue with blood vessels and lymphatics. If the epithelial cells proliferate rapidly, filling the alveoli and extending into the adjacent structures, the tumor having a mushroom growth and reaching in a few months a large size, and consisting very largely of epi-

thelial cells, it is known as a soft, an encephaloid, or medullary carcinoma. On the contrary, if the proliferation of the epithelial cells is carried on slowly so that after a considerable time they only partially fill the alveoli and invade by slender strands the adjacent connective tissue spaces, while at the same time there is a pronounced growth of the connective tissue, the tumor remains small, hard and nodular and is known as a scirrhus carcinoma. (Plate, Fig. 218.)

Glandular carcinomata again have been divided into three classes according to their consistency. In one there is only a moderate rate of growth while the parenchyma and stroma about equal that which occur normally in the mammary gland. In the second, known as the encephaloid the parenchyma predominates, the connective tissue being but slight in amount, the tumor has a rich blood supply, the cells proliferate rapidly, the neoplasm not only grows with great rapidity but is decidedly malignant and is known as a carcinoma molle. Again, in the third class of cases, the cells of the parenchyma proliferate indifferently while the connective tissue cells take on decided growth. This new-formed connective tissue surrounds the alveoli and finally contracting produces pressure upon and often degeneration of the cells. This tumor is very hard, nodular, and seldom reaches any considerable size—scirrhus carcinoma. Any one of these species may undergo colloid degeneration. (Fig. 219.)

Symptoms and Course.—Carcinomata of the mammary gland, like carcinomata in general, make their appearance as a rule in patients who have passed the fiftieth year of age. It is true that there are some exceptions to this rule in that the disease has occurred in young adults and has even been observed in children. The objective symptoms in the course of the disease depend in a large measure upon the character of the growth. If this is what is ordinarily termed a scirrhus tumor it is first noticed, perhaps accidentally, while the patient was taking a bath or when dressing, and is then a hard, somewhat irregular nodule, perhaps not larger than a hickory-

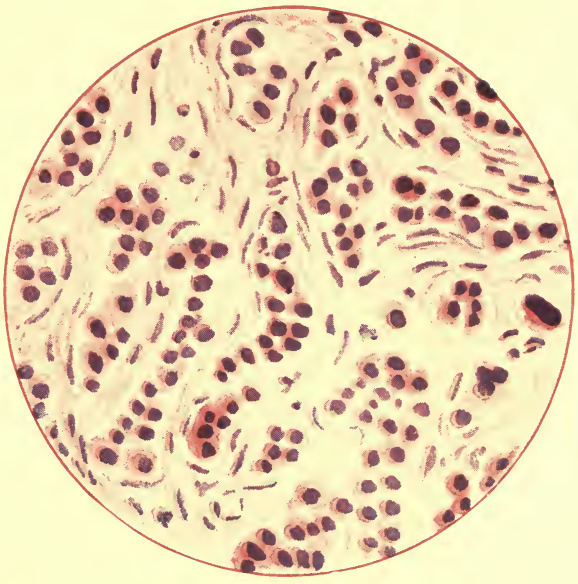


Fig. 218.

Fibro-Carcinoma or Scirrhus-Carcinoma of Mamma.

nut or a walnut. The growth is intimately and inseparably connected with the gland structure and has all of the characteristics which are ascribed to malignant tumors, such as want of capsule, infiltration of adjacent structures, often indistinct border and can be made to change its position only in connection with the structures in which it lies.

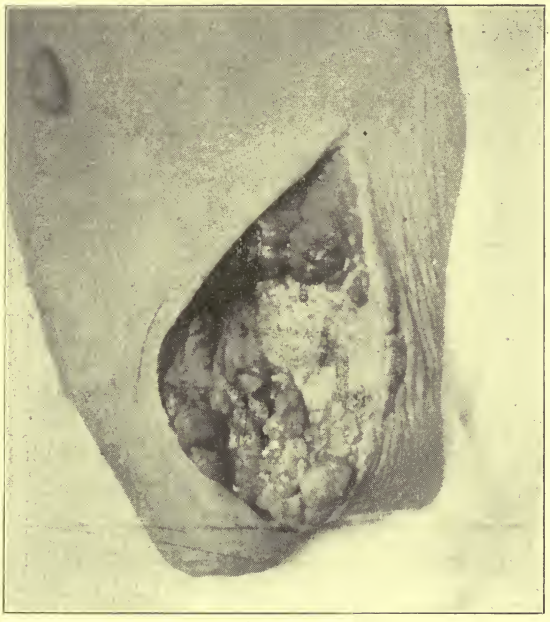


Fig. 219.
Colloid Carcinoma of Breast.

The growth of a scirrhus of the breast is often so slow that months may pass without the tumor increasing materially in size. In fact a scirrhus of the breast almost never produces a tumor of any considerable size. (Figs. 220 and 221.)

These growths or nodes are often of stony hardness and while they often seemingly remain stationary or diminish in size their malignancy is not interfered with. During this time the axillary glands enlarge, the nipple usually becomes

retracted and the node attaches itself to the skin and pectoral fascia.

The epithelial cells of the tumor may invade a small area of the skin directly overlying the growth or a considerable portion of the skin of the thorax may be implicated. In these cases the skin becomes hard, inelastic and leathery —carcinoma encuirasse. The vitality of the part becomes interfered with and sooner or later ulceration occurs.

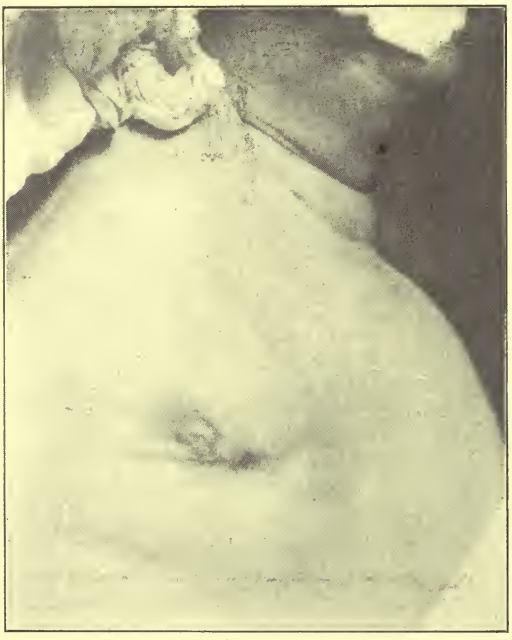


Fig. 220.

Scirrhus of Mammary Gland.

Mrs. M., aged sixty-three. Scirrhus of the breast of three years standing. A large growth along the lower border of the pectoral axillary glands. Enlarged photo shows ulceratiou of skin and retraction of breast. Right breast.

The ulcer of a scirrhus growth is characteristic. It is usually shallow and covered either with a thin film of necrotic tissue or by small, indolent granulations and has an indurated base and border. From the surface of the ulcer a

slight amount of discharge is given off while the hæmorrhage is slight or absent.

In the growth of a scirrhus of the breast the pain primarily is insignificant but gradually becomes more pronounced and usually is of a burning or piercing character. With the occurrence of ulceration the pain usually is very much increased.

Involvement of the axillary glands is usually an early occurrence. Infection of adjacent connective tissue and lymph

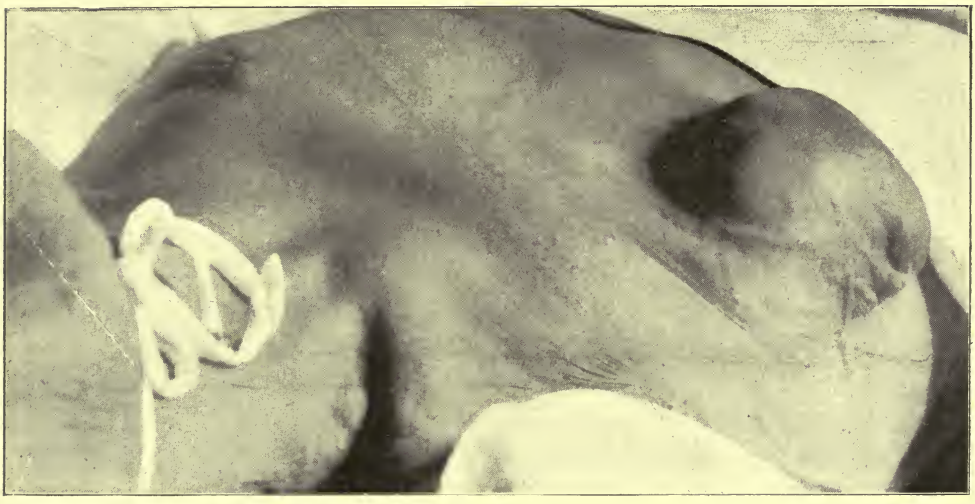


Fig. 221.
Scirrhus affecting both breasts.

spaces and of the over-lying skin, with induration of the latter, often occurs early. Distant metastatic deposits in internal organs and in the bones, with progressive anæmia and cachexia, are likely to occur notwithstanding the fact that the growth has made very slow progress.

The course of encephaloid carcinoma of the breast is quite distinctive from that of a scirrhus. It has a rapid growth and produces in a few months a large, soft, globular tumor. The surface often presents hæmorrhagic areas of

fluctuation, while the remainder of the growth is, in consequence of its softness, semi-fluctuant. These growths are excessively malignant and produce in a few months a decided impression upon the system. The ulcer, when occurring, is also characteristic. It is large and deeply excavated, is covered with a slough of necrotic tissue, bleeds freely and has a soft border and base. Encephaloid carcinoma in this situation, however, is comparatively rare.

DIAGNOSIS.—Malignant growths comprise eighty-two per cent. of all tumors occurring in the mammary gland, and according to Williams forty per cent. of all cancers occur in the mammary gland. Scirrhus, which is most frequently met with in this situation, should be differentiated from benign tumors, tubercular processes, from encephaloid carcinoma and from endothelioma and sarcoma. The benign growths which occur in the mammary gland and which might possibly be mistaken for a scirrhus are the fibroids, the adenomata, lipomata and cystomata. All of these occur as a rule in young adults, are of slow growth, do not implicate the axillary glands or overlying skin, do not affect the health or well-being of the patient, do not cause any considerable pain, never produce debility, anæmia or cachexia, are comparatively soft, encapsulated and freely-movable tumors. The fibroid may show some hardness, but it is not to be compared with the hardness of a scirrhus. The cystoma will show fluctuation, the adenoma and lipoma are usually soft and the latter semi-fluctuant. There is nothing whatsoever in common between these growths and a scirrhus, the latter occurring as a rule after fifty years of age.

A tubercular process or tubercular processes have unquestionably in the past been frequently mistaken for scirrhus. In their course they produce conditions which in some respects are quite like those occurring as the result of malignant infection in that the process is never encapsulated, infiltrates an area of the breast often producing a hard, not well-circumscribed growth which slowly progresses, implicates

the axillary glands, may produce retraction of the nipple and a systemic condition which is in a measure allied to the cancerous cachexia.

Tubercular growths, however, are most frequent during the period of functional activity of the mammary glands. They may be secondary to tubercular processes in the lungs, pleura, chest wall, axillary glands, bones or other distant areas. The induration in tuberculosis of this gland is seldom single in that there are usually several nodes, and this is a most important differential symptom because in scirrhus the process is almost never primarily multiple. The facts that tubercular processes in this situation are often secondary and that they occur as a rule in young adults or during middle life; that the process is usually multiple, there being two or more hard nodes within the breast; that the indurations have not the characteristic hardness of scirrhus and that they often go on to disintegration and suppuration should be sufficient, when taken in connection with the history, to differentiate them from scirrhus.

Scirrhus should be differentiated from encephaloid, from endothelioma, and from sarcoma. Encephaloid carcinomata in this situation are soft, rapidly-growing tumors possessed of great malignancy. They soon come to infiltrate the adjacent structures and produce in a few months a tumor of very considerable size with involvement of the axillary glands and overlying skin. They very early lead to anæmia, cachexia and the death of the patient.

Rapidly-growing sarcomata or endotheliomata in this situation cannot be differentiated by this course or objective symptoms from an encephaloid carcinoma in that they both are usually soft, rapidly-growing, semi-cystic tumors which reach a considerable size in a few months. They also, however, have little or nothing in common with the scirrhus which scarcely increase in size for months or even years.

Prognosis.—Carcinoma of the breast if allowed to pursue an undisturbed course always ends in the death of the

patient. It is claimed by Williams that the records of the Middlesex Hospital show that patients in whom the disease is allowed to run its natural course live 44.8 months. This period impresses one as being perhaps longer than that of the average case of carcinoma met with at the present time.

TREATMENT.—The treatment of carcinoma of the breast is that of removal, which should be carried out at the earliest possible moment that a diagnosis can be made. It is I think pretty well established that if a carcinoma of the breast be removed by free excision during its early stages a permanent cure may be confidently expected. If operation be delayed until the axillary glands are involved the cure is less certain and if it be delayed until marked regional and distant infection has occurred a cure is absolutely impossible.

In considering the methods of treatment one should take into consideration the channels through which infection extends to neighboring and distant organs. It is generally held that the lymphatics in the mammary gland of females are more highly developed than are those of any other gland in the body. They have been divided by anatomists into two groups, the superficial, which pass to the axilla, and the deep which follow the branches of the internal mammary artery and go to the anterior mediastinum. The axillary glands have been divided into three chains, first, the superficial which are placed along the lower border of the pectoralis minor muscle, in relation with the long thoracic vessels, and receive most of the lymphatics from the upper and outer portion of the mammary gland, the front of the chest and from the abdominal wall above the umbilicus; second, the posterior group which lies along the posterior border of the axilla in relation with the subscapular vessels and receives the lymphatics from the scapular region and from the inner and lower quadrants of the breast; third, the middle chain which is situated in the center of the axilla inside of the axillary vein. This group receives the lymphatics from the upper ex-

tremity and also vessels from the superior and posterior chains. (Fig. 222.)

The deep lymphatics of the gland anastomose freely with the superficial and with those from the pectoral fascia. The deep lymphatics which originate in the inner hemisphere of the breast and in the inner portion of the pectoral muscles penetrate the second, third and fourth intercostal spaces and

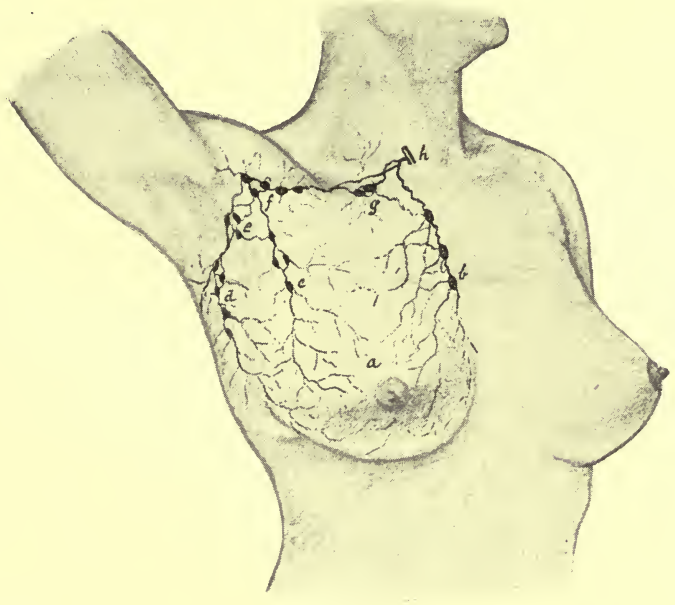


Fig. 222.
Lymphatics of Mammary Gland.

communicate with the glands, six or eight in number, which are situated along the internal mammary artery. The superficial lymphatics from the nipple pass to a gland near the outer border of the clavicle. In many cases in which the glands are large and lymphatics numerous these vessels pass across the sternum to the corresponding mammary gland. In cases in which the tumor is situated in the upper quadrant the glands lying along the pectoral muscles are most frequently

involved. When the growth is in the lower portion the glands along the subscapular vessels are frequently involved. In both these cases the axillary glands which communicate with and are supplied by the superior and inferior chains also become implicated. Growths situated in the deeper structures and especially within the inner border are likely to implicate the vessels going to the glands in the anterior mediastinum.

Local Infection.—This occurs in consequence of the epithelial cells having perforated the basement membrane and passed into the connective tissue spaces, the lymph spaces and vessels. In carcinoma of the breast of long standing one not unfrequently finds either a carcinoma en cuirasse, which represents a compact infiltration of the skin and subcutaneous tissues, or small kernels scattered possibly over a wide area. These kernels are round, very hard and give one the impression as though shot had been implanted within the tissues. They may be as small as bird shot or as large as buckshot, or even much larger. The former condition is probably caused by a contiguity of growth, the latter by a retrograde process through the lymph channels. When we remember the wide area which is drained by the lymphatics going to the breast and axilla we can readily understand that a retrograde process through the lymph currents carrying infectious material might readily produce these nodes over a wide extent of surface.

Implication of the superficial and deep lymphatics of the posterior triangle of the neck also occurs in carcinoma of the breast and this can most reasonably be explained by a retrograde process having taken place through the lymphatic circulation. In carcinoma of the breast metastasis most frequently occurs in the medulla of the long bones. While the contour of the bone is not altered it is often very sensitive and there is at the affected area a pretty continuous, dull, heavy, aching or boring pain.

The *treatment* of carcinoma of the breast by operative measures is described as being carried out along radical or

conservative lines. Believing, as all investigators do at the present time, that carcinoma primarily is a local disease there is no reason in my opinion why conservative methods may not be practised in cases which are seen early. One is forced to believe that for a considerable time a carcinoma of the mammary gland is not only confined to the gland itself but to a very small area, perhaps a single acinus. In such a case for purposes of argument where there is a single node involving but a few of the alveoli, with infection of a small quadrant of the gland, and without adjacent regional infection or the involvement of the axillary glands, there can be no good reason why extreme radical operative measures should be undertaken. In other words, if infection is local and within the gland there is no occasion to remove the pectoral muscles. It is my custom in cases which are seen early, during the first few months, in which the node is small and the axillary involvement apparently insignificant or absent, to make a free excision of the skin and gland, and surrounding subcutaneous fat with the pectoral fascia. The incision is then extended to the axilla, and the chain of lymphatics beneath the pectoral muscles and around the axillary vessels exposed, when the axilla is thoroughly cleaned out of its fat and lymphatics, and with this the fat and lymphatics along the subscapular vessels and beneath the pectoral muscles are also removed.

Radical Methods of Treatment.—The tendency unquestionably for the past few years has been toward a most radical method of operative procedure in carcinoma of the breast, and I think it may be confidently stated that as a general rule, at least when the process has continued for a considerable time, the radical methods, so-called, as practised by Halsted, Meyer and others, have very much to recommend them in that they aim, in so far as is practicable, to remove all of the tissues and glands which are most prone to become implicated. In Halsted's method the incision is an imperfect circle, goes through the skin and subcutaneous fat and includes all of the skin covering the breast. (Figs. 223, 224) From the upper por-

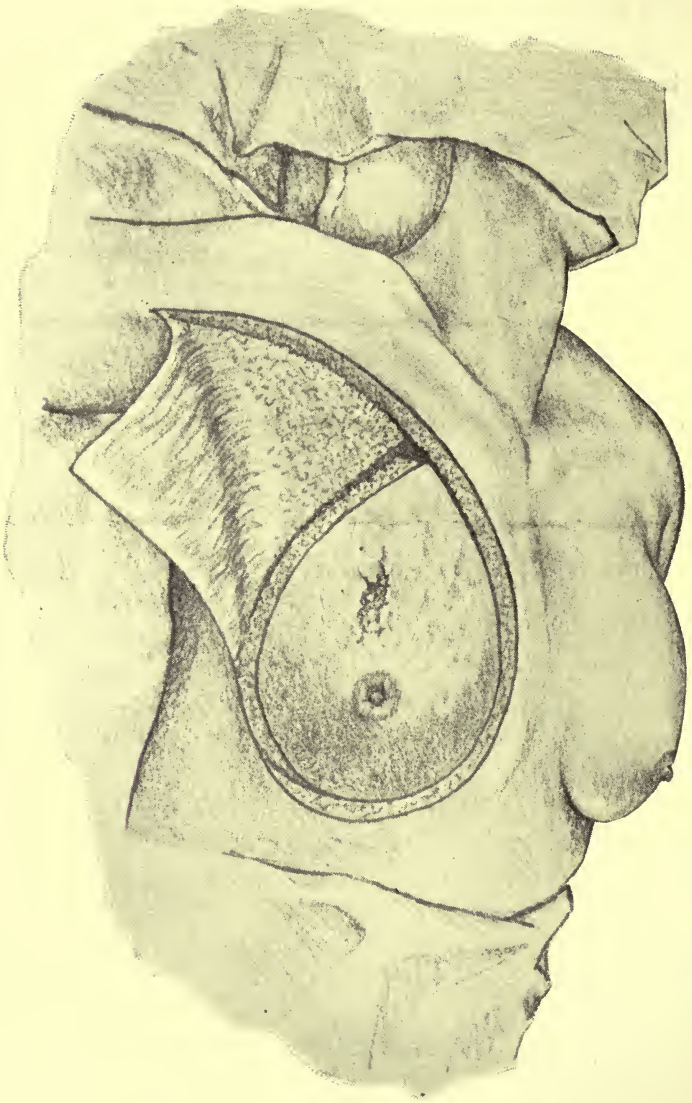


Fig. 223.
Halsted's Operation.

tion of this imperfect circle an incision is carried out on the arm. The flap, B, A, C, is dissected up and consists of skin only. The fat beneath this skin flap is dissected up to the lower edge of

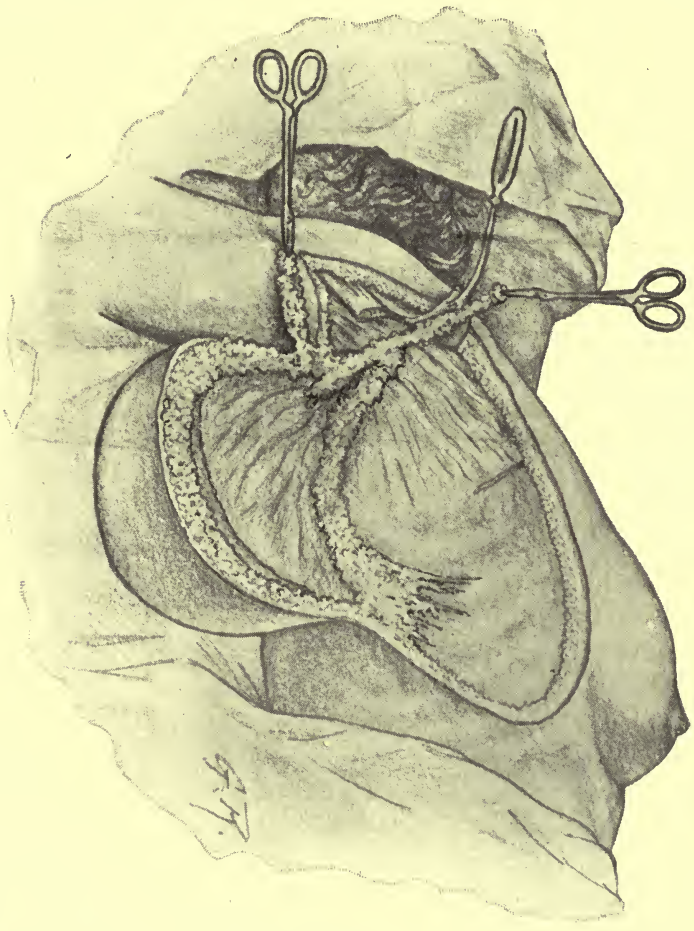


Fig. 224.
Halsted's Method.

the pectoralis major muscle. The costal insertions of this muscle are then divided and the muscle split as far outward as the scalenus tubercle leaving the clavicular attachment undisturbed. At this point the skin is divided and with it the

pectoralis major muscle up to the scalenus tubercle. This exposes freely the apex of the axilla. The loose tissue under the remaining clavicular portion of the muscle is then dissected away. The splitting of the muscle is continued up to the humerus and that portion of the muscle divided and removed. The whole mass of skin, breast, areolar tissue and fat circumscribed by the original skin incision is then raised, put upon the stretch and stripped from the thorax close to the ribs and pectoralis minor muscle. The pectoralis minor is then divided at a right angle to its fibers and at a point a little below its middle. The tissue which over-lies the minor muscle near its coracoid insertion is divided as far out as possible and reflected inward, in order to prepare for the reflection upward of this part of the minor muscle. The small blood vessels under the minor muscle near its insertion are separated with care. These are embedded in loose connective tissue which contains lymphatics and fat. The blood vessels are dissected out and ligated near the axillary vein. This dissection exposes the subclavian vein at its highest point and following this the contents of the axillary vein are dissected away with the sharpest possible knife. Attention is then given to the inner wall of the axilla. The mass to be removed is grasped and pulled outward and upward so as to put the delicate fascia, which still binds it to the chest, on the stretch. This fascia is then cut away close to the ribs or serratus magnus muscle. The posterior wall of the axilla is then cleaned of tissue from within outwards. The mass is then turned back to its normal position and its connection with the body of the patient is severed by a stroke of the knife, repeating the first cut through the skin. The edges of the wound are approximated by a buried, purse-string suture of strong silk. Of the triangular flap of skin, B, A, C, only the base is included in this suture. The rest of the flap is used as a lining for the fornix of the axilla. The axilla is never drained.

Meyer's Method.—(Fig. 225.) This operation although differing somewhat in detail from Halsted's also contemplates a most radical procedure. The primary incision surrounding the breast includes a very liberal portion of the skin. From the axillary apex of this incision a second is carried up into the center of the axilla and onto the arm. A third incision, C, D, is then made from the junction of the middle and outer third of the clavicle downwards, meeting the axillary incision at right

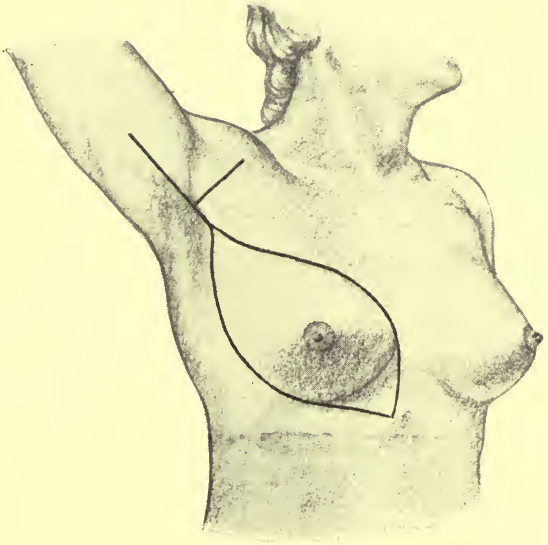


Fig. 225.
Meyer's Method,

angles. The skin flaps are then dissected up taking as little of fat as is possible. The pectoralis major muscle is then divided close to the humerus and separated from its insertions into the clavicle. It is then excised close to its sternal attachment. The subclavian, infra-clavicular and axillary fat, glands and lymphatics are then excised with a knife, beginning high up in the axillary cavity. The posterior and outer walls of the axillary space are then freed from without inwards, including the fat on the subscapularis and teres major

muscles, until the chest wall and the lower surface of the pectoralis muscle is reached. Nowhere is the fat glands or lymphatics cut into, but they remain in one piece and attached to the outer border of pectoralis muscle in their normal relation. The tendon of the pectoralis minor muscle is divided at the coracoid process. The pectoralis major muscle is divided at its inner attachment to the clavicle, and both muscles at their insertion to the ribs and sternum close to the bone. These portions form the pedicle of the whole mass and, when divided, the extirpation is complete. The wound is sutured as far as possible and the axilla drained. Large defects are covered with rubber tissue in order to effect quick healing under a moist blood clot.

