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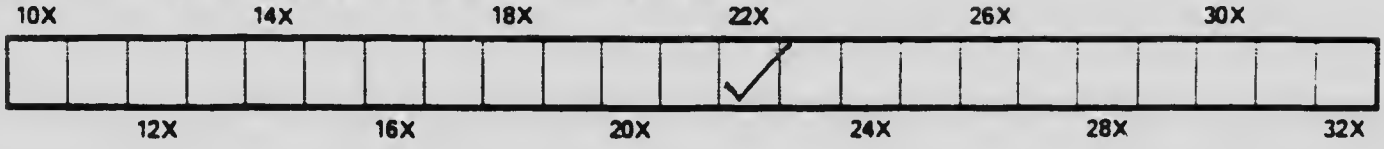

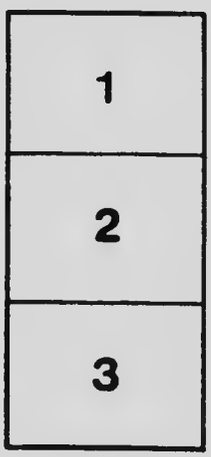

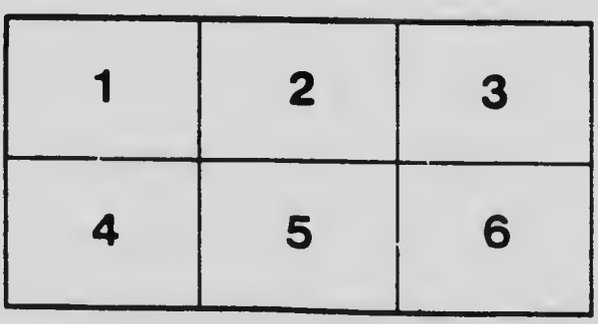

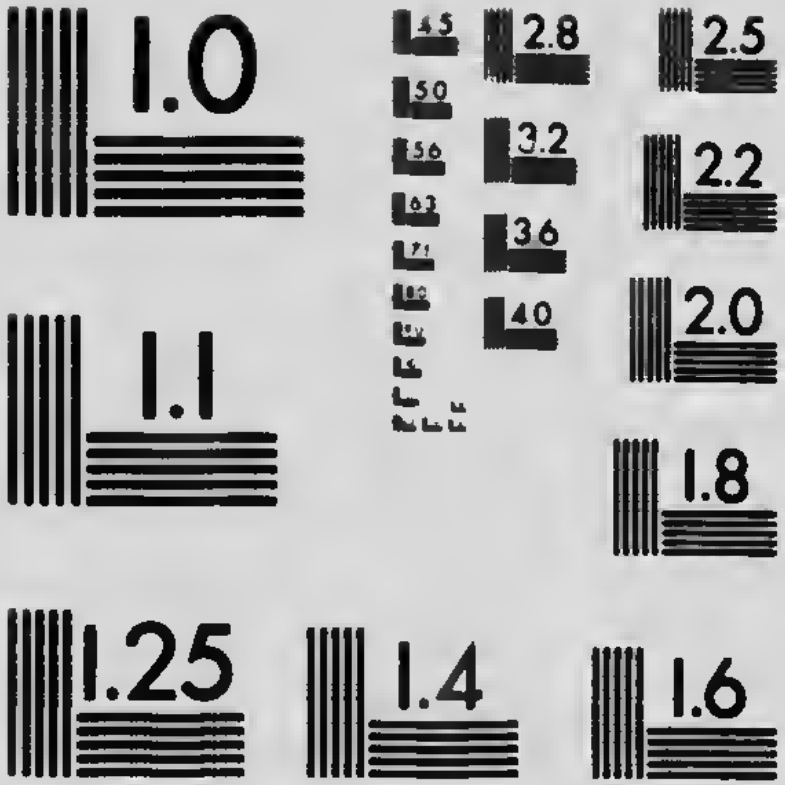

TUMOURS

INNOCENT AND MALIGNANT

BY THE SAME AUTHOR.

SURGICAL DISEASES OF THE OVARIES AND FALLOPIAN TUBES, INCLUDING TUBAL PREGNANCY.

With 140 Illustrations.

CASSELL & COMPANY, LIMITED, *London, Paris, New York, Toronto and Melbourne.*

TUMOURS

INNOCENT AND MALIGNANT

Their Clinical Characters and Appropriate Treatment

BY

J. BLAND-SUTTON, F.R.C.S.

SURGEON TO AND MEMBER OF THE CANCER INVESTIGATION COMMITTEE OF THE MIDDLESEX HOSPITAL, ETC.

FOURTH EDITION

WITH THREE HUNDRED AND FIFTY-FIVE ENGRAVINGS

CASSELL AND COMPANY, LIMITED
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New Edition *November* 1906, *Reprinted* 1907.

PREFACE TO THE FOURTH EDITION.

SINCE the issue of the first edition of this book, a large amount of admirable work has been carried out on the histology of tumours, and the reports of new investigations on morbid growths have literally poured from the press. That great triumph of pathological histology, Chorion-epithelioma, has already a rich literature of its own. This interval has also seen the establishment of organised laboratory research for the purpose of detecting a very elusive foe, the causative agent of cancer. The widespread interest manifested in this scourge of mankind has induced me to adopt the suggestion of many critics and include an account of the prevailing but irreconcilable opinions held by competent men in regard to its origin. Nothing is known as to its cause, but the hypotheses, or guesses at truth, concerning it are impartially set forth in these pages.

Some valuable observations have been collated regarding tumours of the ovary and of the testicle: new growths in these remarkable organs where we can almost see life begin are the despair of taxonomists. To avoid difficulty two essays have been devoted to their consideration independently of the general principles of classification contained

in the rest of the book. To accommodate this new matter, as well as a chapter on Heterotopic teeth and fifty new illustrations, more than one hundred extra pages have been added to the book.

J. BLAND-SUTTON.

47, *Brook Street,*
Grosvenor Square, W.
November, 1906.

EXTRACT FROM THE PREFACE TO THE FIRST EDITION

Very early in the practice of my profession I became convinced of the great increase in diagnostic power that results from the combination of pathological and clinical knowledge. In 1885 I began to collect materials, from man and other vertebrates, in order to make myself acquainted with the histological peculiarities of tumours. Attention was first devoted to cysts, and the results of the investigation were embodied in lectures delivered at the Royal College of Surgeons during the years 1886–91: they dealt particularly with the group of tumours known as Dermoids and Tubulo-cysts. During the same period I contributed to the Odontological Society of Great Britain a series of papers to show that many tumours of the jaws, classed as exostoses, are derived from aberrations of teeth.

Whenever it seemed desirable to illustrate the nature of a genus of tumours by reference to Comparative Pathology, I have not hesitated to do so. Without this aid, any attempt to catch the deeper meaning of many tumours is as difficult as endeavours to decipher a palimpsest in which the first characters, written in an unknown tongue, have been imperfectly removed from the parchment, and are allowed to mingle with the second inscription.

CONTENTS.

TUMOURS: INNOCENT AND MALIGNANT.

INTRODUCTION.

It has long been customary in surgical writings to group together a very heterogeneous assembly of morbid conditions under the term Tumours. This is a very ancient name, and merely means a swelling, but the careful microscopic investigations of morbid anatomists with the aid of differential staining (histologic chemistry), and the study of the relationship of micro-organisms to many swellings called tumours, have led to a revolution in our knowledge, so that the term has been stripped of its former wide significance. In clinical work, the word tumour is not likely to disappear, although it has lost its importance to the pathologist.

Formerly, the term tumour was applied to the abnormal swellings which characterise the gummatous stage of syphilis; the lesions of actinomycosis, leprosy, and other diseases, collectively known as the Infective Granulomata the excessive formation of callus around the fragments of broken bones, and the exuberant production of cicatricial tissue known as keloid. It is noteworthy that almost every increase in our knowledge regarding the cause of tumour-diseases results in reducing the list of morbid conditions known as tumours, either by removing some from this category, or by combining under one term a number of apparently diverse conditions which were formerly regarded as independent. Tumour-diseases of the nervous syste... illustrate this. Among recent evictions from tumours is the big prostate of advanced life, which is usually classed among adenomata, but some excellent ob-

servations indicate that this disease, the bane of elders, is due to micro-organisms which gain access to the glandular recesses of the prostate from the urethra and set up inflammatory (reactive) changes.

In ignorance of the cause of tumours (pathogenesis) we fall back on their minute structure (histology) as a basis of classification (taxonomy). This is the natural outcome of the careful investigation of the minute structure of tumours, because it led investigators to realise that they consisted of the same tissues which compose the normal organs of the body. This was a great step. Anatomic observations taught men that animal bodies are made up of diverse structures, such as fat, suet, bone, gristle, muscle, tendon, and the like, but the microscope revealed that they are composed of fundamental tissues, which enter into the construction of organs of the most diverse form and function. The base is the connective tissues, comprising bone, fat, cartilage, etc., and two remarkable structures known as muscle and nerve. There is also a peculiar material which permeates the body and enters into the composition of every organ; it is called areolar tissue, a ubiquitous web which is stout and strong as fascia and periosteum, extremely delicate in the nervous system, and so fine in the retina as to need careful preparation to render it perceptible to the microscope. The connective tissues form the framework of the body, and constitute a sort of sustentaculum in compound organs, such as the liver, intestines, kidney, and the like, for the support of epithelium, and serve as a mesh in which blood-vessels and lymphatics can ramify to supply the liquid tissue—blood, from which the epithelial cell can obtain material to form the secretion which it is the function of particular glands to elaborate.

The careful and critical study of the minute (microscopic) structure of tumours having revealed that they were composed of tissues normally existing in the animal body, pathologists realised that the histology and embryology of an organ enable an experienced oncologist to predict the various genera of tumours and cysts to which it may be liable. Thus the tibia of a child contains cartilage, bone, fibrous tissue, young connective tissue, fat and red marrow.

The epiphysial cartilages are the source of chondromata; the bone furnishes osteomata, the periosteum sarcomata, and very rarely lipomata, and myelomata arise in the red marrow. Cancers do not arise primarily in bone, as it lacks epithelium, but they often occur as secondary deposits.

Although our knowledge of the intimate structure of tumours, thanks to differential staining methods, is now sufficient to enable us to indicate from the structure of an organ the genera of tumours to which it may be liable, nevertheless, the most careful study of the minute structure of such organs as the salivary glands would not lead us to suspect their liability to pure chondromata; and it is strange that they should occur in the parotid, submaxillary, and lacrimal glands, and yet be unknown in the pancreas. What oncologist, merely from studying the histology of a normal ovary, would suspect that it would be the point of origin of a dermoid? It is like studying the fauna of a country. For instance, who imagined, until Australia was discovered, the existence of extraordinary mammals like kangaroos and duck moles? But knowledge gained from observation enables us to state that gliomata do not arise in bone, nor myomata in the brain, nor dermoids in the spleen, liver, or kidney, with the same certainty that we assert that at the present period of our planet's history lions do not sport about the ice-fields of Greenland, nor do humming birds flit about the flower-beds of Hyde Park.

It is, however, necessary to point out that, although the tissues of an organ determine the species of tumour to which it may be liable, their relative frequency can only be gathered from observation.

The variations in the liability of the organs of the body to tumours is a very curious matter. The heart is very rarely occupied by a tumour; on the other hand, the uterus, also a muscular organ, is with extreme frequency the seat of myomata. The liability of bones to sarcomata is proverbial, yet a sarcoma of a voluntary muscle is most uncommon. A primary tumour of the lung is a rarity, but it is common enough in the brain or the eyeball.

Sarcomata are frequent in the kidneys, but a primary sarcoma in the liver or spleen is extremely rare. These and many kindred questions indicate profound imperfections in our knowledge concerning the cause of tumours. It may be stated, without fear of contradiction, that no one has succeeded in framing a satisfactory classification of tumours. In this work the subjoined plan will be followed:—

Group I. Tumour-Diseases of the Connective Tissues.
This will include Lipomata, Chondromata, Osteomata, Myelomata, Sarcomata, Myxomata, Myomata, Neuromata, Angeiomata, Endotheliomata, and Uterine Fibroids.

Group II. Tumour-Diseases of Teeth.
Odontomata.

Group III. Epithelial Tumours.
This comprises Papillomata (warts), Adenomata, Carcinomata.

Group IV. Tumours arising from the Fœtal Membranes.
Chorion-epithelioma (Deciduoma).

Group V. Teratomata.
Dermoids.
Embryomata.

Group VI. Cysts.

Tumours have from very early times been arranged into a malignant and an innocent or benign division, based on the knowledge gained from observation that some of them inevitably destroy life, whilst others do not display such destructive propensities. This division is sound, because malignant tumours belonging to the connective tissue group (sarcomata), as well as those of the epithelial group (the carcinomata or cancers), present structural peculiarities which enable competent histologists to recognise them.

It is important to remember that benign tumours may, and often do, destroy life. The essential difference between an innocent and a malignant tumour may be expressed thus:—**The baneful effects of innocent tumours depend entirely on their environment, but malignant tumours destroy life whatever their situation.**

Environment in Relation to Tumours.—Although throughout the whole of this book reference will be made to the destructive effects of tumours of all kinds, which will make the reader realise the truth of the words which Byron puts into the mouth of Werner, "Death hath a thousand gates," it will, perhaps, be useful to describe some examples which illustrate the importance of environment. For example, a very small tumour will sometimes destroy life when it occupies a vital organ. Thus a girl of fourteen years was seized with paraplegia and died in ten days. The cervical segment of the cord contained a tumour of the size and shape of a small olive. (Fig. 1.)

Some of the most tragic deaths due to tumours structurally benign occur in connection with the air passages. A man thirty-six years of age was found lying on his back

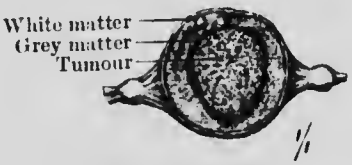

Fig. 1.—Cervical segment of the cord in transverse section, showing a tumour in the grey substance.

in a street adjacent to the Middlesex Hospital, apparently in a fit; when brought into the casualty-room he was dead. At the *post-mortem* examination a tumour was found connected with the cervical section of the windpipe. This tumour was an enlarged accessory thyroid gland; it was embedded in a thick fibrous capsule, its inner segment being firmly fixed to the trachea between the fourth and ninth semi-rings. The tumour, including its capsule, was somewhat larger than a dove's egg (Fig. 2), but it had severely compressed the trachea. (Fig. 3.)

The central part of the tumour exhibited under the microscope the characteristic structure of thyroid gland. The capsule consisted of dense laminæ of fibrous tissue. Had this tumour been recognised during life it could have been easily enucleated from its capsule.

The preceding examples show that the tumours classed as benign or innocent are only dangerous when from their

position they mechanically interfere with vital organs, or obstruct functions necessary to the maintenance of life. Malignant tumours, on the other hand, destroy life in whatever situation they arise. Melanomata illustrate this very well. A man fifty years of age came under my observation with an intra-ocular tumour no larger than a cherry-stone growing from the uveal tract. The eyeball was promptly excised, and the tumour, which in this case

Fig. 2.—An enlarged and encapsuled accessory thyroid gland. It compressed the trachea and produced fatal dyspnœa.

had a deep black hue, had remained strictly confined to the globe. Within two years this man died with secondary tumours in the liver and many other organs; his skin turned quite black, melanin appeared daily in the urine, and the free fluid in his belly also contained pigment in abundance.

Although it is true that malignant tumours destroy life in whatever situation they arise, nevertheless environment exercises great influence on the rapidity as well as

on the mode in which they kill. For instance, a cancer of the larynx may cause death from suffocation, but it is more frequently fatal by setting up septic pneumonia in consequence of the inhalation of septic matter from the sloughing surface of the growth. Cancer of the gastric orifices usually entails death from starvation, and malignant disease of the prostate destroys life by leading to renal disorders consequent upon impediment to the free escape of urine from the bladder.

It may be stated almost as an axiom that when a malignant tumour implicates a vital organ it will often destroy life before there has been time for dissemination.

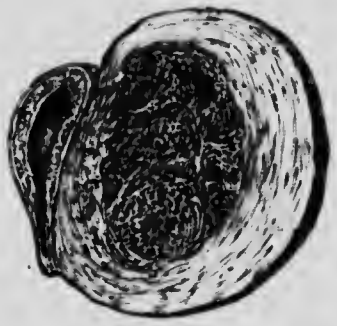

Fig. 3.—Section of the enlarged accessory thyroid gland and trachea, showing the amount of stenosis. (Natural size.)

When the environment has been unfavourable in this respect death is usually induced by secondary nodules occupying important organs, *e.g.* lungs, liver, brain, etc. This is a matter which will receive careful attention in the description of malignant [illegible] as it attacks different organs. It is, however, a very remarkable fact that while a periosteal sarcoma of the femur is the most deadly tumour which attacks the human frame, a sarcoma of the tibia with the same histologic characters will, with precisely the same treatment (amputation), take as many years to destroy life as the tumour of the femur required months. This would appear to indicate that the two tumours though structurally alike, really have different causes, yet there are facts which lead us to suspect that variations in tissue actually constitute an altered environment. The

only condition which supports this view in a positive way is echinococcus-disease. The final chapter of this book contains abundant evidence as to the effects of environment on the character of echinococcus colonies, besides illustrating the varied manner in which the surroundings determine the mode by which these parasites often induce the death of human beings, their involuntary intermediate hosts.

Some of the most terrible examples illustrating dangerous environment are inconspicuous solid ovarian tumours and dermoids, incarcerated in the pelvis by a gravid uterus. In many instances the presence of a tumour is unsuspected even when the woman has been hours in labour. Obstruction of this kind is very fatal to the child and often to the mother, and the injuries which women sustain in such circumstances are often of an appalling character, as works on midwifery testify. Even when ovarian tumours do not obstruct delivery, their co-existence with pregnancy is an inimical condition, and may bring about the death of the mother either in the progress of the pregnancy, during labour, or in puerpery. There are some anatomical conditions which distinguish innocent from malignant tumours: those that are benign usually possess an investing membrane, or capsule, by which they are isolated from the tissues in which they grow: they do not infect lymph glands, nor recur after complete removal, and rarely imperil life save when growing in connection with, or in the immediate vicinity of, vital organs. Malignant tumours, on the other hand, are rarely encapsuled, and tend to infiltrate the surrounding tissues; they infect the lymph glands, which receive the lymphatics from the part affected; are exceedingly liable to recur after removal, tend to become disseminated by the lymph and blood stream, and inevitably destroy life.

Malignant tumours of the connective tissue group are known as Sarcomata, and some are termed Endotheliomata; those of the epithelial group are Carcinomata (cancers). Chorion-epithelioma is excessively malignant, and the malign examples among the dermoid group are termed Malignant Embryomata.

Age Distribution.—Although some tumours may occur at any period of life—*e.g.* fatty tumours and sarcomata—the majority of the genera have a fairly well-defined, and in a few instances a very strict, age-limit. For example, the species of tumour known as glioma, which arises in the retina, has rarely been observed after the twelfth year. It is peculiarly limited to infants, and this is also the case with the remarkable condition known as "gliomatous disease" of the pons and medulla. Myelomata are tumours of adolescence, and this is true of odontomes, for they only arise in connection with the germs of the permanent teeth. Uterine fibroids are produced during menstrual life, and careful inquiry demonstrates that the dread Chorion-epithelioma (deciduoma) is a by-product of conception, and therefore restricted to the child-bearing period of life. Parovarian cysts do not occur before the fifteenth year, and papillomatous cysts of the ovary are fairly well distributed to the three decades bounded by the twenty-fifth and fifty-fifth years. Angeiomata and sequestration dermoids are essentially congenital tumours, whilst melanomata are almost confined to adults.

Cancer, though it occurs throughout the whole period of adult life, has many peculiarities in age distribution. For instance, cancer of the œsophagus and prostate is almost entirely confined to individuals who have attained advanced life, whereas cancer of the pylorus, rectum, or neck of the uterus may arise as early as the twenty-fifth year.