In my own operative work during the last few years I have been guided largely by the following methods:

Conserative Method.—When the patient is seen early, apparently during the first few months, while the node is small, the health good and the axillary glands not palpable, I make a free excision of the breast and over-lying skin, open the axilla and clean out the fat and lymphatics without dividing the pectoral muscles. The axillary space is drained and the wound united with silkworm-gut sutures. My results following this method of treatment, in suitable cases, have been eminently satisfactory.

If a considerable area of the skin over the breast is hard and indurated, indicating infiltration, and the growth attached perhaps to the chest wall, with decided involvement of the axillary glands, and the patient showing a cachexia, I dismiss her as one not suitable for operation, in that I believe every patient suffering from a malignant growth which shows wide dissemination of cancerous infection and with a decided cachexia, is not suitable for, or benefited by, operative measures. In my opinion a cachexia always contraindicates operative procedures.

Radical Operation.—(Fig. 226.) When the skin is not materially implicated or the growth immovably fixed to the

chest wall I commence the operation by making the upper incision first, which includes practically all of the skin overlying the upper and internal portion of the gland. The skin is then dissected up nearly as far as the sternum, when the underlying fat and fascia of the pectoralis major muscle, with the gland, are separated from the chest wall. The lower incision is then made leaving attached to the gland

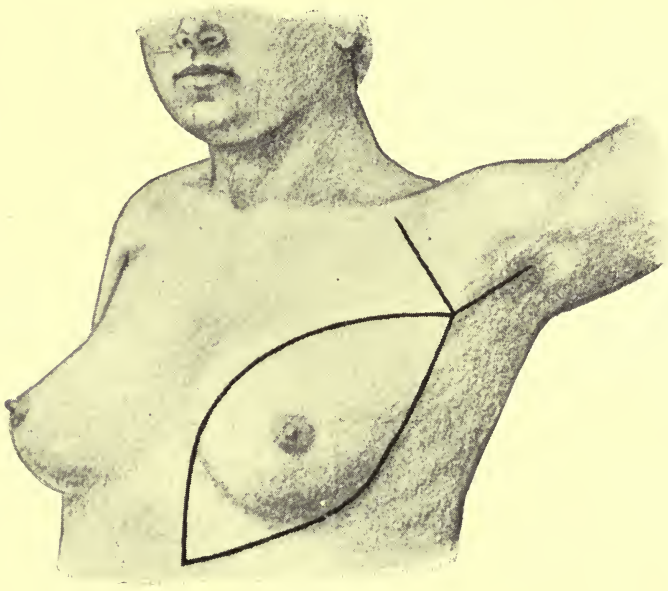


Fig. 226.
Levings' Lines of Incision.

practically all of the skin overlying it and the dissection carried well down upon the side, removing from a large area the subcutaneous fat. The axilla is opened by prolonging the apex of the incisions outwards and reflecting the skin above and below. A perpendicular incision is then carried from the center of the clavicle down to the axilla and the pectoralis major muscle divided. The fascia of the pectoralis minor muscle is then carefully removed and the muscle divided. This exposes the axilla at its highest point. Work-

ing from above downwards and outwards, at first along the axillary vein, the axilla can often be more quickly and completely stripped of its fat, connective tissue and lymphatics by using a piece of gauze in the hand and making slight pressure with this against the tissues, than by any other means. The small vessels running to the axillary vein are ligated and divided as they are exposed.

The subscapular region, especially that along the subscapular vessels, receives the same careful attention as does the area adjacent to the axillary vein. The contents of the axillary is then removed with the breast in one piece.

It occasionally happens that large glands are encountered which are intimately and inseparably attached to the axillary vein. In these cases I have double ligated and excised that portion of the vein implicated. When the axilla has been cleaned out the pectoral muscles are reunited with strong catgut. Following excision of the axillary vein it is necessary to bandage and elevate the arm for a few weeks until the collateral circulation is thoroughly established.

If the supraclavicular glands are implicated they may be readily exposed by making an incision along the posterior border of the sterno-cleido-mastoid muscle to its clavicular attachment, when the incision is carried outwards along the clavicle for a short distance. This flap is then turned backwards and upwards when the glands are exposed and removed. The results of this line of procedure, when the case is seen reasonably early, have been most satisfactory. It is to be presumed from the course of the lymphatics that in a considerable number of patients the glands in the anterior mediastinum will become infected. In other cases the chest wall becomes invaded. If the chest wall over a small area is invaded this portion may be excised.

Halsted thinks that the opening of the anterior mediastinum and the removal of implicated glands in this situation will be as far as surgery will go in its efforts to eradicate cancerous infection in carcinoma of the breast.

The mortality following these operations has been something like five per cent., and Halsted reports that in his cases fifty-two per cent. had passed the third year limit without recurrence or metastases. (Figs. 227, 228, 229, 230.)

Carcinoma of the Testicle.—In the histology of the seminiferous tubules we find them possessed of walls which are composed of several layers of flat, endothelial, connective tis-

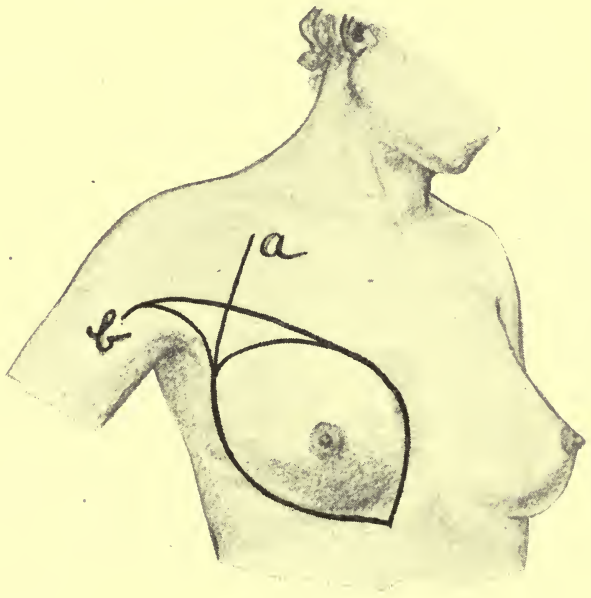


Fig. 227.
a. Line of Kocher's incision.
b. Line of Senn's incision.

sue plates. Applied to this endothelial wall is a thin basement membrane and inside of this a layer of low, cuboidal, nucleated cells. These cells are of two kinds. First, the so-called sustentacular cells which take no part in the formation of generative elements and, second, the spermatogenic cells which produce elements intimately related to the development of the seminal filaments. It is from the cuboidal cells lining the convoluted portion of the seminiferous tubules, or

from the columnar cells lining the straight tubes, that a carcinoma of the testicle has its origin.

A carcinoma in this situation is usually soft or encephaloid in character, although a scirrhus growth has been met with.

Carcinoma of the testicle, contrary to the general rule, occurs more frequently before fifty years of age than after.

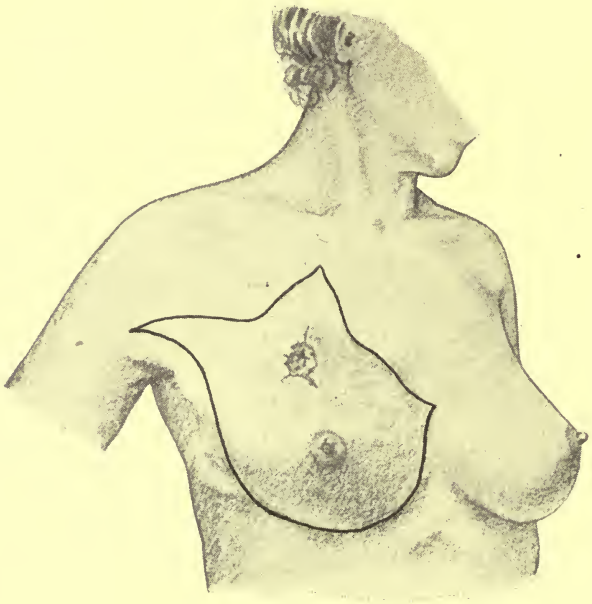


Fig. 228.
Cheyne's lines of incision.

Bryson says they occur most frequently between thirty-five and forty-five, and that they have been observed in young children and also in old men.

A medullary carcinoma in this situation is a soft, rapidly-growing and excessively malignant tumor. In its growth it distends the tunica albuginea, producing primarily a rather hard, oval, slightly elongated and smooth enlargement. Following this the tumor elements penetrate the fibrous capsule and infiltrate the surrounding tissue. The growth then takes

on an irregular outline, becomes soft, semi-fluctuant, advances rapidly and in a short time reaches and infiltrates the skin.

These tumors in a few months may reach the size of a cocoanut or even an adult's head, and not unfrequently the infection extends along the cord as far as the internal ring. The glands in the abdomen and groin are likely to become infected. These growths are very vascular and often pro-

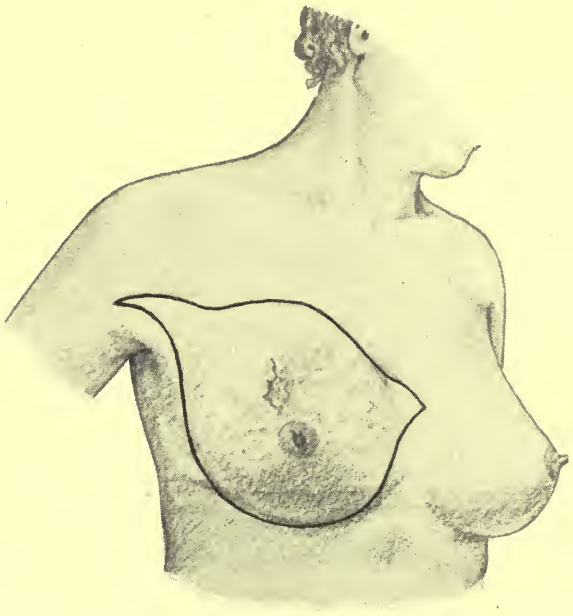


Fig. 229.
Cheyne's lines of incision.

duce hæmorrhagic cystic areas. If the skin becomes infiltrated and finally undergoes ulceration a foul-smelling sinus is produced or there may protrude from the ulcerating area a bleeding, fungus-like mass of tissue.

Metastases occur very early in this growth and may follow one of two courses, namely, by entering the system through the veins or through the lymphatics. The vessels which supply the coverings of the testicle are the superfi-

cial and deep external pudic from the femoral, the superficial perineal branch of the internal pudic and the cremasteric from the epigastric. The veins follow the course of the corresponding arteries. The spermatogenic veins leave the back part of the testicle and receive the branches from the epididymis, pass up the cord uniting to form a single trunk which on the right side terminates in the inferior vena cava and on

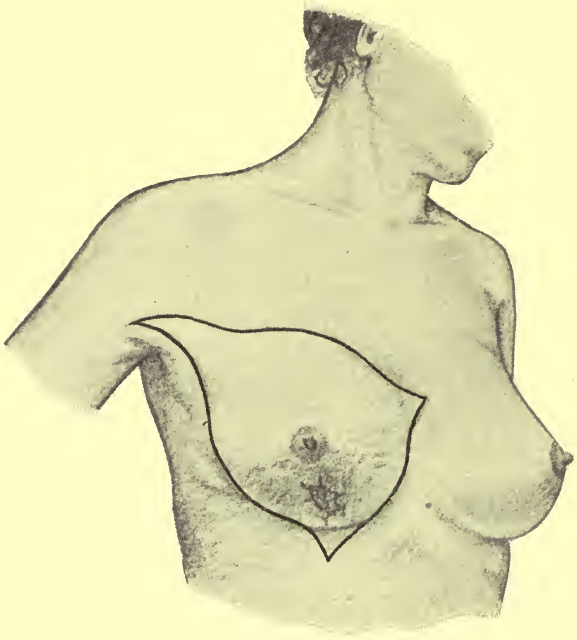


Fig. 230.
Cheyne's lines of incision.

the left side in the left renal vein. The lymphatics from the skin terminate in the inguinal glands while those from the cord, which are of large size and accompany the veins, terminate in the lumbar glands. The deep lymphatic glands in the pelvis are the external and internal iliac and sacral glands. The external iliac surrounds the external iliac artery. All communicate below with the femoral lymphatics. The internal iliac surrounds the internal iliac artery. The lumbar

glands are numerous and are situated in front of the lumbar vertebræ surrounding the common iliac vessel, the aorta and vena cava. They receive the lymphatics from the lower extremity and testis. In malignant disease of the testis one should carefully examine all of these regions for possible glandular enlargement. As the disease advances the glands within the abdomen and the inguinal glands may become involved. The inguinal glands are seldom, perhaps never, implicated unless the skin becomes invaded. *Scirrhus* of the testicle is extremely rare and when occurring is a stony, hard, irregular, nodular and very slowly-growing node presenting the characteristics of a scirrhus of the breast.

Carcinomata of the testicle must be differentiated from benign growths, from syphilis and from tuberculosis.

Benign growths are very infrequent, but occasionally a fibroma, an enchondroma, a cyst or a dermoid occurs. A fibroma and an enchondroma occur in young adult life. They are of slow growth and do not produce metastases or invade adjacent structures. They never affect the constitution of the patient or produce a cachexia, and never reach the size which is attained by a malignant growth in this situation.

Dermoids are usually of slow growth. They may contain a hard mass or present a doughy consistence and, like benign tumors, never affect the glands or the patient's health. A cystoma should be readily differentiated.

Tubercular growths are unfrequent in the testicle, but often occur in the epididymis. They are sometimes disseminated in the testicle in cases of general miliary tuberculosis. The condition is often bilateral and when occurring in the testicle is observed as a small, hard, slowly progressing induration. It may be that there are multiple indurations. These are prone to soften and discharge a tubercular fluid. They never cause such increase in the size of the testicle as is common in malignant growths.

Carcinoma has frequently been mistaken for syphilis. Syphilitic disease in this situation occurs in two forms, both

of which are late manifestations of syphilis. In the interstitial form there is an increase in the connective tissue of the part, with a plastic exudate. In the primary stage the organ becomes enlarged but very seldom reaches a size larger than an ordinary orange. After a few months there is contraction of this new-formed interstitial tissue and the organ undergoes atrophy. The second form is due to the occurrence of gummata within the testicle. These are hard, single or multiple nodules which gradually increase in size, then soften and reach the skin which is finely perforated giving vent to a quantity of glairy and mucilaginous fluid. The discharge takes place much like that from a boil. The history of the case, which will be one of syphilis, the slow progress, and the softening of gummata, will usually be sufficient to establish the diagnosis. It will ordinarily be impossible to differentiate a soft carcinoma in this situation from a rapidly-growing sarcoma or endothelioma as they all present objective symptoms which are practically the same, and the differentiation is not essential as the treatment is the same for all malignant growths.

Prognosis.—The prognosis of carcinoma in this situation is extremely grave, perhaps quite as serious as is the prognosis of carcinoma attacking any other organ in the body. The disease, unquestionably like carcinomatous disease elsewhere, is primarily local, and should operative measures be undertaken during the early stages there is no reason why a cure might not be attained. The difficulty is in the diagnosis. So many physicians treat these cases without making a diligent effort to make a diagnosis, or treat them as tubercular or syphilitic affections until systemic infection has occurred, when there is no longer any probability of cure by operative measures. Many cases have come to me for operative treatment when the growth was larger than the largest orange, with involvement of the skin, inguinal and iliac glands. Butlin has collected 118 cases that were subjected to operation. Of these four died as the result of the operation while only

six were well more than three years after the operation. The success, then, of the operative treatment as carried out at the present time seems not very encouraging.

In operative measures if possible extirpation should be carried out before the connective tissue or skin of the scrotum has become involved, as in these cases the inguinal glands are extremely likely to have become infected as well as the glands along the vessels within the abdomen. Before any operative measures are undertaken most careful examination should be made to determine, if possible, if the inguinal, pelvic or lumbar glands have become involved. If involvement of the glands within the abdomen has occurred operative measures are useless. It has been suggested by Butlin that the removal of these glands may be possible.

The operative measures consist, after thorough asepsis, in making an incision from the external abdominal ring to the lower border of the scrotum, deepening the incision through successive layers until the tunica vaginalis has been reached when this, within the tumor, is shelled out by blunt dissection with the fingers, aided occasionally by light strokes of the knife. The tumor is drawn downwards and the cord ligated and divided at the external inguinal ring, or if there is fear of implication of the cord the inguinal canal should be opened and the cord ligated at the internal ring. If any portion of the skin be implicated it must be freely excised, no matter to what extent the excision is carried. Even the raphé may be excised. The principle should be the thorough removal, is possible, of all infected tissue, and if the diagnosis can be made early and a free excision carried out there should be no reason why a permanent cure may not be effected.

Carcinoma of the Prostate.—The prostate is a compound tubular gland. The alveoli are lined by short columnar epithelium, usually in a single row, although occasionally there is an additional row of round or elongated cells. (Fig. 231.) The carcinomatous growth takes origin within the columnar cells and produces a rapid proliferation which

results in the filling of the alveoli with cells more or less changed in their histological structure. The altered cells break through the basement membrane and permeate the adjacent connective and muscular tissues, distend the capsule, cause the gland to become enlarged and hard, and finally penetrate the capsule and invade the surrounding connective tissue, the wall of the rectum and bladder. It is well in this connection to study the vascular supply of the prostate and the course of its lymphatics. The vessels going to the prostate are the vesico-prostatic artery from the inferior vesicle, the small, unnamed branches from the internal pubic and mid-

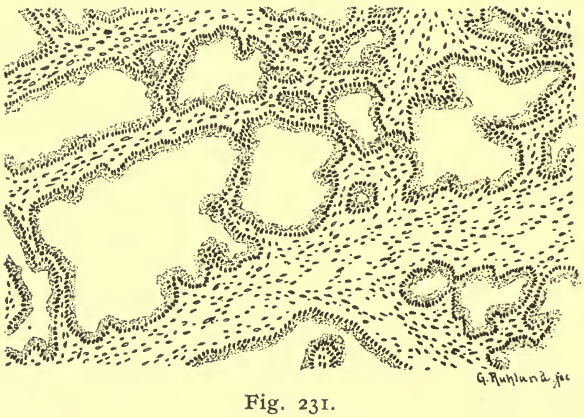


Fig. 231.
Normal prostate.

dle hemorrhoidal. The veins which may distribute carcinomatous tissue follow largely the course of these arteries. The small lympathic radicles which surround the alveoli unite into large branches in the septa of the prostate and ascend to the glands below the external iliac vessels. They are also indirectly connected with a chain of lymphatics in the inguinal region. The glands, then, along the iliac vessels are likely to become affected in carcinoma of the prostate.

Carcinoma of the prostate has been described as occurring in two forms. In one of these the neoplasm is circumscribed, has a slow growth, and remains for a very con-

siderable time confined to the prostate gland. In the other the tumor is much more malignant, is diffuse, grows rapidly and early produces regional infection and metastases. This last is called by Gruni the diffuse, prostato-pelvic form.

The species of carcinoma which usually occurs in the prostate is the encephaloid or soft carcinoma. It is held by Thompson that scirrhous never occurs in this gland, although some writers are of the opinion that scirrhous does occur although very rarely. Thompson also states that there is no authentic case of carcinoma of the prostate between the ages of eight and forty-one. According to Tanchon in 1,904 males who died of carcinoma there were but five in which the condition was primarily in the prostate. In 8,289 cases the bladder was given as the site of the disease in 72. One-half of these could presumably be set off as occurring in women, and it is probable that of the remaining a considerable number had their origin in the prostate gland.

Symptoms and Course.—The disease occurs with very rare exceptions after the forty-first year of age. It produces quite a rapid enlargement of the gland, which is primarily smooth and hard. As the growth of epithelial cells penetrates the capsule, the contour of the gland is changed and becomes nodular or bossed and slightly softer. With increased growth and infiltration of adjacent tissues the size of the gland seems to be rapidly increased and with this the prostate and base of the bladder and floor of the pelvis often become matted together in one hard, practically inseparable mass. The symptoms primarily are those of urinary obstruction, and unquestionably when we take into consideration the age of the patient and the fact that the gland for a time is enlarged and somewhat hardened, carcinoma of the prostate during its early stages cannot be differentiated from senile enlargement. The growth, however, is much more rapid than in senile enlargement, and the symptoms are somewhat different, especially as the case progresses. In senile enlargement the objective symptoms are largely connected with urina-

tion while this is not always the case in carcinoma. In carcinoma the pain is often decided, pretty constant and widely distributed. There is often severe pain in the perineum and rectum and in the course of the crural and ischiatic nerves, also in the nates, lumbar region and in the glans penis. Hæmorrhage is also frequent, and while this may occur in senile enlargement, as the result of ulceration, in this condition it is preceded by pronounced cystitis with a large amount of pus in the urine. A malignant growth which causes destruction of the mucous membrane, projects into the urethra or bladder as a fungus mass and produces a hæmorrhage which may be continued for days or weeks. This hæmorrhage may be very severe and continuous, or it may be interrupted. It is, however, not necessarily connected with a previous cystitis or with pus in the urine. The growth is also much more rapid than in senile enlargement. If one can exclude tuberculosis, which is often secondary, and inflammatory changes, then a rapid enlargement of the prostate is significant. The implication of the seminal vesicles and base of the bladder with the above-named symptoms would be almost conclusive of carcinoma. A rectal examination of these cases, from time to time, showing a rapid increase, change in contour and perhaps infiltration of the adjacent structure, would be of the greatest advantage in a diagnostic sense. Cystoscopic examination of the bladder is valuable in cases in which the mucous membrane has been destroyed, providing there is no hæmorrhage. Bimanual palpation under an anæsthetic also often affords valuable information. Fragments of the growth may occasionally be found in the urine. It is probably true that at least a few cases diagnosed as senile hypertrophy are carcinomatous in origin.

The following is the history and findings of a case of carcinoma of the prostrate recently seen by me: Male, aged sixty, quite well, free from pain and without functional disturbance of bladder until three months ago when he found difficulty in passing urine. This condition lasted for four

weeks, when the catheter had to be used a few times. Then for a week the man could not hold his urine. Five weeks ago blood made its appearance in the urine in considerable quantities. This condition lasted for six days and then stopped for one week when it came again for three days and again ceased. For the past ten days there has been a continuous hæmorrhage. Patient has never suffered any pain. Patient well-nourished, corpulent, very pale, anæmic. *Examination.*—Heart and lungs normal. Liver cirrhotic, spleen slightly enlarged. Nothing could be felt in the region of the kidneys. No pain there. Per rectum the prostate seems spread out, covering the entire pelvic floor. On the right side there is quite a sulcus between the growth and the ramus of pubis. Prostate hard and immovable. Microscopic examination of the bloody urine shows the red cells to be well preserved. Number of whites not excessive. No casts. Only an occasional pus corpuscle. From these findings a diagnosis was unhesitatingly made of carcinoma of the prostate and an operation discouraged.

Prognosis.—The prognosis of carcinoma of the prostate is most grave. Ordinarily the treatment can be nothing more than palliative. In cases in which the urethra is obstructed the urine should be drawn by the use of a soft, prostatic catheter. Hæmorrhage may be in a measure controlled by the washing out of the bladder with a hot boric acid or carbolic solution and by the internal administration of ergot. Pain is relieved by the use of rectal suppositories or the internal administration of some one of the preparations of opium.

Radical operations have been attempted with more or less success by a number of operators. Billroth is said to have been the first surgeon to remove the prostate gland for malignant disease. The patient did well immediately after the operation, but there was a recurrence in six weeks and the patient died after fourteen months. Leisriak operated by making a semilunar incision from near the tuberosity of one ischium to the other, anterior to the rectum. The pros-

tate was easily brought into the wound by means of a strong hook. The growth was separated from the bladder and from contiguous structure and removed.

There is no doubt but what a carcinoma of the prostate, like carcinomatous growths elsewhere, is primarily distinctly a local disease and that if it could be early recognized before adjacent structures are involved it could be dealt with successfully. Early recognition is the all-important point.

The technic of prostatectomy for malignant disease does not necessarily differ from that for senile enlargement. There should, however, be an intelligent effort made to remove the gland entire. The prostate is readily reached through a perineal incision and if the malignant growth has not invaded the tissues outside of the capsule this may be separated from the rectum, the gland dragged downwards and enucleated by blunt dissection aided by the free use of the shears. There is ordinarily considerable hæmorrhage as the result of the removal of the prostate. This ceases spontaneously or may be controlled by gauze packing. The bladder is drained through the perineum for a few days. The superficial parts of the wound should be brought together by interrupted silkworm gut sutures.

Adeno-Carcinoma of the Cervix Uteri.—The cervical canal, barring its lower third, is linked by a single layer of ciliated columnar epithelium. These cells are placed directly upon a delicate membrane, the membrana propria, and with it are projected into the deeper tissues forming slightly wavy tubules or branching glands. Aside from these delicate tubules or glands there are in the mucosa of the cervix numerous crypts with expanded blind ends. These lie embedded within the mucosa and secete the thick, glairy mucous so characteristic of the glands of the cervix.

A carcinomatous process may be situated anywhere in the cervical canal and commences as a multiplication of the epithelial cells lining a gland. This proliferation of cells produces various offshoots or excresences in the lumen of the

gland which, uniting with those from the opposite surface and with one another, form new glands. By this means Cullen states that in a portion of a single gland as a result of proliferation some twenty or thirty new glands may be formed. The proliferation in older sections results in the production of two or more layers lining the tubules, or the proliferation may be carried to such an extent that the tubules are converted into solid cell strands. In the formation of new glandular tissue the acini or tubules are often decidedly convoluted, greatly elongated and placed in close juxtaposition often even without any inter-acinus stroma.