It may with truth be stated that age constitutes an environing condition when we reflect that sarcoma in infancy tends to be bilateral—*e.g.* when it attacks the kidneys, eyes, adrenals, or ovaries. In adult life sarcoma of these same organs is invariably unilateral; but, apart from this peculiarity, as many of the subsequent chapters will show, the tumours at these diverse periods of life exhibit obvious and unmistakable differences in their minute structure.

Multiplicity.—Innocent tumours are often multiple: five, ten, or twenty lipomata on an individual is not an uncommon event. A thousand neuromata have been counted

on one patient; a hundred fibroids may grow concurrently in the tissues of the uterus, and ten adenomata occasionally occupy a single thyroid gland, but the occurrence of two primary cancers in the same patient is excessively rare, with the exception of the peculiar variety known as rodent cancer.

The co-existence in the same person of two genera of innocent tumours is well known—indeed, is almost a matter of daily observation, uterine fibroids and ovarian dermoids, lipomata and sequestration dermoids, chondromata and osteomata being frequent combinations.

An individual may have one or more innocent tumours for many years, and then a carcinoma may arise, sometimes in an organ already occupied by a tumour. For example, the uterus may be the seat of a large fibroid and carcinoma may subsequently arise in the endometrium. Mammary carcinoma and ovarian adenoma occasionally grow concurrently; or cancer may arise in the mamma a year or more after the removal of an ovarian tumour.

The Transformation of Innocent into Malignant Tumours.—A long study of the histogenesis of tumours has convinced the writer that the clearly innocent and the decidedly malignant tumours present distinct histologic features, but there are intermediate varieties which cannot be sharply defined in relation to these points, and this comes out in a striking and suggestive way when an individual possesses tumours of a supposed innocent genus in multiples: for example, from uterine fibroids when they are multiple, a tumour may be selected which sometimes requires a saw to divide it; another may be as soft as a ripe fig, and a third will be as viscous as jelly and almost diffluent: a soft fibroid of this character will sometimes recur after enucleation. Careful records are accessible in which fibroids of apparently simple structure have disseminated and destroyed life; it should be borne in mind that the uterus is liable to be the seat of true sarcomata, which in the early stages mimic fibroids in their naked-eye characters.

It is so difficult to decide between the slow grow-

ing spindle-cell sarcoma, the fibrifying sarcoma, and the gelatinous fibroid (myxoma) that it is unwise to argue from our present knowledge that innocent connective tissue tumours may undergo transformation into sarcomata until distinctive methods have been introduced by the histologist, chemist, biologist, or bacteriologist. It may be stated that every genus of the connective tissue group, with the exception of the lipomata and osteomata, presents varieties which shade away indefinitely from the typical species towards the sarcomata, and display malignancy. It is also clear, from a careful study of the histology of tumours, that the more perfectly they approach in type normal tissues the more benign is their clinical conduct, and the more widely the tissues of a tumour depart from the normal elements in which they arise, so much more likely are such tumours to be malignant. It may be stated that a wide departure from the normal type of tissue in a given tumour expresses the degree of malignity. Certainly the more widely the cells of a tumour deviate from those normal to the matrix in which it grows the more rapidly do they multiply, and this persistent cell-proliferation is one of the most obvious features of malignancy. The more carefully the histology of tumours is investigated, the more obvious does it become that the borderland between innocent and malignant species becomes less easily definable. This has been very definitely revealed in the case of ovarian dermoids: few tumours had a better reputation for innocency, yet we now know that the less typical forms are liable to infect the peritoneum and even disseminate, and some varieties of testicular embryomata are among the most malign tumours that attack mankind. Realising the uncertainty attending the diagnosis and prognosis of tumours and tumour-diseases, pathology confirms the practice advocated by surgeons in dealing with them, namely, **removal, whenever practicable, at the earliest possible moment.**

Group I.

CONNECTIVE TISSUE TUMOURS.

CHAPTER I.

LIPOMATA (FATTY TUMOURS).

A **lipoma** is a tumour composed of fat; the genus consists of a single species. With the exception of sarcomata it is the most generalised genus of tumours which occurs in man. It therefore will be convenient to consider lipomata according to the situations in which they arise, such as the subcutaneous and subserous tissues; beneath synovial or mucous membranes; between or even in muscles; or in connection with periosteum, and the meninges of the brain and spinal cord.

1. **Subcutaneous Lipomata.**—Beneath the skin there exists a layer of fat, which varies in thickness in different parts, but is most abundant over the trunk and trunk ends of the limbs. This subcutaneous fat is a common situation in which to find lipomata. Usually they occur as irregularly lobulated encapsuled tumours, more or less adherent to the skin. Unless they have been irritated, lipomata are movable within their capsules. Generally one lipoma is present, but two, ten, twenty, or more may occur concurrently on the same individual. In size they vary widely; a lipoma weighing sixteen ounces is a tumour of fair size; exceptional specimens have been reported to weigh fifty, eighty, and even one hundred pounds. Although subcutaneous lipomata are for the most part confined to the trunk and trunk ends of limbs, they may arise on the distal parts of the limbs, such as the hands and feet. (Figs. 4 and 5.) Many specimens have been

observed in the palm of the hand, a situation in which they are apt to give rise to difficulty in diagnosis, more especially as they simulate compound ganglia of the flexor tendons. The lobes of fat are apt to burrow beneath the palmar fascia, and it is probable that some lipomata of the palm originate beneath this fascia, in the lobules of fat lying between the lumbricales. A lipoma has been observed on the back of the hand of a boy eight years old,

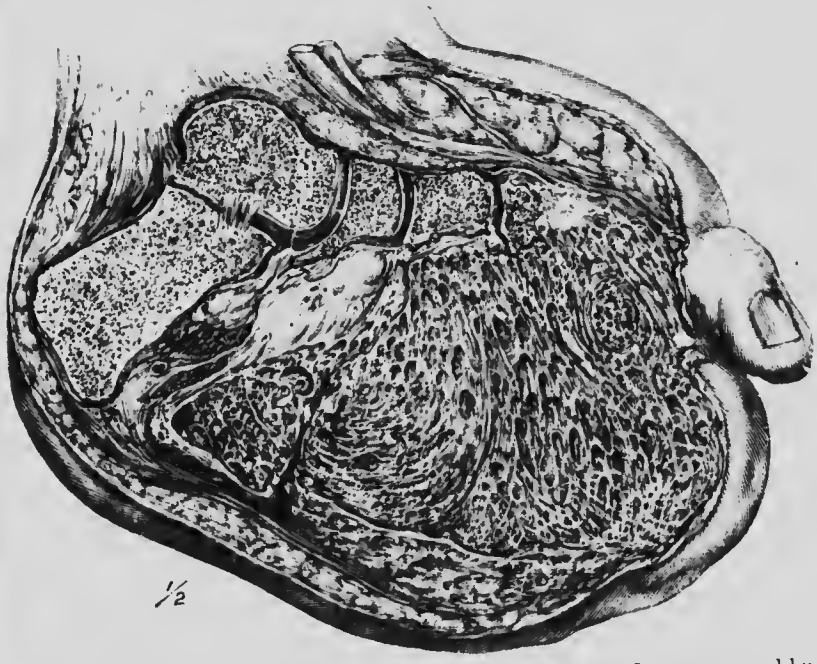

Fig. 1.—Lipoma of the sole which had existed for thirty years. It was removed by Percival Pott. (*Museum of St. Bartholomew's Hospital.*)

and a process of the tumour passed between the third and fourth metacarpals into the palm (Pupovac). Fatty tumours are occasionally found on the fingers: Steinheil has collected a large number of examples. A lipoma in the sole is more comprehensible than one in the palm, yet, strange to relate, they are far more frequent in the hand than in the foot; in both situations they are apt to be congenital, and nearly always cause doubt in diagnosis. (Gay, Lockwood.)

Subcutaneous lipomata are often symmetrical, and are

apt to become pedunculated, especially when growing from the thigh. Pedunculated lipomata are never very large, and when the pedicle is thin it will become twisted by the rotatory movements of the tumour, the growth of which will in consequence be arrested, or at least checked.

Fatty tumours are rarely met with upon the head or face, but I have on three occasions removed a lipoma from

Fig. 5.—Lipoma in the palm.

beneath the skin covering the temporal fascia. There is a variety of fatty tumour sometimes called, on account of its vascularity, *nævo-lipoma:* this may be a nævus which has undergone fatty degeneration. Probably some of the vascular lipomata which occasionally occur on the face are of this nature.

Fatty tumours which have existed many years sometimes calcify, the earthy matter being deposited in the fibrous septa of the tumours. A partially calcified lipoma

is preserved in the museum of St. Bartholomew's Hospital which came from the arm of an Arab sheikh, where it had existed fifty years. Calcification may be associated with saponification of the fat.

The subcutaneous fat in the neck, axilla, and groin sometimes forms irregularly lobulated masses called diffuse lipomata, but they are not strictly tumours (Fig. 6.)

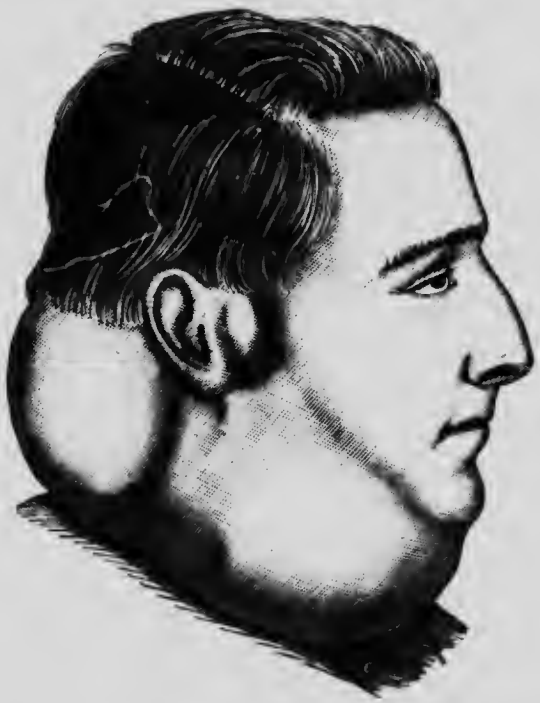

Fig. 6.—Diffuse lipoma of the neck. (*After Morrant Baker.*)

Subserous Lipomata.—The peritoneum, like the skin, rests upon a bed of fat, the thickness of which varies considerably. Lipomata occurring in subserous tissue are sessile, or pedunculated.

Surgeons have long been aware, in operating for inguinal or femoral hernia, that occasionally they come across a mass of fat, and find difficulty in determining whether it be omental or a local increase of the subserous fat surrounding the hernial sac. It is now clear that in the neighbourhood of the femoral and inguinal canals an over-

growth of the subserous fat may occur and be mistaken for a hernia, and individuals have been recommended to wear, and have actually worn, trusses for fatty masses of this character. It is also clear that as these local overgrowths of fat arise and protrude in the groin, they occasionally draw with them a pouch of peritoneum unassociated with a hernia. These pouches may afterwards lodge a piece of gut, and become true hernial sacs. Thus peritoneal pouches, produced mechanically by subserous lipomata, may subsequently become hernial sacs; on the other hand, lipomata may arise in relation with peritoneal pouches which were originally hernial sacs. In some cases a subserous lipoma of this character will invaginate a peritoneal pouch and form a pedunculated tumour within the hernial sac. More rarely a fatty tumour will arise in connection with the spermatic cord. Gabryszewski has collected the more important cases, and discussed the difficulty such tumours cause in diagnosis. Andrewes found a tumour which appeared to be a lipoma of the spermatic cord, but on microscopic examination it exhibited the structure of an adrenal. Fatty tumours arise in the scrotum or labium without being connected with hernia pouches. (Hutchinson.)

Lipomata arising in the subperitoneal tissue occasionally appear in the anterior abdominal wall, especially near the umbilicus; they are known as "fatty herniæ of the linea-alba," and are frequently associated with peritoneal pouches.

Lipomata sometimes grow between the layers of the mesometrium, and in some instances are so large as to simulate ovarian tumours. (Parono, Treves.)

Masses of fat, in many respects resembling the so-called "diffuse lipoma" of the subcutaneous tissue, have been removed from the abdomen weighing thirty and even fifty pounds. (Pick, Cooper Forster.)

Hernial lipomata are interesting, for they explain the mode in which appendices epiploicæ arise: these are localised pedunculated overgrowths of subserous fat, and are particularly large and arborescent in the neighbourhood of an old syphilitic stricture of the rectum.

In well-nourished individuals the fat of the appendices

epiploicæ is directly continuous with the fat in the layers of the mesentery: when wasting occurs the fat between the appendices and the mesentery is liable to atrophy and to leave an adipose nodule at the bottom of a peritoneal pouch. The movements of the intestine and the traction of the nodule lead to the formation of a pedicle which often becomes twisted; sometimes the pedicle is so thin that it breaks, and the appendix is set free. Pieces of fat, not unfrequently calcified, detached in this way, have been found in hernial sacs.

A fatty tumour may arise in the fat behind the ensiform cartilage, and, extending through the gap in the diaphragm in this situation, occupy the lower end of the anterior mediastinum.

Rokitansky pointed out that the subpleural fat in the intercostal region sometimes forms a lobulated mass which prolapses into the sac of the pleura. C. Gussenbauer has described and figured a subpleural lipoma which made its way on each side of the ribs. The two lobes were joined by a narrow isthmus so as to form an intra- and an extra-thoracic portion; the latter bulged under the pectoralis major and simulated a sarcoma.

3. **Submucous Lipomata.**—Fat exists in submucous tissue in many situations, and, like that in the subcutaneous tissue, is not infrequently the source of lipomata.

(*a*) *Subconjunctival Lipomata.*—These occur near the line where the conjunctiva is reflected from the lower lid to the eyeball; they are almost entirely confined to children. Fatty tumours sometimes arise from the orbital fat and cause the conjunctiva to protrude in the neighbourhood of the lacrimal gland and near the insertions of the ocular muscles.

(*b*) *The Lips.*—Lipomata in this situation are very rare and never large. (Edmunds.)

(*c*) *Laryngeal Lipomata.*—A few remarkable examples have been reported. Holt met with a pedunculated lipoma 22·5 cm. in length, which grew from the side of the left aryteno-epiglottic fold and extended into the œsophagus. Sidney Jones removed a lipoma from the right aryteno-epiglottic fold of a man 40 years of age. The patient could protrude the tumour into his mouth.

(*d*) *Gastric Lipomata.*—Virchow has figured a lipoma which grew beneath the mucous membrane near the pylorus; it was as big as a nut.

(*e*) *Intestinal Lipomata.*—A submucous fatty tumour of the small or the large intestine is very rare, and in both situations may be occasionally inimical to life. The danger of a lipoma of the ileum is well set out in a case recorded by Stabb; the tumour arose in the submucous tissue 75 cm. from the ileo-cæcal valve; in size and shape it resembled three acorns conjoined at the cups, and it caused intussusception of the bowel. The invagination was reduced and the tumour excised. Unfortunately the mucous membrane sloughed, and the patient, a man of 32 years, died. The specimen is preserved in the museum of St. Thomas's Hospital.

I successfully removed from a man 44 years of age a lipoma, weighing two ounces, which occupied the submucous tissue of the ascending colon, 5 cm. above the ileo-cæcal valve. The patient had passed through several acute attacks of intestinal obstruction. During the operation in this case I saw that the serous coat over the tumour was dimpled. Stabb noticed the same condition in his case, so that it is quite possible that these lipomata, though projecting into the gut, really arose in the subserous stratum of fat.

Submucous fatty tumours have been observed on several occasions in the jejunum and colon. The great danger is, of course, their liability to obstruct the intestine. The literature of intestinal lipomata has been collected by Hillier and by Langemak.

4. **Subsynovial Lipomata.**—Beneath the subserous tissue of large joints, such as the knee, there is a layer of fat of varying thickness. This fat may, as in the case of inguinal lipomata, increase in quantity and, projecting into the joint, form a fatty tumour. A common situation for this to occur is beside the patella, at the spot normally occupied by the alar ligaments. Many specimens are doubtless due to overgrowth of the fat in the alar fringes, but they may arise in other parts of the joint.

The best-known variety of subsynovial fatty tumour is

that to which Müller applied the term "lipoma arborescens." This condition is often, but by no means always associated with rheumatoid arthritis. A typical specimen (Fig. 7) consists of small finger-like processes of fat projecting into the cavity of the joint; each process is covered with synovial membrane. The lipoma arborescens bears precisely the same relation to the synovial membrane that

Fig. 7.—Lipoma arborescens of the shoulder-joint.
A. Acromion. G. Coracoid. F. Glenoid fossa.

the appendices epiploicæ bear to the peritoneal investment of the colon and sigmoid flexure.

5. **Intermuscular Lipomata.**—Fatty tumours now and then arise in the connective tissue between muscles; they have been found between the greater and lesser pectorals between the muscles of the tongue, and the intermuscular strata of the anterior abdominal wall. In the last-mentioned situation they have been known to attain prodigious

proportions. Exceptional examples have been described by Astley Cooper, Eve, and Abdel-Fattah Fehmy.

The most remarkable example of this variety of lipoma arises in connection with the sucking-cushion (Fig. 8). This curious ball of fat is situated between the masseter and buccinator muscles, and comes into close relation with the buccal mucous membrane. It is believed to play an important function in connection with sucking, by distributing atmospheric pressure and preventing the buccinators

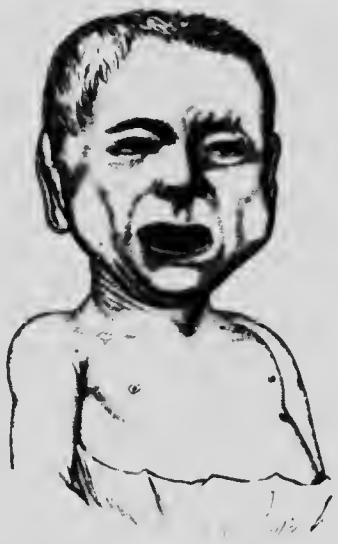

Fig. 8.—Emaciated child crying and displaying sucking-cushions.
(*After Ranke.*)

from being forced between the alveolar arches when a vacuum is created in the mouth. They are relatively much larger in infants than in adults. Ranke also points out that in emaciated children the cushions are only slightly diminished in size, even when there is scarcely any subcutaneous fat.

The sucking-cushions sometimes enlarge in adults, and simulate more serious species of tumours, and it is curious that in some of the recorded cases the enlargement of the cushion has been associated with the impaction of a salivary calculus in the duct of the parotid gland (Berger, Owen). The association of an impacted salivary calculus

and an enlarged sucking-cushion is interesting in relation with an observation of Norman Moore, who found a large collection of fat around a ureter at the site of an impacted calculus (Museum, Royal College of Surgeons).

6. **Intramuscular Lipomata.**—Many examples of fatty tumours occurring in the midst of muscles have been reported, and are of interest from the trouble they cause in diagnosis. They have been found in the deltoid, biceps humeri, complexus, and rectus abdominis; and in the middle of a submucous myoma of the uterus (T. Smith, Lebert). The condition described as fatty tumour of the heart is simply overgrowth of the fat occupying the auriculo-ventricular grove.

7. **Parosteal Lipomata.**—This term has been applied to fatty tumours arising from the periosteum of bone. They are usually congenital, and nearly always contain tracts of striated muscle fibre. Some of these tumours are clinical puzzles. Dr. F. Taylor reported a case in which a fatty tumour grew from the anterior surface of the bodies of the cervical vertebræ; it caused the posterior wall of the pharynx to project, and simulated a post-pharyngeal abscess. The patient was a girl four years old. I have removed parosteal lipomata from the dorsal surface of the infraspinous fossa of the scapula, the body of the pubes, and the frontal bone immediately above the right superciliary ridge.