The differentiation of an adeno-carcinoma from an adenoma rests upon the facts that in the former there is an atypical or irregular growth of gland structure in which the acini have a lining often of several layers of epithelial cells or are converted into solid cell strands in consequence of the pronounced cellular proliferation. The cells are not necessarily confined by a basement membrane, they are usually atypical, polymorphous cells representing almost every shape and size, so that at times scarcely any two cells are alike, while their nuclei are large, irregular and frequently multiple. Cross sections of these branching tubules, especially if they are nearly or quite filled with cells, present a microscopical picture which is easily mistaken for a squamous cell nest. Macroscopically in an adeno-carcinoma of the cervical canal there is primarily a round node, which may invade a very considerable part of the cervix before any portion of it breaks down or appears upon the surface of the mucous membrane. If this is primarily implicated, there will be an elevated area which will be soft and covered with finger-like or villous processes. These are quite delicate and may readily be broken down. As the growth invades the cervix if situated near the vaginal portion it produces a reasonably hard, nodular or irregular surface with much thickening and induration of the lip affected. In cases in which the growth occurs in the immediate vicinity of the external os small, club-like,

villous processes are often protruded from out the canal. When the disease has its origin near the internal os it may reach a considerable size and invade the major portion of the cervix before it causes any subjective or objective manifestations.

Adeno-carcinoma of the cervix grows with considerable rapidity and if situated in the lower portion it will not only infiltrate this but is likely to break through the vaginal cervix and appear within the vagina as a fungus mass. If situated in the middle third it will project into the cervical as a soft, villous growth which bleeds readily. If situated higher up it may invade the uterine cavity. If situated anteriorly the bladder may suffer, or if situated posteriorly the rectum. In any event the lymphatics and the connective tissue in the broad ligaments are nearly always implicated, and this is true microscopically when it cannot be demonstrated macroscopically.

Adeno-carcinoma of the cervix occurs most frequently in the decade between forty and fifty, although cases have been observed in middle-aged persons and those far advanced in years.

Symptoms.—The symptoms most frequently met with in adeno-carcinoma of the cervix are, first, an irregular discharge of blood. This may be profuse and last for days or even months, or it may be quite slight and be of short duration. It nearly always increases with time; is recurrent and persistant. Perhaps quite as frequent a symptom is an offensive leucorrhœal discharge. This is pretty continuous, often considerable in amonnt, has a most penetrating odor and is watery in character. Pain is also ususally present. This is often situated in the uterus and is complained of as a full feeling, a heavinèss, a burning or a bearing down. With implication of the bladder there will be frequent urination, often accompanied with blood and severe pain. With implication of the rectum or broad ligaments there is likely to be painful defacation. If the disease is allowed to progress

loss of appetite and flesh, anæmia, toxæmia, cachexia and death follow.

Diagnosis.—The early diagnosis of adeno-carcinoma of the cervix is of the first importance. It is unfortunate that many, perhaps the great majority, of these cases run a comparatively insidious course, at least, for months. They are then quite far advanced before the symptoms become pronounced. The diagnosis will rest upon the symptoms, the age of the patient, upon a digital examination of the uterus and a microscopical examination of the uterine scrapings. The symptoms have already been given. Those which are the most pronounced are irregular hæmorrhages from the uterus, an offensive watery discharge and pain. The hæmorrhage may be the first to attract attention, or it may not occur until months after the appearance of the offensive watery discharge. Both of these symptoms are present to some extent with those soft, friable growths springing from the vaginal portion of the cervix or within the cervical canal. These villous processes freely supplied with delicate blood vessels are readily broken off and bleed easily.

They may be the site of an infectious inflammatory process and the cause of an offensive discharge. An examination may show a fungus mass within the upper part of the vagina springing from the cervix or cervical canal. It may show an indurated, nodular and enlarged cervix with infiltration, perhaps, of a broad ligament and adjacent structures, or it may be difficult by digital examination to determine if there is anything abnormal. The process always implicating the mucous membrane curettage of the canal is certain to bring away adeno-carcinomatous tissue. A careful microscopical examination of this tissue will ordinarily establish the diagnosis.

The condition is to be differentiated from excessive enlargement of the Nabothian glands. I recently saw a case diagnosed as carcinoma of the cervix. The patient had passed the menopause and was suffering from irregular

hæmorrhages with very decided uterine pain. The hæmorrhages had not been controlled by curettage. The cervix was very large, nodular and indurated. A vaginal hysterectomy was done when it was found that the hardness and enlargement of the cervix was due to the impaction of great numbers of Nabothian glands. In fact the cervix was largely made up of large, hard glands closely packed together. Upon the vaginal portion of the cervix none were to be seen. Had an examination of the cervical scrapings been made or the cervical spear used, the diagnosis might have been corrected.

The condition must also be differentiated from so-called ulceration. In this there is little in common as the ulcers are superifical, not indurated, and seldom attended with any considerable discharge or hæmorrhage.

Adeno-carcinoma should be differentiated from cervical polypi. The latter are round, smooth and pedunculated, but may give rise to hæmorrhages and a discharge which is, however, almost never offensive.

They should be differentiated from submucous cervical myomata. These growths in this situation are very rare. They most frequently occur before the menopause and are situated beneath the mucous membrane. They seldom cause irregular hæmorrhages and never an offensive discharge. They produce a hard, pretty well circumscribed induration and are often associated with myomata in the body of the uterus.

The condition should be differentiated from tuberculosis of the cervix. Tuberculosis in this situation is certainly very rare. A few cases, however, have been reported. Tuberculosis taking origin within the mucosa may produce an enlarged, nodular condition of the cervix with infiltration of granulation tissue within the cervical mucous membrane. This may project into the canal as a foreign body and be the occasion of a considerable discharge tinged with blood. In the cases so far reported the process has usually been

secondary to tubercular processes elsewhere and is usually associated with tuberculosis of the tubes. The differentation, however, is not so important as excision of the uterus, for tuberculosis would be the proper treatment.

The squamous-cellel carcinoma with few exceptions has its origin from the vaginal cervix, while the adeno-carcinoma originates in the canal. Where the growth has its origin near the exernal os it will frequently be extremely difficult, macroscopically, to differentiate them. Histologically they are quite different, as the epithelioma is made up of flat, squamous cells occurring in nests, while the adeno-carcinoma takes origin from columnar or cylindrical epithelium and has the form of an atypical glandular structure. In order to establish the diagnosis in any given case the uterus and cervical canal should be curetted and a microscopical examination made of the scrapings.

TREATMENT.—The treatment of an adeno-carcinoma of the cervical canal should be removal with the entire uterus as early as a positive diagnosis can be made. As was stated under the head of treatment of the epithelioma of the cervix, if the malignant growth has invaded much of the adjacent tissue operative measures for anything more than palliation are ordinarily contra-indicated. It is very rarely the case after the disease has invaded adjacent tissue that permanent relief by operative measures can be obtained, and it should also be remembered that in every case the microscopical invasion is of much wider extent than the findings by digital examination. It is quite true that in some of the cases glandular involvement and involvement of the broad ligaments is the result of inflammatory irritation and not due to the germs of the neoplasm. If there is a fungus growth projecting into the vault of the vagina with involvement of the broad ligaments, hæmorrhage and a foul-smelling discharge, a curettage of the fungus tissue, perhaps with a light application of the paquelin cautery and a packing of iodoform gauze, will give the patient a period of relief. If the upper portion

of the vagina be implicated this should be removed, if operation is permissible, as explained under the head of epithelioma of the cervix.

The operation of excision of the uterus may be carried out through the vagina or through the abdomen, or the combined operation may be practised. Ordinarily when the process is limited to the uterus the vaginal route is to be preferred. In cases in which the broad ligaments are involved and the glands along the larger vessels implicated, either the combined method or abdominal route is to be preferred.

Adeno-Carcinoma of the Body of the Uterus.—This may take its origin from any portion of the mucous membrane lining the body of the uterus. It is primarily a circumscribed, soft, vascular growth which very seldom presents itself at the external os. It consists primarily of many delicate, finger-like processes, which give it a shaggy appearance. These finger-like processes may coalesce and produce a tree-like growth or form a more or less solid mass with slight nodular projections. A tumor is occasionally produced which is soft aud lobular and has the feel of brain tissue.

The process may have its origin from a single area or it may apparently simultaneously take origin as a diffuse process extending over a considerable portion of the mucous membrane. The growths contain ordinarily a considerable quantity of connective tissue and are, therefore, harder and more resistant than those taking origin from the cervix. As the cells multiply they produce a tumor which not only projects into the uterine cavity, but also invades the muscular tissue of the uterine wall and may even penetrate these walls and produce nodular masses beneath the peritoneum. The growths as they appear here are yellowish-white, soft and easily demonstrable. Sooner or later necrosis occurs, the growth breaks down, sloughs form, are cast off, and a crater like area within the wall of the uterus is produced.

HISTOLOGY.—Carcinoma of the body of the uterus may develop from the epithelial cells covering the surface or from those of the glands. (Fig. 232.) It is stated by Cullen that at a short distance from the carcinomatous growth the epithelium covering the mucosa proliferates and projects as small, finger-like processes from the surface. Between these processes there is to be seen normal epithelium. The excresencies are made up of several layers of epithelium below which the mucous membrane is more or less normal. At the site of the

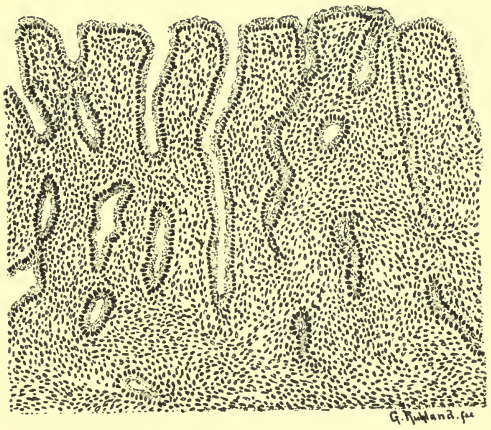


Fig. 232.
Uterine Mucosa.

carcinomatous growth all semblance of mucous membrane disappears and the finger-like processes cover the entire area. These processes may have but a single layer of epithelium, and when so the cells are usually cylindrical and uniform or they may be covered by many epithelial cell layers in which case the cells are usually polymorphous. As a result of this rapid proliferation of epithelial cells new glands are formed. In the older portions of the growth solid cords or columns of epithelial cells are to be seen. The nuclei are usually large and stain deeply. With this multiplication of epithelial cells there is also an outgrowth of

stroma which assists in the formation of glands or solid columns of cells. (Fig. 233.)

DIAGNOSIS.—The increase in the size of the cells, the fact that the nuclei are large and stain more deeply, coupled with the increase in the number of cell layers and the formation of solid cords or columns of cells are sufficient ordinarily to establish the diagnosis.

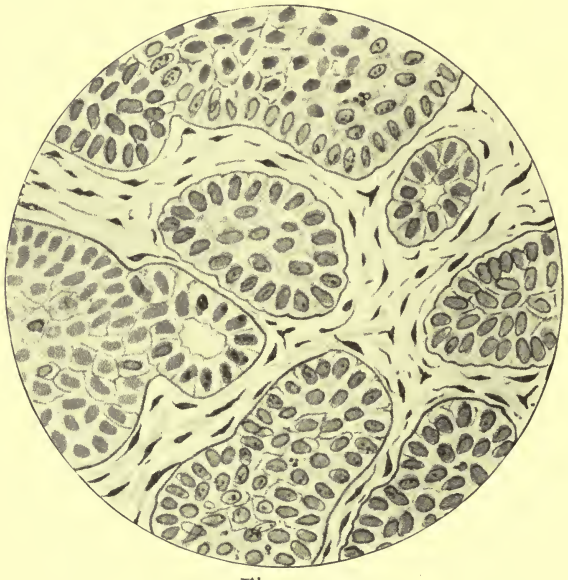


Fig. 233.
Adeno-carcinoma of Uterus.

The diagnosis of adeno-carcinoma of the uterus, however, is made by a study of the clinical symptoms as well as by a microscopical examination of the scrapings from the uterus. The majority of cases occur after the climacteric, although a number have been reported at the age of thirty and one case was observed at the age of eight.

The clinical course does not differ materially from that of an adeno-carcinoma of the cervix. There is usually a bloody discharge recurring at intervals. The hæmorrhages are perhaps not as severe as in adeno-carcinoma of the cervix.

There is also usually a watery or purulent discharge having a penetrating odor. Pain in the lower abdomen is usually present. As the case progresses loss of appetite, emaciation, cachexia and metastases occur. If these symptoms present themselves in a patient after the third decade, and more especially if in one after the menopause, a careful curettment should be done for the purpose of making a microscopical examination of the scrapings. The uterus in these cases is often not perceptibly enlarged. In some cases, however, in which there is a very considerable amount of soft, adeno-carcinomatous tissue within the cavity of the uterus it will be decidedly enlarged and may reach that of a two or even three months pregnancy.

Metastases may occur in the bronchial, inguinal, pericardial and cervical lymph glands. Metastases, however, are not frequent, at least not nearly so frequent as in adeno-carcinoma of the cervix. Williams states that in seventy-nine autopsies metastases occurred in sixteen of the cases. As complications adhesions with the intestines or omentum are frequent. Myomata and sarcomata may also occur as complications.

PROGNOSIS.—Without operation the result is death. With operation during the early stages the results have been most promising, as the disease shows little disposition during the first months to invade any of the structures outside of the uterus. In Cullen's twelve cases of adeno-carcinoma of the cervix only two were well five years after operation. In thirty cases of adeno-carcinoma of the body of the uterus thirteen were alive and without symptoms of return after three years. Many of these cases had passed the sixth year and still remained apparently well.

TREATMENT.—The treatment of an adeno-carcinoma of the uterus is the early removal of the organ. This may be carried out through the vagina or through the abdomen. In a considerable number of cases the operations have been through the abdomen leaving the cervix. The abdominal

route is especially applicable in cases which show complications, such as hydro-salpinx, pyo-salpinx, pyometra or myomata.

Deciduoma Malignum.—This name has been applied to a malignant growth which makes its appearance within the uterus, or possibly Fallopian tube, shortly after labor at term, premature delivery or abortion, or after the expulsion of a mole. Sanger was the first to call attention to this condition, in 1888. He reported two cases. In one the woman was twenty-three years of age, had aborted during the eighth week and died seven months later. At the autopsy four large, soft, spongy, reddish tumors were found in the uterine wall. There were metastases in the lungs, the diaphragm, the tenth rib and the right iliac fossa. Dorland, in 1897, collected the reports of fifty-two cases. Since that time the number of cases has markedly increased.

The growth has its origin from the placental site usually during the course or after the termination of pregnancy. The tumor is a soft, spongy, villous, bleeding mass. It grows with decided rapidity and causes the uterus to increase rapidly in size. There may be but a single growth or there may be multiple growths springing from different areas. The tumor rapidly invades the uterine wall and produces metastases frequently in the vagina and labia, then in the lungs, kidneys, gall bladder, thyroid, periosteum, intestines and brain.

The clinical picture is about as follows: A short time after the termination of labor at term, an abortion, or the expulsion of a mole, uterine hæmorrhage makes its appearance without apparent cause. Coincident with this, or shortly after it, the uterus increases rapidly in size. The cervix is often enlarged and softened. Shreds and pieces of new growth are frequently extruded from the uterus in connection with the hæmorrhage. If a digital examination be made and the finger passed through the cervix, a soft, friable, spongy,

bleeding mass, one which is easily broken down and which bleeds readily, is encountered.

The Tissue Origin of a Deciduoma Malignum. — Between the chorionic villi of the fœtal membranes and the decidua serotina (which is that portion of the mucous membrane of the uterus to which the placenta is attached) are two distinct layers. The first, or syncytium, is a protoplasmic layer containing large nuclei. It has the appearance of a nucleated protoplasm rather than of a collection of cells. Occasionally it contains large, irregular, nucleated masses. It is thought by some embryologists that this layer has its origin from the decidual cells and is maternal in character. The second layer, or that which immediately covers the villi, consists of cubical epithelial cells (Langhan's cells) and comes from the fœtal membranes. It is presumed that from one of these layers of cells, perhaps from both, this peculiar tumor takes its origin. Histologically the tumor is made up entirely of parenchyma. This is composed of two elements—first, a plasmodium or amorphous ground substance containing numerous large nuclei, long ribbons, or bands and, second, polymorphous cells (Langhan's cells). These cells occur in alveoli, or are grouped in masses making up a considerable part of the growth. Occasionally the plasmodium is divided into large nucleated masses, into giant cells, or into large epitheliold cells. Within the tissue there are often a large number of blood sinuses and in these sinuses masses of plasmodium are frequently found. It is now quite generally held by pathologists that the growth is of placental origin. (Fig. 234.)

The diagnosis of a deciduoma malignum rests upon the clinical history and upon the microscopical examination of the uterine scrapings.

If the case is left to take its own course the patient's life is destroyed in a few months in consequence of frequent hæmorrhages, metastases, toxæmia and sepsis. Very early in the growth of the tumor, as our own specimens show, the uterine wall is invaded.

The indications for treatment are the early removal of the uterus which, if accomplished, may be successful in averting the death of the patient.

Carcinomata of the Ovary.—These tumors occur under the form of solid or cystic growths. The solid may be hard or soft. The scirrhus form is rare. The medullary is a soft, lobular growth, an adeno-carcinoma. The cystic form may

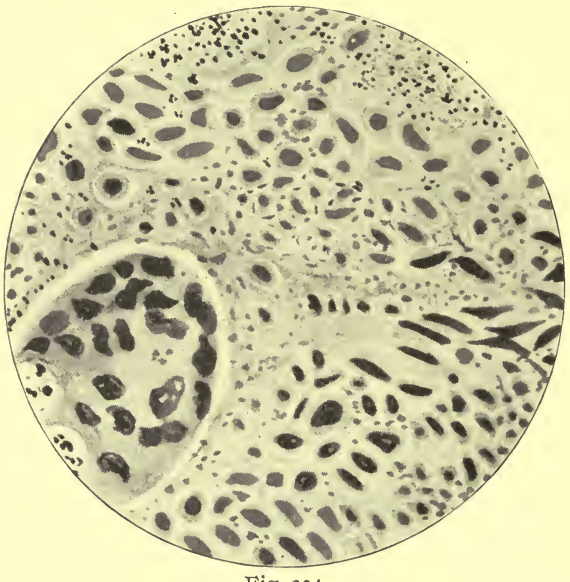


Fig. 234.
Deciduoma Malignum.

be a cysto-carcinoma or an adeno-cysto-carcinoma. The cystic form of a carcinoma is primarily a papilloma. Papillomatous growths may project into or from the cyst wall or both conditions may occur.

Carcinoma of the ovary is presumed to take its origin from the germinal epithelium of the surface of the ovary, from that which is invaginated into the ovary to form the Graaffian follicles or from the rests of the Wolffian body. These tumors occur most frequently between the ages of thirty and fifty and in one-third of the cases they are bilateral.

The medullary or adeno-carcinoma occasionally reaches the size of a fœtal head. (Plate, Fig. 235.) Papillary cystic growths may fill the abdomen. The scirrhus tumor is seldom larger than an orange. The medullary carcinoma of the ovary has a white or yellowish color and is slightly nodular. The adeno-carcinoma may occur in adult life. The scirrhus growth occurs at an advanced age and is made up of epithelial cells. The cells are in nests or strands and are surrounded by a dense connective tissue stroma. The cystic carcinoma has the appearance of a cystic adenoma. The contents of the cyst or cysts is often a clear or slightly cloudy serous fluid. If it contains many cells it resembles pus in appearance or it may contain a considerable quantity of blood. The cysts are in places lined by a single layer of cylindrical epithelial cells. In other places there are many layers of multiple polymorphous cells producing nodes or excresencies.

DIAGNOSIS.—These tumors produce no special symptoms. Their growth, however, usually causes considerable pain in the ovary. They grow rapidly and if papillomatous become adherent to adjacent structures, omentum, intestine, and peritoneal wall. They consequently become more or less immovable and present a semi-solid consistence on palpation. Malignant growths of the ovary often produce ascites, the fluid being stained with blood. Later in the course of the disease loss of appetite and flesh, metastases, cachexia and death occur.

TREATMENT.—The treatment should be the removal of the growth. If this be accomplished early while the malignant tissue is confined to the ovary there will be a good prospect of a cure resulting. It is also occasionally the case in papillomatous growths of malignant character in which the fringes have become attached to the peritoneum, the intestines or omentum that the papillomatous tissue may be separated and the ovary removed with a reasonable prospect of success.

In all cases of carcinoma of the ovary the opposite ovary

should be examined in consequence of the liability there is of both being affected.

Carcinoma of the Kidney.—Carcinoma of the kidney occurs with very few exceptions after adult age. The most frequent period is between thirty and fifty. There is a medullary or soft, a scirrhus or hard and a mixed form of tumor in this situation. The encephaloid carcinomata take on the choracteristics of these growths in other situations. The scirrhous seldom produce a tumor of any considerable size, but one which is very hard, nodular, indurated, and of slow growth. The encephaloid tumor grows rapidly, infiltrates adjacent structures and produces the soft, lobulated growth which may attain the size of an adult head or become even larger than this.

A carcinoma in this situation may be circumscribed or diffuse. They are never circumscribed in the sense in which a benign tumor is, nevertheless, a carcinoma of the kidney not unfrequently is confined to a single quadrant of the organ for a considerable time and has a distinct capsule. In other cases they are without the semblance of a capsule and simply infiltrate and destroy the parts affected. A carcinoma in this situation, even if diffuse, is confined for a considerable time within the capsule. This unquestionably results for months in a distinctly local disease, but with the progress of time the epithelial cells invade the capsule of the kidney, reach the adjacent structure, get into the veins and lymphatics, produce enlargement of the lymphatic glands and cause metastases in the lungs, liver and other internal organs. Metastatic deposits from malignant growths in this situation usually occur through the venous circulation. The growth gaining the lumen of a branch of the renal vein produces a thrombus which is broken up into numerous infected emboli, carried to distant parts, lungs, liver, brain or other organs and tissues where they produce metastatic growths.

A third species of tumor always malignant and often carcinomatous, at least in part, has been especially studied

by Grawitz. The Grawitz tumor has been held at times to be an adenoma, then a sarcoma, a carcinoma, or an endothelioma. From Grawitz' investigations he believes that these growths are the result of inclusions or rests of the suprarenal glands within the capsule of the kidney. Both Grawitz and Klebs have shown that the adrenals are sometimes in part or entirely contained in the kidney capsule.

It is pretty generally held at the present time that the tumors described by Grawitz have their origin from adrenal rests embedded within or beneath the capsule of the kidney. Israel, Askanazy and others have had cases in which the growths in the kidneys were like those described by Grawitz and which they believed came from adrenal rests. Bayard Holmes has reported a case of adrenal tumor iu a man aged fifty-six with marked constitutional symptoms and secondary growths, and he states his belief that about one-third of all tumors of the kidney appearing in adult life are of adrenal origin. He believes that but a small portion of them produce metastases, and that these metastatic growths when occurring are usually found in the lungs or bones. It seems, then, pretty satisfactorily established that not unfrequently a growth occurs in the kidney of adrenal origin, which growth may be an adenoma, in part a lipoma, a sarcoma, an endothelioma or a carcinoma, or be composed of two or more of these elements in combination. The Grawitz tumor occurs as a rule in people past middle life. It is more frequent in men than in women. It grows rapidly, ordinarily gives rise to metastases, these seemingly occurring by preference through the blood stream and being found most frequently in the lungs, liver or bones. The tumors vary markedly in size and while some are small, others come to be very large. In the early part of their growth they are apparently separated from the kidney structure by a distinct capsule. On section they present a whitish or yellowish appearance and are usually composed of an aggregation of nodules. They also may show hæmorrhagic or necrotic areas.

Histology of the Malignant Kidney.—The medullary carcinoma is evidently an adeno-carcinoma and takes its origin from the cells lining the uriniferous tubules. The scirrhus also takes origin from the epithelial cells of the tubules, but differs from the encephaloid in that the cells occur in nests and are surrounded by a quantity of fibrous tissue. The pathological histology of the Grawitz tumor differs greatly, depending upon the character of the growth. The tumor is composed of a stroma and parenchyma. The former is usually sparsely developed, consists largely of a net-work of capillaries forming meshes in which the cells are placed. At times the stroma is more liberally developed and produces septa of considerable dimensions. The appearance of the cells varies greatly. At times the structure has the appearance of that of a suparenal gland. The cells may be large, round or polymorphous. They contain a considerable amount of protoplasm and sometimes fat. The nucleus is large, stains well, and is often excentrically situated. At times the large or giant cells have many nuclei. The shape of the cells may be changed as the result of pressure. Occasionally the growth has the appearance of adenoma in consequence of the cells being placed in single or double rows. At the external portion of the growth the character of the cells and their arrangement is often complex, and differs from that found in the more deeply situated portion. At times groups of round cells are found. Then again the cells are columnar. Cysts are occasionally formed and are supposed to be due to necrotic softening of central areas of cell nests. They may also be caused by dilatation of lymph channels. It is thought by some that the malignant tumors of the kidneys are formed in consequence of the presence and irritation of a calculus. The irritation causes cell proliferation which takes on malignant characteristics. A microscopical section of a Grawitz tumor which I removed shows in some areas nearly normal kidney tissue, in other places the tubules are filled with cells which look like cancer cells. In

other areas the tumor cells are round and spindle-shaped, giving the field the appearance of a mixed-cell sarcoma. The lumen of many of the capillaries is dilated and nearly filled with endthelial cells. In one field a delicate thrombus is to be made out in a vein, the thrombus being composed of delicate spindle- and star-shaped cells of varying sizes intermingled with blood corpuscles. The thrombus presents the appearance of adrenal tissue.

Symptoms of Carcinoma of the Kidney.—There are three symptoms of especial importance. One of these is hæmorrhage; another, the presence of a tumor, and the third, pain.

Hæmaturia is frequently the first symptom to be observed. It may be slight or severe, may last but for a day or two or continue for weeks.

It is necessary to establish the source of the bleeding. Hæmorrhage from the kidney diffuses itself very intimately with the urine so that the color is usually pretty uniform, there being ordinarily no increase of blood during the commencement or at the end of micturition. The blood also shows more or less disintegration of its corpuscles. Another characteristic symptom often present when the blood comes from the kidney is the passage from the urethra of long, slender, ribbon-like clots. Denaclara, in a collection of 409 cases of new growths in the kidney, found that hæmaturia was the first symptom in 68.8 per cent. The hæmorrhage usually occurs spontaneously, without pain or obivous cause, the patient unexpectedly finding that he is passing blood with the urine. The persistence of this bleeding often causes a grave form of anæmia. Guillet says that the bleeding from the kidney is often spontaneous; second, it is not influenced by repose or exertion; third, it occurs at any period of the disease; fourth, it is repeated at variable intervals; fifth, it is usually profuse; sixth, it lasts from one to six days, and may subside completely to recur in a few days; seventh, it is often preceded by pain.

Presence of a Tumor.—In about twenty-five per cent. of the cases a tumor is the first discoverable symptom. The tumor may cause a sense of weight or dragging in the lumbar region. For a considerable time the growth conforms closely to the shape of the normal kidney, if it penetrates the capsule it will change the contour of the organ. Tumors situated in the lower pole are more readily palpated than those in the upper portion of the kidney. The tumor may be large or small, consequently the necessity for a careful examination of the organ in order to establish the enlargement.

Israel's Method of Palpation.—In examining the left kidney the patient s turned on the right side. The surgeon, standing so as to face the patient, places the tips of the fingers of the left hand just below the costal arches, while the flat of the right hand is placed against the loin. The patient is directed to take a full inspiration with the mouth open. At the close of the inspiration gentle pressure is made by the hands against the kidney, when it can be readily palpated. It has been my practice when about to palpate the right kidney to have the patient's right side brought close to the edge of the bed while the knees are flexed and the head somewhat elevated. Sitting and facing the bed the palm and fingers of the left hand are placed beneath the lumbar region while the fingers of the right hand impinge directly below the ribs. The patient is then directed to take a full breath with the mouth open. If the abdominal muscles are relaxed and the kidney enlarged, it can be readily felt to come down between the fingers of the two hands. Its size and hardness can also ordinarily readily be determined.

Pain.—This symptom is present as a first indication in about thirty-five per cent. of the cases. The pain is frequently slight. It is situated in the lumbar region and from there may radiate into the chest, simulating an intercostal neuralgia, or downwards onto the thigh or into the genital organs and across the abdomen. The pain is spontaneous and unin-

fluenced by rest, exercise, or the time of day. It is ordinarily intermittent and not very severe. Occasionally it is agonizing and this is especially true in cases in which blood clots or portions of the tumor are passed under force through the ureter, producing renal colic. Pain may be caused by pressure upon adjacent nerves, or invasion of, and with the destruction of, adjacent tissue.

Products in the Urine.—As a rule, barring the occasional presence of blood, the urine is not especially altered. In some particular cases the urine may be increased or diminished or its secretion arrested. Portions of the tumor have been occasionally discovered in the urine on microscopical examination. This, however, is comparatively rare. Pus as an ingredient in the urine is also rare.

Varicocele.—Morris and Guyon have both noticed enlargement of the spermatic veins of the cord in cases of tumor of the kidney. This presumably is due to the growth making pressure upon the spermatic vein, or it is thought to be due at times to the pressure of adjacent lymphatic glands.

DIAGNOSIS.—A tumor in the region of the kidney, with hæmaturia, will ordinarily be strongly suggestive that the tumor is in the kidney. A tumor of the kidney is situated in the lumbar region and, if of sufficient size, presents itself on deep inspiration below the lower ribs. It should be differentiated from an enlarged liver or spleen and from a tumor in the abdomen. The spleen and liver both have sharp borders. A tumor of the kidney, almost without exception, has a round border, preserving in a large measure the normal contour of the kidney. A tumor of the kidney with few exceptions is situated behind the colon and has consequently a tympanitic area in front. This is not the case with the liver or spleen. It is true in some cases of enlargement of the liver with pronounced ascites that the intestines may float up over the edge of the liver. A tumor of the kidney will usually have the colon in front of or upon its

internal surface. Occasionally the colon, if empty and collapsed, may be without resonance and felt as a considerable cord upon the surface of the growth. Again a tumor of the kidney may, in its descent into the abdomen, carry the colon down with it, or, in exceptional cases, may become situated centrally to the colon. A tumor of the kidney is usually depressed upon inspiration, except in cases in which there is an inflammation in the perinephritic tissue. Tumors of the kidney seldom produce any prominence posteriorly. It may obliterate the lumbar hollow, however. If they reach any considerable size they make their appearance beneath the ribs, which condition is very noticeable when the patient is lying upon the back.

These tumors should be differentiated from benign growths. The latter occur at an earlier age; they grow slowly, are seldom the cause of any considerable hæmorrhage and never produce metastases or a cachexia and seldom produce tumors of any considerable size. They cannot be differentiated from sarcomata or endotheliomata, but this differentation is not essential as the treatment is the same.

They should be differentiated from tubercular processes which may produce tumors of almost any size. A tubercular process of the kidney may be primary or secondary. It is seldom attended with hæmorrhage, but with a fever and considerable quantity of pus in the urine. The urine should contain the bacilli of tuberculosis. The growth is ordinarily slow and the history and appearance of the patient are usually those of a tubercular person.

Carcinoma of the kidney must be differentiated from hydro- and pyo-nephrosis. In hydronephrosis there may be a large tumor, but this is more quickly produced than in a case of carcinoma. A hydronephrotic tumor as large as an adult head may be attained in a few days, and then suddenly disappear. The tumor formation occurs with severe colicky pain, but without cachexia, fever or symptoms of altered urine. Again there may be almost a suppression of urine, and then

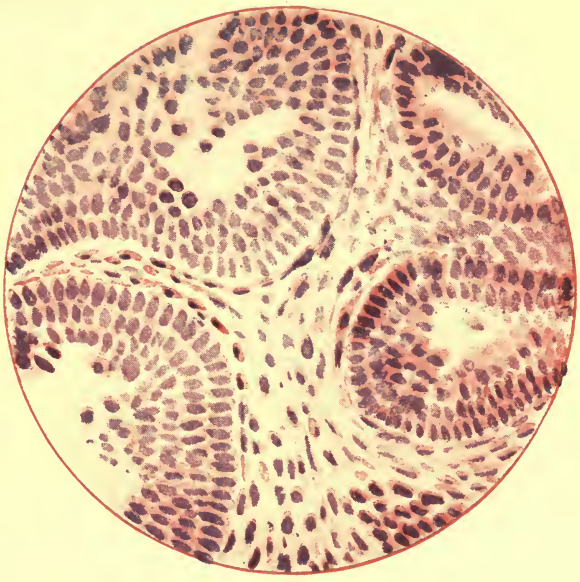


Fig. 235.

Adeno-Carcinoma of Ovary.

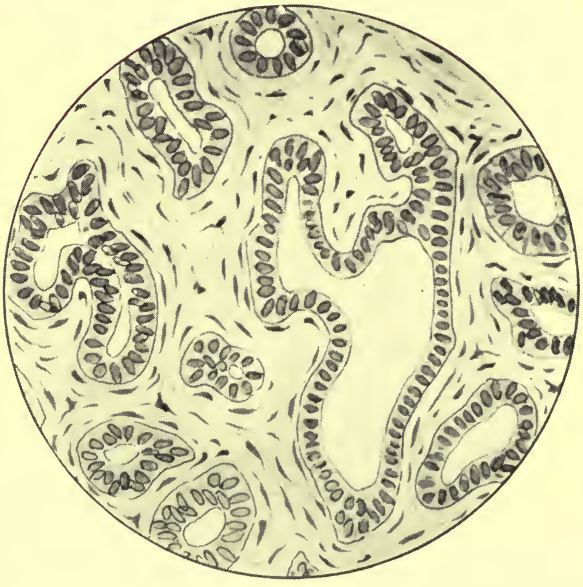


Fig. 237.

Adeno-Carcinoma of Stomach.

the patient voids large quantities. The tumor is usually cystic. In pyonephrosis there is a decided fever, perhaps chills, and a severe pain in the side, with quantities of pus in the urine.

PROGNOSIS.—When once a carcinomatous process has become established the condition steadily progresses. Without surgical interference death is effected in consequence of hæmorrhage, metastases, pain, toxæmia, suppuration and exhaustion. Ordinarily without operative interference the patient will not live longer than from two to four years. Guillet has collected five cases in which the patient survived from four to ten years, and six cases in which the patient lived from ten to sixteen years. Metastases, it may be said, seem not so frequent in tumors of the kidney as in that of some other organs. Roberts in fifty-one cases found secondary growths in thirty-one, while in the remaining the kidney alone was attacked. Dickinson found secondary growths in fourteen out of fifty-nine cases. Rohrer in one hundred and fifteen cases found secondary growths in fifty. The lungs appear to be a favored seat of these secondary deposits, the liver and lumbar glands, however, are frequently affected. (Morris).

TREATMENT.—The treatment of a carcinomatous kidney consists in the removal of the organ as soon as a probable diagnosis can be made.

The kidney may be approached from the front through the linea alba or at the outer border of the rectus or from behind. Many abdominal surgeons prefer the abdominal route, and when this incision is adopted the outer border of the rectus is to be preferred as the place for the incision. The peritoneum should be divided on the outer border of the colon and then by blunt dissection, aided, now and then, by the scalpel, the colon is reflected over the internal surface of the tumor with its peritoneal covering. The tumor is then shelled out, being very careful not to break into the kidney capsule. In cases in which the capsule has been invaded by the growth or in which the capsule is intimately adherent to

the surrounding structures in consequence of a perinephritic inflammation a break into the tumor will be almost unavoidable and its complete removal almost impossible. These cases are attended with the greatest danger on account of the severe hæmorrhage which is likely to occur, and also in consequence of possible injury to adjacent structures. The peritoneum being opened infection may follow. The colon has been torn and in one case the inferior vena cava was opened, and in another it was accidentally ligated. If the tumor can be shelled out to its pedicle this may be transfixed and ligated, placing the ligatures as far distant from the tumor as is possible. The ureter may be included in the same ligatures with the vessels if there be no infection in the kidney or pelvis. If the ureter is in a state of infection in consequence of suppuration within the kidney it had better be separately ligated and after section asepticized by carbolic acid and its end inverted. It may then be brought out through an opening in the lumbar region at the border of the erector spinæ muscles. During and after enucleation of the kidney all small bleeding vessels should be ligated with catgut. The incision in the peritoneum should then be closed with catgut and following this the wound in the abdominal wall is closed. This method of procedure is applicable to tumors of very large size. A transverse incision, however, commencing at the border of the erector spinæ muscles and carried around the side, if necessary even to the outer border of the rectus is the incision usually adopted by surgeons at the present time.

This incision has several advantages. One is that the intestines are not exposed or handled and consequently shock is likely to be less. Another, that the operation is done extra-peritoneal, and consequently peritoneal infection is avoided. The vessels are also more accessible and consequently hæmorrhage is more easily controlled. If the tumor be not too large this incision should be adopted, as it has a less mortality than has the abdominal incision. Before

making the incision, however, one should carefully palpate the side for resonance and determine the probable site of the colon. One must make the anterior portion of the incision with great care so as to avoid opening the peritoneal cavity or wounding the colon. If the peritoneal cavity is opened, as has occasionally occurred in my practice, it should be immediately closed with a continuous catgut suture. While the transverse incision is undoubtedly to be preferred, a perpendicular one may be chosen along the outer border of the erector spinæ muscles, this incision being supplemented, if necessary, by additional transverse incisions placed at either extremity of the perpendicular one. In the operation for malignant disease when the fatty capsule of the kidney has been reached so much of this capsule as possible should be shelled out with the tumor, as this is likely to lessen the probability of subsequent recurrence.

The mortality following nephrectomy by the abdominal route has been placed at from forty to fifty per cent., and by the lumbar route at from twenty to thirty per cent. I am very much impressed with the idea that both of these percentages are much higher than they should be. From my own experience, which is quite large in nephrectomies, I am forced to believe that when the operation is properly carried out in cases in which the conditions are suitable, that is, where the tumor has a capsule which can be defined and the growth shelled out, the mortality by the lumbar incision should be very low. Shock, hæmorrhage and sepsis will ordinarily be the causes of death. The first and second can usually be avoided or put under control, and as sepsis cannot always be avoided its harmful effects when it occurs may be minimized by drainage. In my nephrectomies I take great pains to firmly secure the vessels by transfixing and ligating each side and then cutting the pedicle at a good distance from the ligatures. The stump is also kept under control for a time with a large pair of hæmostatic forceps. After the removal of the growth the cavity is lightly packed with iodoform gauze.

This is gradually withdrawn after a few days to be replaced by fresh gauze, or a drainage tube. This gives support and lessens greatly the liability of hæmorrhage.

Guillett's figures of all the nephrectomies for malignant renal tumors performed up to 1888 showed a mortality of seventy-two per cent. Chevalier's statistics in 1891 showed a mortality of fifty-eight per cent. Kuster's statistics in 1896 showed a mortality of twenty-four per cent. Max Jordan's, in 1895, twenty per cent. Czerny in his first nine cases had a mortality of seventy-five per cent., whereas in the following nine all recovered. Israel lost three cases out of twenty-four.

Thus it would seem that the mortality which up to 1899 ranged from sixty-eight to seventy-two per cent. has been reduced to twenty-five or twenty per cent.

Recurrences.—Heresto's figures show that of sixty-two patients who survived the operation of nephrectomy for malignant disease thirty-six were alive and well at dates varying from two months to three years. Twenty-two died from a recurrence of the disease at periods varying from three months to three and a half years and four died of intercurrent disease. In Morris' cases one out of eight lived nearly three years and then died of a recurrence. Of the others four died of recurrence between six and twelve months, two within three months and one is still alive and well three months after operation.

Carcinoma of the Parotid.—Carcinoma of the parotid has been thought in the past to be not unfrequent, but a more careful microscopical examination of the tumors removed has seemed to show that a considerable number, probably the large majority, of malignant growths taking origin within the parotid gland were either sarcomatous, coming from the connective tissue, or endotheliomatous taking origin from the blood vessels, lymph vessels or spaces. Car-

cinomata, however, do occur in this situation, although rarely.

It is a disease of middle or advanced age and begins as a small, firm nodule within the substance of the gland. The nodule gradually extends, enlarges, growing quite rapidly, and soon comes to invade a considerable portion of the gland structure. It is really an adeno-carcinoma in the majority of cases. In its growth the confines of the gland are overreached, the surrounding tissue implicated, and the lymphatic glands of the neck invaded. The tumor becomes attached to the skull and inferior maxillary bone and is then quite immovable. Ulceration is likely to occur, while metastases are frequent in the lungs, bones and liver. The adjacent muscles become invaded, such as the masseter, temporal and pterygoid. The deep structures of the neck, including the pharynx, may also be invaded. This regional and general infection is more particularly the case with the soft, spheroidal-cell carcinoma which grows rapidly and is extremely malignant. The scirrhus carcinoma also occurs in this situation, but it is made up in large part of connective tissue. It is hard, nodular, and seldom reaches any considerable size.

Diagnosis.—It will be impossible ordinarily to differentiate the different malignant growths taking origin within the parotid gland. The fact that sarcomatous growths occur as a rule in children or young adults and that they have an unequal consistency, being reasonably hard over certain areas and then again cystic, will lend some aid toward differentiating them from carcinomata. The soft, rapidly growing endotheliomata and soft carcinomata run practically parallel courses and are not clinically to be differentiated. This, however, is unimportant, as the treatment is necessarily the same.

Malignant growths in this situation should be differentiated from the benign. The latter occur as a rule in young adults, have a slow progress, are confined within the capsule and are freely movable. They are ordinarily harder than are the malignant growths, being frequently made up in part at least

of cartilage. The carcinomata grow with greater rapidity, are not encapsulated, produce decided pain and often cause paralysis of the facial nerve. Facial paralysis seems to be almost pathognomonic of malignancy, that is, it seldom, almost never, occurs in benign growths. The paralysis is presumably due to an infiltration and destruction of the nerve fibers.

It is of the greatest importance to be able to early determine the malignancy of these growths before the confines of the gland have been transgressed. The rapidity of growth, with infiltration rather than with close definition of the outlines, and paresis or paralysis of the facial nerve, some considerable pain, in conjunction with a parotid tumor, should be sufficient to warrant a diagnosis of malignancy. Later fixation and metastatic deposits occur in various parts of the body. There may be infiltration of the skin, pernaps ulceration, with the appearance of a fungus mass protruding or growing from the ulcer, hæmorrhages, cachexia and death.

The prognosis corresponds in general to that of carcinomatous growths in other glandular organs.

TREATMENT—The treatment should be that of excision, which, however, represents unusual difficulties on account of the anatomical relationships. The parotid gland is situated below and in front of the ear. Passing through it is the external carotid artery and the facial nerve. The gland extends for a variable distance in front, crossing a portion of the masseter muscle and then dips beneath the ramus between the two pterygoid muscles. Its inner surface extends deeply into the neck. One of these outgrowths is placed behind the styloid process and projects beneath the mastoid and sternomastoid muscle, while the other is situated in front of the styloid process and passes into the back part of the glenoid fossa behind the articulation of the lower jaw. The posterior auricular artery emerges from the posterior border, the temporal artery from above, the transverse facial in front

and the internal maxillary winds through it, going behind the neck of the jaw.

Superficial to the external parotid is the large venous trunk, formed by the union of the temporal and internal maxillary veins. A branch connecting the temporo-maxillary with the internal jugular vein also traverses the gland. The auricular nerve pierces the parotid to join the facial and the temporal branch of the inferior maxillary nerve lies above the upper part of the gland. The internal carotid artery and internal jugular vein lie close to its deep surface.

It is possible to enucleate a tumor of the parotid while the growth is still within the confines of the capsule of the gland. After the growth has become fixed to the surrounding structures it is practically impossible to remove a carcinoma successfully so that recurrence will not take place.

In the removal of a tumor of the parotid any incision which exposes the part may be made. Usually the first incision is a perpendicular one, and this may be supplemented by one or more transverse cuts. It is advisable to control the circulation through the gland as early as possible, and for this purpose it is well to deepen the lower end of the incision and expose, double ligate and divide the external carotid artery. The temporo-maxillary vein lies superficial to the carotid and will ordinarily require double ligation and division. The tumor is then carefully separated from the deeper structures by blunt dissection, double ligating and dividing any vessels which pass from the tumor to the adjacent tissues. The internal carotid artery and jugular vein lie directly beneath the tumor, and if the growth is confined within the capsule they may be spared. If the walls of these vessels are implicated they may be exposed, ligated and divided, saving, if possible, the vagus nerve, although this nerve has been removed in a number of cases without more serious effect than to cause hoarseness. Paralysis of the corresponding side of the face is almost certain to follow the removal of the thyroid, although in a few instances the nerve

has been separated by blunt dissection and preserved. As the growth projects beneath the ramus of the jaw some operators, in order to gain additional room, resect the ramus of the inferior maxillary bone. When the internal carotid and internal jugular are free the gland may ordinarily be shelled out, after ligating the external carotid, without encountering unsurmountable difficulties. In a few cases in my own experience in which the internal jugular and carotid were implicated, the former close to the point where it made its exit from the skull, the difficulties of the operation were enormously enhanced.

The greatest difficulties from hæmorrhage in this situation are from the veins and not from the arteries, as the latter can be more readily defined and ligated, and also in consequence of the fact that the blood stream in the arteries comes from below and can be located and arrested, while that in the veins comes from above, and it is difficult or impossible at times either to locate or arrest it before the division of the vessel.

In cases in which the tumor is immovable operative measures are contra-indicated. A fungus mass may be curetted away and the wound packed with temporary benefit to the patient. After the removal of the growth the skin flaps are brought together and the wound drained or packed if there is any considerable oozing.

Carcinoma of the Œsophagus.—The œsophagus is composed of four coats, the mucous, submucous, muscular and fibrous. The mucous membrane is lined by stratified squamous epithelium resting upon a connective tissue matrix, the tunica propria. Within the submucous tissue are to be found the mucous glands. They are especially numerous in the lower third, and are lined by a columnar epithelium.

Carcinomatous tumors taking origin from the epithelial cells of the œsophagus are of two kinds. First, the epitheliomata, which represent about ninety per cent. of the carcinomatous growths and which take origin from the stratified

squamous cells lining the surface, and second, the glandular carcinomata, or those which have their origin in the columnar cells lining the mucous glands.

The epitheliomata of the œsophagus have the clinical and histological characteristics of epitheliomatous growths occurring in other situations. They take their origin from the surface epithelium, and as the result of the vigorous cell proliferation, columns, whorls and nests of cells are formed in the mucous membrane and deeper tissues. The cells are flat, polymorphous or squamous. The growth seldom produces finger-like outgrowths upon the surface, but causes a hard, nodular infiltration which may extend from one to several inches up or down the œsophagus or around its circumference, the latter being the more frequent condition. Ulceration occurs early in the infiltrated area and stenosis soon follows in consequence of the contraction of the new fibrous tissue formed around the cell columns and nests, and also on account of the infiltration.

The glandular carcinomata represent about ten per cent. of the malignant growths of the œsophagus and take their origin from the columnar cells of the mucous glands. These cells proliferate rapidly and acini are formed with many layers of polymorphous cells instead of a single layer of columnar cells. As the result of this cell multiplication, projections, nodes and new glands are formed. The rapidly proliferating epithelial cells of an adeno-carcinoma not only invade the walls of the œsophagus, but project into its lumen as a fungus mass which is likely to cause stenosis and hæmorrhage. As the result of injury or infections large or small pieces are disintegrated or come away as sloughs.

These growths may be situated in any portion of the œsophagus, but are frequent in the upper portion behind the cricoid cartilage or in the middle third, where the œsophagus is crossed by the left bronchus. They may occur before middle life and only occasionally give rise to metastases or cause a cachexia.

Carcinomata of the œsophagus are ordinarily primary, but they may be secondary to a growth in the mediastinum, tongue, epiglottis, pharynx, larynx or stomach. In their growth they have invaded the trachea, adjacent pleura and bronchus, and a fistulous tract has been established between the œsophagus and each of these structures. The aorta has in at least two instances ruptured in consequence of the invasion of carcinomata of the œsophagus.

Symptoms.—In a carcinoma of the œsophagus the first symptoms which are at all distinctive relate to difficulty in deglutition. The patient is usually over fifty and may have shown a loss of appetite and flesh with weakness and some pain or distress upon deglutition. Before or with these symptoms there is some difficulty in swallowing solid food, associated often with a feeling as though there was a stone or something heavy in the œsophageal region. The food seems to lodge there. After a time the patient is unable to swallow solid food and finds that even liquids must be taken slowly. The patient now has lost considerable strength and flesh and looks pale and worn. The condition before reaching this stage has perhaps been noticeable for several months. As the stenosis increases the patient finally is unable to swallow even liquids. Vomiting is also an early symptom; that is, the food or liquids reach the stenosed area and being unable to pass to the stomach are regurgitated. This occurs usually in a few moments after the taking of solid food or liquids, and these return almost as taken, except perhaps that with them there is a quantity of mucus and it may be some blood.

The diagnosis is proven if necessary by the passage of a large stomach tube or an œsophageal bougie. It has not unfrequently happened in my practice during the earlier stages that a small bougie will pass to the stomach without locating the stricture. Great gentleness must be exercised in passing a bougie, or a false passage may be created or other serious harm done.

The stomach, in cases of œsophageal cancer, contracts, becomes smaller and undergoes more or less of atrophy.

PROGNOSIS.—Death is the inevitable result of a carcinoma of the œsophagus if the disease is allowed to take its own course. Death occurs as a rule within one or two years.

TREATMENT.—The treatment may be considered under the head of prophylactic and surgical. The former consists in providing proper nourishment for the patient. Before the stenosis becomes complete the patient will be able to pass a quantity of liquid food into the stomach if it is taken slowly and at frequent intervals. In this way the patient is nourished, though perhaps imperfectly, for a very considerable time. Following this, or in conjunction with it, rectal feeding should be resorted to. Predigested milk, eggs in milk, beef tea, malted milk or other liquid foods may be administered.

Early in the course of the disease the question of gastrostomy should be presented to the patient for his consideration. Personally I have never felt like urging very strongly this operation upon patients, feeling as I do that life can be sustained nearly as long by rectal feeding as through a gastrostomy fistula in cases of œsophageal cancer.

Œsophagectomy, Excision of the Œsophagus.—Œsophagectomy was first suggested by Billroth, who did the operation on dogs. Kappler, in 1875–6, performed two operations upon the human being. Both were unsuccessful. Czerny, in 1877, was the first to successfully resect a portion of the œsophagus for cancer. Up to 1899 there were fourteen cases in which a portion of the œsophagus had been resected for cancer. In thirteen of these the growth was situated in the cervical portion and in one in the middle portion. In the latter case the œsophagus was approached from behind by resecting a portion of several ribs, and the tumor removed through the posterior mediastinum. This patient did not survive the operation. Where the cancer is situated in the cervical portion it is approached by an incision in the left side

of the neck the same as in a case of œsophagotomy. The omohyoid muscle is divided, the thyroid gland drawn forward, the vessels backward, the œsophagus exposed, separated from the adjacent structures and the portion implicated removed. It has frequently been the case in these operations to find that the disease has extended to the larynx or trachea and even implicated the thyroid gland and recurrent laryngeal nerve. Resection then is difficult and often impossible.

The results of resection thus far have been most discouraging. Of the fourteen patients subjected to operation five died. In the sixth there was a false passage produced seven weeks after the operation. In six there were recurrences in a short time. Two were not reported. Thirteen months is the longest period any patient has been known to live without recurrence. In the cases where resection has been practised it has been found difficult to maintain the lumen of the œsophagus open. In the cases which have shown the best results the cut end of the lower portion has been brought into the wound and stitched to the skin.

Carcinoma of the Cardia.—The symptoms here do not differ from those given for carcinoma of the œsophagus. The diagnosis may also be proven by the use of a large œsophageal bougie or the tube of a stomach pump. The treatment is palliative, giving strict attention to the diet and doing possibly a gastrostomy.

Carcinoma of the Stomach.—Cancer in this situation has been divided by pathologists into four species. First, the cylindrical cell or adeno-carcinoma; second, the soft glandular or medullary carcinoma; third, the hard glandular carcinoma or scirrhus; fourth, the mucous or colloid carcinoma.

It is necessary pathologically, and so far as is possible clinically, to differentiate these species as they run different courses and have varying degrees of malignancy. The adeno-carcinoma is a soft, glandular tumor, which makes its appearance upon the inner surface of the mucosa as an irregular growth, covered with small fungus elevations. The fungus

or finger-like outgrowths upon the surface of the tumor are delicate processes, each one of which contains a blood vessel surrounded by a column of cells. Its rich blood supply gives the neoplasm a red color, and is the occasion of more or less frequent hæmorrhages. Microscopically the glandular arrangement is distinct. If the tubules are cut across they are

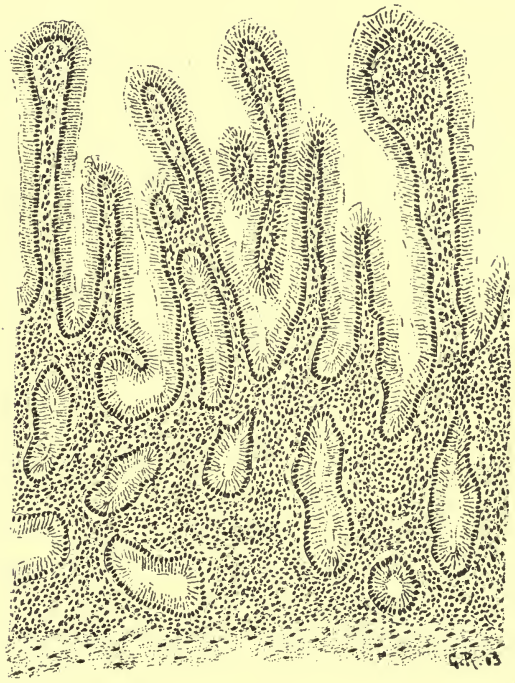


Fig. 236.
Normal Mucosa of Pylorus.

seen to be very irregular in size and shape, and the cells instead of constituting a single layer of cylindrical cells are in many irregular layers or fill the lumen. The cells are also irregular in form.