The appended table contains references to descriptions and accessible examples of parosteal lipomata.

PAROSTEAL LIPOMATA.

Seat.	Reported by	Reference.
Femur	D'Arcy Power	*Trans. Path. Soc.*, xxxix. 270.
	F. Page	*Lancet*, 1895, vol. ii. 150.
Tibia and Fibula	Butlin	*Trans. Path. Soc.*, xxviii. 221.
Ischium	T. Smith	*Trans. Path. Soc.*, xvii. 286.
Spine of Ilium	Walsham	*Trans. Path. Soc.*, xxxi. 310.
Clavicle	Gould	Museum, Middlesex Hospital.
Scapula	T. W. Nunn	Museum, Middlesex Hospital.
Neck of Radius	T. Smith	*Trans. Path. Soc.*, xix. 344.
Coccyx	T. Smith	*Trans. Path. Soc.*, xxi. 334.
Frontal	Sidney Jones	*Trans. Path. Soc.*, xxxii. 243.

8. **Lipomata on Nerves.**—Occasionally a fatty tumour arises from the sheath of a peripheral nerve; such are sometimes called *neuro-lipomata*. There is a specimen in the museum of the Middlesex Hospital which grew from the sheath of the median nerve as it escaped from the anterior annular ligament into the palm. It was situated entirely beneath the palmar fascia. Vickery recorded a case in which he succeeded in removing a lipoma weighing 12½ ounces from the thigh of an infant nine months old

Fig. 9.—Infant 9 months old with a large lipoma growing among the hamstring muscles. It was successfully removed. (*After Vickery.*)

(Fig. 9). The tumour was adherent to the sheath of the great sciatic nerve. Before operation it simulated a sarcoma.

9. **Meningeal Lipomata.**—Fatty tumours occur within the spinal dura mater, as well as externally to this membrane. When growing within the sheath they surround the cord. Gowers, Recklinghausen, and Obré have recorded examples. In the cases described by the first two observers the tumours contained striped muscle tissue. The occurrence of an intra-dural lipoma is not surprising, as the loose connective tissue between the cord and dura mater contains fat.

Fatty tumours are not uncommon in the middle line of

the back, especially in the lumbo-sacral region, overlying the sac of a spina bifida (Figs. 10 and 11).

A lipoma has been observed encapsuled between the layers of the dura mater lining the sella turcica; it extended into the middle fossa of the skull on the left side. The patient, who was a woman forty-four years of age, suffered from periodical

Fig 10.—Meningeal lipoma simulating a spina bifida in a child eight months old. (*After Témoin.*)

pain in the head, and eventually from ptosis (two years). The tumour was of the dimensions of a hen's egg.

Clinical Features.—Although lipomata occur more frequently than any other genus of connective tissue tumours, and may, in most instances, be diagnosed with absolute certainty, yet under some conditions they are very puzzling, and give rise to much difference of opinion. The sub-

cutaneous species is rarely the source of doubtful diagnosis, unless situated in the palm, the sole, or on the scalp. The intimate relation between the tumour and the overlying skin, the absence of definite boundaries, and its dough-like consistence are usually sufficiently trustworthy guides. When a lipoma is connected with the periosteum of a long bone it will sometimes simulate a

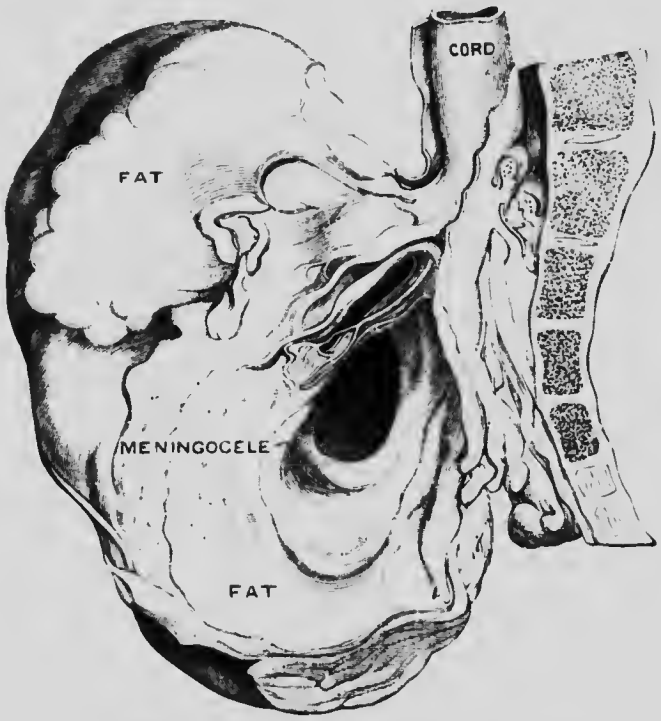

Fig. 11. – Meningeal lipoma overlying the sac of a spina bifida.
(*Museum, Royal College of Surgeons.*)

sarcoma: when embedded in a muscle the most divergent opinions are often expressed in regard to the nature of the tumour: and a lipoma in the posterior triangle of the neck has been mistaken for an aneurysm of the subclavian artery.

Reference has already been made to those large lipomata which arise in the subperitoneal tissue, and the way in which they mimic the signs of ovarian tumours. Lipomata in the neighbourhood of hernial openings have also been confounded with hernia.

Especial attention must be drawn to supposed fatty tumours situated in the middle line of the back: in most cases these are abnormal masses of fat overlying the sacs of spinæ bifidæ. Incautious surgeons, in operating upon such tumours, have unexpectedly opened the dura mater.

Treatment.—Solitary subcutaneous lipomata should, as a general rule, be removed. When very many tumours are present (ten or twenty) it is not customary to interfere with them, for when multiple they rarely attain uncomfortable or dangerous proportions. It occasionally happens with multiple (and also with solitary) lipomata, that one or other becomes irritated by some part of the dress, such as petticoat bands, braces, etc., or in some particular employment followed by the individual. Such tumours should invariably be removed.

The removal of a subcutaneous lipoma is one of the simplest proceedings in surgery, but the extirpation of a large subperitoneal fatty tumour is often attended with difficulty and grave danger.

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CHAPTER II.

CHONDROMATA (CARTILAGE TUMOURS).

A **chondroma** (or enchondroma) is a tumour composed of hyalin cartilage. Its tissue resembles histologically the bluish transl[illegible]t cartilage of an epiphysis. This genus contains th[illegible] cies—(1) chondroma, (2) ecchondrosis, (3) loose cart[illegible] in joints.

1. **Chondromata.**—This species in its most typical conditions occurs in long bones, and, as a rule, in relation with the epiphysial cartilages; hence this tumour is most frequently observed in children and young adults. A single tumour may be present, but frequently many grow concurrently, especially on the long bones of the hand and feet. An exceptional example is represented in Fig. 12, but similar conditions have been described by Kast, Steudel, and Recklinghausen.

Chondromata are always encapsuled, and often form deep hollows in the bones from which they arise. They are painless, grow slowly, and are firm to the touch. Frequently they undergo mucoid degeneration, then the softened area give rise to fluctuation. This serves to distinguish them from osteomata, with which they are apt to be confounded clinically. A chondroma frequently calcifies, and sometimes ossifies (Fig. 13).

The frequency of chondromata in those who suffered from rickets in early life may be due, as Virchow thought probable, to the existence of untransformed pieces of cartilage acting the part of tumour germs. Such remnants of unossified cartilage are not difficult of demonstration in rickety bones (Fig. 14).

A chondroma is a very benign tumour, and even when it grows into the skull may require a long time to destroy life, as [illegible] very remarkable specimen in the museum of

St. George's Hospital proves. It is a cartilage tumour which arose in the mesethmoid of a young woman, and then filled the nasal fossæ and occupied both orbits, and dislocated the globes outwards: it filled the antra, expanded the nasal bones, invaded the spheno-maxillary fossæ, and formed a large mound in the anterior fossa of

Fig. 12.—Multiple chondromata. (The lad was stunted from rickets.)

the skull, and almost reached the roof of the cranium. Its disruptive effects upon the facial bones were very extraordinary. In spite of this, the patient's health was but little disturbed; she had no loss of intellect, and, it is believed, no paralysis. The course of the disease from its origin till the patient died was about six years.

Although a chondroma invading the skull may require (as in the example just described) years to kill a patient,

there is a situation in which in certain circumstances it will cause great distress and death—namely, in the pelvis. The effects which such tumours produce on the pelvic viscera are in some cases very remarkable. The specimen represented in section in Fig. 13 was obtained from a woman 21 years of age who, with a large chondroma in her pelvis, became pregnant. Delivery by natural means

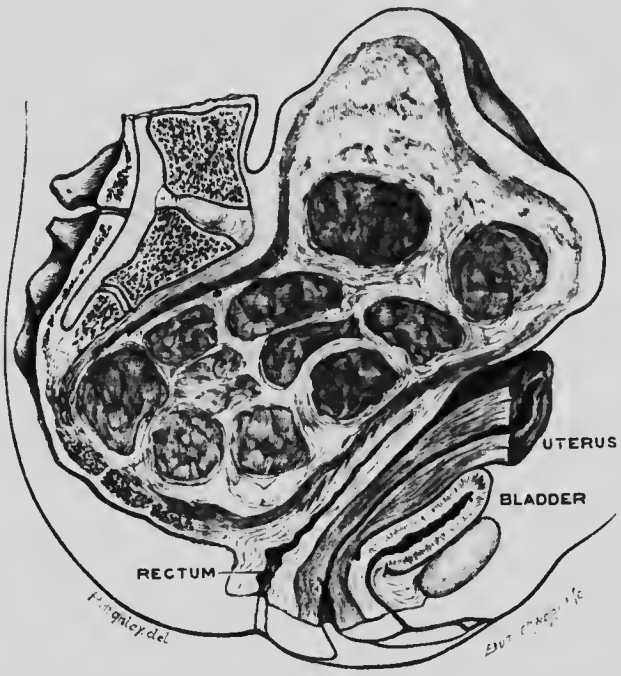

Fig 13.—Pelvis occupied by a large, partially ossified chondroma, shown in sagittal section; from a woman 21 years of age who died from hysterectomy performed for obstructed labour at term. (*Museum of University College, London.*)

being impossible, hysterectomy was performed; but the patient died. Apart from obstructing labour, the tumour had pressed on the ureters and produced dilation of both of them and sacculation of the kidneys. This unfortunate woman was known to have a tumour in her pelvis seven years previous to her tragic death.

One of the greatest anomalies in connection with chondromata is their occurrence in the parotid, lacrimal, and submandibular glands. (See Chap. VIII.)

2. **Ecchondroses.**—These may be defined as small local overgrowths of cartilage. They are best studied along the edges of articular cartilages, the laryngeal cartilages, and the triangular cartilage of the nose.

Ecchondroses are especially common in the knee-joint, and often in association with the condition termed rheumatoid arthritis. They are frequent in the joints of individuals who have passed the meridian of life, and they occur as small projecting prominences along the margins of the articular cartilage. Often the edge of the cartilage is produced into a raised prominent lip, the regularity of

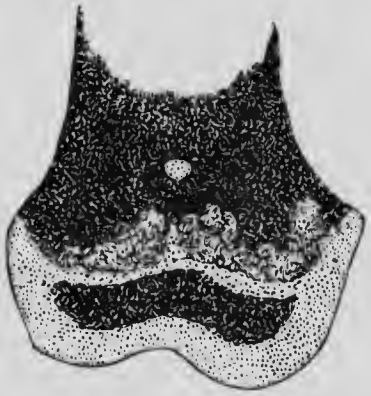

Fig. 14.—Condyles and epiphysial line of a rickety femur, with a cartilage island. (*Museum of the Middlesex Hospital.*)

which is broken here and there by a sessile or pedunculated nodule.

When these nodules are examined many of them present on their outer surface a convex outline, but on the inner aspect—that looking towards the joint—they are concave, the concavity being produced by friction during the movements of the joint, or by pressure when the parts are at rest. Occasionally erosion of the ecchondrosis may extend so deeply that by some extra movement of the joint the pedicle is broken, and the detached nodule either falls as a loose body into the joint-cavity, or it may be retained in position by its attachments to the fibrous structures of the articulation.

Laryngeal ecchondroses are by no means common; they grow from the thyroid, cricoid, and occasionally the

arytenoid cartilages, but very rarely from the semi-rings of the trachea. Paul Bruns collected fourteen cases of laryngeal chondromata; of these, eight sprang from the cricoid, four from the thyroid, one from the arytenoid, and one from the epiglottis. Most of the ecchondroses of the cricoid cartilage sprang from the broad posterior plate. In many of the cases the inner and outer surfaces of the cricoid were involved, so that the tumour encroached upon the cavity of the larynx. Ecchondroses vary greatly in size: some are scarcely larger than a pea, others may be as big as walnuts. Morell Mackenzie has described an example growing from the cricoid which attained the size of a bantam's egg; in this instance the tumour extended downwards in front of the trachea. Small ecchondroses growing from the inner surfaces of the laryngeal cartilages are more dangerous than the larger examples springing from their outer surfaces. Ecchondroses, when projecting into the larynx, are covered with its mucous membrane; they may be smooth or tuberculated, round or conical. In exceptional cases the overlying mucous membrane has been found ulcerated. Chondromata, when they project into the larynx, produce stridor, difficulty in breathing, and sometimes interfere with the movements of the vocal cords. When the tumours only involve the outer surfaces of the laryngeal cartilages, they do not as a rule produce any inconvenience, unless they are exceptionally large.

Small outgrowths from the triangular cartilage of the nose are by no means uncommon; they never attain a large size, and are always sessile. It is difficult to imagine that ecchondroses of the nasal cartilage could be a source of much inconvenience, but surgeons who study diseases of the nasal passages view them with disfavour.

3. **Loose Cartilages.**—Bodies of various kinds are found loose in the cavities of large joints, but those to be considered under the head of chondromata, in addition to detached ecchondroses, are pieces of hyaline cartilage found hanging in the joint by narrow pedicles, or occupying depressions in the bone from which they are occasionally dislodged. Structurally they are composed of hyaline cartilage, and assume various forms. Some appear as flat discs, others are ovoid: they may

be perfectly smooth, or present an irregular worm-eaten appearance, and the majority are impregnated with calcareous particles. It is a remarkable fact that in many instances in which a loose cartilage has been found in one joint, a body identical in size and shape has been found in the corresponding joint of the opposite limb (Bowlby, Clutton, Weichselbaum). Loose cartilages may be single or multiple: several hundred may exist in one joint, and vary in size from a rape-seed to an almond.

The origin of these cartilages is interesting. In large joints, such as those of the hip, knee, or shoulder, it is easy to demonstrate, in the recesses of the joint near the spot where the synovial membrane becomes continuous with the margin of the articular cartilage, villous-like processes of the synovial membrane projecting into the joint. Under certain conditions, especially that known as rheumatoid arthritis, these villi become greatly enlarged and increase in number until the whole synovial membrane may be so covered with them as to become quite velvety in appearance. Structurally, these synovial villi consist of a reduplication of the serous membrane, and contain tufts of capillaries. As they enlarge, some of them undergo chondrification, and this change may take place so extensively that a villous process is entirely converted into hyalin cartilage, which becomes the matrix for a deposit of lime salts. As these nodules of cartilage are merely sustained by narrow pedicles, the nodules may be detached either by their mere weight, by undue movement of the joint, or from axial rotation, and, tumbling into the joint, give rise to all the inconveniences characteristic of a loose body. Specimens occasionally come to hand in which cartilaginous bodies of this description may be found sessile among the fringes, or hanging on good pedicles, or with stalks so thin that they appear to be on the eve of detachment.

Occasionally these overgrown synovial villi, instead of chondrifying, are converted into oval bodies, which, on microscopic examination, present a central cavity surrounded by a laminated structureless substance. To the naked eye many of these oval bodies resemble cartilage, and it is only on microscopical examination that it is possible to distinguish between them: many are infiltrated with calcareous granules.

These oval bodies are present, in some cases, in great number. On one occasion I counted 1,532 which were removed from the shoulder-joint. Bodies of this description occur not only in joints, but in compound ganglia and bursæ.

A good physiological type for the loose cartilaginous bodies which infest joints is furnished by the temporo-mandibular joint of the skate. A recess communicating with this articular cavity usually contains a collection of smooth cartilaginous bodies, in contour and size like melon seeds.

Treatment.—The operative treatment of chondromata has been greatly simplified since surgeons have appreciated the fact that these tumours, when growing in relation with bones, are distinctly encapsuled. Now, when it is necessary to interfere with a chondroma, even in cases where several tumours are present, it has become customary to incise the capsule and shell out the cartilage. In most instances this simple method is successful. Exceptionally, however, cases come under observation which demand more serious measures. When the cartilage tumours are very numerous on the bones of the hand, the fingers are so crippled and useless that amputation becomes necessary. Fortunately, such severe treatment is very rarely needed.

In the case of loose bodies in joints it is the usual practice, when the pieces of cartilage are in the habit of getting between the opposed surfaces of the joint, to open the synovial cavity, and remove the loose body or bodies. When this manœuvre is conducted with proper care it is highly successful. When the loose body is lodged in a sacculus, it is in a measure isolated from the general cavity of the joint, and does not call for interference. The smaller bodies, which, like mice, slip in and out of the recesses of a complex joint, are more likely to give trouble than those larger pieces of cartilage, sometimes as big as chestnuts, which the patients can grasp with their fingers and push in and out of the great cul-de-sac above the patella almost as readily as a marble may be manipulated under a tablecloth.

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CHAPTER III.

OSTEOMATA (OSSEOUS TUMOURS).

An **osteoma** may be defined as an ossifying chondroma. The genus contains two species: 1, Compact osteoma; 2. Cancellous osteoma.

1. **Compact Osteomata.**—These occur as sessile tumours on the parietal and frontal bones; in the frontal sinus, roof of

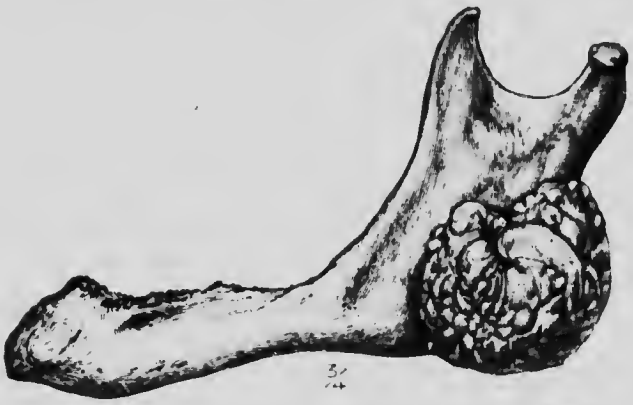

Fig. 15.—Osteoma of mandible. (*St. George's Hospital Museum.*)

the orbit, walls of the external auditory meatus, mastoid process, and angle of the mandible (Fig. 15). They are composed of tissue as dense and as hard as ivory, and are frequently called "ivory exostoses." Those which arise in the frontal sinus and orbit are very remarkable tumours, and may attain large proportions (Figs. 16, 17, 18, and 19). Many large tumours removed from the maxilla and described as exostoses were large odontomes (see Chapter XXI.).

Large osteomata of the facial bones sometimes produce hideous deformity, and when they grow from the bones forming the rim of the orbit sometimes destroy the eye. All. The clinical histories of some of these cases are very remark-

able; for example, a man came under Lediard's observation with a large osteoma protruding from the orbit (Fig. 16). The patient, a sailor, stated that the tumour was noticed at birth, when it seemed scarcely larger than a pea; it slowly increased in size, and when he was nine years old it destroyed the eyeball. When he was 25 years of age the skin of the eyelid sloughed. Eight years later the tumour fell out of the orbit.