The adeno-carcinomata are most frequent in the pyloric region. They have their origin from the pyloric glands, and seldom extend into the duodenum. (Fig. 236.) Regional

infection occurs in the walls of the stomach, although late. Metastases take place in the liver and in the adjacent glands, especially in those about the lesser curvature. The process infiltrates the walls of the stomach, and adhesions are frequent between the pylorus and liver and between the anterior wall or greater curvature of the stomach and colon. Disintegration and necrosis occur, and in fact the greater portion of the tumor may slough away, leaving an ulcer, which extends into the wall of the stomach, or one which causes perforation. Plate, Fig. 237.)

The Soft Glandular or Medullary Carcinoma.—This species of carcinoma, as well as the adeno-carcinoma, not unfrequently forms large tumors. I have several times met with soft glandular carcinomata within the stomach which were so large as to almost fill its lumen and present a large, readily visible tumor on inspection. Primarily their appearance upon or within the mucous membrane is that of knotty projections, nodes, or of fungus masses. As the growth progresses it takes on ulceration. This often produces destruction of the major portion of the tumor, leaving a bare, smooth ulcer or one with a ragged, fungus appearance. The tumor is soft and bleeds readily. Histologically it is very largely composed of epithelial cells. These may be quite small, and are often polymorphous. The stroma is inconsiderable. The cells rapidly invade the gastric walls and form nodes beneath the peritoneum. These infiltrations follow the connective tissue septa which convey the lymph vessels. Small foci are found between the muscular fibres. The process of infiltration of the muscular walls seems to follow very closely the lymphatics. It may extend over the entire stomach wall, with the exception, perhaps, of the fundus. In these cases Orth has found that the entire lymphatic network of the mucosa and submucosa was filled with cancerous tissue.

This form of carcinoma has a very decided tendency toward local dissemination and lymphatic involvement. The

epigastric, cæliac, portal and retro-peritoneal glands are frequently involved, and the supra-clavicular glands upon the left side may also be invaded. Metastatic foci are frequently found in the lymphatic and blood channels. Dissemination of cancer nodules are also quite frequent in the abdomen.

The medullary carcinoma is not limited to any particular part of the stomach. It may be found in the cardia, anterior or posterior wall, in the lesser curvature, or in the pylorus. It is, however, more frequent in the pyloric antrum than in any other region.

Scirrhus carcinoma of the stomach, the hard glandular form, differs from the two species already considered largely in consequence of its hardness. A scirrhus growth here or elsewhere does not produce a tumor of any considerable size. It is simply a thickening and hardening of the part affected. This induration started in the pylorus may invade practically the entire muscular wall of the stomach. The surface affected often shows superficial ulcerations. These ulcers are flat and smooth and have a hard base. The surface of the ulcer may be covered with papillomata or irregular outgrowths, or have an eroded appearance. The edges are usually quite flat, and the transition from the scirrhus ulcer to the healthy tissue gradual. The infiltrated area is usually hard, resistant and creaks under the knife. The indurated area is also thickened and the wall of the stomach contracted, rendering its cavity much smaller than natural.

The histological structure of a scirrhus of the pylorus does not differ materially from that of a scirrhus situated elsewhere and consists largely of stroma surrounding the epithelial cells which occur in slender strands, in nests, or whorls.

In carcinoma of the stomach metastases may occur in the liver and in distant organs, adhesions are frequent between the pylorus and liver, the pylorus and transverse colon, and the pylorus and omentum. Adhesions may also occur between the stomach and anterior abdominal wall. The

thoracic duct may be affected and the lymph vessels of the diaphragm filled with cancerous masses. These elements may be disseminated through the pleural cavity, bronchial glands and lungs. The metastases are often rich in cells and may represent the characteristics of a medullary carcinoma instead of that of a scirrhus.

A colloid carcinoma is generally considered by pathologists to be the result of a metamorphosis or degeneration occurring in the epithelial cells of a carcinoma. It may in part be the result of a mucoid secretion taking place in the individual epithelial cells. Colloid carcinoma usually occurs as a diffuse thickening of the stomach walls. The stroma is a gelatinous, translucent, colorless tissue. Microscopically there is an alveolar framework filled with colloid material in which there are cells and cell fragments. Macroscopically the gelatinous masses are recognizable on the inner surface of the mucosa, which presents a flat, ulcerated surface. The masses have a shiny, mucoid appearance. The colloid carcinoma usually has its origin in the pylorus, but may invade the entire wall of the stomach. It extends through the lymphatics and causes metastases in the liver, lungs and other organs.

Structural Effects of Carcinomata of the Stomach.—There may be the adhesions already spoken of to different organs such as the liver, the transverse colon, omentum or abdominal wall. The size and position of the stomach are often changed. In cancer of the cardia the stomach is usually shrunken and its lumen very much diminished. A scirrhus growth which has invaded a large part of the stomach walls without producing stenosis of the pylorus causes the stomach to contract, the walls to become thickened and the lumen to diminish. In stenosis of the pylorus the stomach ordinarily becomes very much dilated.

Situation and Age.—According to Orth sixty per cent. of all gastric carcinomata affect the pylorus; twenty per cent. the lesser curvature, ten per cent. the cardia and ten per

cent. the remaining portions. Gastric cancer make up thirty-five to forty per cent. of all cancers. In the middle region of the stomach a carcinoma is often confined to a limited area, whereas at the two extremities it often invades the entire circumference of the organ. Ninety per cent. of the cases appear between the fortieth and seventieth year and ninety-five per cent. between the thirtieth and seventieth year (Welsh, Bresito and Sebert). Cullenworth found a case of gastric cancer in a child five weeks old. Three other cases in children have been reported by Scheffer. I have met with two cases of carcinoma of the stomach between the thirtieth and thirty-second year.

Heredity.—Hereditary influences here as elsewhere frequently play some part in the production of carcinoma. In one hundred and fifty cases Osler found that there were eleven in which heredity seemed to be an important factor. Welsch found in 1,784 cases that 242 were the result of hereditary influences. It is generally estimated that from four to six per cent. of the carcinomata are due to heredity. Probably every physician in his experience has observed one or more families in which cancer was seemingly the result of hereditary influences. A family was recently under my observation in which the father and two sons had died of cancer of the stomach. Whether it is a condition actually transmitted from parent to offspring, as occurs in syphilis, or only a predisposition, as in scrofula, or a condition which is the result of infection, as occurs in tuberculosis, it is difficult at the present time to state; but that there is some influence which is at times present and active in a family suffering from carcinoma there can be but little doubt.

Causation.—*Ulcers.*—There is now no question but that ulcers of the stomach are frequently the cause, directly or indirectly, of carcinoma, in that the process becomes engrafted upon an ulcer or is caused by the irritation of the cicatricial tissue formed in the healing process. In one hundred and fifty cases of carcinoma of the stomach Osler found

that four had been preceded by ulceration. A patient recently under my care gave a history covering several months, during which time there was localized pain, a sensitive area in the epigastrium, pain increased by eating, a sour stomach, and then a terrific hæmorrhage. Some few months following this a carcinoma developed. A traumatism is also said occasionally to act as an exciting cause.

A very frequent cause, apparently, of carcinoma of the stomach is a dyspeptic or catarrhal condition produced by improper food and alcoholic drinks. Here, as elsewhere, anything which produces and maintains an irritation and which increases the blood supply is likely to lead to cell proliferation, and in the end may be a causative factor of carcinoma. It is almost proverbial that the regular drinker of alcoholics is predisposed to carcinoma, and he whose stomach is more or less in a state of chronic irritation in consequence of the indigestion of improper food is also predisposed to carcinoma. It is claimed that in more than seventy per cent. of the cases of gastric carcinoma the patients have been steady drinkers of spirituous liquors. It is also claimed that in about thirty-five per cent. of the cases of carcinoma of the stomach there has been a previous history of dyspepsia.

Frequency.—Carcinoma is said to affect the stomach more frequently than any other organ of the body, except the uterus. In 30,000 cases Welsch found the stomach involved in 21.4 per cent.

Carcinoma of the stomach affects men more frequently than women at about the ratio of three to two or even two to one.

Drs. Berry and Shaw found that the average age was 51.1 years. Ordinarily one does not expect to find a carcinoma of the stomach before the age of forty, but from this period on it increases rapidly in frequency up to between and sixty, when it becomes less frequent.

Symptoms and Course.—The symptoms of carcinoma of the stomach, when not situated at the cardia, may make

their appearance suddenly or steal on the patient so insidiously and gradually that he is unable to determine the time of their first appearance. In rare cases the symptoms may be wanting, the process remaining latent until death. Osler states that in thirty-seven of his one hundred and fifty cases the onset was sudden.

A case which gave the following history recently came under my observation. A woman, aged sixty-five apparently in perfect health, strong, robust, well-nourished, and never having had any stomach trouble, left her home in the country for a few days' visit in a distant city. On the first day of her visit she ate a hearty meal of corned beef and cabbage, and a few hours thereafter was taken with vomiting and diarrhœa. The looseness of the bowels lasted for a few days, but the vomiting was never arrested and soon became characteristic of pyloric obstruction. The stomach became greatly dilated and the patient died eight weeks after the occurrence of the first symptom. The autopsy showed an annular scirrhus confined to the pylorus, which had produced almost complete obstruction. There were no metastases.

The first symptoms ordinarily are those which are usually ascribed to dyspepsia. After meals there is pressure and fullness in the stomach with eructation of gases. Then comes loss of appetite, nausea and vomiting. Cardialgia and a coated tongue, thirst and constipation of the bowels follow. Pain as a symptom varies greatly. At first it is difficult for the patient to define what he feels. The feeling is often described as one of distress or uneasiness, an unpleasant sensation which may occur after eating or it may be quite independent of the taking of food. A patient suffering from carcinoma of the stomach said to me that the sensation which he first felt in his stomach was simply a slight uneasiness below the tip of the ensiform cartilage. The area implicated seemed to be not larger than a ten-cent piece and could be covered with the tip of the little finger. This very slight disturbance remained for weeks in the same position, located in the anterior wall of

the stomach, but finally it become more diffused and the pain and distress more severe. Primarily he stated that the "distress resembled pain as mist resembles rain." Another patient complained of distress in the stomach every day between the hours of three and five in the afternoon for several months, following which the symptoms more characteristic of carcinoma made their appearance.

The pain primarily is slight and insignificant, but later becomes a matter of considerable moment. There is often after a time a heavy dragging sensation in the stomach, severe distress, or a piercing, lancinating pain, or there may be paroxysms of pain of greater or lesser severity, during which the patient suffers severely. The pain of carcinoma is not always relieved by vomiting nor exaggerated by the taking of food.

Vomiting.—Vomiting is present sooner or later in nearly every case. Its character will depend upon the position of the growth. If the tumor is situated in the cardia, especially if producing obstruction, there will be primarily a difficulty in swallowing solid food and after a time an inability to swallow liquids except slowly and in small quantities. The vomiting which occurs in cardiac stenosis is likely to be immediately, or shortly, after eating or drinking, and to be the materials that have been swallowed in practically an unaltered condition. In carcinoma of the pylorus the vomiting as a rule only occurs after the other symptoms of stomach trouble have become pronounced. If stenosis of the pylorus and subsequent dilatation of the stomach takes place vomiting becomes more frequent and the quantity ejected not only large, but it may be measured by quarts. It occasionally happens that the material vomited during the first stage will show upon microscopical examination portions of undigested food, bacteria, and red blood corpuscles. The latter are of diagnostic significance. Often in the course of the disease, as the stenosis becomes pronounced and the retention of food and liquids marked, ulceration of the growth occurs and in consequence

of this hæmorrhages takes place into the stomach. Hæmatemesis, though not abundant, is usually a frequent symptom in carcinoma of the pylorus and lesser curvature. If the blood remains in the stomach for a time its pigment is changed into hæmatin, and this being uniformly mixed with the gastric contents produces the "coffee-ground" material which is held to be so characteristic of gastric carcinoma.

The Chemistry of the Gastric Juice.—Free HCL is absent in the great majority of cases of carcinoma. In ninety-four cases examined by Osler it was absent in eighty-four. It is held by the great majority of writers that free HCL is absent practically in all cases of carcinoma of the stomach which are primary. In those which have their origin from a gastric ulcer free HCL is usually present. The absence of free HCL depends largely, perhaps entirely, upon the destruction of the mucous membrane of the stomach in consequence of the invasion of the growth. The absence of free HCL is also noted in chronic gastritis, in achylia gastrica, atony of the stomach and in certain nervous affections. The symptoms and course of these diseases, however, are quite different from those of carcinoma.

Lactic Acid.—The presence of lactic acid in the stomach contents is also of diagnostic worth. This acid is the result of fermentation produced by micro-organisms upon the carbo-hydrates, and is practically always present in cases of obstruction of the pylorus by carcinoma. Hemmeter says four conditions are necessary in order to produce excessive formation of the lactic acid:

1st. Impaired gastric peristalsis, which means stagnation.

2d. Absence or great reduction of HCL secretion.

3d. Reduction of albumin digestion.

4th. Impaired absorbtion.

The Oppler-Boas bacillus occurs in lactic acid fermentation, and is to a certain extent characteristic of carcinoma of the stomach. It may occur, however, in a case of benign stenosis with impaired motility. This bacillus was found in

1895 by Oppler in the contents of carcinomatous stomachs. Hemmeter found this bacillus in fifty-two out of fifty-five cases. Ullman found the bacillus in all of ten cases of carcinoma.

Loss of Weight.—Progressive emaciation is one of the most characteristic features of this disease. It is quite true that in some exceptional cases it may not be continuous. Patients may have periods during which they will not only not lose weight, but may even make considerable gains. On the whole, however, the loss of weight is continuous, and in the course of a few months will reach from twenty to thirty pounds or more. The gain which is sometimes experienced may be due to medicinal treatment, changes in diet, an operation or to an optimistic opinion. Keene reports a case of exploratory operation after which the patient gained seventy pounds. Osler relates the case of a patient who after receiving the opinion of an optimistic consultant gained ten pounds. I had under my care a patient who gained thirty pounds after an exploratory operation. This gain, however, is only transient and is soon followed by pronounced loss of flesh.

The loss of strength usually keeps pace with that of weight, the patient finding himself becoming progressively weaker from month to month, week to week, and, it may be, from day to day.

The patient's appearance is often characteristic. The cancerous cachexia, so called, in which the patients show loss of flesh, great weakness, a lemon tinge of the skin, pinched and anxious face and sunken eyes is often pronounced. It is the general expression of distress and toxæmia.

Fever.—It is claimed that fifteen per cent. of these patients suffer from elevation of temperature. This may reach 101° F. or even more, but the rise is usually of a short duration. The bowels, in consequence of the failure of much of the ingested food to gain an entrance into the intestinal

canal, are constipated. The urine often shows indican, aceton, albumen and even casts.

The Condition of the Blood.—As the result of the inability of the patient to take and assimilate food, and in consequence of toxæmia, the red blood corpuscles in carcinoma of the stomach are always reduced. They not unfrequently fall as low as two millions per cubic millimeter. The hæmaglobin is reduced in about the same ratio, averaging about forty-four per cent. The leucocytes are not materially changed. In some cases there seems to be a slight leucocytosis while in others the count shows the leucocytes to be diminished below the normal, and often the reduction may be such as to reduce the number to two thousand per cubic millimeter.

In a short resumé of the important symptoms and conditions indicative of carcinoma of the stomach one would expect the patient to be between fifty and sixty-five years of age and to complain of distress or pain in the epigastric region after eating. With this there is loss of flesh and strength. With the progress of time the pain increases, becomes considerable and is soon associated with vomiting, which is progressively more frequent. The ejected material is greater in amount and has a "coffee-ground" appearance. A chemical examination of the stomach contents will show an absence of HCL, the presence of lactic acid with the Oppler-Boas bacillus.

In cases of carcinoma of the pylorus with narrowing of its lumen the stomach will become markedly dilated. A tumor may be detected during some part of the course in eighty per cent. of the cases. The right rectus is often tense. The ankles are frequently swollen. An examination of the blood will ordinarily show a diminution of the red blood corpuscles to about two million per cubic millimeter and a reduction of the hæmoglobin to about forty-four per cent.

The above symptoms are pretty conclusive of carcinoma of the stomach. Under normal conditions the pylorus is

situated to the right of a perpendicular line passing through the ensiform cartilage and symphysis pubis. The remainder of the stomach is situated to the left of this line. Tumors, therefore, which take their origin from the pylorus are usually found to the right of the median line, while those which take origin from the greater or lesser curvature of the stomach, or the cardia are situated to the left of this line. Gastric tumors which are not confined by adhesions are usually very movable. This is especially true of tumors situated in the body or fundus of the stomach. They may be pushed to almost any position in the upper abdomen. They are often depressed slightly upon inspiration, and are with few exceptions the most movable tumors situated in the upper abdominal region.

They must be differentiated from neoplasms taking origin from the liver. In hepatic tumors the characteristic border of the liver may usually be felt with its longitudinal notch. A neoplasm of the liver is also dull upon percussion and the liver is usually tender and somewhat enlarged. The liver descends upon inspiration while under ordinary conditions the stomach, although descending somewhat, does not change its position so pronouncedly as does the liver. In tumors of the liver there is not likely to be dilatation of the stomach, absence of HCL, or the presence of lactic acid. In tumors of the stomach when the organ is filled with water the area of dullness produced by the tumor runs into or becomes a part of that produced by the water. This would not be the case with a tumor of the liver. In a tumor of the stomach if the organ be inflated with gas there will be resonance above and below the tumor. These two symptoms are considered pathognomonic of stomach tumors. A tumor of the stomach is often resonant on percussion. This is especially true of a tumor situated in the posterior wall. Tumors of the liver will often show hepatic disturbance and jaundice.

Gastric tumors should be differentiated from splenic growths. Sixty per cent. of the malignant tumors of the

stomach are situated in the pylorus to the right of the median line. These tumors at least will be readily differentiated from tumors of the spleen. The spleen has a sharp border which is characteristic. It is dull upon percussion and will not be the cause of dyspeptic symptoms of dilatation of the stomach which are usually present in gastric carcinoma.

Differentiation from Tumors of the Gall Bladder and from Gall Stones.—These tumors if present are in direct relation with the liver. The dullness of the tumor without interruption runs into that of the liver. The tumor moves downwards upon inspiration and is not separable ordinarily from the liver. There will also have been symptoms of hepatic disturbance, jaundice and probably biliary colic. It is true the gall bladder has been known to press upon the duodenum causing disturbances of the gastric function and dilatation of the stomach, but these cases are very rare.

The process should be differentiated from tumors of the pancreas. These are quite immovable, are apt to interfere with the portal circulation, to cause jaundice, ascites and a fatty diarrhœa. There should be in these cases no special dyspeptic symptoms or change in the free HCL.

Tumors of the omentum and peritoneum are to be differentiated. In these conditions the stomach is likely to possess its normal function, while a tumor of the omentum or peritoneum is likely to be situated below the umbilicus and to cause ascites.

Tumors of the transverse colon are to be differentiated. These frequently present great mobility and many sink downwards as far as the pelvis. In tumors of the colon the filling of the colon with air or water may give characteristic symptoms. A tumor situated in the stomach is often pushed up beneath the ribs or behind the ensiform cartilage when the colon is filled. A tumor situated in the posterior wall of the colon will disappear if air is made to fill the colon. If situated in the anterior wall it will be made more prominent. In tumors of the colon stenosis is likely to occur and this will

be associated with acute symptoms, such as great pain, persistent vomiting, tenesmus and dilatation of the canal above the stenosed area.

The condition should be differentiated from benign ulceration of the stomach. Ulcers of the stomach run an acute or chronic course. The acute ulcer is observed most frequently in young anæmic girls and is attended with more or less pain. The pain is localized and coincident with a distinct, well-circumscribed area of tenderness. This pain is increased by the taking of food and relieved by vomiting. The latter often occurs shortly after each meal. In the acute ulcer hæmorrhages not unfrequently occur and the amount of free HCL is usually increased.

The chronic ulcer which is more likely to be mistaken for carcinoma occurs in middle life or at an advanced age. There may have been an acute ulceration followed by years of gastric pain and more or less vomiting, periods of relief or apparent healing being followed by others in which there is a recurrence of pain and gastric distress. Chronic ulcer may be the site of severe and frequently repeated hæmorrhages. It may lead to decided thickening of the area implicated, may cause perforation into an adjacent hollow viscus, as the bowel, pleural or pericardial sac. It may open into the lungs or into the peritoneal cavity. In chronic ulcer free HCL is usually increased while the course is more chronic and the stomach usually not dilated.

Pernicious anæmia may be mistaken for insidious cancer in that both present dyspeptic symptoms, distress after eating, disgust of food, nausea, vomiting and an elevation of temperature. In pernicious anæmia emaciation does not occur and the red blood corpuscles often fall below one million per cubic millimeter. The red blood corpuscles in pernicious anæmia are also increased in size, and the hæmoglobin, although reduced to forty or even thirty per cent., is increased per corpuscle. The color index, then, in pernicious anæmia is increased while in carcinoma it is diminished.

DIAGNOSIS.—This may be approximately established in the early stages by considering the history, examining the contour, size and motility of the stomach, as well as the stomach contents. It is claimed by Hemmeter that if the stomach contents be carefully and systematically examined by allowing the solid particles to settle in a conical glass that these will often show atypical epithelial cells practically characteristic of carcinoma.

PROGNOSIS.—The prognosis of carcinoma of the stomach without operative interference leaves absolutely no ray of hope for the comfort or life of the patient.

TREATMENT.—*Carcinoma of the Cardia.*—Unfortunately as has been already stated a carcinoma in this situation can receive only palliative treatment. This should consist in providing suitable nourishment for the patient, in relieving pain and possibly in doing a gastrostomy. What has been said under the treatment of carcinoma of the œsophagus will hold good in carcinoma of the cardia.

In regard to gastrostomy Kaiser has collected thirty-one cases, in which twenty-eight died as the result of operation. Zesas collected one hundred and thirty-one cases from the literature, and among these 19.5 recovered sufficiently from the operation so that it might be called a success. If the operation is to be performed it should be done early before great debility has occurred, and while there is a fair prospect of the patient withstanding the shock of the operation.

Treatment of Carcinoma of the Pylorus and Body of the Stomach.—The majority of writers on internal medicine, while recognizing the fact that they are only able to give temporary relief in carcinoma of the stomach, devote pages to its palliative treatment. Knowing as we do that the medicinal treatment of carcinoma of the stomach without a single exception has effected no permanent benefit to the patient, but in every case has resulted in death, it would seem that the time had arrived when intelligent practitioners of medicine should stop and consider if there is not some other

method of treatment which can offer more favorable results. There can be no question but that carcinoma of the stomach in its early stages is just as amenable to surgical treatment as is malignant disease situated elsewhere in the body, and it probably would, if the treatment was instituted sufficiently early, show as great success as that which attends the surgical treatment of carcinoma of the breast. Who is there at the present time, either physician or surgeon, who would wait in a supposed case of carcinoma of the breast until the diagnosis was made absolutely certain by ulceration or by regional or systemic infection before advising surgical intervention? The great majority of cases of malignant disease of the stomach primarily come to the attention of the internist and come to him at a time when he should suspect carcinomatous disease. They are too often treated for dyspepsia and given digestives and opiates week after week and month after month. The stomach is washed out and perhaps the contents examined for free HCL. The patient is examined again and again for the presence of a tumor and the treatment for dyspepsia continued until a tumor makes its appearance.

Clinical experience has shown that these cases if they are to be treated successfully must be operated upon early. If one waits until a tumor can be felt then in the great majority of cases regional infection, metastases and adhesions to adjacent organs have occurred rendering a successful operation an absolute impossibility.

A great responsibility rests upon the internist in these cases knowing as he does the absolute hopelessness of his treatment. A probable diagnosis of carcinoma can ordinarily be made without great difficulty and he who treats his patients medicinally until a tumor can be felt when, ordinarily, there is but little hope of operative interference, must be considered most negligent. The crying need of to-day is that the internist should have a clear comprehension of the early symptoms indicative of carcinoma of the stomach and make at least a probable diagnosis.

That the results of the surgery of the stomach have not been better is very largely the fault of the physician. The patients even have been led to believe that they must wait until a tumor could be palpated or seen before an operation could be done. Everyone knows that then there is little hope from operative intervention. There has been in the past too much of waiting and too great attention given to the apparent importance of frequent examinations into the chemistry of the stomach contents, and not enough of surgery. What is wanted is not a better surgical technic, but a knowledge of the fact that carcinoma of the stomach is primarily limited to a small area which may ordinarily be easily removed. More frequent exploratory operations are wanted for the purpose of diagnosis and less of diagnostic niceties in the way of chemical analysis, unusual symptoms and the waiting for a neoplasm. It is stated by Hemmeter that it is better to make an occasional exploratory operation and find that the patient is not suffering from carcinoma of the stomach than to allow a case to go without surgical interference and find at the autopsy that the patient had been suffering from a well-circumscribed tumor that could have been readily removed. Hemmeter advises operations under the following conditions: 1st. When dilatation is associated with cachexia. 2nd. The absence of HCL in the gastric contents. 3rd. Excessive lactic acid and 4th. The presence of Oppler-Boas bacillus. Keene adds the following: 5th. When the age of the patient is over forty years. 6th. When hæmatemesis is present and 7th. When an examination of blood shows a diminution of red blood corpuscles and hæmoglobin and when digestive leucocytosis is absent.

Symptoms of stenosis when accompanied by these signs are held as indicating an operation even in the absence of a palpable tumor. Hemmeter says he personally always urges operations when the first three conditions are persistently present and the case does not improve after three weeks of appropriate treatment.