The spontaneous detachment of an osteoma in this way is

Fig. 16.—A sailor with a large osteoma growing from the orbit. (From a water-colour sketch in the Museum of the Royal College of Surgeons.)

due to necrosis of the tumour, and is parallel to the shedding of the antlers in the stag. Osteomata of the orbit which have resisted the efforts of surgeons to remove them have years after such operations fallen of their own accord.

The large and exceedingly hard ivory-like tumours which grow in the frontal sinuses are uncommon. An admirable example figured by Baillie, and preserved in the museum of the Royal College of Surgeons, is unfortunately without history.

Osteomata of this kind arise occasionally in the frontal sinuses of oxen, and form huge irregular lobulated masses,

sometimes weighing as much as sixteen pounds. Similar tumours grow from the petrosal and encroach upon the cranial cavity; some of these have been reported in veterinary literature as ossified brains!

Osteomata at the margins of the external auditory meatus have been especially studied because they are apt to obstruct the meatus and cause deafness; when both meatuses are affected—and this is not rare—absolute deafness may result.

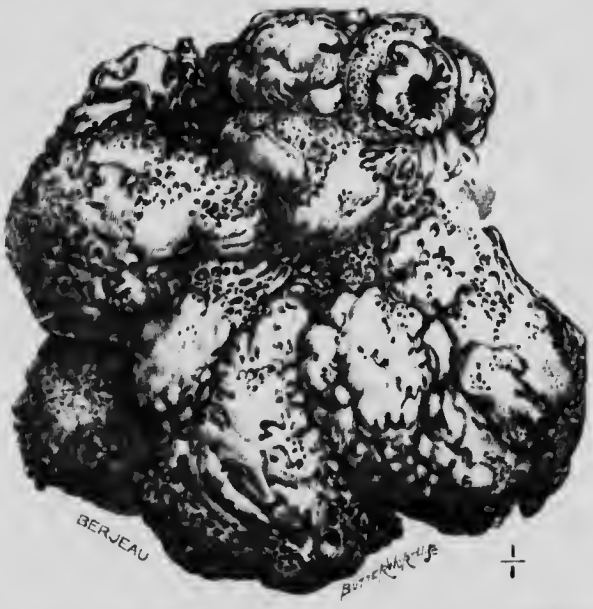

Fig. 17.—An orbital osteoma weighing 9½ ounces, which underwent spontaneous detachment. (*Museum of the Royal College of Surgeons.*)

It is a curious fact that osteomata at the margins of the auditory meatus have been observed in many different races of men. Professor Sir William Turner has drawn attention to observations of Seligmann, Welcker, and Barnard Davis, and added some of his own, concerning the presence of such exostoses in certain deformed skulls described as Titicaca's, Huanaka's, and Aymara's. Also in skulls from the Marquesas Islands, Sandwich Islands, Chatham Island, and New Zealand. It is not surprising that osteomata should arise from the walls of the external auditory meatus when we remember the number of centres by which the periotic cartilage is

transformed into bone, and the various ossific elements that come into relation with each other at this meatus.

2. **Cancellous Osteomata.**—These tumours in structure

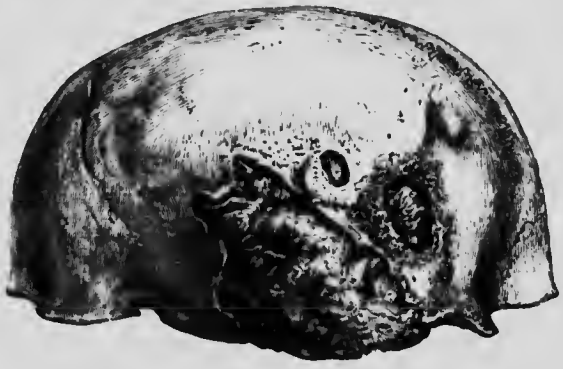

Fig. 18.—Osteoma of the left frontal sinus (anterior view).

resemble the cancellous tissue of bone, and are soft in comparison with the preceding species. They usually possess a thick covering of hyaline cartilage, and when growing at the distal end of the radius, or tibia, present a series of deep

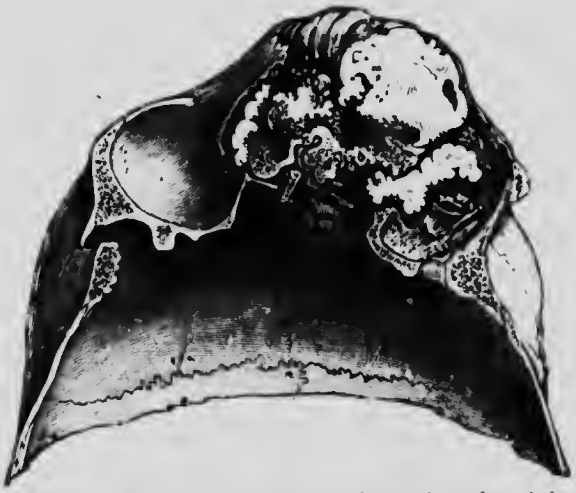

Fig. 19.—Osteoma of the left frontal sinus (seen from below).
(*Museum of the Royal College of Surgeons.*)

channels for the passage of tendons. Occasionally an osteoma is pedunculated; more frequently it has a broad base. Osteomata, whether sessile or stalked, usually grow slowly, but in

the course of years they sometimes attain large proportions. They are innocent tumours, but occasionally imperil life by mechanically interfering with the function of vital organs. Reid described a case in which an osteoma grew from the posterior surface of the odontoid process and projected into the neural canal to the extent of 8 mm. and compressed the spinal cord with fatal effect. Although in themselves painless, osteomata sometimes induce pain by pressing on nerve

Fig. 20.—Cancellous osteoma of the scapula. (*Museum of the Royal College of Surgeons.*)

trunks in their vicinity. Often an osteoma is quite harmless (Fig. 20).

Multiple cartilage-tipped osteomata are most frequent on the long bones of the arms and forearms, thighs and legs, and are often congenital, hereditary, and, so far as position is concerned, fairly symmetrical. Otto Weber recorded a remarkable case of numerous symmetrical exostoses of the long bones of the upper and lower limbs, the ribs, and scapula in a man 25 years old. A chondro-sarcoma arose in the right hip bone and attained enormous proportions. It perforated

the left external iliac vein, and pieces of the tumour, detached as emboli, lodged in the pulmonary artery.

Exostoses.—It has been customary to describe all kinds of tumours composed of bone, or bone-like tissue, under the name of exostoses. The term exostosis should be limited to irregular outgrowths of bone to which the term tumour is not

Fig. 21.—Exostosis of the femur, produced by ossification of the tendon of the adductor magnus. (*Museum of the Royal College of Surgeons.*)

in any sense applicable. The various bony outgrowths classed as exostoses fall into three groups:—

1. Ossification of tendons at their attachments.
2. The subungual exostosis.
3. Calcification of inflammatory exudations.

1. *Exostoses formed by Ossification of Tendons at their Attachments.*—The long bones of a child at birth are smooth in outline and almost cylindrical in shape: the periosteum is relatively thick, and gives attachment to the muscles. On examining the long bones of an adult muscular man their shafts are found to be irregular, and present many asperities, such as the linea aspera, gluteal ridge (sometimes called the third trochanter), oblique lines, and the like. These ridges

and lines, in the majority of instances, are the ossified insertions of muscles, and occasionally they are so pronounced as to be appreciable through the soft structures, and are then described clinically as exostoses. The two most frequent examples of this form of exostosis are the adductor tubercle of the femur and the tubercle on the first rib at the insertion of the scalenus anticus. Probably the most common exostosis is that which occurs in the tendon of insertion of the adductor magnus (Fig. 21): it usually assumes the form of a broad ledge of bone; exceptionally it is stalked, and in rare cases surmounted by a bursa: the walls of such bursæ are now and then furnished with villi, and even loose bodies have been

Fig. 22.—Symmetrical exostoses of the nasal processes of the maxillæ. (*After Hutchinson.*)

found in them (Orlow). Care must be taken not to confound a supracondyloid process of the humerus, and the occasional third trochanter of the femur, with exostoses.

Localised outgrowths are very common on the facial bones, especially the nasal processes of the maxillæ, where they may be unilateral or bilateral (Fig. 22). The cause of these exostoses is obscure. Small irregular osseous prominences are fairly frequent along the alveolar borders of the maxillæ and mandible.

Exostoses of the maxillæ have been observed in natives of the West Coast of Africa, and in all probability have originated the myth of the existence of horned men in this region. Interesting particulars relating to this ques-

Fig. 23.—So-called horned men of the Ivory Coast. (*Macland.*)

tion are furnished by Macalister and by Lamprey. Strachan has observed them in the West Indian negro, and Dr. Macland, of the French Navy, met with them frequently in the natives of certain villages on the Ivory Coast (Fig. 23).

2. *The Subungual Exostosis* is a troublesome outgrowth from the ungual phalanx of the big toe; it makes its way through the bed of the nail, and peers out between the

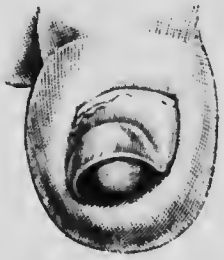

Fig. 24.—Big toe with a subungual exostosis.

nail and the skin at the tip of the toe, near the inner side (Fig. 24); its appearance is so characteristic that it only requires to be once seen to be appreciated readily. It is rarely bigger than a cherry-stone.

When the soft investing tissues are removed, the tumour

appears as a low prominence of cancellous bone jutting from the dorsal surface of the terminal phalanx. These outgrowths are probably due to the pressure of ill-fitting boots, and should be ranked among inflammatory productions.

3. *Exostoses due to calcification of inflammatory exudations* scarcely require consideration in this work; there is reason to believe that some of the cases described as multiple exostoses were really examples of the strange and rare disease known as "myositis ossificans."

Bony tumours are of fairly frequent occurrence in all

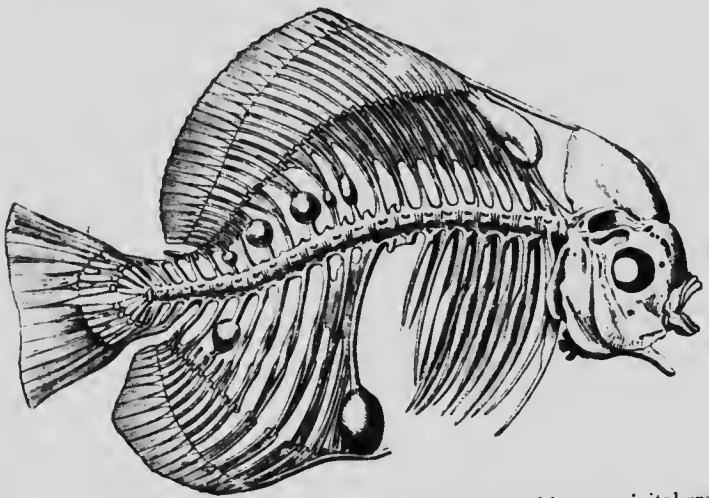

Fig. 25.—Bell's specimen of Chætodon with its tumours and large occipital crest.

vertebrata. Paul Gervais has published descriptions of many interesting specimens from fish. Perhaps the most striking example is furnished by the skeleton of the fish Chætodon, in which some of the bones are furnished with rounded bony tumours. The museum of the Royal College of Surgeons contains many loose bones with tumours, as well as the skeleton of the original fish sent by William Bell to John Hunter (Fig. 25). Single bones of Chætodon are common in osteological collections. Cuvier explained this by stating that they are brought home by travellers who have eaten the fish. On section the outline of the ray can be seen running through the tumour.

Clinical Characters.—Osteomata are easily recognised

on account of their extreme hardness, and in being localised to bones: they rarely cause pain, except when growing in the vicinity of and pressing upon the trunks of nerves. Osteomata growing from the walls of the auditory meatus will occasionally interfere with hearing, and if they are bilateral, and completely block both meatuses, produce total deafness (Field). Large osteomata of the orbit and frontal bone distort the eyeball, and produce hideous deformity. In determining the characters and mode of attachment of osteomata, especially in the limbs, the X-rays render valuable assistance.

Treatment.—Osteomata, unless they interfere with nerves or with the movement of joints, or, as in the case of the facial bones, produce deformity or deafness, are rarely interfered with. In a patient under the writer's care, with a large intrapelvic osteoma, a process of the tumour pressed upon the great sciatic nerve as it issued from the pelvis: this offending process was exposed through an incision in the buttock, and removed by means of a chisel and mallet. Pedunculated osteomata may be easily removed with the help of stout forceps. Sessile osteomata of the ivory variety sometimes require the most persevering efforts of the surgeon, aided by the best surgical cutlery. Exostoses near joints should not be interfered with, unless they produce great inconvenience. It should also be remembered that in removing osteomata, the cancellous tissue of the bone from which they grow is opened.

Cranial osteomata are often formidable objects for the surgeon; when they grow from the roof of the orbit or the frontal bone, they not unfrequently extend as deeply into the cranial cavity as they project beyond it. The museum of St. George's Hospital contains a small ivory tumour which grew on the frontal bone of a man. Keate vainly endeavoured to remove it with trephine, saw, chisel and mallet for nearly two hours. Potassa fusa and nitric acid were applied to the base, and in the course of years the tumour dropped off.

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CHAPTER IV.

MYELOMATA.

A **myeloma** is composed of tissue identical with the red marrow of young bone. These tumours were formerly called myeloid sarcomata.

The genus contains a single species—myeloma. These

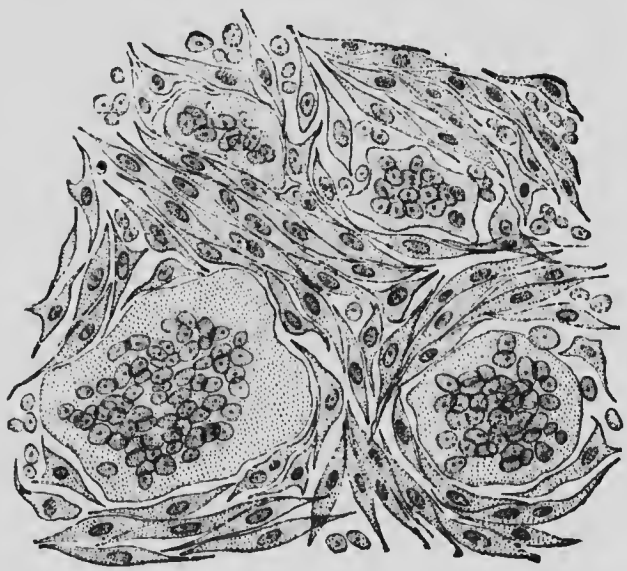

Fig. 26.—Microscopic characters of a myeloma from the acromial end of the clavicle.

tumours arise only in the cancellous tissue of bone. When fresh the cut surface of the tumour is deep red, and looks not unlike a piece of fresh liver, and is very vascular. Microscopically, this tissue abounds in large multinuclear cells (giant cells, myeloplaques) embedded among round and spindle cells. The giant cells are so numerous as to constitute the greater proportion of the tumour (Fig. 26).

The distribution of myelomata is that of red marrow, but they exhibit a striking preference for certain bones; the tibia

, the favourite bone in the lower, and the radius in the upper limb: whilst so far as the bones of the head are concerned, they appear to be peculiar to the jaw bones. I have never seen a myeloma in a vertebra. In the long bones they arise in the shaft of the bone immediately adjacent to the epiphysial junction (Fig. 27); and if the epiphysial cartilage be present it would seem to play the same neutral part to a myeloma as to a sarcoma.

Fig. 27.—Lower end of a femur in longitudinal section, showing a myeloma. (From a girl aged 16 years.)

In the lower limb myelomata have been observed in all the large bones, but they show a decided preference for the head of the tibia.

The **tibia** is the seat of a myeloma five times more frequently than any other long bone, and it is five times commoner in its upper than in its lower end (Figs. 28, 29).

In the **radius,** the lower end is the favourite site, but myelomata of the upper end are not unknown (Figs. 30, 31).

The same reversal applies to the fibula and the ulna, myelomata preferring the head of the fibula, but the lower end of the ulna; but in both situations they are very rare.

In the **clavicle** several examples have been recorded in the sternal end, and I have observed one at the acromial end, an excessively rare situation (Fig. 32).

In the **humerus** the upper end of the bone is the usual

Fig. 28.—Coronal section of the upper end of the tibia showing a myeloma in the outer tuberosity. (From a woman of 25 years.)

site, but in the **femur** it is the condyloid end. A myeloma is very rare in the **patella** (Fig. 33).

In the **mandible** myelomata affect the body of the bone, but in the **maxilla** they prefer the alveolar border, and may sometimes remain in the early stage restricted to the premaxilla.

Clinical Characters.—These are, as a rule, sufficiently characteristic to ensure accurate diagnosis. The patients are

young, rarely above twenty-five years of age: the tumour grows slowly, expands the bone, and thins the osseous capsule while expanding it until the bony shell is so thin that it crepitates when pressed by the finger (egg-shell crackling). Here and there the myelomatous tissue perforates the capsule and markedly pulsates synchronously with the cardiac systole. Myelomata do not infect lymph glands, nor disseminate.

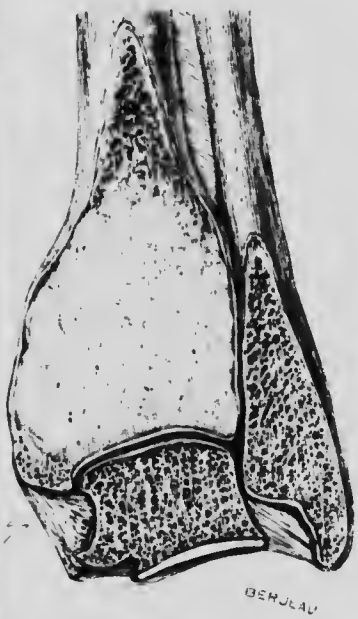

Fig. 29.—Coronal section of the lower ends of the tibia and fibula, with the astragalus; a myeloma occupies the lower end of the tibia. (From a woman aged 23 years.)

Fig. 30.—A myeloma of the upper end of the radius; from a man of 28 years. (*Museum, St. Thomas's Hospital.*)

Treatment.—When the patient comes under observation before the tumour has perforated its capsule, it may be thoroughly extirpated without fear of recurrence. The manner of thorough extirpation varies with the situation of the tumour.

In the upper limb the lower extremities of the radius and ulna have been excised for myeloma, leaving an extremely useful hand. It is an important fact to remember that the lower third of the ulna may be excised alone, but when the radius is the affected bone it is an advantage to remove the

corresponding section of the ulna. The upper third of the humerus, the inner half, and the outer half of the clavicle have been resected for myeloma with excellent results. In the case

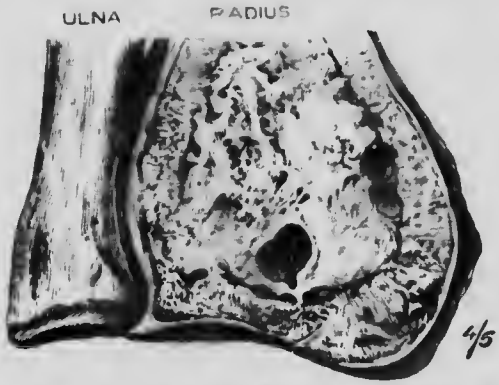

Fig. 31.—Myeloma of the lower end of the radius. (*Museum, St. Thomas' Hospital.*)

of the jaws partial excision has been performed for myeloma with good consequences, but when the patient allows one of these tumours in the maxilla to fungate before seeking surgical aid, the marrow tissue will so invade the surrounding soft

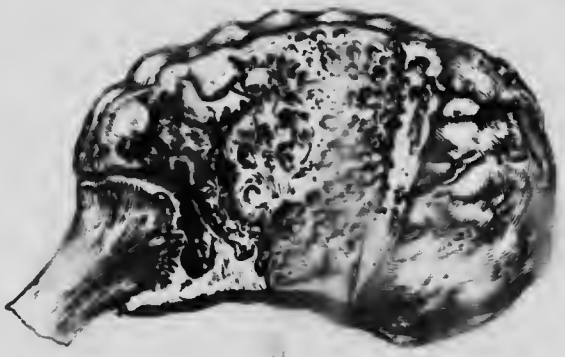

Fig. 32.—Myeloma of the acromial end of the clavicle from a woman of [illegible]. (*Museum, Royal College of Surgeons.*)

parts that complete extirpation is [illegible] and recurrence is probable.

In the lower limb the best method of dealing with myeloma is not so certain. For those in the lower end of the femur, amputation is necessary. [illegible] method has also

been employed for the patella by Robert Jones. Excision has been successfully employed for myeloid sarcoma in the head of the tibia (Morrison), and in this situation a milder method—enucleation, first suggested and practised by Paget—has given excellent results.

A close study of myelomata indicates that they differ histologically, pathologically, and clinically from sarcomata, with which they have hitherto been grouped.

They are rare tumours, and a careful perusal of periodical literature and hospital reports makes me think that at each of the eleven large general hospitals in London one myeloma a year is above the average.

The subjoined table represents the good consequences which attend the surgical treatment of this genus of tumours.

Observer.	Age of Patient and Bone Affected.	Nature of Operation.	Result.	Reference.
M	end ns	Resection of lower ends of radius and ulna	Free from recurrence 16 years later	*Trans.* vols xvii a
	nd ulna	Resection of lower end ulna	Free from recurrence 10 years later	56.
Atton	26. A	Resection of outer half of clavicle	No recurrence 10 years later	xiv. 12. 2. 52
n	28 Upper radius	Resection of upper fourth of radius	Died of albuminuria 1½ years later No recurrence	*Trans. Clin. Soc.*, vol. xxvii. 86. See Fig. 30.
tton	35. Head tibia	Amputation	No recurrence 10 years later	Treves's "System of Surgery," i. 917.
Sutton	Premaxilla	Excision of the premaxilla	No recurrence years later	shed.
Sutton	25. Lower end of tibia	Amputation through middle of the leg	No recurrence years later	shed. See Fig. 29.
Jones (Robert)	20. Patella	Amputation	No recurrence years later	*Path. Soc.*, vol. xlv 343. See Fig. 33.

It is fair to assume that the remarkable case in which Mott in 1828 excised the sternal two-thirds of the clavicle for what he called, in the terms of his day, "an osteo-sarcoma," in a lad eighteen years of age was in all probability a myeloma. The boy survived the operation fifty years. (Porcher.)

One of the difficulties connected with the treatment of a myeloma is the doubtful character of the diagnosis in some instances. A myeloma at the lower end of the

radius is rarely missed, but in other long bones a tumour of this kind is simulated by tuberculous disease, the common species of sarcomata, gumma, and rarely echinococcus disease. In well-marked examples the thinned and expanded bone furnishes the classic egg-shell or parch-

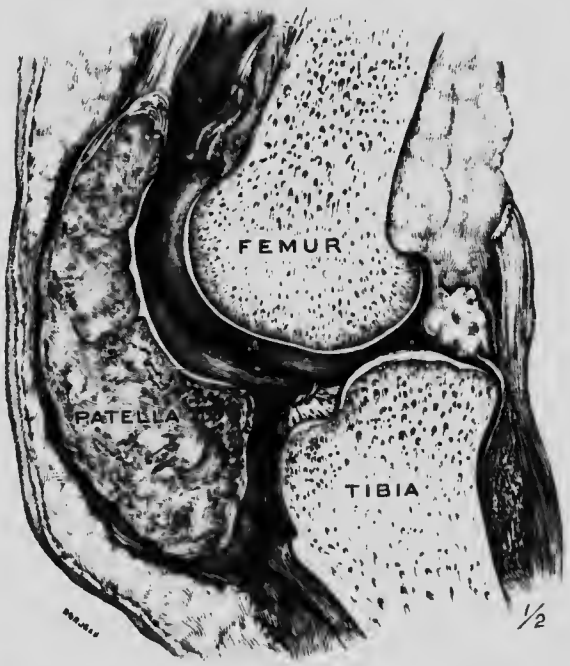

Fig. 33.—Myeloma of the patella; from a girl of 20 years. (*Museum, Royal College of Surgeons.*)

ment-like crackling, which is a clinical feature of great value, and was especially marked in the myeloma at the acromial end of the clavicle (Fig. 32).

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CHAPTER V.

SARCOMATA: THEIR HISTOLOGIC CHARACTERS.

THE term **sarcoma** is applied to any connective tissue tumour which exhibits malignant characters. As a matter of fact, almost any kind of connective tissue—fat, bone, cartilage, and even striated muscle tissue—occurs in sarcomata, but, as a rule, the greater part of the tumour consists of immature connective tissue in which cells preponderate over the intracellular tissue. The species are determined according to the prevailing type of cell: thus we have round-celled and spindle-celled sarcomata; some contain pigment, and are known as melano-sarcomata. A peculiar species arising in pigmented moles is known as alveolar sarcoma. Of each there are one or more varieties, which have received qualifying names, such as lympho-sarcomata, myo-sarcomata, chondro-sarcomata, and the like.

1. **Round-celled Sarcomata.**—This species is of very simple construction, and consists of round cells with very little intercellular substance. Each cell contains a large round vesicular nucleus, and a small proportion of protoplasm; the nuclei are always conspicuous objects in stained sections. Blood-vessels are abundant, often appearing as mere channels between the cells. Lymphatics are absent. Round-celled sarcomata grow very rapidly, infiltrate surrounding tissues, recur quickly after removal, and give rise to secondary deposits, especially in the lungs.

There is a variety, known as the large round-celled sarcoma, in which the cells are of unequal size: some of them contain two or more nuclei; a few are multinuclear, and resemble myeloid cells.

The round-celled sarcoma is the most generalised tumour that affects the human body; it may occur in any tissue, osseous, muscular, nervous, thymic, ovarian, or testicular, and even in the delicate sustentacular framework of the retina. It attacks the body at all periods of life, from the fœtus *in utero*

and the child just born, up to the extreme limits of age, and arises in vestigial organs, as well as in those which are in the full exercise of their functions, namely, the kidney or the parotid gland.

2. **Lympho-sarcomata** consist of cells identical with those of the round-celled species, but the cells are contained in delicate meshes: the tissue resembles that of lymph glands (Fig. 34), hence the origin of the term lympho-sarcoma. These tumours must not be confounded with simple (irritative) enlargement of lymph glands, nor with the general overgrowth of lymphadenoid tissue associated with leukæmia or lymph-

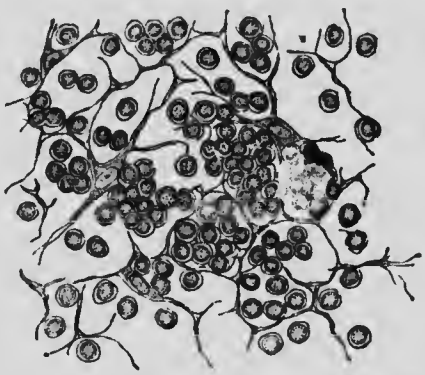

Fig. 34.—Microscopic characters of a lympho-sarcoma from the mediastinum.

adenoma (Hodgkin's disease). The lympho-sarcomata exhibit a very characteristic structure, occur as a rule in very definite situations, and have somewhat special clinical features. These tumours occur in the superior mediastinum, in the subpleural and subperitoneal connective tissue, at the base of the tongue, in the larynx, in the tonsil, and in the testis. Fortunately, sarcomata of this species are rare, for they are excessively malignant.

3. **Spindle-celled Sarcomata.**—The cells in this species vary much in size, but they all agree in being oat-shaped or fusiform (Figs. 35, 36). The cells tend to run in bundles, which take different directions, so that in sections of the tumour seen under the microscope some bundles will have the cells cut in the direction of their lengths, and others at

right angles. This must be borne in mind, or an incorrect opinion will be formed as to the nature of the tumour.

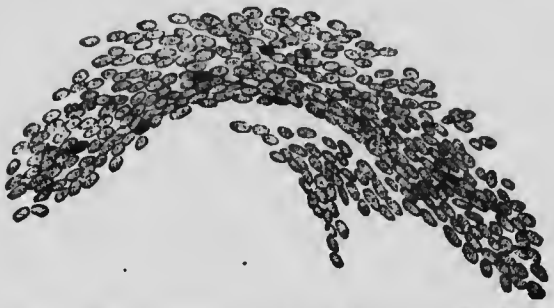

Fig. 35.—Microscopic characters of a small spindle-celled sarcoma from a metacarpal bone.

In some sarcomata the cells are so slender and contain so little protoplasm that they appear to consist of merely a nucleus

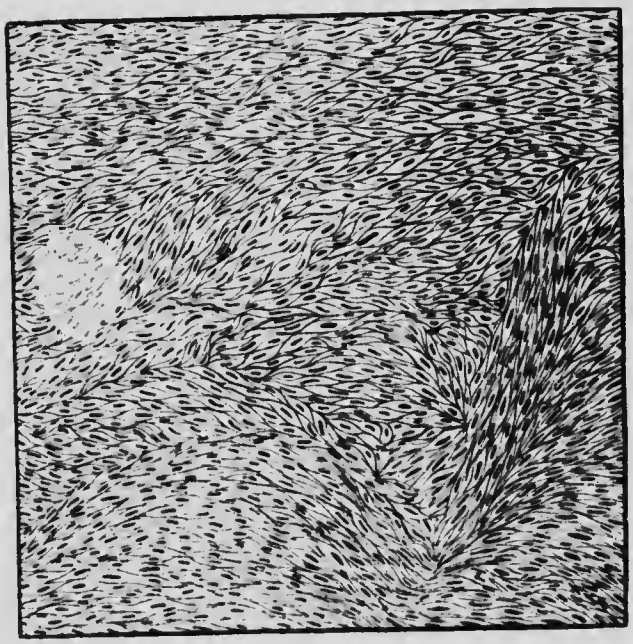

Fig. 36.—Section of a spindle-celled sarcoma from the first phalanx of the thumb. (*Highly magnified.*)

and cell processes. In others the cells are large, fusiform, and rich in protoplasm, and resemble the cells of young unstriped

muscle. Occasionally these spindle cells are transversely striped like young striated muscle fibre.

Another peculiarity of spindle-celled sarcomata is the frequent presence of tracts of immature hyalin cartilage; indeed, in many instances this tissue constitutes so large a proportion of the tumours that they are described as chondromata; the cartilage is sometimes calcified and even ossified. It may seem strange to associate tumours containing striped cells and cartilage with sarcomata, but the correctness of the classification is demonstrated by the fact that such tumours are apt to recur after removal, and in some of the cases in which the primary and recurrent tumours have been carefully examined the primary tumour has contained cartilage, or muscle, whilst the recurrent mass has shown no evidence of these tissues, but has conformed to the structure of a pure spindle-celled or a round-celled sarcoma. In order, therefore, to indicate the nature of such composite sarcomata, they will be referred to as myo-sarcomata (rhabdomyomata) and chondro-sarcomata. Spindle-celled sarcomata often contain round and even multinuclear cells.

Myo-sarcomata.—It is a remarkable fact, considering the large amount of striped muscle tissue existing in the body, that tumours composed of or containing this tissue do not arise in connection with the voluntary muscles, but make their appearance in such unexpected situations as the kidney, testis, neck of the uterus, parotid gland, and in organs and tissues which, under normal conditions, do not contain muscle cells of the striped variety.

There has been much speculation as to the mode of origin of myo-sarcomata. When our knowledge of them was limited to those which occurred in the kidney, the notion that they arose in detached portions of the mesoblastic somites (Cohnheim) found favour with many; further observation, however, has shown this view to be untenable.

Myo-sarcomata of the testis have been mainly observed in children (Hulke, Neumann, Ribbert). (See Chapter LII.)

Prudden has found cells with the transverse markings in a tumour from the angle of the mandible of a boy seven years of age; other examples connected with the periosteum have been reported by Zenker and Bayer, who found them

in the orbit. Targett found one on the scapula of a child six months old; and Marchand describes one which grew from the ischial tuberosity of a boy four years of age.

Pernice has recorded in detail a remarkable example connected with the neck of the uterus. The tumour contained a large number of transversely striated spindles

Fig. 37.—Racemose sarcoma of the neck of the uterus. (*After Pernice.*)

(Figs. 37, 38). The tumour was removed, but quickly recurred: it was removed a second time, but reappeared and speedily caused death. A careful examination of the recurrent tumour showed it to consist of spindle cells, but no striation could be detected.

Grape-like (Racemose) **Sarcoma of the Neck of the Uterus.**—Pernice's specimen, to which reference has already been made, belongs to a rare variety of sarcomata, of which about a dozen carefully observed examples have been

described since Spiegelberg drew attention to this disease in 1879 (Whitridge Williams). Curtis has described an example which occurred in an infant a year old, and has collected the literature. In some of the specimens the grape-like bodies are covered with columnar epithelium, the bulk of the grape consisting of œdematous spindle- and round-celled sarcomatous tissue.

In an example which I had an opportunity of

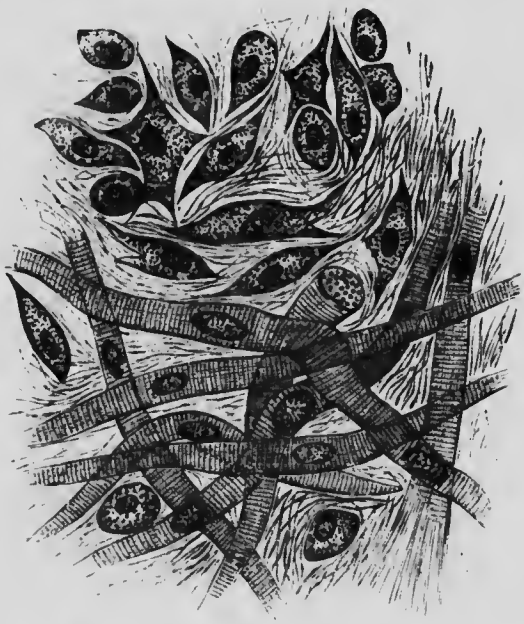

Fig. 38.—Microscopic characters of a uterine sarcoma containing muscle cells. (*Pernice.*)

examining, the grape-like bodies were hollow, and lined with columnar epithelium, and led me to regard them as dilated glands in the cervical endometrium involved in a sarcoma.

This form of tumour has been observed exclusively in girls and young women: it is very malignant, recurs locally, invades the uterus in the late stages, and gives rise to metastases.

Sarcomata of the Subperitoneal Tissue.—Very large spindle-celled sarcomata are occasionally found in the

belly and pelvis arising in the subperitoneal connective tissue. These tumours present some peculiar features. In the first place, they are nearly always globular, and not unfrequently resemble a football in shape and in size. They have been observed in the neighbourhood of the kidney, and in some instances this organ occupies a recess in the tumour. Retroperitoneal sarcomata of this kind often have the adjective perirenal applied to them. There was a large tumour of this kind in the museum of St. Mary's Hospital. In the description of it by Jackson Clarke, it was described as growing from the lesser omentum. The museum of McGill College contains a large globular tumour of this kind weighing eight pounds, which was removed by Shepherd in 1897 from the mesentery of a man aged twenty-eight years; eight feet of small intestine were removed at the same time. The man was alive in 1900. I have twice removed sarcomata of this character from between the layers of the mesometrium (broad ligament), and many of the cases reported as "myomata of the broad ligament" are probably large, slowly growing spindle-celled tumours. They would appear to be the least malignant of all the varieties of sarcomata, and are extremely rare. Many of the reported cases weighed upwards of thirty pounds.

The genus sarcomata is certainly very heterogeneous and unsatisfactory, and will continue so until the cause of malignant connective tissue tumours is discovered. The difficulty in regard to fibromata, myxomata, and myomata has long been recognised; for example, fibromata, or tumours composed of fibrous tissue, were regarded as common, but careful histologic research has shown them to be very rare. The tumours of the uterus, known as myomata and fibromyomata, were formerly regarded as fibromata: traces of this belief still linger in the term "uterine fibroids." Many tumours now called spindle-celled sarcomata were, a few years ago, called "recurring fibroids." The difficulty of distinguishing between a myoma, a slowly growing spindle-celled sarcoma, and a fibroma is well known to skilled histologists.

Neuromata are often referred to as fibrous tumours,

and the tumours which grow on the gums as epulides. The term epulis has only a topographic meaning. The best examples of fibroids occur in the uterus and ovary.

Myxomata.—These are tumours composed of tissue identical with the jelly-like substance which exists in the umbilical cord. Here we have to deal with a difficulty, because there is a very great tendency in many connective tissue tumours to degenerate into this soft gelatinous or myxomatous tissue and become as diffluent as the vitreous body in the eyeball.

The common nasal polypus furnishes an excellent example of this tissue; it consists of cells with long, slender processes interlacing with those of adjacent cells and ramifying in a structureless, unstainable, diffluent mass, the whole being bounded by a thin layer of mucous membrane covered with columnar ciliated epithelium. Nasal polypi may be regarded as pendulous processes of œdematous mucous membrane.

The condition termed an aural polypus has no claim to rank as a tumour; it consists of myxomatous tissue. Jacobson has suggested that tympanic polypi consisting of myxomatous tissue may arise in vestiges of the fœtal connective tissue which fills the tympanum at birth and slowly disappears as pulmonary respiration is established.

The tumours which have come under my notice and to which the term myxoma most properly applies have grown from the lumbar fascia; they were sessile tumours, and when cut open looked like colourless masses of transparent, trembling jelly. These tumours recurred after removal; in one case there were several recurrences extending over a period of ten years. There was no evidence of dissemination. It is probable that they were sarcomata which had undergone myxomatous degeneration. It would be convenient and perfectly justifiable to deprive myxomata of even the rank of species among tumours.

The heart is of all the organs of the body the least liable to tumours, primary or secondary, yet the few examples of primary tumours which have been observed in it are described by the reporters as fibromata, or

myxomata, or fibro-myxomata. The chief cases have been collected and the clinical signs analysed by Pavlowsky.

Myomata, or tumours composed of unstriped muscle fibre, are very rare, and are met with exclusively in organs containing this tissue, *e.g.*, the œsophagus, stomach, duodenum, bladder, and uterus.

Attention has already been directed to the difficulty of determining between the fusiform cells of sarcomata and unstriped muscle fibre. This difficulty is further increased by the fact that many malignant tumours composed of spindle cells (sarcomata) contain tracts of cells which present a transverse striation such as is seen in voluntary muscle in its embryonic stage; but it is remarkable that cells with the transverse striation occur in situations where voluntary muscle is not found normally. It is also a fact that tumours consisting of mature striated (voluntary) muscle fibre have not been observed. Much caution needs to be exercised before deciding that a tumour is a myoma: formerly many of the spindle-celled sarcomata of the choroid were regarded as myomata arising in the ciliary muscle. It is also extremely probable that many of the tumours described as myomata from the œsophagus (Hilton Fagge), stomach, duodenum, bladder (Parker, Terrier, and Hartmann), and vagina were sarcomata.

Dermatologists are familiar with small tumours of the skin, which are occasionally multiple, and consist of smooth muscle fibres. Such myomata may arise from the *arrectores pili*. Marc found one on the skin of the occiput of an infant which had a diameter of 3·5 cm., and I removed one from the scrotum of a boy a few months old.

In two instances I have removed tumours from the stomach which were regarded by an experienced pathologist (Foulerton) as leiomyomata. In one instance the tumour was as big as an almond; the other, as large as an orange, projected from the serous coat at the great *cul-de-sac*. The clinical course in each instance justified the microscopic characters as to benignity.

The common situation for tumours containing unstriped muscle fibres is the uterus (see Fibroids).

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CHAPTER VI.

SARCOMATA (*continued*).

THEIR GENERAL CHARACTERS.