I am forced to believe that should the surgeon wait in every case until the above seven indications are present not a single case of carcinoma of the stomach would be operated successfully. I have very serious objections to the first indication, that is, before advising operation one should wait for dilatation of the stomach and cachexia. Dilatation of the stomach is not effected until pyloric stenosis occurs, and I

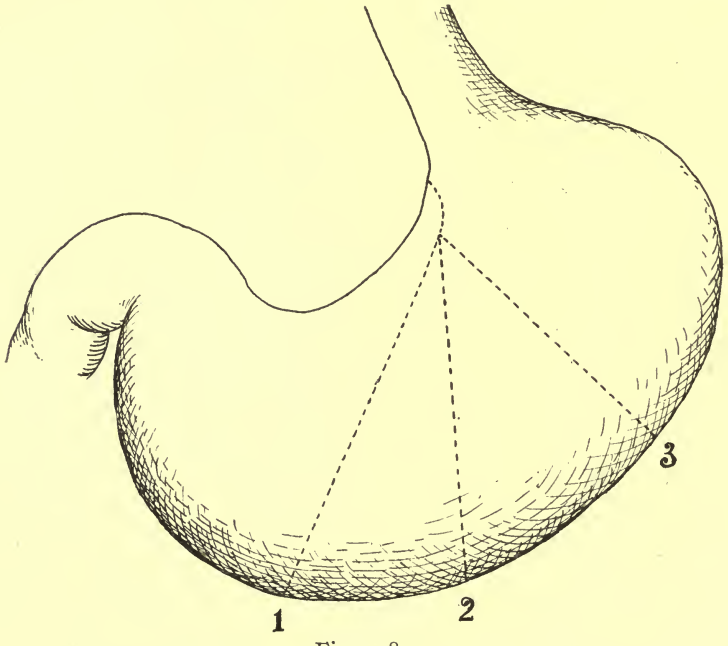


Fig. 238.

Lines of excision practised by different surgeons. 1. Hartmann. 2. Mikulicz. 3. Robson, Moynihan, Mayo.

have opened the abdomen in a goodly number of cases in which a tumor of the stomach as large as a cocoanut was encountered without the organ being dilated to any appreciable degree.

But I make more serious objection to the cachexia, as I firmly believe that every case of carcinoma in which there is a decided cachexia is already beyond the stage for successful

operative treatment no matter where situated. A cancerous cachexia, as previously stated, is an expression of systemic poisoning and when well-marked is, in my opinion, an absolute contra-indication for operative treatment.

I would suggest the following indications for exploratory incision in cases of suspected carcinoma:

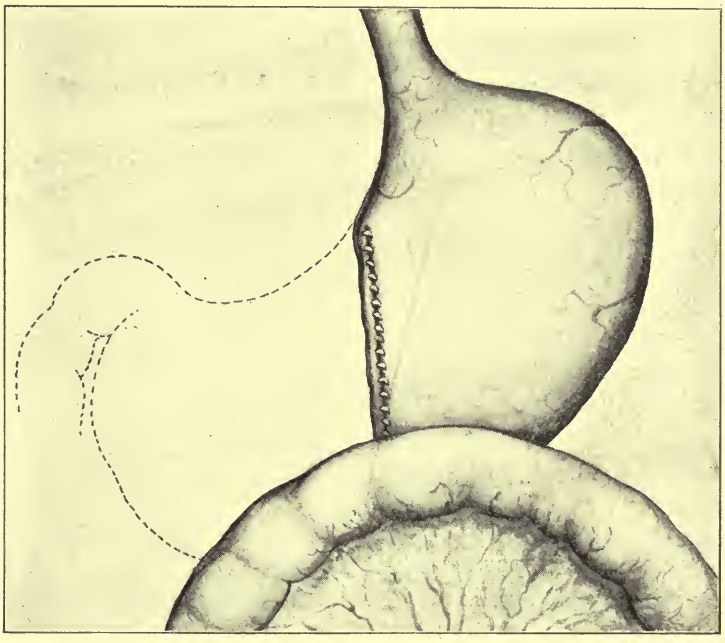


Fig. 239.
Operation complete.

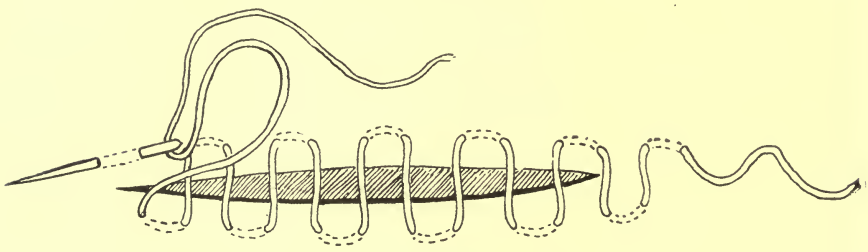
1st. A patient usually past forty years of age.

2nd. Distress and pain in the stomach which is not relieved in three weeks by proper diet and medication.

3rd. The absence of HCL in the gastric contents and

4th. The presence of lactic acid. Neither would I hesitate very long in the absence of any one of these conditions if the others were present and the symptoms and history were indicative of carcinoma.

Cases Suitable for Resection. Atypical Pylorectomy.—This class represents those growths irrespective of size situated to the left of line 3 (Fig. 238) in which there are no distant metastases and few if any adhesions to adjacent organs. The operative technic here is to tie off the gastro-colic and remove after ligation the gastro-hepatic omentum. That portion of the stomach is removed to the right of a perpendicular line placed at the left extremity of the lesser curvature. The stomach and duodenum are clamped at least three-quarters of an inch from the proposed line of incision, which, if possible, should not be less than one-half an inch outside of the limit of the apparent carcinomatous infiltration. The



The Continuous Cushing Suture.

portion to be removed is then excised and the duodenum and stomach closed separately by three rows of continuous suture, the first of which rolls in the mucous membrane, the second, the muscularis, and the third approximates the surfaces of the peritoneum. An anastomosis is then made between the jejunum and the anterior wall of the fundus of the stomach near its lower portion. Caremust be taken in this anastomosis that there is no undue traction upon the jejunum and that it is given a half turn to the right so that the peristaltic wave of the stomach will correspond to that of the small intestine. (Fig. 239.)

The stomach and jejunum are brought out of the wound and united as follows: They are approximated and held together by two traction sutures, the peritoneal cavity

having been well protected from infection by gauze packing. An incision an inch or half long is then made through the peritoneum of the intestine directly opposite its mesenteric attachment and one of corresponding length through the peritoneum covering the stomach near its lower border. A continuous Cushing suture including the peritoneum and getting a good

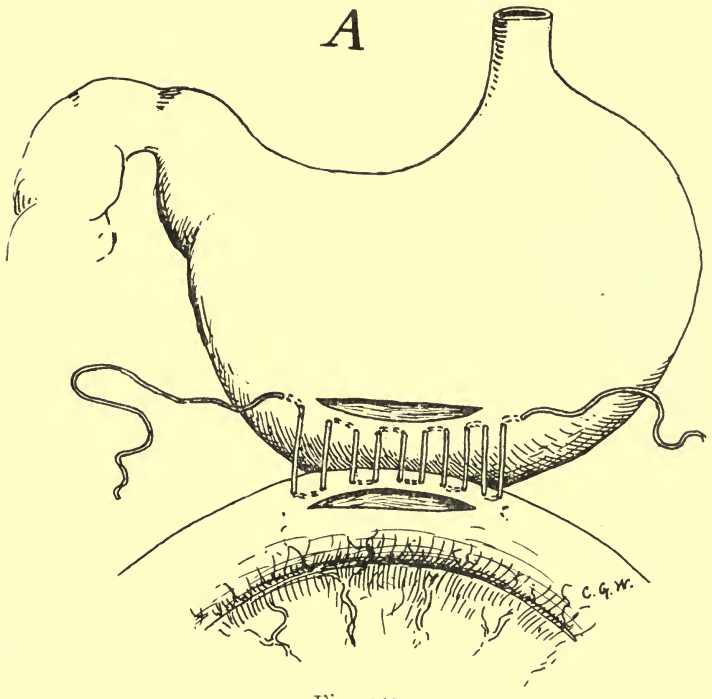


Fig. 241.
The First Suture in an Anastomosis.

hold upon the muscularis is then made to unite the surfaces below the two incisions. (Figs. 240, 241.) The cuts are then extended directly into the lumen of the bowel and stomach and the approximating surfaces united by a continous overhand suture which includes all of the coats. (Fig. 242.) The two widely separated sides of the opening, the lower border of the intestinal and the upper border of the opening in the

stomach, are then united by a continuous suture which commences at one extremity and is made to penetrate from without inwards and then from within outwards. The anastomosis is completed by applying a Cushing suture above corresponding to the one first inserted below and the ends of the two threads tied at each extremity of the incision. (Fig. 243.)

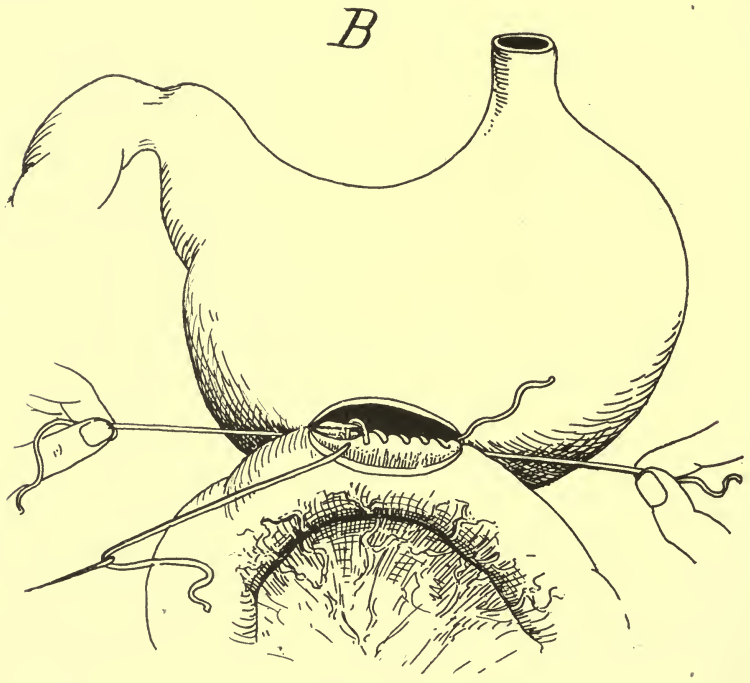


Fig. 242.
The Cushing suture has been drawn out and the continuous overhand suture is being placed.

An anastomosis can be made with rapidity by this method and it is absolutely safe from leakage. When one desires to use the Murphy button the approximation may be quickly and neatly done. Any enlarged glands found about the lesser or greater curvature should be removed.

An anastomosis of the jejunum with the posterior wall

of the stomach may be made through a slit in the transverse meso-colon, using the same technic as before. Following this anastomosis the wall of the stomach should be stitched to the border of the rent in the meso-colon for the purpose of preventing its pinching and rendering parallel the two arms of the anastomosed jejunum. The mortality from atypical

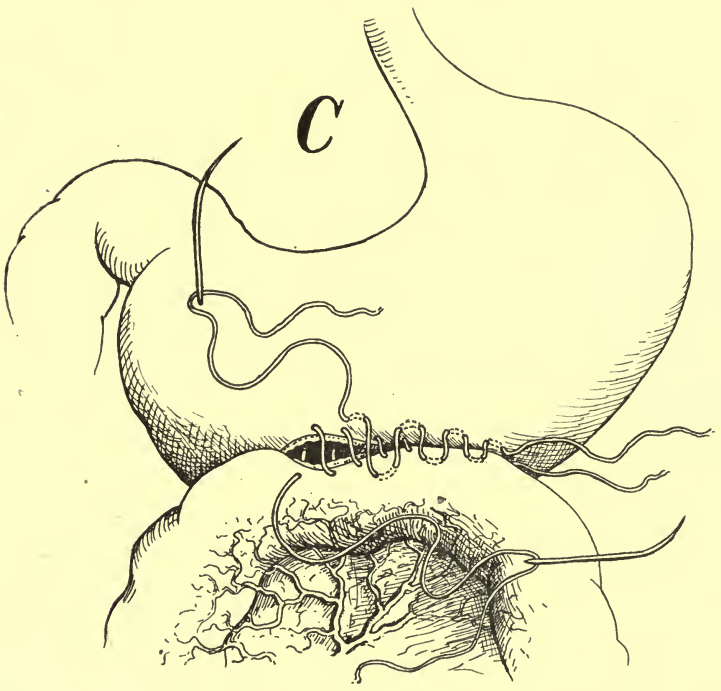


Fig. 243.
This cut shows the continuous suture uniting the upper border of the stomach wound to the lower border of the intestinal wound, and also the placing of the second Cushing suture.]

pylorectomy is now about twenty per cent. Even this mortality will be greatly reduced when the patients come to the surgeon earlier.

Total Gastrectomy.—In 1897 Schlatter reported the first complete gastrectomy. The patient lived one year and two months. Since that time there have been a considerable

number of total gastrectomies performed both in this country and abroad. It may be safe to say, however, that this operation presents unusual technical difficulties and will only rarely be resorted to.

Gastro-enterostomy.—This operation is resorted to in such cases of gastric carcinoma as do not permit removal of the tumor, and which show pyloric obstruction. The anastomosis is made between the jejunum and the anterior or posterior wall of the stomach near the greater curvature, using the same technic as before.

Results of Gastro-enterostomy—In 388 cases Kant found that the mortality was 43.5 in cases of carcinoma. In fifty-eighty cases of gastro-enterostomy for cancer in which the cases were traced for a considerable time forty-two died within twenty-two months and sixteen were living after periods ranging from two months to two years.

Carcinomata of the Intestines.—Carcinomata of the intestines correspond in their histological structure very closely with carcinomata of the stomach. They have, however, been divided by pathologists into four, and sometimes into five, species.

First, the cylindrical cell carcinoma. This species has an atypical glandular structure.

Second, the medullary carcinoma. This is a soft, rapidly-growing, very malignant tumor rich in cells.

Third, the colloid carcinoma. It is generally held that this form is but a degeneration of those just mentioned.

Fourth, the epithelioma which occurs at or near the anus.

The cylindrical cell carcinoma is the form most frequently encountered and is generally spoken of under the head of an adeno-carcinoma and has its origin in the glandular epithelium of the intestinal canal. It does not differ to any extent histologically from an adeno-carinoma taking orgin from within the stomach.

It is claimed by some that scirrhus occurs as a distinct

species, but this seems somewhat doubtful from the investigations of Treves, Butlin and others.

Cancer of the intestines occurs much less frequently than does cancer of the stomach. It may be primary or secondary. If primary it may occur in the duodenum, jejunum, ileum, cæcum, colon, sigmoid flexure and rectum. In fact there is no part of the intestinal canal in which a carcinoma may not have its origin. They are, however, very infrequent in the small intestines, but are found most often in the rectum, cæcum, flexures of the colon and sigmoid. According to Von Leube eighty per cent. of intestinal cancers occur in the rectum, fifteen per cent. in the large intestine and five per cent in the small intestine. In one hundred and ten cases collected by Bryant there were six in the small intestine, cæcum and ileo-cæcal region, seven in the transverse colon and its flexures, nineteen in the sigmoid and seventy-eight in the rectum. In 21,358 autopsies in the General Hospital at Vienna cancer of the intestine was found in three hundred and forty-three cases. Of this number seven occurred in the duodenum, ten in the ileum, one hundred and sixty-four in the colon and one hundred and sixty-two in the rectum. From the statistics of 69,083 autopsies collected by Zemann, Maydl, Muller and Nothnagel there were 5,796 cases of carcinoma. One thousand two hundred and ninety-six of these occurred in the intestinal tract. In two hundred and eighty cases of intestinal cancer collected by Courties, Sufftt, Bourchard and Beissend four were in the jejunum, twenty-one in the ileum, forty-eight in the cæcum, thirty-two in the ascending colon, eight in the hepatic flexure, twenty-six in the transverse colon, ten in the splenic flexure, twenty-nine in the descending colon and one hundred in the sigmoid flexure. Ewalds complied statistics from various sources showing 1,148 cases. Of this number nineteen were in the duodenum, seventeen in the jejunum, twenty-six in the ileum, sixty-four in the cæcum and appendix, one hundred and forty-eight in the colon and eight hundred and seventy-four in the rectum.

Carcinoma of the intestines may be secondary to carcinoma in the stomach, omentum, lymphatic glands, bladder, prostate gland, uterus and ovaries.

Metastases.—Metastases may occur through the blood and lymph channels. The process is ordinarily held to be of infrequent occurrence, at least during the early stages. The glands in the mesentery and the retro-peritoneal glands are frequently

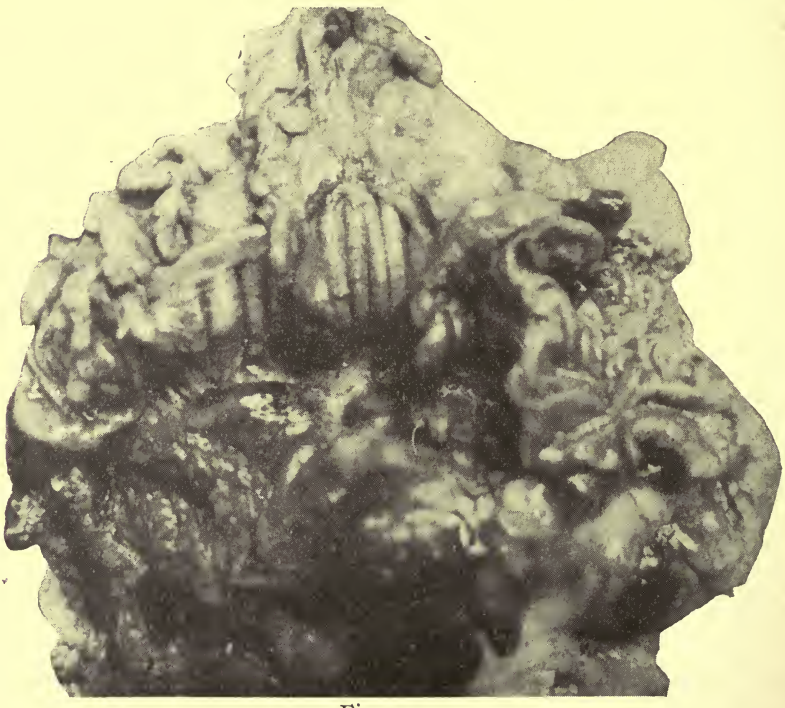


Fig. 244.
Carcinoma of Colon.

primarily implicated. In cancer of the rectum the retro-peritoneal, sacral and lumbar glands may be implicated. The inguinal glands are only affected in case the process invades the skin. Orth believes that lymphatic and peritoneal involvement occurs early and that metastases show frequently in the liver and other internal organs. Iverson investigated

forty-seven cases of rectal carcinoma and found metastases in twenty-six. According to Hauser medullary carcinoma most frequently produces metastases in the lymphatic glands; scirrhus, in the liver; and colloid in the bones, lymphatic glands and peritoneum.

In carcinomatous processes of the intestine adhesions with adjacent organs are likely to occur as soon as the process

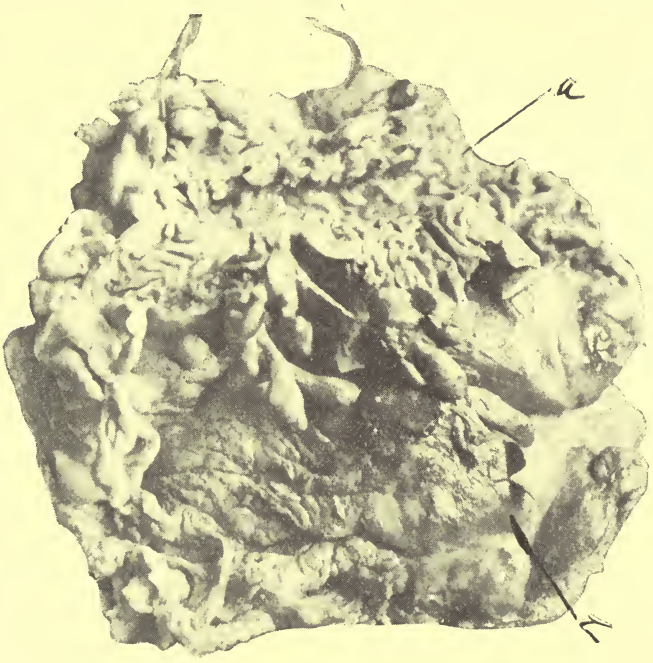


Fig. 245.
Carcinoma of Colon laid open. a. and b. thickened walls.

has implicated the peritoneal covering of the bowel. Adhesions between colon and stomach and between small intestine and colon, between the small intestine, bladder, uterus, ovaries and perietal peritoneum are of frequent occurrence. Perforation has occurred in carcinoma of the intestines as the result of sloughing, digestion and disintegration of carcinomatous masses. When adhesions have preceded the process the intestinal contents may be discharged into

the intestine which has become adherent, or into the bladder. If there are no adhesions the discharge will be into the peritoneal canal, resulting in acute peritonitis.

Pathological Anatomy.—A malignant growth situated in the intestines is made up of parenchyma and stroma. The tumor may be rich in cells while the stroma is of small amount producing a medullary carcinoma, or the stroma may be excessive and the cells but few, and placed in slender strands producing a scirrhus. The presence of the latter form, however, is questioned by many investigators. The growth appears primarily as a hard nodule or plate within the mucous membrane, or as a soft, ragged mass projecting into the lumen of the intestine. As the growth extends it infiltrates the wall of the bowel, it may be both circumferentially and perpendicularly. Ulceration sets in and this may be represented by a flat, annular ulcer which extends around a part of the bowel or encircles its entire circumference. As the growth continues the lumen of the bowel becomes contracted in consequence of the infiltration of its walls, and the contraction and sclerosis of its connective tissue. A tumor may grow in the lumen as a medullary mass obstructing the intestine. If the lumen is obstructed by a soft mass its continuity may be re-established in consequence of the sloughing and disintegration of the tumor tissue. (Figs. 244 and 245.)

Age.—Carcinomata of the intestines occur most frequently in persons between the ages of forty and sixty. Garrod reports a case of carcinoma of the sigmoid in a child of twelve years. Czerny reports one at the age of thirteen.

The disease seems more common in men than in women, although this preponderance is not great. Nothnagel observed a case of carcinoma of the cæcum in a boy of twelve. Schoning saw two cases of rectal carcinoma in girls aged seventeen and eighteen. Clas observed a case of carcinoma in a boy aged three years. Maydl says one-sixth of all cases occur between the thirtieth and fortieth years. But a few

weeks since I resected the rectum of a girl aged twenty-two for carcinoma.

Symptoms and Course.—In the great majority of cases of carcinomata of the intestines the disease developes so insidiously that it is difficult and usually impossible to determine anything like the date of its commencement. Many cases go on to emaciation, cachexia and death, the condition only being discovered and perhaps not even suspected until an autopsy is made. Ordinarily the nearer the disease is situated to the stomach the greater the functional disturbance. It may be that emaciation is the first thing noticed, or the appetite may remain good and the patient hold his weight. Frequently the first indication is some disturbance of the function of the bowels.

Among the more important and pronounced symptoms are increasing constipation with occasional attacks of diarrhœa and with perverted and increased peristalsis. The patient finds that there is a constant and increasing difficulty in getting the bowels to move, and with this constipation there is decided flatulency with colic and increased peristalsis. The condition is only relieved by a free diarrhœa. There may be at the same time a feeling of oppression, fullness and tension in the abdomen. The appetite is usually undisturbed for a considerable time, and this is especially true of carcinomata situated low in the canal. As the growth progresses obstruction may become complete with all its untoward symptoms, such as nausea, vomiting, great pain, distention of the abdomen, obstinate constipation and collapse.

Tumor.—A tumor may be felt in about thirty per cent. of the cases. The enlargement is made up not wholly by the growth but also, and this is frequently the case, by the agglutination of neighboring intestines. In a considerable majority of the cases a tumor is not to be felt until a late stage.

In seeking for a tumor the examination should be made

after the bowels are thoroughly emptied and then again after they have been filled either with water or air. Repeated examinations should be made if necessary. A tumor of the intestines usually has the following characteristics. It is hard, nodular and, unless fixed by adhesions, freely movable. If situated in the more movable parts of the intestiual canal, it may sink down to the pelvis. If situated in the transverse portion of the duodenum or in the cæcum or flexures of the colon, it will be quite immovable, but when situated in the other parts of the intestinal canal the tumor can often be pushed in almost any direction.

Pain.—Pain is seldom present to any considerable degree before obstruction occurs. Superficial soreness and heaviness are common, and pain may be induced by the infiltration of the walls of the bowel and by the weight of the tumor dragging on the intestine. With stenosis the bowel becomes hyperthrophied, and then severe, colicy pains occur in consequence of the bowel trying to force its contents through the stricture.

Increased Peristalsis.—Increased peristalsis is one of the most characteristic symptoms of obstruction. It usually comes in paroxysms which may recur every few moments or only once in a quarter or half an hour. These paroxysms are the occasion of a good deal of pain and distress and throughout the attacks the coils of intestines can be outlined distinctly against the abdominal wall and can be seen and felt to undergo excessive emotion. During the paroxysm there is more or less gurgling within the bowels. This increased peristalsis is Nature's method of trying to overcome the stenosis. Much of the bowel above the stricture is hypertrophied, dilated and filled with fluid or solid fæces. The intestines above the stricture are, during a paroxysm, in constant motion, while the bowel below remains quiescent and is more or less collapsed. By watching one or more paroxysms one can often locate more or less exactly the site of the stenosis. If it is at the ilio-cæcal valve or near that

region the contortion will only occur in the small intestine, while the flanks and region of the transverse colon will be quiescent and more or less flat. If situated in the sigmoid or rectum the entire abdomen will be prominent and will show laterally as well as centrally intestinal contortions.

Differential Diagnosis.—The symptoms presented by a tumor of the intestinal canal will vary according to its situation. If in the first portion of the duodenum it will present symptoms usually attributed to stenosis of the pylorus. HCL, however, will be present. The stomach in these cases may be dilated. If situated in the transverse portion it is likely to produce obstruction of the hepatic and pancreatic ducts, the former resulting in jaundice, the latter perhaps in fatty diarrhœa. If the obstruction is acute it will be followed by fever, great prostratiou, and even death. If situated in the jejunum there will not only be HCL in the gastric juice but bile in the material vomited. In these cases after the stomach has been repeatedly washed out particles of food and bile make their appearance in the material vomited. These materials come from the dilated duodenum.

Tumors situated iu the jejunæum and ileum are usually freely movable. Those in the cæcum are quite fixed. The lower the tumor is situated in the intestinal canal the less there is of acute or sevère vomiting, but the more of peristalsis and distention of the abdomen. A tumor situated in the cæcum will ordinarily give the symptoms of a slow but progressive obstruction of the bowels with increased peristalsis in the small intestines, spasms and colic.