SARCOMATA are distinguished from the preceding genera of tumours in rarely possessing capsules, and when they do it is generally a spurious escapsulation depending on environment, as when they occur in the kidney, the eyeball, or the centre of a bone. It is lack of a capsule which permits them to infiltrate surrounding tissues and favours dissemination. It will be convenient to devote this chapter to the consideration of the way in which sarcomata display their malignancy.

Blood Supply of Sarcomata.—The vascularity of sarcomata varies greatly in all, the circulation is mainly capillary. In the small round-celled species the vessels are so numerous as to cause distinct pulsation; in the slow-growing spindle-celled varieties—especially those undergoing chondrification—the vessels are not numerous, and the tumours on section are yellowish white. It has already been pointed out, in describing the minute structure of sarcomata, that the walls of the vessels are very thin, and are often so attenuated as to resemble channels between the cells. This explains the frequency of haemorrhage within the soft and rapidly growing varieties—Repeated extravasations of blood will sometimes convert these tumours into cysts containing blood intermixed with sarcomatous cells. Tumours transformed in this way were formerly described as malignant blood-cysts.

Although the vessels in a sarcoma are, in the main, capillaries, nevertheless the arteries supplying the tumour may be very large and numerous. When a sarcoma grows from the distal end of the femur and attains a large size, arteries supplying it from neighbouring muscular, periosteal, and articular trunks become important branches, and in such circumstances an incision into the tumour will be attended with alarming haemorrhage. When attempts are made to dissect out such a

tumour from the limb instead of adopting more radical measures, such as amputation, these enlarged vessels must not be forgotten, or they will intrude themselves upon the surgeon in a very unmistakable manner. Arteries which under ordinary conditions are almost inappreciable will, when

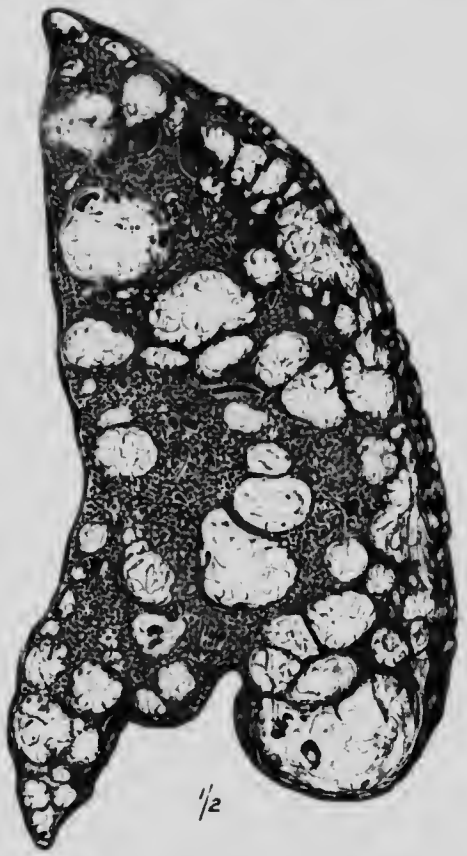

Fig. 39.—Section of lung, with nodules of sarcoma secondary to a chondrifying tumour of the testis. (*Museum, Royal College of Surgeons.*)

nourishing a sarcoma, attain the dimensions of the radial or even larger trunks.

Dissemination.—Sarcomata are liable to reproduce themselves in distant organs, a phenomenon frequently referred to as metastasis. It is due to minute particles of the tumour growing into the vessels: these, becoming detached, are transported by the current of blood to distant organs, where

they become arrested by the capillaries, engraft themselves, and then grow into independent tumours. This dissemination takes place mainly through the veins, because, as has already been mentioned, sarcomata are devoid of lymphatics. The most common organ in which to find secondary sarcomata is the lung, unless the primary growth is situated in the territory of the portal circulation, when they will be found in the liver. In very malignant sarcomata, especially the small round-celled species, secondary deposits may form in any organ of the body: they are always identical in structure with the primary tumour. Secondary deposits of sarcoma in the lungs may destroy life by mechanically obstructing the trachea and bronchi. I have known a nodule to slough and find its way into the trachea, and when expelled by coughing it became impacted between the vocal cords and suffocated the patient, a girl of nineteen years. In this instance the primary tumour was a periosteal sarcoma of the femur, for which amputation had been performed several months before.

Infiltrating Properties of Sarcomata.—The tendency to extensive infiltration of the planes of connective tissue adjacent to the tumour is not peculiar to sarcomata, for it is an obvious character of carcinoma. This property of sarcomata may be studied in a marked manner in the case of mediastinal lympho-sarcomata. These tumours grow rapidly, enveloping the trachea and bronchi, the aorta, and other large vessels: the œsophagus, and large nerve trunks. The tumour extends along the branches of the bronchi, and invades the interlobular connective tissue at the roots of the lungs. When the tumour starts in the superior mediastinum it descends along the big vessels and invests the pericardium. It may even creep along the sheaths of the vessels to the heart and infiltrate its substance, and nodules of the tumour may project into the cavity of the auricles. Processes of the tumour may find their way along the sheaths of the big vessels and appear in the posterior triangles of the neck.

The relation of a mediastinal lympho-sarcoma to the adjacent structures is interesting. For instance, the large arterial trunks, though embedded in the tumour, are not as a rule damaged by it. The aorta may be so compressed by the tumour as to produce a murmur: the thin-walled veins are

early compressed, and interference with the venous circulation is a marked feature. In some of the cases infiltration of the walls of the veins takes place, and processes of the tumour project into their channels.

The bronchi are very liable to be damaged by a lympho-sarcoma, for the tumour moulds itself round these tubes, and by pressure causes them to be narrowed: apart from this effect, the tissues proper of the tubes become eroded and destroyed. These changes not only induce difficulty in respiration by restricting the admission of air, but the compression of the vessels accompanying the bronchi leads to changes in the nutrition of the pulmonary tissue, which end in pneumonia, gangrene, and death.

The important nerves traversing the mediastinum, the vagus and phrenic nerves especially, are often involved in the tumour, but their sheaths are rarely invaded by the cells: in some instances the left recurrent laryngeal nerve is compressed sufficiently to produce severe laryngeal spasms and even paralysis of the muscles supplied by it.

The œsophagus becomes compressed by an intrathoracic lympho-sarcoma, but dysphagia is not so prominent a symptom as in many cases of intrathoracic aneurysm. The œsophagus may be invaded and even perforated; when this happens, ulceration and sloughing may form a cavity in the tumour, and the ulceration may even broach the aorta (Hale White).

It is a somewhat remarkable feature of lympho-sarcomata that they extend to and enclose neighbouring lymph glands without affecting them: it is by no means unusual in a section of a large mediastinal sarcoma to find bronchial lymph glands fully charged with pigment embedded in the tumour (Fig. 40). Some writers are of opinion that some lympho-sarcomata of the superior mediastinum arise in the thymus. This, of course, is possible, but it is very difficult of proof.

The infiltrating power of sarcomata may be studied when they invade the sheath of a muscle. For instance, when a retinal sarcoma protrudes through the sclerotic and invades the orbit it sometimes makes its way into the sheaths of the recti, and converts them into masses resembling yellow wax. On microscopic examination the various fasciculi will be found isolated by the cells of the

Sarcoma. Periosteal sarcomata often invade muscles, and this is easily comprehended when the intimate relations of muscles to periosteum are remembered.

Burrowing Tendencies of Sarcomata.—All tumours in their growth tend to follow the lines of least resistance, and thus enter into nooks and crannies in the most

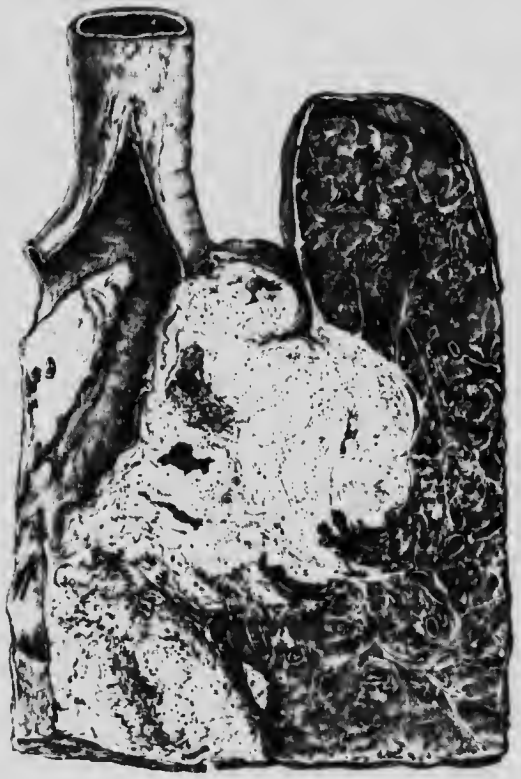

Fig. 40.—Portion of a mediastinal lympho-sarcoma, to show the manner in which the tumour extends along the bronchi and pulmonary vessels.

unexpected manner. Every surgeon knows how a sarcoma of the maxilla will send processes into the spheno-maxillary fossa and creep through the foramen rotundum, to appear in the cranial cavity. Sarcomata springing from the heads of the ribs or processes of the vertebrae have been known to extend through intervertebral foramina and compress the cord, giving rise to fatal paraplegia.

It is also remarkable what slender barriers will serve as

checks to sarcomata. For example, it is no uncommon condition for one of these tumours springing from the periosteum near a joint to extend in all directions and envelop the synovial membrane, yet be prevented by it from invading the joint.

Relation of Sarcomata to Veins.—It has long been recognised that when sarcomata become disseminated the secondary tumours occur in situations which indicate that the distribution has been effected by means of the veins. Attention has already been drawn to the tendency which seems inherent in most species of sarcomata to burrow; this tendency comes out in a striking way when studied in connection with veins.

Perhaps the simplest form occurs in the eyeball. When a melanoma arises in the uveal tract, especially when the tumour is in close relation with the choroid, it remains for a period restricted to the interior of the globe, until it produces such changes in the intra-ocular tension that the cornea sloughs and the growth protrudes externally. In many of these specimens, if the sclerotic be carefully examined in the situations where the venæ vorticosæ pierce it, small nodules of the tumour will be detected projecting through these openings, having made their way out by burrowing in the sheaths, and in some cases actually travelling along the lumina of the veins.

The relations of sarcomata to veins come out strongly when these tumours affect bones. In some examples of periosteal sarcomata the medulla is invaded by processes of the tumour making their way along the veins traversing the Haversian canals. The converse of this is also true for a central sarcoma will sometimes implicate the periosteum by way of the Haversian canals.

It is well established that most examples of central sarcomata occur near the joint ends of bones, and yet it is exceptional to find the joints invaded. When joint invasion happens, it occurs late in the course of the disease and then, in most cases, the tumour creeps in through the synovial membrane. This comparative immunity of joints is usually attributed to the articular cartilage acting as neutral tissue, but it appears rather to be due to the

fact that the cartilage, unlike the compact tissue of bone, is not traversed by a multitude of narrow venous channels. Extraordinary examples of the invasion of veins by sarcomata occur in the abdomen. In cases of renal sarcomata processes of tumour will find their way into the

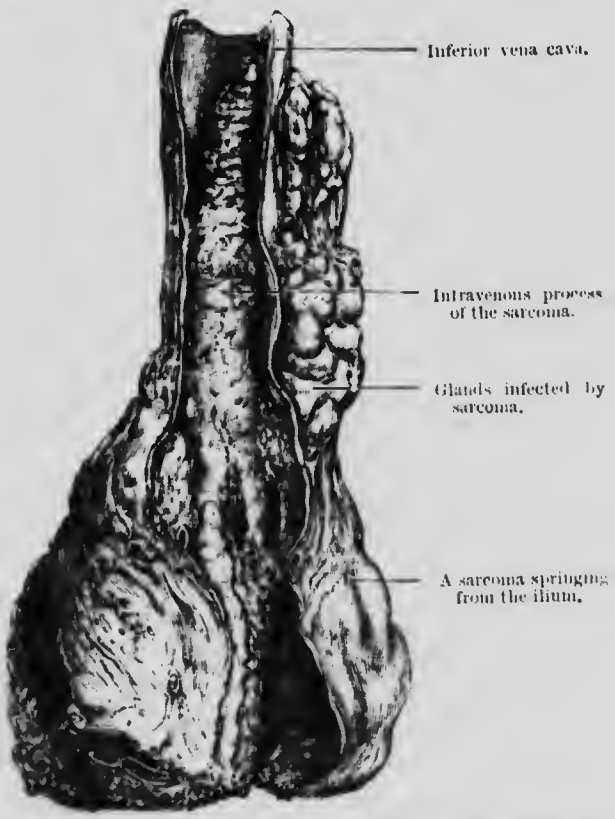

Fig. 41.—Periosteal sarcoma of the ilium invading the inferior vena cava (*Museum, St. Bartholomew's Hospital.*)

renal vein, and thus enter the inferior vena cava. Periosteal sarcomata of the pelvic surface of the ilium are very liable to infiltrate the iliac veins and extend into the vena cava. The specimen represented in Fig. 41 illustrates very well the general relation of an intravenous outrunner from a sarcoma: the process lies freely in the lumen of the vein its apex is smooth and rounded, and there are no lateral adhesions save in the situations where the main

mass of the tumour infiltrates the wall of the vein: the portion within the vein is, as would be expected, structurally identical with the main mass, and has its own blood-vessels, which are continuous with those of the extravenous portion of the tumour. When processes from a sarcoma project into a vein, the circulating blood is apt to detach large fragments, and these become dangerous emboli.

The mere presence of a sarcomatous outgrowth in a vein does not necessarily imply dissemination of the sarcoma, for very large intravenous processes may exist, and the lungs be free from any gross lesion of a sarcomatous nature. On the other hand, a very small invasion may lead to extensive infection of the lungs, especially if the protruding surface of the tumour be eroded by the blood current.

Dr. Pitt has described a case in which a man with sarcoma of the thyroid gland died suddenly. At the *post-mortem* examination the cavities on the right side of the heart contained fragments of growth embedded in clot: on dissection it was ascertained that the sarcoma had ulcerated into the internal jugular vein.

When a vein is invaded by a sarcoma, and discharges of emboli frequently occur, they easily traverse, when small, the right auricle and ventricle, but are too large to pass through the pulmonary capillaries: hence the small vessels in the lungs act as filters, and these arrested particles act as grafts, and grow into secondary nodules.

Secondary Changes.—Sarcomata are very prone to degenerative changes: for instance, haemorrhage is very apt to take place in those which grow quickly, producing spurious cysts. The tissues of the tumour are prone to liquefy, and myxomatous changes are very common. Calcification occurs in those which grow slowly, especially if connected with bone. When sarcomata grow rapidly and involve the skin, ulceration may occur and lead to profuse and oft-repeated haemorrhages, which not only exhaust the patient, but in many cases induce death.

Occasionally considerable portions of a sarcoma will necrose, especially in very large tumours. In such cases a

cavity forms in the sarcoma, and on cutting into it the fluid escapes, with large irregular pieces of the tumour, which are generally of a greyish-white colour. When necrosis occurs extensively in a large sarcoma it will sometimes check its course in a very marked manner.

Distribution.—As connective tissue occurs in every organ of the body, so sarcomata are ubiquitous, but they occur in some situations more commonly than in others. They frequently grow from subcutaneous tissue and fascia, periosteum, the testis and ovary. They are so rare as primary tumours of the liver, spleen, and bowel that it is not possible to write a general account of such tumours, from lack of material. As primary tumours of voluntary muscles sarcomata are rare. They may be of the round-celled or spindle-celled species. For a time, at least, the tumour is limited by the sheath of the affected muscle. At first the tumour appears localised to a particular spot in the muscle, but it gradually extends until the whole bulk of the muscle is involved and becomes transformed into an indurated mass. On section the muscle appears to be replaced by hard, tough, pale-grey material. When sections are examined under the microscope the appearance is very striking, for each fasciculus is isolated from its neighbour by collections of cells characteristic of the sarcoma.

As in sarcoma of other organs, haemorrhage is very liable to occur in the substance of the tumour, leading to the formation of cavities with ragged walls.

Primary sarcomata have been recorded in the following muscles: rectus abdominis, peroneus longus, gracilis tensor vaginæ femoris, adductor brevis, sartorius, tibialis anticus, and the triceps. Three cases under my own notice occurred in the pectoralis major, the extensor carpi radialis, the adductor longus, and the vastus externus.

The age distribution of sarcoma of muscle is a wide one, in the instances enumerated above the youngest patient was eighteen, and the oldest sixty years. The disease shows a marked preference for the muscles of the lower limb.

Extreme care is necessary to avoid mistaking a syphilitic gumma in a muscle for a sarcoma.

It is a curious fact that **sarcomata of nerves** or "malignant neuromata," as they are sometimes called, should show the same preference for the lower limbs as in the case of muscles. In the majority of instances it is the great sciatic, or its branches, the popliteal, posterior tibial, peroneal, or the plantar nerves. In more than half the cases it is the trunk of the great sciatic which is attacked.

Sarcoma of Synovial Membrane.—A primary sarcoma of a synovial membrane is a rare disease, and it shows the same marked preference for this membrane in the lower limb as is the case with muscles and nerves. The tumours may be of the round or spindle-cell species, but some contain giant cells and cartilage.

The disease may be diffuse, or so localised as to form a distinct tumour, and it rarely takes the form of pedunculated bodies. It attacks men and women equally, and the age of the patients varies from 20 to 35 years. The disease is of slow progress, and causes the patients very little inconvenience, as it does not interfere with the movements of the joint. The diagnosis is a matter of great difficulty, as the disease resembles a tuberculous affection of the joint more strongly than anything else. In Annandale's patient the disease was regarded as a myeloma, and in a patient under my own care the enlargement of the joint and the interference with its mobility was attributed to loose bodies, and the operation was undertaken on this diagnosis.

The disease lends itself to three kinds of operative treatment:—

(*a*) Enucleation, when the disease is limited to a portion of the synovial membrane. Turner has successfully practised this treatment on the ankle joint, and Howard Marsh on the knee. My patient was free from recurrence five years after the operation (Fig. 42).

(*b*) Resection of the joint when the sarcoma is diffuse.

(*c*) Amputation. This seems to be the best guarantee against recurrence, and is a method of treatment more particularly resorted to when the sarcoma is diffuse.

Julliard and Descendres have reported an additional case, collected the records, and carefully summarised the facts relating to this rare disease.

Primary Sarcoma of Bursæ.—It is well known that bursæ are prone to undergo inflammatory changes, especially when situated in exposed situations, such as those which arise in relation with the patella, and it is a matter of common observation that a prepatellar bursa when chronically irritated, as in housemaids and carpet-layers, will become almost solid: specimens illustrating this are common in pathological museums. There are a number of care-

Fig. 12.—Pedunculated bodies removed from the knee: the joint contained thirty-six such bodies.

fully observed cases which show that a bursa may become the seat of sarcoma, and in which local recurrence followed extirpation of the tumour. Sarcomatous bursæ have been observed in connection with the patella, the semimembranosus sac at the knee joint, and the subdeltoid bursa.

The chief clinical signs on which a diagnosis may be founded would appear to be these: a chronically enlarged bursa takes on active growth, and becomes firmer in consistence, and this is accompanied by great enlargement of the veins in the skin overlying the bursa

It must be remembered that prepatellar bursæ in syphilitics sometimes rapidly solidify.

The literature of sarcomata arising in bursal sacs has been collected by Adrian. It is characterised by great poverty.

Sarcomata of the Alimentary Canal.—Although carcinoma is the prevailing type of malignant disease which attacks the alimentary canal from the œsophagus to the anus, cases of sarcoma have been observed and reported in sufficient numbers to enable their leading clinical features to be summarised. The disease arises in the submucous tissue, and may assume the form of a polypus, or infiltrate the wall of the canal, or project on the surface of the intestine in the form of plaques. All species of sarcomata have been observed. It is also noteworthy that sarcomata are more prone to attack those regions of the stomach and intestines which are in a measure respected by carcinoma. Thus in the stomach sarcomata prefer the body of the organ, and they occur with greater frequency in the small than in the large intestine. In the small intestine the liability to the disease increases from duodenum to ileum. Sarcomata have been reported in the vermiform appendix. Secondary deposits appear to be most common in the liver.