A tumor can often be palpated. The process must, however, be differentiated from appendicitis. A patient came under my care some two years since in whose case the abdomen has been opened twice, supposing that he was suffering from appendiceal trouble. He had in fact a large cæcal carcinoma.

A boy, aged sixteen, was sent to me less than a year ago by a physician with the statement that the patient had been

suffering for three or four days from an attack of acute appendicitis. He gave a history of perfect health previous to this attack. No abdominal disturbances of any kind. In fact he had been working on the farm every day. On examination there was no fever, but a considerable tumor to be felt in the right iliac region. The abdomen was opened and a large cæcal carcinoma which implicated the terminal portion of the ileum found. The growth was successfully resected and the ileum implanted into the ascending colon.

Ordinarily there will be no difficulty in differentiating an appendiceal induration attended with fever from a cæcal tumor, but occasionally, as in my own case, where the history seemed to show that the patient was absolutely well until within a few days, when he was suddenly taken ill, had pain in the right side, fever, and then a tumor, an immediate diagnosis will be difficult, if not impossible. If one should procrastinate, however, for a few days a correct diagnosis will be established.

In tumors of the flexures of the colon, or of the sigmoid, when obstruction is occurring there will be dilatation of that portion of the intestine immediately above the seat of the disease. When in the sigmoid the ballooning of the colon has been compared to the rim of a bowl which stands out prominently upon the three sides of the abdomen. Within this bowl the small intestines are dilated and prominent and show periods of remarkable peristalsis. There is likely to be pain at the seat of the obstruction and a tumor may be felt.

Tumors in the intestinal canal, when the site of ulceration, cause the appearance of pus, mucus, blood and perhaps shreds of the tumor with the intestinal discharges. If the tumor is situated high up this material will be most intimately mixed with the evacuations and difficult to detect. If the growth is low down the material is likely to be separated and upon the external surface of the stool and consequently easy of detection.

TREATMENT.—The treatment should consist in resecting the portion of the bowel implicated when this is practicable, or an artificial anus may be made or an anastomosis done above and below the tumor, short circuiting the bowel.

In making a resection of a carcinoma of the small intestine one should bring the affected loop outside of the abdomen and surround it most carefully with sterilized gauze. The limits of the growth are then accurately defined and the bowel emptied of its contents for a short distance above and below the neoplasm and constricting forceps applied at a point at least two inches above and below the limits of the growth. The mesentery corresponding to the growth is then tied off and the tumor, with one inch of healthy intestine, excised. After carefully cleaning the ends of the divided bowel they are united. In carcinoma of the cæcum it is often necessary to resect not only the cæcum, but also a portion of the ascending colon as well as some portion of the ileum. The technic here is somewhat different from that which is applicable to resection of a portion of the small intestine as it is often impossible to bring a tumor of the cæcum outside of the abdomen and then the two portions of the intestine when resection has been affected are of unequal diameter. The field of operation within the abdomen should be well surrounded with sterilized gauze sponges to protect the peritoneal cavity from possible soiling during the operation. The mesentery of the ileum, cæcum and colon may be infiltrated or contracted or their glands enlarged, and so much of the tissues as are diseased should be tied off and removed with the tumor. The operation is then continued by clamping the ileum and colon with forceps or tying them with strips of iodoform gauze some two or three inches above and below the site of the disease.

Infiltration of the mesentery is often a serious complication and renders the technic more difficult and the probability of recurrence greater.

In a case of carcinoma of the cæcum upon which I re-

cently operated the tumor was intimately adherent to the anterior abdominal wall and peritoneum in the iliac fossa. The growth had extended a considerable distance into the ileum and implicated the major portion of the ascending colon. The adherent portion of the abdominal wall was resected during which we crossed the circumflex iliac artery with the loss of considerable blood. The peritoneum covering the iliac fossa, with a portion of the muscle, was removed and the iliac vessels uncovered. The entire mesentery of the

Fig. 246.
Implanting ileum into side of colon.

cæcum was implicated and contracted and was removed. It was necessary to resect almost the entire ascending colon, the end of which was closed by three rows of continuous sutures. The lower end of the ileum was also closed and then a lateral anastomosis made between the ileum and transverse colon. The patient made an excellent recovery, and up to this time, now fourteen months after the operation, there has been no return.

The cæcum and ileum being of unequal size it is better

ordinarily to close the cæcum or colon by continuous suture and then implant the end of the ileum into the side of the colon. (Fig. 246.) This may be done by the Murphy button or by two rows of continuous sutures, or the method of lateral anastomosis may be practiced. In tumors of the colon or sigmoid resection should be made as before and an end-to-end anastomosis done by suture.

The use of the Murphy button is ordinarily not looked upon with favor in end-to-end anastomosis of the colon on account of its posterior portion being without a serous covering.

In cases in which obstruction has occurred or is imminent in the colon or sigmoid, with fæcal accumulation, a temporary

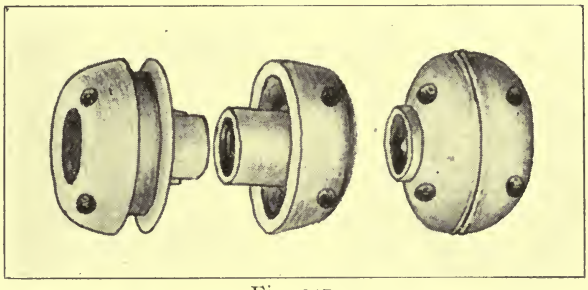


Fig. 247.
The Murphy Button opened and closed,

colostomy may be made above the seat of the stricture for the purpose of draining the upper intestines previous to resection. This is not necessary, however, unless there is considerable fæcal accumulation.

In cases of inoperable carcinoma of the cæcum an ileostomy may be done, or, what is preferable, a lateral anastomosis between the ileum and ascending or transvere colon.

An artificial anus, when one must be made for drainage or in cases of inoperable carcinoma, should be situated as low down in the intestinal canal as is possible.

After resection a great variety of methods have been used

for the purpose of reuniting the ends of the divided intestine. Ordinarily after resection of any portion of the small intestine there should be an end-to-end anastomosis done, that is the end of one portion is united directly to that of the other. When sutures are used for this purpose the term circular enterorrhaphy is applied. The sutures may be interrupted, as the Czerny-Lembert suture, or they may be continuous.

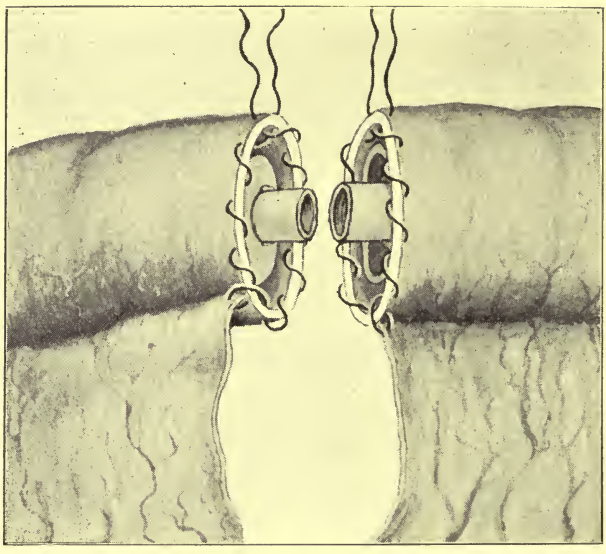


Fig. 248.
Showing the introduction of the purse-string suture in the use of the Murphy button.

Of the mechauical appliances the Murphy button in the small intestine has practically taken the place of all other methods. The button is found in every hospital, the technic of its application is simple, an anastomosis is quickly established, and the results probably equal, if they do not exceed, those from any other method. (Figs. 247, 248, 249.) It may happen that a Murphy button is not at hand or one may choose to coapt the intestines by sutures. In my opinion interrupted

sutures for an intestinal anastomosis should no longer be used, as it is difficult by this means to render the bowel absolutely water-tight. Excepting perhaps the Murphy button the use of the continuous suture is the greatest advance made in the technic of intestinal surgery during the past few years. It is almost impossible for one to have at hand all of the various mechanical appliances or to retain accurately in

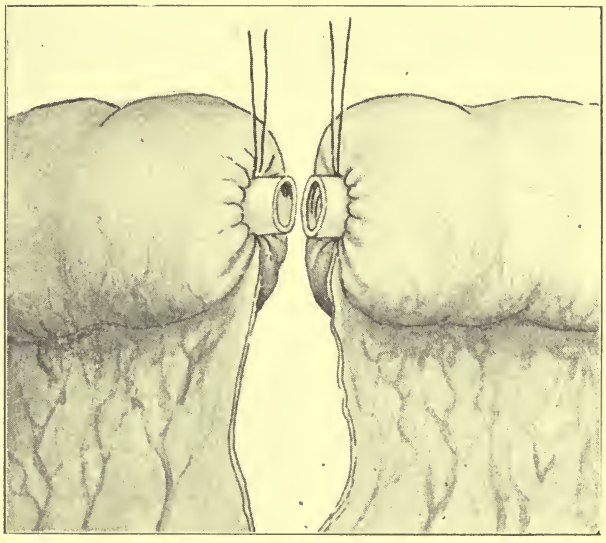


Fig. 249.
Purse-string sutures drawn tightly before closing the button. The rent in the mesentery should be closed with a continued catgut suture.

mind their application, or the use of the many varied and somewhat intricate intestinal sutures. It is absolutely necessary, however, for the surgeon to have at least one, perhaps two, mechanical applicances which will be nearly always at hand, and to have a good suture upon which he can always rely for an end-to-end or a lateral anastomosis. It is not very material as to the kind of suture used so long as it firmly, evenly and securely coapts the two surfaces and renders the bowel absolutely water-tight.

In circular enterorrhaphy the mucous membrane should be coapted by an overhand, continuous suture. This should not go more than half way round the circumference of the bowel before it is interrupted and tied. The suture is then in two distinct parts.

In the union of the peritoneal and muscular coats I use the continuous, right-angle Cushing suture which I believe has no superior in intestinal work. (See Fig. 240.) I have used it many times and with great satisfaction. It can be quickly applied and its seam is water and air tight. The thread does

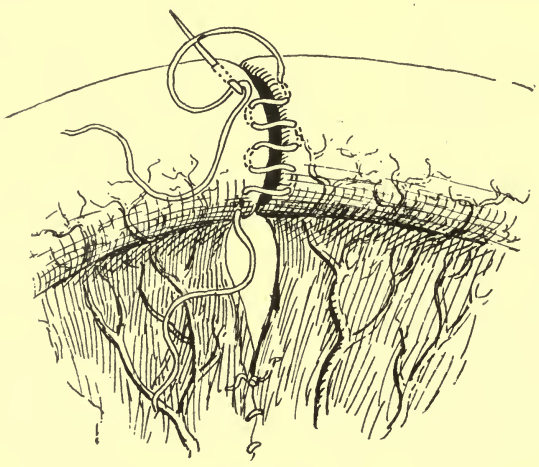


Fig. 250.
The right angle continuous Cushing suture.

not enter the lumen of the bowel, therefore does not invite infection of the peritoneum by capillarity. Technic.—A flat, well-polished needle without cutting edge is to be prefered. The most suitable silk is No. 10 twist. The ends of the bowel being approximated by supporting threads a continuous, overhand suture is made to coapt the mucosa. The Cushing suture is then placed by entering the needle on one side parallel to the cut surface and directly opposite to or at the mesentery when it is made to pick up serosa and muscularis to the extent of about one-sixth of an inch. It is then

carried squarely across the wound where it picks up the same amount of tissue from the other end of the bowel. This is continued forward and back until the mesenteric attachment is reached when the needle is brought out on the same side of the wound on which it entered. (Fig. 250.) Seizing

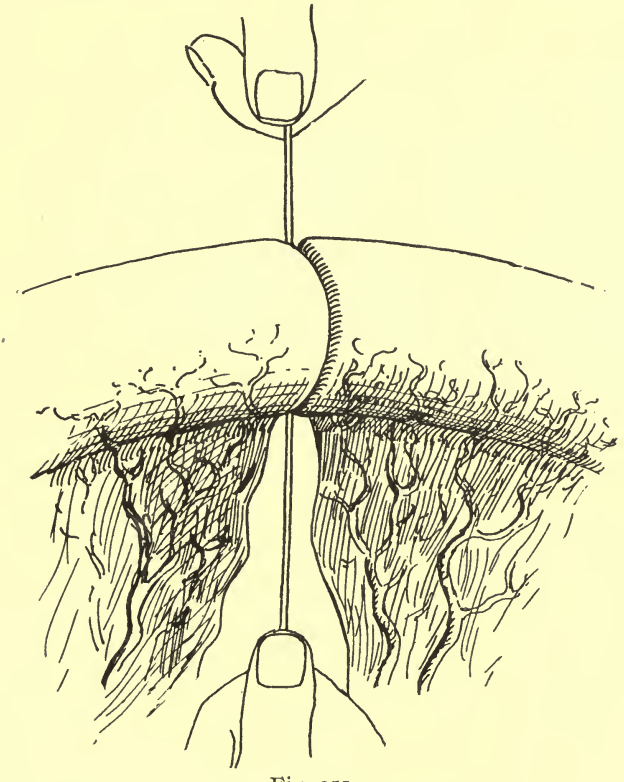


Fig. 251.
The Cushing suture shown tight.

each end of the thread it is drawn tight which approximates the serous surfaces and buries the suture. With a second needle and thread the same process is repeated on the opposite side of the bowel. The needle must, however, enter and be brought out on the opposite side of the wound from the first.

The suture is now drawn tight producing the same roll-

ing in of tissue, approximation of serous surfaces and burying of suture. (Fig. 251.) The ends of the two threads are knotted, cut short and the supporting threads removed. The operation is complete by uniting the cut edges of the mesentery with a running catgut suture.

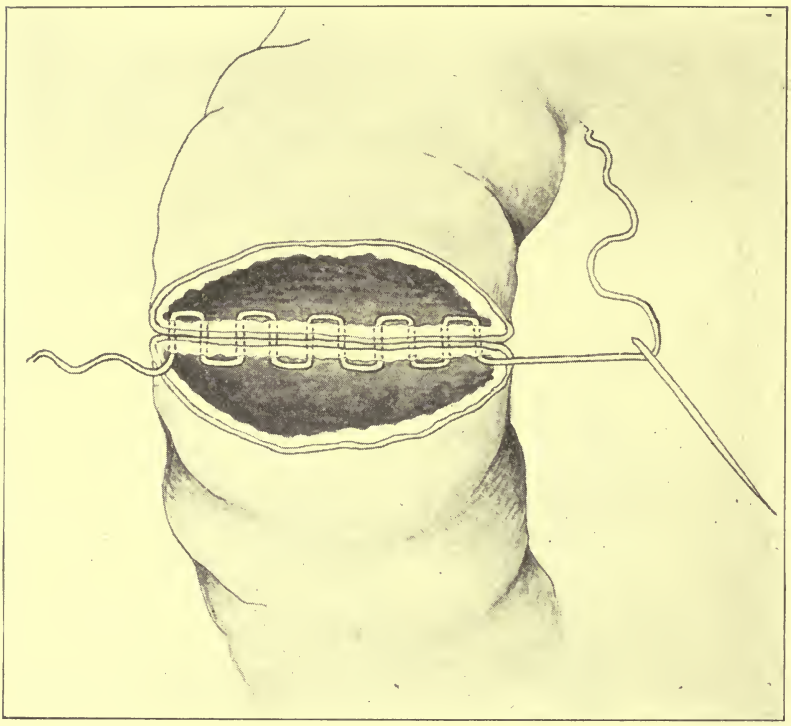


Fig. 252.
The Connell suture coupling the posterior walls of bowel.

Figs. 252 and 253 represent the Connell suture. This suture has been received with favor and may be used where one desires to coapt with one suture all of the intestinal coats and have the knot within the lumen.

Carcinomata of the Rectum.—Carcinomata are more frequent in this situation than in any other portion of the intestinal canal. They usually occur as adeno-carcinomata,

although the scirrhus and medullary forms are occasionally found, and at the anus an epithelioma not unfrequently is seen. (See Plate, Fig. 254.)

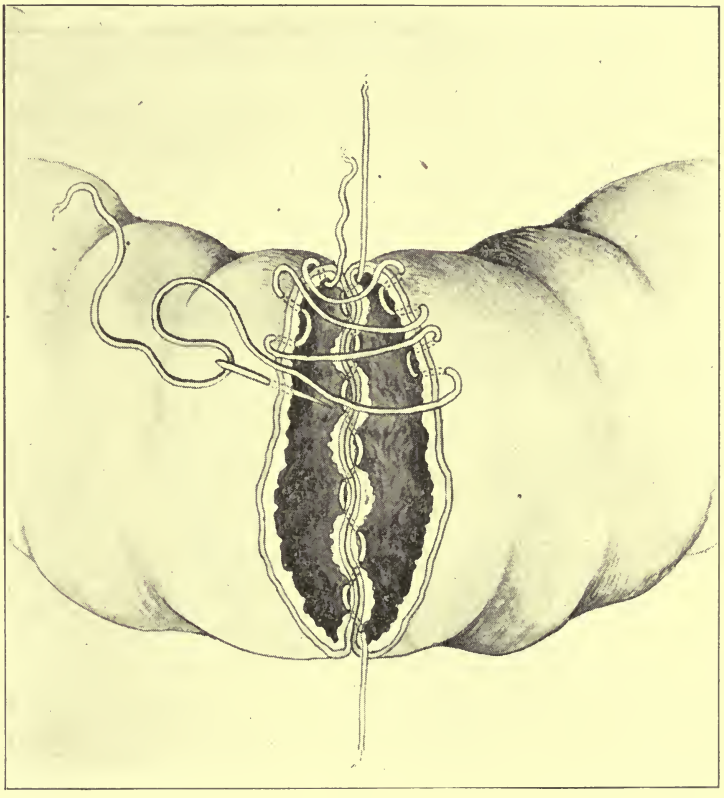


Fig. 253.

The Connell suture coupling the anterior intestinal walls.

The growths are usually situated from three to five inches above the anus and in their development either extend upwards, following the course of the blood and lymph vessels or encircle the bowel.

Primarily there is a proliferation of cells within the mucous membrane which produces a hard node or plaque.

This gradually spreads upwards, downwards and circumferentially until a ring more or less completely surrounds the rectum. The perpendicular extent of such a growth is seldom more than a few inches. Upon its surface are irregular nodes, flat plaques or papillomatous outgrowths. After a time disintegration sets in and the surface becomes covered with a hard, smooth ulcer. The constriction which always occurs is due to the infiltration of the walls of the rectum and to the subsequent contraction.

The medullary carcinoma as it occurs here is a fungus growth which projects into the lumen of the bowel causing

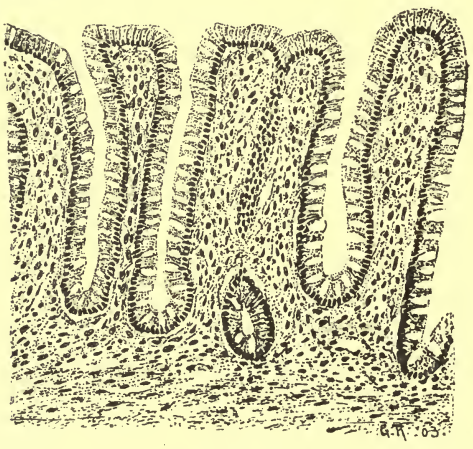


Fig. 255.
Normal Mucosa of Rectum.

more or less obstruction. In this species ulceration, disintegration and sloughing are the rule. Mucus, pus, blood and fragments of the neoplasm may be found within the evacuations.

An epithelioma, that is a squamous cell carcinoma, occurs at the border of or within the first inch of the anus as an indurated node, flat, hard area or ulcer. It has the characteristics of epitheliomatous indurations and ulcers when situated elsewhere.

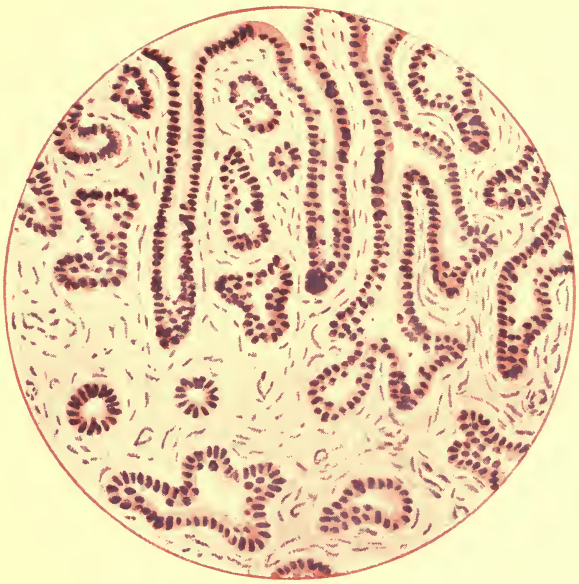


Fig. 254.

Adeno-Carcinoma of Rectum.

A malignant neoplasm of the rectum may be pedunculated and even quite freely movable. (Fig. 256.) The growth primarily is entirely circumscribed and limited to a distinct area of the mucous membrane. Later it extends

Fig. 256.
Villous Carcinoma of Rectum.

both circumferentially and upwards and downwards, invading all of the coats of the rectum. It may invade the adjacent connective tissue and peritoneum and implicate in men the prostate, bladder, mesenteric and retro-peritoneal glands,

and in women the vagina, bladder and uterus, and in both the abdominal lymphatics.

Often the first symptom of a carcinoma of the rectum is an increasing difficulty in evacuating the bowels. In two of my cases, one a girl of twenty-two and the other a man of fifty-five, both of whom appeared to be in perfect health, the only symptom of which they complained was an increasing difficulty, and at times almost impossibility, to move the bowels. This to these patients seemed in consequence of some obstruction low down in the rectum. With this constipation there is increased peristalsis of the intestines, which is often distinctly visible above the site of the obstruction. There is also above the obstruction dilatation and an accumulation of fæcal contents.

In a considerable number of cases, especially after ulceration has occurred, there is soreness, tenderness, a feeling of fullness in the rectum, and occasionally excruciating pain when the bowels are evacuated. So great is this distress with some patients that they put off each evacuations as long as possible.

Another presumably characteristic symptom is the passage of small, ribbon-like fæces, or the ejecta may occur in small, hard, round balls which have been likened to the droppings of sheep.

Hæmorrhoids are usually present and there is occasionally very decided tenesmus, the patient feeling as though there was some hard substance in the rectum which should be expelled. It occasionally happens when these patients go to stool and in consequence of the tenesmus that the hæmorrhoids, and often the mucous membrane of the rectum with the growth, are pressed out through the external sphincter. The sphincter at such times becomes much relaxed and there may be a more or less constant discharge of a bloody or mucopurulent fluid from the rectum.

The diagnosis can be established in these cases by making

a rectal examination. If the growth is situated high up, this may be done under an anæsthetic.

Differential Diagnosis.—Malignant neoplasms should be differentiated from benign growths and from cicatricial contractions. The age of the patient is presumably important. Tumors occurring in young persons and being freely movable, or having a pedicle, are generally benign. A history of previous dysentery or syphilitic ulceration would be presumptive evidence of cicatricial stenosis, in the absence of a tumor. In

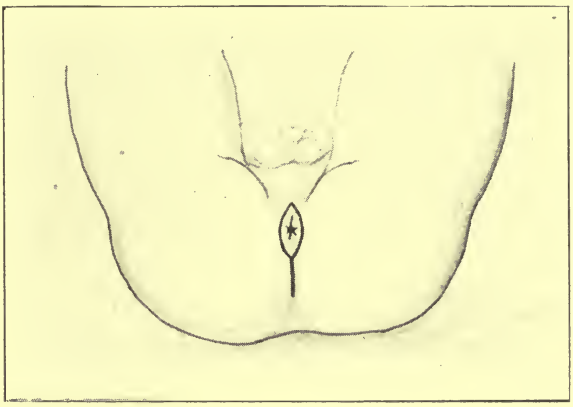


Fig. 257.
Incision for perineal proctectomy.

cicatricial stenosis of the rectum the stricture is usually much thinner, has a smooth surface, is often without the presence of ulceration and is semi-elastic and does not present the infiltration of the walls of the bowel as does a carcinomatous process. In syphilis the differentiation will be at times extremely difficult, in that the induration of syphilis usually extends for a considerable distance up and down the walls of the intestines, rendering them in part rigid and immovable. The process is not so progressive, will usually give a history of previous syphilis, and may yield in part to anti-syphilitic treatment.

TREATMENT OF CARCINOMA OF THE RECTUM.—Carcinoma of the lower inch of the rectum, or rather of the anus, occurs usually as an epithelioma and requires excision which may be carried out through the perineum. Two curvilinear incisions are made to surround the anus at about an inch from the border of the disease. The incisions should go into the ischio-rectal fossæ and may be extended down to the region of the coccyx if additional room is needed. (Fig. 257). The anus is separated from the adjacent tissues, being careful not to wound the membranous portion of the urethra or prostate in men and the vagina in women. Going well above the disease, the rectum is cut across and removed. The lower end of the rectum is then brought down to the cutaneous incision where it is stitched to the wound.

In carcinoma of the lower portion of the rectum, place the patient upon his left side and make an incision from near the anus upwards along the right border of the coccyx to the sacrum. The incision is carefully deepened through the perineum until the gut is reached, when the diseased portion is carefully separated from the adjacent structure, care being taken not to open the peritoneum, tear the rectum, or wound the prostate, seminal vesicles or bladder in men. The diseased portion being isolated is then tied off with a tape and divided about one inch above and below the limits of the disease, and removed. The cut end of the rectum is then brought down and united with silk sutures to the distal portion, or if this has been removed, to the skin. The incision is partially closed by suture and partially packed.

Kraske's Operation.—Modified. Tumors in the upper portion of the rectum and in the lower portion of the sigmoid may be removed by this operation.