One of the most important clinical features which distinguish sarcoma of the intestine, both large and small, from carcinoma is its occurrence in the early years of life, many examples have been observed in children. The disease runs a more rapid course, causes more pain, and forms a much larger tumour than is the rule with carcinoma. As a sarcoma often tends to become polypoid the occurrence of intussusception is a frequent complication (Fig. 43). The results of operative treatment are unfavourable: rapid recurrence is the rule. Corner and Fairbank have collected and analysed the records of this disease in an admirable paper founded on a case under their care.

The **vagina** is an uncommon situation for sarcomata and here they exhibit unusual characters connected with age-distribution—for in children they have a great

terwards to become polypoid, or they form flattened masses in the submucous layer. Occasionally the tumours may be multiple. Often the sarcoma interferes with the functions of the rectum and bladder. The literature of sarcoma of the vagina in infants has been collected by Powell; for adults, by W. Roger Williams and Gow.

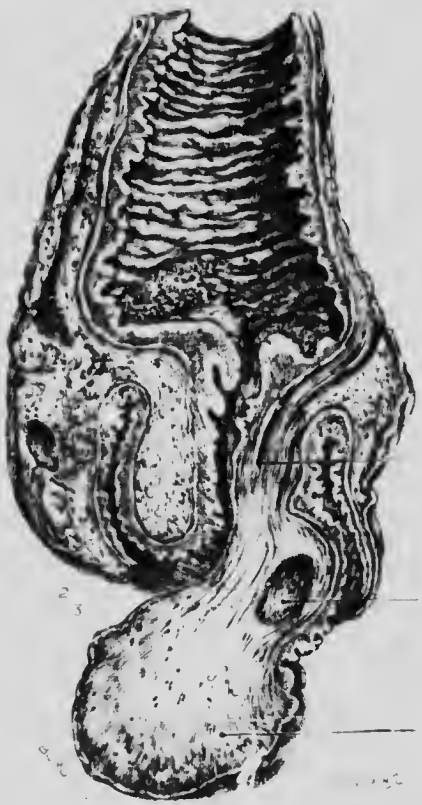

FIG. 1.—Portion of pegnum in section; a pedunculated tumour had invaginated the bowel and produced intestinal obstruction. (From a man 35 years of age.)

As sarcomata differ materially among themselves according to the organs in which they arise, it will be necessary to devote several chapters to the consideration of this subject.

Treatment. The only treatment available for the relief of sarcomata consists in the wide removal of the affected part whenever this is possible by means of the knife. The

method of effecting this varies according to the seat of the disease, and the organ affected. In the ensuing chapters dealing with the distribution of these tumours, references will be made to the principles governing the surgical treatment applicable to each situation. There are many conditions, apart from the size of the tumour, which prevent its complete extirpation, such as its position in relation to vital organs, and generalisation (metastasis): when sarcomata do not permit of radical surgical treatment they are said to be inoperable. Much earnest investigation has been made with the hope of finding some means by which patients with inoperable sarcoma may be relieved, especially in the domain of serumtherapy. The most promising is that introduced by Coley: the principles underlying this method and a summary of the results obtained from it, are described in Chapter XXVII., p. 301.

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CHAPTER VII.

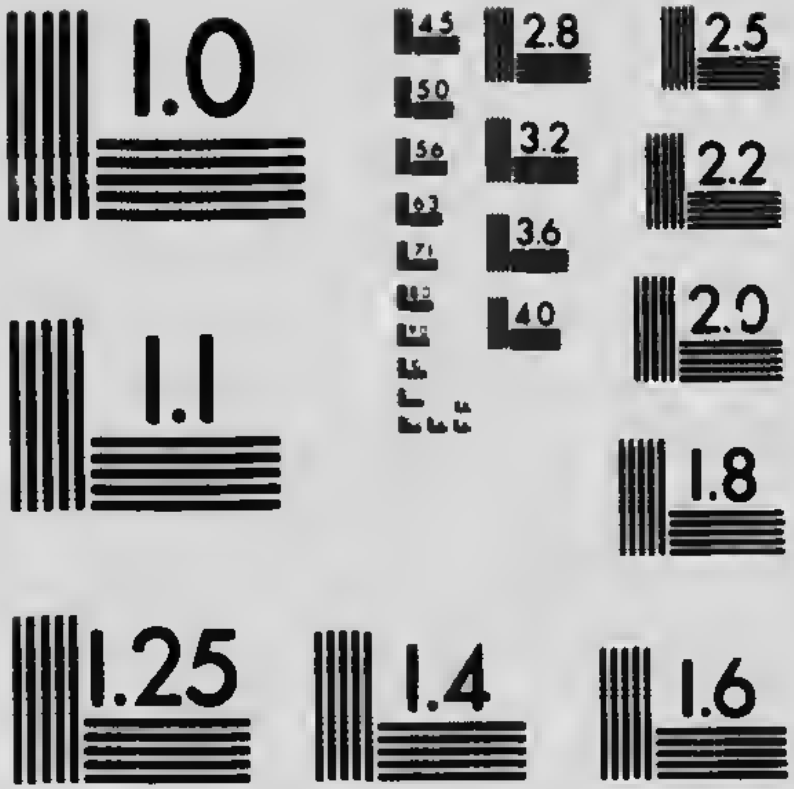
SARCOMATA OF BONES.

These tumours arise in connection with bones in two situations, either in the interior of a bone, or in the deeper (osteogenetic) layer of its periosteum: hence they are spoken of as Central and Periosteal Sarcomata.

1. **Central Sarcomata** may arise in the middle of the shaft, but more frequently they originate in the cancellous tissue near the ends of the long bones. Sarcomata arising in the diaphysis belong, as a rule, to the round-celled species. Those which grow at the extremities are generally spindle-celled, and contain a variable quantity of myeloid cells; cartilage is sometimes present. They occur at any age, but are most frequent between ten and forty, and are more common in the long bones of the lower than in those of the upper limb.

When a tumour occupies the centre of the diaphysis, its growth causes expansion of the osseous boundaries, and produces a rounded or spindle-shaped swelling, and the bone may become so thin that, upon some slight exertion it breaks. In cases where the tumour affects the extremity of the bone it will, in young subjects, infiltrate the epiphysis, but it rarely transgresses the articular cartilage.

Central sarcomata rarely affect the adjacent lymph glands. In exceptional cases, especially with small round-celled sarcomata, the cells will make their way along the Haversian canals and form a tumour beneath the periosteum. Central sarcomata lead to enlargement of the surrounding bone; hence when the soft tissues are removed by maceration a large bulb-like osseous mass is left. These specimens are common in pathological museums. In some cases this osseous capsule is so thin that the tissue of the tumour makes its way through, and as it is very vas-



cular a strong rhythmical pulsation (accompanied by a bruit) is perceptible over the protruding portion.

2. **Periosteal Sarcomata.**—These may be round-celled or spindle-celled, and are liable to the various metamorphoses and degenerations affecting sarcomata generally, but are more liable to calcification and ossification than central tumours. They occur earlier in life than those of the preceding class, and are frequently associated with antecedent injury. They do not, as a rule, invade joints.

When growing from the periosteum near the middle of the shaft, a sarcoma may be restricted to a portion of its circumference, or entirely surround it, producing a fusiform swelling. In such specimens the shaft of the bone traverses the tumour, and may, beyond a slight amount of erosion, be unaffected by it. In such a case, however, the medulla may be infected by the cells making their way along the Haversian canals. Periosteal, like central, sarcomata have a greater predilection for the joint-ends of the bone than for the central portion of its shaft.

In size periosteal sarcomata vary greatly: in exceptional cases they have been known to exceed a metre (40″) in circumference. Many become more or less ossified, the osseous matter taking the form of delicate spicules arranged at right angles to the shaft of the bone: sometimes it forms an irregular bony mesh, the spaces being filled with sarcomatous tissue. In some specimens the bone is greatly thickened in the parts related to the tumour. The extensive ossification associated with sarcoma of the periosteum is not a matter for surprise when we remember the bone-forming function of this tissue. The crystal-like spicules so frequently found probably represent ossification of the fibrous trabeculæ which connect the periosteum with the compact tissue of the shaft: as the periosteum is raised from the bone by the growing tumour, these trabeculæ elongate and subsequently ossify.

The Femur.—This bone is very liable to sarcomata, especially the periosteal variety; they are most frequently associated with its lower third, and invariably run a rapidly fatal course. This duration of life rarely exceeds eighteen months: often it is very much less. Usually they occur

between the fifteenth and fortieth years. A sarcoma situated at the lower end of the femur often simulates disease of the knee very closely, and gives great difficulty in diagnosis; also a sarcoma of the femur may invade the knee joint and resemble a primary sarcoma of the

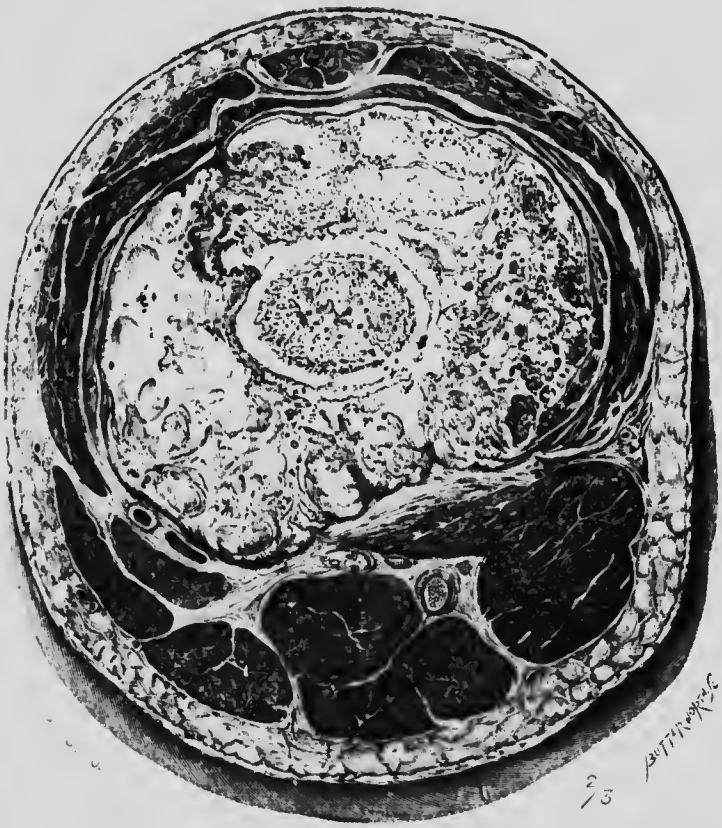


Fig. 11.—An ossifying spindle-celled sarcoma of the femur: in transverse section.

synovial membrane of that joint. The rapidity with which a periosteal sarcoma of the femur will destroy life, especially when it occurs in early life, is illustrated in the following case:—A man, 24 years of age, felt pain in his knee; a month later it was found that a sarcoma occupied the lower end of his femur. Two months later he came under my care, and the leg was promptly amputated. The tumour, a periosteal sarcoma, had circum-

scribed the lower portion of the femur (Fig. 44). A few days after the operation difficulty of breathing began to declare itself, and a month after the operation the man died, slowly suffocated. At the *post-mortem* examination

Fig. 15.—Skeleton of an ossifying periosteal sarcoma of the femur.

secondary deposits were found in the liver, pancreas, and ileum. The lungs were thickly occupied with secondary deposits; and a large conglomerate mass as big as the fist compressed the trachea and adjacent segments of the bronchi. All the secondary deposits were hard and grated

under the knife, and some of them seemed to be contained in an imperfectly formed osseous capsule, or shell.

In its general characters—the disposition of the

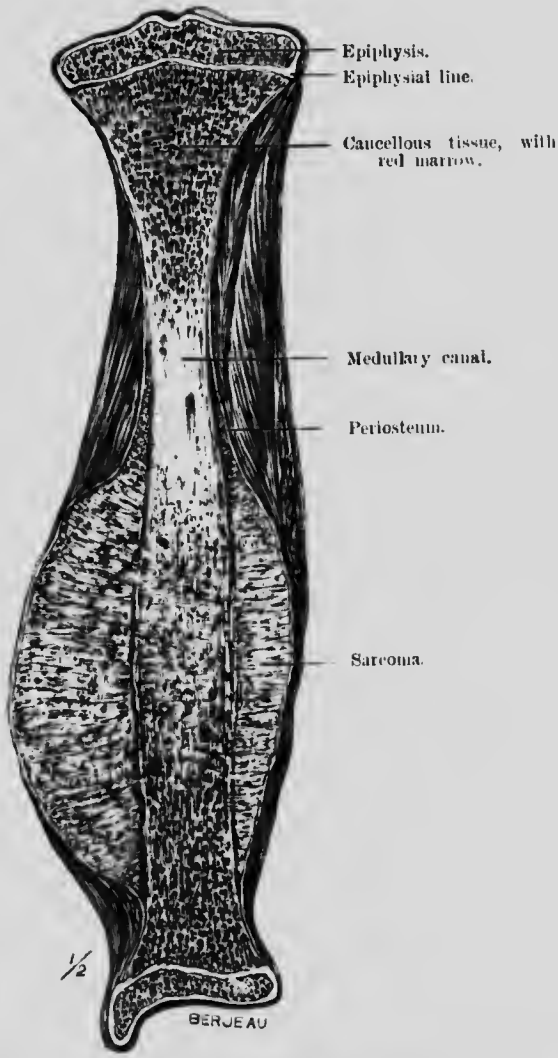


Fig. 16.—Coronal section of the tibia of a girl with a periosteal sarcoma. She was alive and well five years after the amputation.

secondary deposits and in the mode by which it destroyed this man—the sarcoma displayed thoroughly the usual features of an ossifying periosteal sarcoma of the femur.

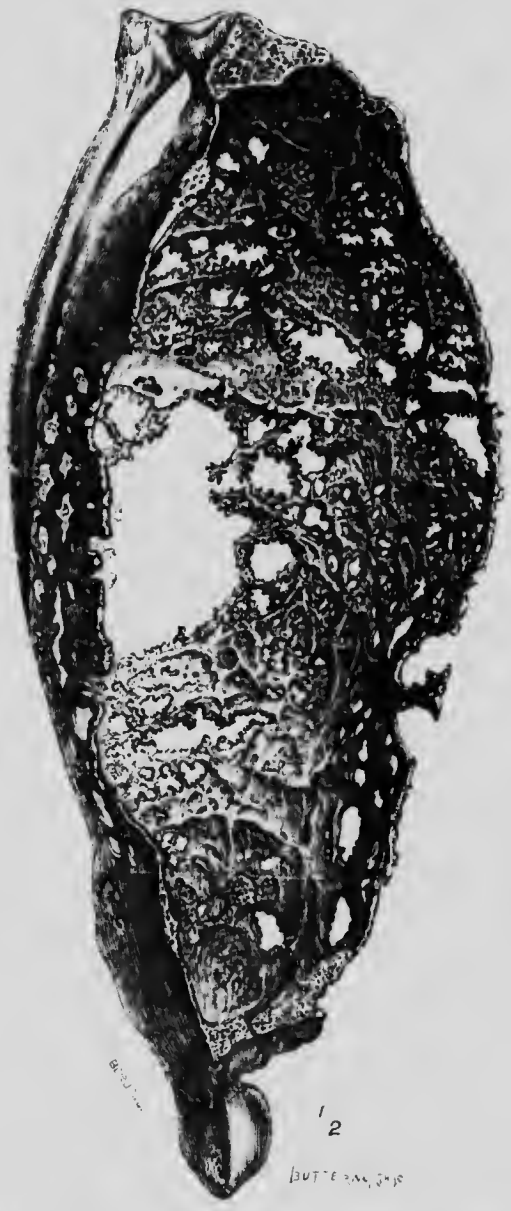


Fig. 17. - Tibia and fibula. The tibia is greatly expanded throughout its length by a central sarcoma. From a man 21 years of age. (*Museum, Royal College of Surgeons.*)

This man had no notion that anything was wrong with his thigh until October, and by the middle of the following

February he was suffocated by large secondary nodules of sarcoma compressing the bronchi.

The Tibia.—Sarcomata are fairly common in this bone; they prefer the upper to the lower end, and they do not

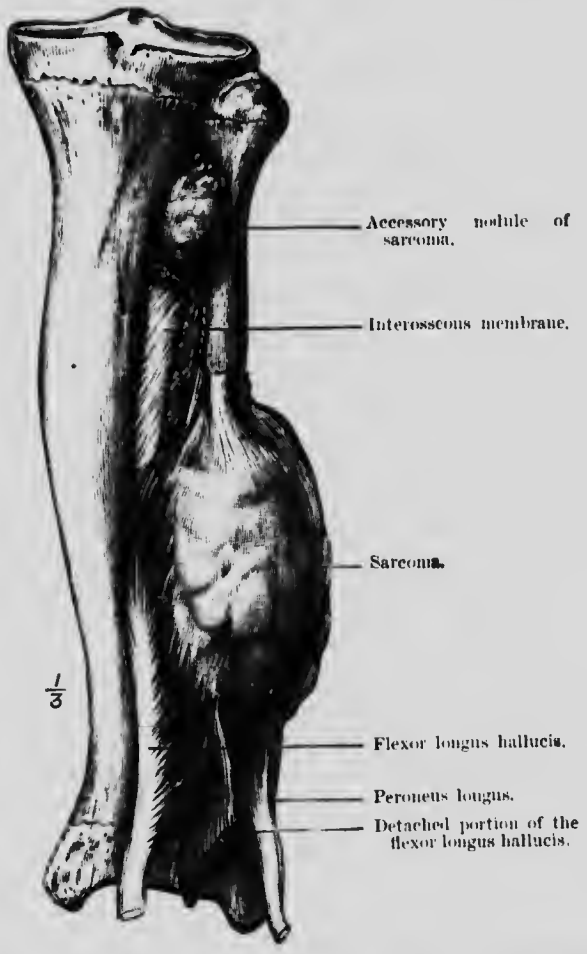


Fig. 18.—Spindle-celled sarcoma of the fibula. (*Museum, Middlesex Hospital.*)

run such a rapid course as in the femur. For instance, I have had the opportunity of following nine cases of sarcoma of the femur throughout their whole clinical course. All the patients died within a year of operation from dissemination of the tumour or from local recurrence. In the case of the tibia I have known several patients, who have

survived amputation of the leg for periosteal sarcoma, to be alive and in good health five years later (Fig. 46).

A very large proportion of central tumours of the tibia, formerly classed as sarcomata, now rank with myelomata, and I am inclined to think that spindle-celled and round-

Fig. 19.—Periosteal sarcoma of the upper portion of the fibula. The side figure shows the bone in section.

celled central sarcomata of the tibia are rare tumours. The extraordinary manner in which a central sarcoma of the tibia will expand the bone is well shown in Fig. 47. The details of this remarkable case have been reported by Eve.

The Fibula.—This bone is not often attacked; the upper end is the favourite situation, but periosteal sarco-

mata may spring from any part of its shaft (Figs. 48, 49, 50).

Sarcomata of this bone are interesting because its upper

Fig. 50.—Fibula showing the change produced by a central sarcoma growing in its upper end.

two-thirds is vestigial, and its persistence is probably mainly due to the fact that it affords attachment to the muscles of the leg. The lower one-third has undergone excessive development to meet the demands of the ankle

joint for greater security necessitated by the upright position in man. These facts induced me some years ago to depart from the usual rule in treating periosteal sarcoma of the fibula. We know that when sarcomata attack the bones of the leg they do not run a very rapid course, so in a favourable case which came under my care in 1895 I resected the upper half of the fibula. The patient recovered with a very useful limb, and was able to walk about. Recurrence took place in the scar eighteen months later; this was removed. Six months afterwards a more extensive recurrence rendered amputation a necessity. The patient died two years and six months after the origi operation with signs indicating dissemination in the lungs.