The patient is placed upon the left side with a firm pillow under the buttock. An incision is then made commencing with the third sacral foramen and extending down the right border of the sacrum and coccyx to the region of the anus. (Fig. 258). The incision divides a portion of the gluteus

maximus muscle, the sacro-sciatic ligaments, the coccygeal and levator ani muscles and goes into the cellular tissue surrounding the rectum. The rectum is exposed and separated from the sacrum by blunt dissection. Following this, a considerable strip of iodoform gauze is carried up between the rectum and sacrum. An incision is then made, commencing at the upper extremity of the first and carried directly across the sacrum. The bone is chiseled through on this line and the entire flap, consisting of skin and the lower two

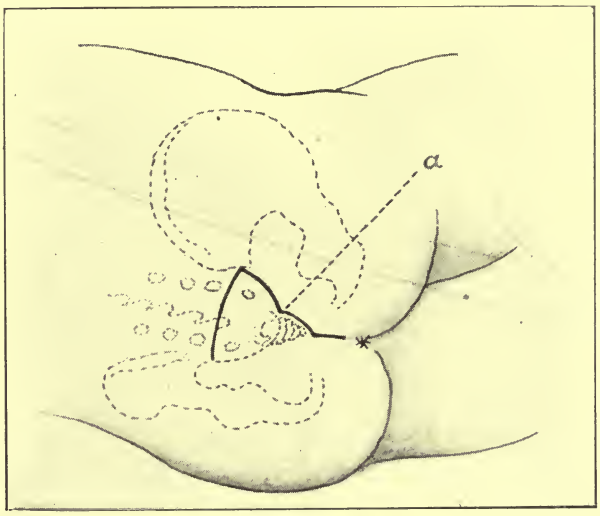


Fig. 258.
Showing Kraske's modified incision.

segments of the sacrum and coccyx, turned down upon the left buttock. There is usually considerable hæmorrhage during the time that the sacrum is cut through, but if one works expeditiously and turns the flap down, this is readily controlled by gauze pressure. The rectum, including the tumor, is then isolated by separating it from its connective tissue attachments posteriorly and upon the sides, care being

taken not to make undue traction upon the rectum, as it tears easily.

One should be cautious, in separating the rectum and tumor from the urethra, prostate, bladder or vagina, not to injure these structures. For the purpose of identification, it is often well to pass a sound into the bladder.

In isolating the bowel it is usually found impossible to carry the finger entirely around it on account of its size. It cannot be drawn down because of its firm peritoneal and mesenteric attachments. The limits of the neoplasm should now be determined. If situated in the upper portion of the rectum the peritoneum should be opened by drawing the bowel to the left and carefully dividing with shears the strands of connective tissue and peritoneum which are given off from this side. After opening the peritoneum the finger may be thrust from right to left about the bowel when the peritoneal attachments upon the left side should be divided. This division is made at the lowest part of the recto-vesical reflection in man, and the recto-vaginal reflection in women. The peritoneal cavity should now be well walled off and the intestines protected by gauze packing. The rectum or sigmoid may be drawn down now to almost any extent by dividing the meso-rectum or meso-colon. The mesentery contains its blood supply, the hæmorrhoidal and the media-sacral arteries. The superior hæmorrhoidal runs very close to the intestine and if the mesentery be clamped and divided close to the sacrum its nutrition will be preserved.

After division the mesentery should be carefully ligated as it often contains vessels of considerable size.

When the meso-rectum or meso-colon has been sufficiently divided so as to allow of sufficient descent of the bowel it is constricted some two to three inches above the tumor with a pair of forceps or by passing a tape about it. The bowel is now divided at least one inch above and below the growth and the tumor removed. The ends of the bowel should be carefully protected by gauze. The proximal end

of the intestine can then be brought down and united with the distal end by interrupted silk sutures, or the mucous mem-

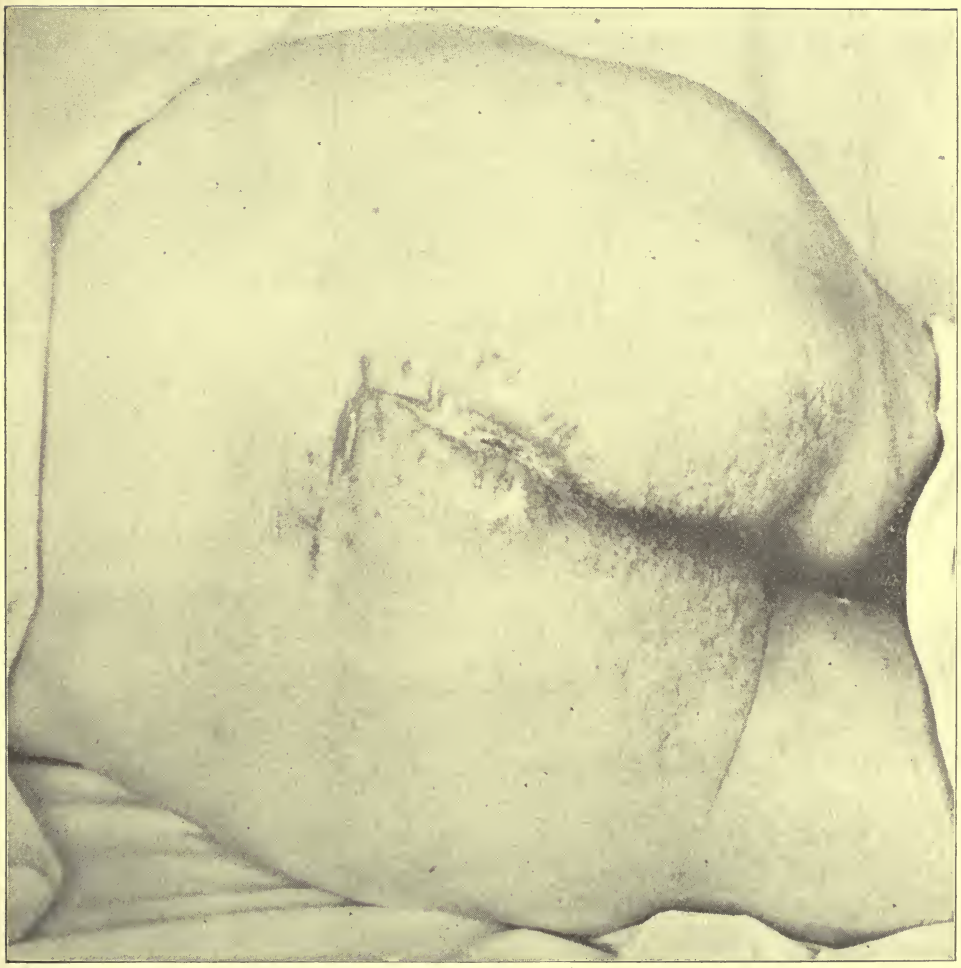


Fig. 259.
The Kraske operation after healing.

brane of the distal portion may be removed, and the proximal portion carried through the distal and attached to the border of the skin by sutures.

If the entire rectum and anus have been excised the proximal portion should be united to the skin at the most favorable position. The ends of the gauze which were placed in the peritoneal cavity to protect the intestine are brought out of the wound. The osteoplastic flap is then turned back in position and retained by a few strong catgut sutures through its muscular and fibrous coverings and the wound closed partly by suture and partly by gauze packing.

In my experience the results of the operation have been most satisfactory. Fig. 259 shows results of operation.

Statistics.—Hochenegg has operated 237 times for carcinoma of the rectum, 174 of these were treated by the radical method, with sixteen deaths, or a mortality of 9.19 per cent. He gives the statistics of operations for rectal carcinoma at thirteen prominent German clinics. The mortality varies from 9.19 per cent. to 32.5 per cent. He lays great stress upon the preparation of the patient and the thorough cleansing of the intestinal tract. His permanent results are 17.3 per cent. which are second only to Kocher's , 28.5 per cent. He states that of his own 174 cases radically operated upon, eight in which the perineal route was employed and 112 of those operated upon by the sacral route have passed the three-year limit.

Kronlein reports 881 cases collected of radical operations. A cure was obtained in fourteen per cent., an operative success in eighty per cent. The best functional result followed resection of the rectum with preservation of the sphincter.

Kraske reports 120 cases with satisfactory results.

F. Schneider analyzed 115 cases of rectal carcinomata operated upon from 1883 to 1893. Sixty-six were in males, forty-nine in females. The average age for males was fifty-nine, for females fifty-five. One case occurred during the fourteenth year, one during the fifteenth and two during the seventeenth. The Kocher operation was employed in car-

cinomata within the anus. Kraske's method was employed when the growth was large and adherent to the sacrum.

If the carcinoma is lateral, non-adherent, does not extend higher than 8 cm. above the anus, it is removed without interfering with any of the bony tissues.

When the intestines or bladder are involved the case should be regarded as inoperable.

Of twenty operations without bony resection thirteen died after one year and ten months. Two died from the operation, three escaped incontinence, seven lived about three years, and of these two survived nine years.

Of seventeen Kraske operations four patients died of the operation, seven after one year and five survived after one year.

In the perineal and Kraske operations many advise doing a previous colostomy. This adds a second operation and seems unnecessary in cases in which the intestinal canal can be thoroughly unloaded and cleansed. In patients where there has been protracted obstruction with an inability to thoroughly unload the intestinal canal the operation is advisable. In one of my cases there had not been an evacuation from the bowels for six weeks previous to operation.

In carcinoma situated in the rectum or in the lower sigmoid a plastic operation is thought by some to be inapplicable, as the proximal portion could not be sutured in this portion of the wound and could not be brought below this or to the normal position. In my own cases I have not encountered difficulty when the meso-rectum or meso-colon was freely divided, and I have never had a case of gangrene of the proximal portion of the bowel.

Many surgeons at the present time are doing a combined operation. This method is to be recommended in cases in which the carcinoma is situated in the upper portion of the rectum, or in the lower portion of the sigmoid, and especially in cases where there are complications such as enlarged lymphatic glands or infiltration of adjacent tissue. Abbe rec-

ommends opening the abdomen by a long median incision, the patient being in the Trendelenburg position. Two purse-string sutures are then placed around the bowel at a considerable distance above the tumor and the intestine divided between them. The stumps are then cleansed and inverted. The superior hæmorrhoidal artery should then be ligated and if practicable the two middle hæmorrhoidals, when the tumor with the enlarged glands, if any, and adjacent tissue is removed. The proximal portion of the intestine is brought out beneath the skin and over the crest of the ilium, making an artificial anus. The abdominal wound is closed, the patient put in the lithotomy position, when the operation is concluded from below.

Deaver advises the modified Kraske method. When possible he makes an end-to-end anastomosis, and when this is impossible an artificial anus in the left iliac.

Mann resects the rectum through an abdominal incision and unites the ends with a Murphy button. The Mayos use the abdominal route, making an artificial anus in the left inguinal region.

Vaginal Route.—This method was first practised by Des Quins in 1890. Murphy recommends the following technic and reports a number of cases. The cervix is drawn down with vulcellum forceps and the cul-de-sac opened by a transverse incision. Large sponges are then packed into the wound to protect the intestines. The retro-vaginal septum is divided down to the rectum, the incision including the sphincter muscle. The posterior vaginal wall is dissected laterally from its attachments to the rectum. The anterior rectal wall is then divided to the lower portion of the tumor and the anal segment of the rectum separated from that above it by a transverse incision placed one inch below the lower limit of the tumor. The portion of the rectum containing the tumor is then freed and removed well above the upper limit of the growth. The upper segment is then brought down and sutured to the sphincteric segment by silk

sutures, the sutures so placed that they pass from within outwards leaving all the knots on the inside. The vaginal wall is repaired and a drainage tube one inch in diameter sutured in the rectum.

Carcinoma of the Pancreas.—The neoplasm takes its origin from the epithelial cells lining the ducts and acini. The process is most frequently found in the head of the gland, although any portion may be implicated. The species of growth is usually an adeno-carcinoma, although a scirrhus tumor or a soft medullary growth may occur.

The growth usually makes its appearance after the fortieth year of age. It is about twice as frequent in men as in women. The process is frequently surrounded by a distinct fibrous capsule. It is usually primary, although it may be secondary to carcinomata of the stomach, duodenum, transverse colon or gall bladder. Metastases occur in the retro-peritoneal glands and in the liver. The growth in its progress not unfrequently compresses or obstructs the duct of Wirsung, which leads to a chronic inflammation and the formation of numerous cysts. If the process is situated in the head of the pancreas it may also obstruct the common bile duct, leading to jaundice. It has been known to produce sufficient pressure upon the pylorus as to cause obstruction and lead to the diagnosis of pyloric carcinoma. A tumor of the head of the pancreas has been known to produce obstruction of the right ureter and hydronephrosis. It not unfrequently obstructs the portal vein leading to congestion of the intestines and ascites, or partial obstruction of the inferior vena cava leading to œdema of the lower extremities. It may also produce pressure upon the splenic vein causing splenic enlargement.

Frequency.—In 3,223 autopsies, Flabio found only two cases of carcinoma of the pancreas. At the General Hospital in Vienna Block found twenty-two cases in 18,069 autopsies. Richardson met with five cases of carcinoma of the pancreas in twenty-three fatal cases of gall bladder obstruction. Rob-

son has seen fifty cases of carcinoma of the pancreas. In fifty cases collected by Baldwin, thirty-three were males and seventeen females. The apparently frequent connection between cholelithiasis and interstitial pancreatitis, and even carcinoma of the pancreas, has led many clinicians and pathologists to consider the former as the possible cause of the latter.

Symptoms.—Carcinoma of the pancreas usually causes loss of appetite, muscular weakness, prostration, emaciation, and a deep-seated pain in the region of the pancreas, which may be acute and paroxysmal or dull and heavy, perhaps represented largely by a sense of soreness or increased sensitiveness on pressure. There may be diarrhœa, lipæmia and lipuria. Diabetes may also be present. In 150 cases of carcinoma of the pancreas, glycosuria was present seventeen times. (Bard and Rick.) Fatty diarrhœa is only an occasional symptom. A pronounced cachexia, great weakness and local tenderness are often the only symptoms manifest. There is usually distress in the stomach region, with nausea and vomiting. Great mental lethargy, occasionally delirium and even acute mania may be present. In some cases the blood shows a condition of leucocytosis with blood plaques and a decrease in the hæmoglobin. Progressive weakness, loss of flesh, painless jaundice associated with enlargement of the gall bladder and sensitiveness in the region of the pancreas, are held to be almost pathognomonic of carcinoma. Ascites is a late but pretty constant symptom, as is also œdema of the lower extremities. As the condition progresses, cachexia with petechial spots, may occur. In cases in which jaundice is absent the skin is apt to assume an ashen or silvery-gray hue. (Douglas). Bullæ are also said to occasionally make their appearance upon the dorsal aspect of the hands.

Tumor.—A tumor may be present or absent. If the growth is a scirrhus it is usually not to be felt. In other cases it may attain a very considerable size and then occupy the umbilical region.

Carcinoma of the pancreas should be differentiated from

carcinoma of the pylorus. This can frequently be done when one considers that in the former disease there is usually no special stomach disturbance, the stomach is not enlarged and contains HCL. Tumors of the pylorus, before adhesions have occurred, are usually quite movable. Those of the pancreas, on the contrary, are fixed. Indurative pancreatitis, especially when associated with obstruction of the duct by a calculus, may present all the symptoms of carcinoma.

Differentiation from Disease of the Gall Bladder.—The history of biliary colic, the occurrence of jaundice and the enlargement of the liver, are sufficiently distinctive of cholelithiasis. In many cases, however, of induration of the pancreas, in which it is hard and nodular, there may be difficulty even after the abdomen is opened in differentiating the condition from carcinoma.

PROGNOSIS.—The growth tends to a fatal termination.

TREATMENT.—The depth of the pancreas, the importance of the surrounding structures, its intimate relations with large blood vessels, the duodenum and bile ducts, renders operative interference most difficult. Rugge claims, however, to have successfully extirpated the pancreas for carcinoma. Clinically pancreatitis the result of cholelithiasis runs a course which is almost identical with carcinoma of the pancreas. Von Mikulicz states that he has often mistaken chronic pancreatitis, before and after opening the abdomen, for a carcinoma. Chronic pancreatitis due to cholelithiasis, is often relieved and even cured by an operation on the gall passages.

Von Mikulicz divides the operative methods for exposing the pancreas into two groups. In the transperitoneal method one enters the abdomen through a median, or lateral incision, and then either through the gastro-colic or gastro-hepatic omentum, or, after pushing up the omentum and transverse colon, through the meso-colon. The retro-peritoneal method aims to reach the pancreas by an incision in the lumbar region. By this means one is able to expose only the extremities of the organ.

It is quite properly held that in carcinoma of the head, or of any considerable portion of the pancreas in which there is implication of adjacent organs, the condition is not suitable for operative measures. The process at best represents the greatest anatomical difficulties in that any injury to the pancreas will lead to the escape of pancreatic juice, which has a most deleterious effect upon the tissues and also favors infection. The tail of the pancreas, or perhaps the major portion of the body, may be removed. In an operation upon the transverse colon for carcinoma, in which the major portion of the pancreatic body was involved, I removed the implicated part with the transverse colon. The patient died, however, from shock.

It is most essential, in operating upon the pancreas, to prevent the escape of the pancreatic fluid. It is advisable for this purpose, according to Von Mikulicz, to close the end of the divided pancreas by deep sutures, the wound being then drained with gauze.

He thinks that simple ligature of the soft structures is not enongh.

Carcinoma of the Gall Bladder.—The gall bladder is lined by a mucous membrane having a columnar epithelial covering. This epithelium dips down into the mucosa forming the mucous glands. Outside of the mucous membrane there is a muscular coat, then a fibrous coat, and outside of this the serosa.

A carcinoma is the most frequent tumor situated in the gall bladder. It may take the form of a scirrhus, a medullary or colloid growth. Neoplasms which take origin from the epithelial cells lining the mucosa are composed of columnar cells, while those coming from mucous glands are composed of cylindrical or polymorphous cells.

The growth may be primary or secondary. When primary, it may spring from the surface and grow into the lumen of the gall bladder, as a well-circumscribed tumor. The fundus of the bladder is most frequently invaded. In

other instances the growth may become more or less diffuse and implicate the entire gall bladder. The process being primary in the gall bladder may invade neighboring structures, as the liver, adjacent lymphatic glands, the duodenum, hepatic flexure of the colon, stomach and abdominal wall. The disease may be secondary to a carcinoma in the gall ducts. In these cases alveoli are to be seen in the growths, which recall in their appearance the histology of normal bile ducts. The process may be secondary in the gall bladder to a primary carcinoma in the liver, duodenum, stomach or colon.

CAUSATION.—It has been estimated that gall stones are present in at least eighty-seven per cent. of the cases of carcinoma, and it is held by many clinicians, and probably correctly, that the presence of gall stones leads indirectly, through irritation, to the formation of carcinoma. In Mayo's cases of cholelithiasis, carcinoma occured in five per cent.

It is held by some that primarily there is an ulcerative process in the gall bladder and that in the cicatrix produced by the healing process the carcinoma takes its origin. This, however, is quite unlikely, as the cicatrix is composed of connective tissue and could not, according to our present ideas, produce an epitheliomatous growth. A cicatrix, in consequence of the irritation which it may cause, or more properly the chronic inflammation which has been established and maintained in the gall bladder by the constant traumatism of the gall stones, leads, or may lead, to excessive cell proliferation and then be a pronounced causative factor in the production of a carcinoma.

SYMPTOMS.—The symptoms of carcinoma of the gall bladder are very vague, indefinite and not sufficient as a rule to make anything more than a probable diagnosis. In the great majority of cases the patients complain of pain in the right hypochondrium. There is tenderness in this region and after a time a tumor. It is claimed that a tumor may be felt in sixty-nine per cent. of the cases and when present it is usually sensitive, hard, lobulated, round or ovoid and

may be either small or large. It gives the sensation on palpation of being a solid growth. In Musser's 100 cases a tumor was present in 68. In twenty-seven of these it occupied the right hypochondriac region, in twelve the umbilical, in four the right iliac fossa, in two the inguinal region and in one the situation corresponded to that of the pylorus. In ten cases it was adherent to the liver.

The tumor moves downwards synchronously with the liver. Below, the border of the growth is quite distinct; above, it shades off into the liver. In some cases it has reached the umbilical region or even the right inguinal region. Its dullness is usually continuous with that of the liver. It does not give the smooth, elastic feel of a cystic gall bladder.

Jaunice is one of the most important symptoms. This is said to be present in sixty-nine per cent. of the cases. (Waring.) It only occurs, however, when the growth has invaded or produced pressure upon some of the bile ducts. The jaundice is usually progressive, the patient finally becoming of a greenish color.

Disturbances of the stomach with anorexia, nausea and vomiting are frequent. The vomited material occasionally contains blood, and when the patient has become much debilitated there may be hæmorrhages beneath the mucous and cutaneous surface producing petechial spots or bloody stools. There may be dropsy and after a time a cancerous cachexia. None of these symptoms, however, are pathognomonic.

Sex.—Siebert collected 101 cases up to 1891, of which seventy-nine were females and fourteen males. The sex of eight was undetermined. Musser collected 100 cases and found the disease three times as frequent in women as in men. Courvoisier had statistics of ninety-eight cases; seventy-five of these were females and twenty-three males. The disease is most frequent during the period from forty-five to fifty, although a number of cases have occurred between twenty and thirty.

DIAGNOSIS.—A presumptive diagnosis may perhaps be reached when a patient between forty and sixty has a hard, uneven, sensitive tumor in the gall bladder region, attended with jaundice and preceded perhaps for years by symptoms of biliary colic. These symptoms are usually followed by disturbance of the stomach, such as nausea with occasional vomiting. There may be slight fever, emaciation and cachexia.

PROGNOSIS.—The disease if allowed to take its own course ends fatally. Waring observed ten cases in which the duration from the first observable symptom varied from a few months to two years. Steller says that the disease lasts from five to six years. One can, however, hardly believe that any considerable number of patients suffering from an adeno-carcinoma could live from five to six years, no matter in what organ the process was situated. Courvoisier and Musser agree that patients with carcinoma of the gall bladder live but a few months.

TREATMENT.—It seems to be pretty generally held that during the first few months a carcinoma of the gall bladder remains entirely local. If any treatment is to be instituted it should be undertaken early before regional infection or metastases have occurred.

In any case in which there is an intelligent suspicion that the patient is suffering from carcinoma of this organ the region should be exposed by a suitable incision. If the gall bladder is found thickened, indurated or nodular, or is the site of a distinct tumor a cholecystectomy should be done. This may be carried out as follows: If there are adhesions to the gall bladder these should be separated, and then the peritoneal reflections from the gall bladder on the liver divided by perpendicular incisions one upon each side, and a transverse incision made above the fundus connecting the upper ends of the first two incisions. The gall bladder may then be easily stripped from the surface of the liver. It is now only attached by the cystic duct and this may be ligated

near its junction with the common duct, distally divided and the gall bladder removed. If it is thought best to drain the common or hepatic ducts the cystic duct may be divided without ligation. In the latter case the area should be well surrounded by gauze drainage.

Hepatectomy.—In cases in which the adjacent but limited portion of the liver has been implicated from the gall bladder this may be excised. A great variety of methods have been proposed for this purpose. Portions of the liver have been excised more than a dozen times for malignant disease. One patient died from the operation and at least two patients were known to be living without recurrence after two years.

Technic.—The circulation through the right lobe of the liver may be controlled during the operation at least in a measure by winding about the lobe an elastic tube. The affected portion may then be excised, removing a V-shaped piece with a knife or Paquelin cautery. After excision the individual vessels in so far as is possible are separately ligated with catgut. The remaining vessels are controlled by gauze pressure and by coapting the surfaces of the liver with deeply-placed silk sutures. If there be considerable hæmorrhage which is not controlled by this means gauze pressure may be maintained for a time, the wound being left open.

Carcinoma of the Bile Ducts.—A carcinoma may commence in any portion of the ducts between the liver and the duodenum. Histologically the tumor is usually a columnar cell carcinoma. In all of Musser's eighteen cases the structure was of this kind. It most frequently implicates the common duct. According to the statistics of Musser, the common bile duct was affected in fourteen cases, the hepatic duct in three and the cystic and hepatic ducts in one case. In eleven cases collected by Rollstein the common duct was the seat of the primary affection in all.

These growths may take their origin from the columnar cells of the mucous membrane or from the mucous glands. They have the form of small flat growths or are round and

oval in outline. They often project from the mucous membrane into the lumen of the duct and cause partial or complete obstruction. The carcinomatous process often extends about the duct until it has implicated its entire circumference. Primarily the process is confined to the ducts, but later invades the adjacent tissues. When the growth commences in the cystic duct it frequently invades the adjacent portion of the liver, and when it has its origin in the common duct it has implicated the duodenum. When that portion of the common duct which lies in the gastro-hepatic omentum is implicated the portal vein may become affected. Gall stones do not occur so frequently in carcinoma of the bile ducts as in carcinoma of the gall bladder. In Musser's eighteen cases gall stones were present in seven. In eleven cases collected by Rollstein gall stones were met with four times.

Sex.—There seems to be no special difference in the two sexes as regards their liability to carcinoma of the bile ducts.

Symptoms.—The symptoms of malignant disease in this situation are very obscure. The first symptom in cases in which the hepatic, cystic or common ducts are affected relates to the obstruction to the flow of bile. This obstruction, when in the hepatic or common duct, will produce jaundice. The process may be preceded by and accompanied with more or less pain or soreness in the right hypochondriac or epigastric region. With the increase of obstruction the jaundice becomes more pronounced.

The patient may present a dark-green or almost black color. If the growth should press upon the duodenum or stomach attacks of nausea and vomiting are likely to occur. Constipation and symptoms of gastro-intestinal disturbance are frequent. If the portal vein is interfered with ascites may occur. With obstruction of the cystic duct the gall bladder may become enlarged. The liver dullness is increased with the obstruction of any of the bile ducts. In the progress of the disease there is a loss of appetite, emaciation and general weakness associated it may be with the can-

cerous cachexia. A tumor, if present, can very seldom be made out on account of its depth and small size. In the latter stages when metastases and regional infection in the adjacent organs and especially in the liver have occurred a tumor may be recognizable.

Carcinoma of the head of the pancreas and chronic jaundice due to the impaction of a gall stone in the common duct, are pathological conditions to be differentiated from carcinoma of the ducts. Jaundice due to a gall stone in the common duct will usually give a history of biliary colic and show varying degrees of jaundice. Carcinoma of the head of the pancreas may produce a distinct tumor, jaundice and a fatty diarrhœa.

Diabetes may be present, while emaciation and cachexia are early symptoms.

PROGNOSIS.—The prognosis in cases of carcinoma of the bile ducts is most grave. The patients succumb in a few months. Life may be prolonged, however, in some of these cases by operative measures.

TREATMENT.—On account of the deep situation of the bile ducts and the great difficulty in making an early diagnosis, surgery will probably never accomplish very much in the treatment. If an operation is carried out sufficiently early, while the process is confined to the duct, it may be successful. If the disease be in the cystic duct, this duct, with the gall bladder, should be removed. If the adjacent portion of the liver is implicated, a V-shaped piece of the liver may be excised. If the common bile duct is implicated a portion may be excised, the ends united with sutures and the fundus of the gall bladder attached to the wound or to the intestine. If the common bile duct be implicated and the growth cannot be removed, an anastomosis may be made between the fundus of the gall bladder and the duodenum—cholecystenterostomy. If the growth is situated in the head of the pancreas and involves the common bile duct, excision is impracticable and a cholecystenterostomy should be done.

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