A careful examination of the literature relating to sarcoma of bone makes me think that these tumours are rare in the fibula, and certainly they do not run a very rapid course.

The Humerus.—Periosteal sarcomata of this bone are very dangerous to life; they occur at all ages, and generally involve the whole shaft of the bone, and form large, soft, rapidly growing, spindle-shaped masses.

Sarcomata situated at the upper end of the humerus have been very freely operated upon since 1887 by the interscapulo-thoracic method of amputation. The immediate results are good, but the remote consequences are discouraging.

The Radius and Ulna.—Sarcomata of these bones, whether central or periosteal, are so rare that it is impossible to collect a sufficient number of cases to make deductions of any value. The few available records are sufficient to show that amputation has been followed by good consequences, immediate and remote. Some of these tumours, however, may have been myelomata.

Clavicle.—Periosteal sarcomata of this bone are rare, and in nearly all the recorded cases have originated near the middle of the bone. A fair number of cases have been reported in which the bone and tumour have been successfully excised.

Examples reported to be central sarcomata arose mainly in the sternal end, but these were in all probability myelomata.

Attempts to treat sarcomata by complete excision of the bone have been attended by a high mortality. The remote results are bad, speedy recurrence being the invariable rule. It is a well substantiated fact that com-

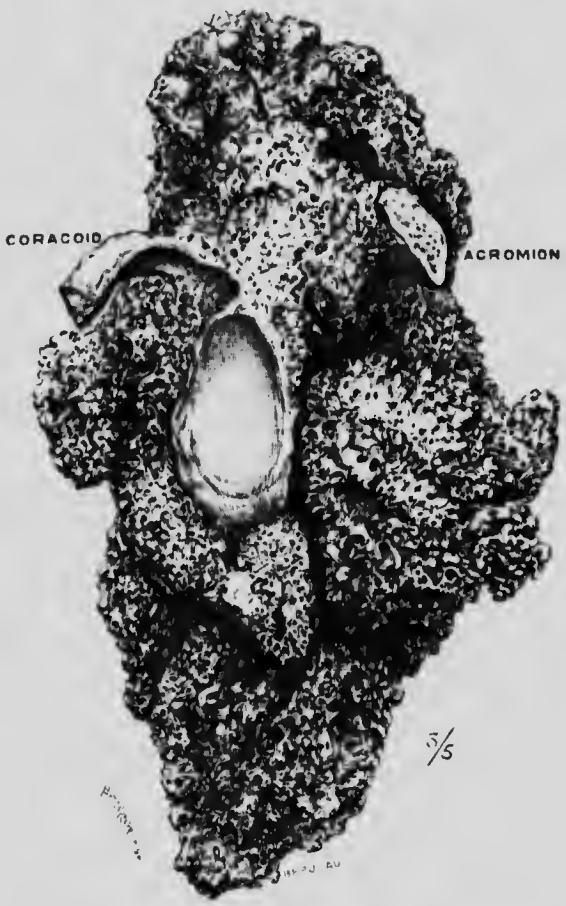


Fig. 51.—Skeleton of a periosteal sarcoma of the scapula.
(*Museum, St. Thomas's Hosp.tal.*)

plete removal of the clavicle does not impair the movements of the upper limb.

Scapula.—It is easy to collect a score or more records relating to sarcomata of the scapula. They arise mainly from the periosteum of the dorsal and ventral surface of this bone and often assume formidable proportions. It is

rare for sarcomata to arise in connection with the processes of the scapula, but a central sarcoma of the coracoid process has been observed.

Scapular sarcomata are usually of the spindle-celled species, and many of them chondrify and ossify, often very extensively (Fig. 51).

Since 1887, when Berger introduced the operation known as interscapulo-thoracic amputation, many surgeons have removed the scapula and upper limb in cases of scapular sarcoma. The immediate results of this formidable operation are very gratifying, and though in a large proportion of the patients there is a quick recurrence, nevertheless, life is more often prolonged than in amputation for sarcomata of many of the long bones. Occasionally when a sarcoma is confined to a limited area of the scapula, it is possible to excise the body of the bone, leaving the head in its normal relation to the shoulder joint: some patients have recovered from this operation with a useful upper limb.

Innominate Bone.—Sarcomata occasionally arise in connection with this bone; they may be periosteal or central, and may occur in any part of it. On the whole, the ilium is the segment most commonly affected, and the tumours attain a great size. Stimulated by the success of the interscapulo-thoracic amputation for sarcoma of the scapula, attempts have been made to remove the innominate bone, or the greater part of it, with the lower limb, as a radical means of dealing with sarcoma of the ilium. This operation has been termed the interilio-abdominal amputation (Jaboulay, 1894). Keen and Da Costa have collected fifteen cases and added one under their own care. The results are not encouraging.

Sternum.—This bone is sometimes the seat of primary sarcoma, and a few surgeons have excised portions of the bone with the hope of eradicating the disease. The results, immediate and remote, are not calculated to bring the operation into favour. Keen has reported a very successful example and collected the best known cases.

Ribs.—Sarcomata attack the ribs, and when they grow from the heads or necks of these bones are apt to send

processes through the intervertebral foramina which, extending into the spinal canal, compress the cord. (Fig. 54.)

A number of instances have been described in which surgeons have removed costal sarcomata, in some cases without opening the pleura, but the results are not encouraging, and in the cases where the pleura was opened in the course of the operation the effects upon respiration and circulation were very grave. Webber, in removing a spindle-celled sarcoma of the sixth rib from a man forty-six years of age, opened the left pleura and the pericardium. The patient recovered.

Bones of the Hand and Foot.—Sarcomata of the carpal and metatarsal bones, or the phalanges, are very exceptional. Large, rapidly growing sarcomata arise from the tarsus, but it is unusual to find a central tumour in these cubical bones, though they have been reported in the calcaneum (Barthaner).

Sufficient facts are not available to enable anything like a satisfactory account to be furnished of the clinical course of sarcomata of the hands and feet; this is due to their rarity.

Patella.—A sarcoma of this bone is a great rarity, but a careful report of a case has been published by Parker.

The Skull.—The large bones of the cranial vault—parietal, squamo-occipital, and the tabular portion of the frontal—are liable to be attacked by periosteal sarcomata: they grow rapidly, and form large tumours which cannot often be submitted to surgery. Pathological museums of any pretensions usually contain one or more crania exhibiting the peculiar formation of spiculated new bone characteristic of a periosteal sarcoma.

The mesethmoid is an unusual situation for a sarcoma, but Moore has described an example (Fig. 52) which is interesting from the very extraordinary effects it produced, for as the tumour increased in size it compressed the walls of the antrum and flattened out the body of each maxilla until these bones formed a thin expanded shell to the tumour, but the bones were not eroded or invaded by it. The sarcoma also greatly widened the space between the orbits and caused great deformity of the face, but

did not invade the skull. There was no pain. Moore attempted the formidable task of removing this tumour, but the patient died during its progress. The parts are preserved in the museum of the Middlesex Hospital.

Sarcomata arising in the muco-periosteum of the roof of the pharynx constitute an important clinical group under the name of *Naso-pharyngeal* tumours. They are commonly met with in patients between the ages of fifteen and twenty, and in many cases arise from the

Fig. 52.—Deformity produced by a sarcoma of the nasal septum. (*Moore's case.*)

muco-periosteum of the under surface of the body of the sphenoid, and in some instances from that lining the sphenoidal sinuses. Such tumours sometimes extend into and plug one or both nasal fossæ, processes of the tumour appearing at the nostril; or they may extend downwards into the pharynx and impede deglutition. Sometimes the base of the skull is perforated by the tumour, and the patient dies of meningitis. Naso-pharyngeal sarcomata give rise to agonising pain and intense frontal headache. Whilst the pain wears out the patient, his strength is further exhausted by frequently recurring and often profuse epistaxis. Exceptionally, a piece of the

tumour will slough and become impacted in the larynx; suffocation has followed this accident.

Sarcomata of the Jaws.—Although it is customary to speak of sarcomata connected with the maxilla and mandible clinically as tumours of the jaws, it would be erroneous to describe them indiscriminately as tumours of bone. In each jaw there are, in addition to the bone and periosteum, two structures to consider—mucous membrane

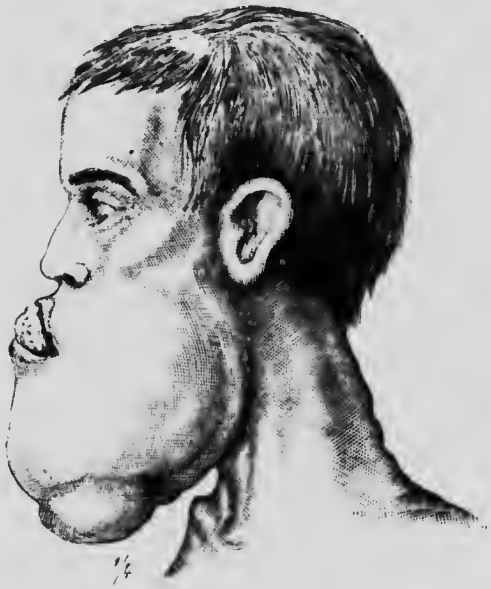


Fig. 53.—Large recurrent sarcoma of mandible.

and teeth. In the case of the maxilla, the antrum requires to be considered, with its gland-containing muco-periosteum.

Periosteal sarcomata of the jaws are rare before the fifteenth year, but they may occur at any age, even in infants a few months old. They belong to the round- and spindle-celled species, and grow very rapidly (Fig. 53). These tumours are less frequent on the mandible than the maxilla; they grow from any part of it Those which spring from the outer surface of the ramus are apt to be mistaken for parotid tumours.

Periosteal sarcomata originate in any part of the maxilla, but they rarely arise from its facial surface, and,

though fairly frequent on the gums, are very rare in connection with the mucous membrane of the palatine process. The muco-periosteum of the antrum is a common situation for these tumours, and as they grow they cause thinning and expansion of the walls of this chamber. This enlargement of the body of the maxilla causes it to encroach on the nasal fossa and obstruct respiration; often the tumour pushes up the orbital plate and displaces the eyeball (proptosis), and in a certain proportion of cases the alveolar border is depressed. The nasal duct is frequently implicated, and when completely obstructed epiphora is the consequence. Clinically, a sarcoma originating within the antrum expands its walls, and by degrees processes of the tumour make their way through and implicate the skin of the cheek, or, projecting into the nasal fossa, ulcerate, and give rise to frequently recurring haemorrhage. When the tumour perforates the posterior wall of the antrum, it will enter the zygomatic and spheno-maxillary fossæ, and creep thence into the temporal fossa, or make its way through the spheno-maxillary fissure and ramify in the orbit, or steal through the sphenoidal fissure or foramen rotundum into the middle fossa of the cranium.

Sarcomata arising in the **follicles of teeth** are composed of small, round, and spindle cells, with a few multinuclear cells interspersed. In their early stages these tumours are distinctly encapsuled, but as they increase in size and involve the gums the exposed surfaces ulcerate and give rise to haemorrhage. When ulceration occurs, the neighbouring lymph glands are apt to become infected.

Sarcoma of a tooth follicle only occurs in children, and is particularly apt to involve the germ of the first permanent molar.

Sarcomata of the Palate.—The mucous membrane of the hard and soft palate is liable to malignant tumours belonging to the sarcomata and squamous-celled carcinomata. It is also liable to a peculiar tumour which is somewhat rare, named "adenoma of the palate." These tumours are usually ovoid in shape, and vary in size from a cob-nut to a hen's egg; they occur more frequently in the soft than

in the hard palate, and are invariably encapsuled. These "palatine adenomata" are complex in structure. Some possess glandular tissue with ill-formed ducts and acini which in their structure mimic cancer, whilst the stroma in which they are embedded imitates sarcomatous tissue. They occur most strongly between the thirtieth and fiftieth years, but they have been met with at puberty. They

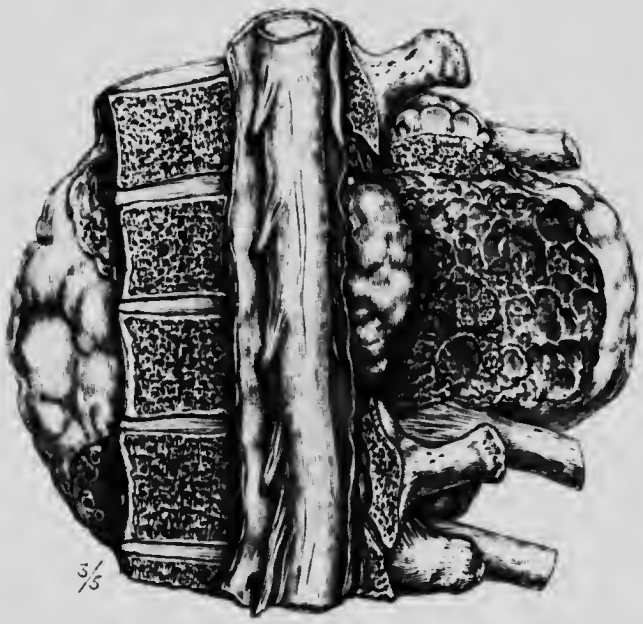


Fig. 51.—Chondrifying sarcoma of the vertebræ and ribs. A portion of the tumour crept into the spinal canal and produced fatal paraplegia. (*Museum, St. Bartholomew's Hospital.*)

are innocent tumours. They have been carefully studied by Stephen Paget and Hutchinson, jun.

In addition to these, the palate is occasionally occupied by globular or ovoid tumours, which are extremely malignant and display all the worst features of sarcomata such as arise in the mucous membrane of the antrum. These tumours have been carefully studied in Germany (especially by Nasse and Volkmann), and ranked in a separate group as endotheliomata. They are interesting because of the similarity of their histologic features and clinical conduct to the mixed tumours of the parotid

gland. My own observations lead me to the view that tumours of this kind occasionally arise not only in the mucous membrane of the palate, but also in that lining the nasal fossæ and the gums. Of the two most typical examples that have come under my notice, the one grew from the mucous membrane covering the alveolar process of the mandible in a woman of fifty years, and the other arose on the mucous membrane of the nostril of a man

Fig. 55. A portion of the lumbar spine infiltrated with malignant disease and slowly absorbed till two intervertebral discs came into apposition.

fifty-four years of age. The tumour was freely excised in each case, and three years later there was no recurrence.

Vertebræ.—Primary sarcomata of the vertebral column are rare tumours. They tend to invade the spinal canal and compress the cord (Fig. 54). It is very unusual for one to be amenable to surgical treatment, but Davies-Colley succeeded in removing one, and the patient, who was paraplegic, recovered motion and sensation.

Secondary deposits of sarcomata and cancer occur with tolerable frequency in the spine; and it is not an uncom-

more event for an individual to come under observation complaining of severe pain in the vertebral column, which may or may not be accompanied by a local swelling, proved by careful investigation to be due to a secondary deposit of malignant disease. In some of these cases the primary source of the disease was not known to exist until the "pain in the back" led to the examination. In one instructive case mentioned by Horsley he actually operated on a spine for severe paraplegia, and discovered tumour-tissue in the arches and spine of the vertebra. Examination determined it to be thyroid gland tissue, and the patient had a goitre. There is one aspect of secondary malignant disease of the spine which needs consideration When a deposit of sarcoma occupies bone, it softens the texture of the bone; when this happens in the body of a vertebra, especially of the lumbar set, the superincumbent weight will gradually compress and slowly efface the affected centrum. In some cases this is so complete that the two intervertebral discs, formerly separated by the diseased vertebra, will come into apposition (Fig. 55).

The pain which is set up by this slow "settling" of the column is very great, and may often be described as agonising. I have noted its occurrence in the cervical as well as in the lumbar segments of the vertebral column.

It is difficult to offer any explanation of the manner in which secondary deposits of sarcoma or carcinoma in bone are determined. Certainly secondary cancer of bone is very much more common than secondary deposits of sarcoma.

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CHAPTER VIII.

SARCOMATA OF THE PAROTID, SUBMAXILLARY, AND LACRIMAL GLANDS, THE PROSTATE, AND THE MAMMARY GLAND.

In describing spindle-celled sarcomata it was mentioned that it is no uncommon condition to find tracts of hyalin cartilage, usually of an immature type, in the substance of the tumour. When the cartilage is fairly abundant, the tumour is usually described as a chondrifying sarcoma. In addition to bone, tumours containing hyalin cartilage occur in the parotid, submaxillary, and lacrimal glands; in the testis and in the mamma.

Sarcomata of the salivary glands, especially those arising in the parotid, have already received particular attention at the hands of pathological histologists, on account of the variety of connective and epithelial tissues which compose them. In recent years German investigators have attempted to show that many of these tumours arise from the endothelium of the lymphatics, such tumours being called endotheliomata (see Chap. XV.). More research is required in this direction, but it is certain that the innocent and malignant tumours of the parotid gland differ not only in their histology, but also in their clinical characters, from what may be regarded as the usual course of sarcomata in other secreting glands.

1. **Sarcomata of the Parotid Gland.**—These appear as oval, smooth, and elastic swellings in the parotid immediately in front of or behind the angle of the mandible; increasing in size, they become tuberous and may implicate the tragus. Left to themselves, they burrow deeply among the tissues of the neck, dip beneath the sterno-mastoid, and acquire attachments to the carotid sheath; sometimes they creep upwards and adhere to the under surface of the petrosal, and, pushing towards the middle line, so bulge the pharyngeal wall inwards as to impede deglutition.

Rapidly growing tumours tend to involve the skin and ulcerate; in very large tumours semi-fluctuating spaces form in consequence of degenerate (mucoid) changes.

The facial nerve is usually involved in large parotid tumours; the small specimens which burrow behind the ramus of the mandible often implicate the nerve as it issues from the stylo-mastoid foramen.

Structurally, these tumours exhibit extraordinary variety. Some consist entirely of hyalin cartilage arranged in lobules bound together by loose connective tissue. The cells of the cartilage rarely possess capsules, and are often stellate, as in immature cartilage. Such grow with extreme slowness, and rarely exceed a bantam's egg in size, and may require ten or even twelve years to attain such proportions.

The large, rapidly growing tumours consist of spindle cells in which tracts and islets of hyalin cartilage are interspersed. When chondral tissue is abundant, it is very prone to mucoid changes, and soft, fluctuating spaces are formed. The connective tissue is very liable to undergo myxomatous change, and, as if to render these tumours more complex, portions of the secreting tissue of the gland are imprisoned in them.

It is not unusual in sections from a parotid sarcoma to meet with spindle cells, cartilage, myxomatous tissue, glandular acini, and fibrous tissue in an area of 2 cm. square. Exceptionally, transversely striped spindle cells are seen. Parotid tumours of such complex structure grow rapidly, and attain a large size, and often infiltrate the surrounding tissue and skin. Some of them infect the adjacent lymph glands and give rise to secondary deposits in the lungs.

Chondrifying tumours of the parotid are most frequently met with between the fifteenth and thirty-fifth years, but they have been observed as late as the seventy-fourth year. They present very characteristic features (Fig. 56). In their early stages they are easily removed, but many of the rapidly growing forms so quickly infiltrate the tissues that their complete extirpation is not always possible.

When left to themselves they cause death in a variety of ways. Thus they may press upon the pharynx and lead to fatal dysphagia, or ulceration may open some large

Fig. 56. Parotid tumour which had been slowly growing 17 years. When the woman was 57 it grew rapidly and infected the lymph glands, and destroyed the patient in six months.

vessel in the neck and produce fatal haemorrhage; secondary nodules sometimes form in the lungs, and induce fatal broncho-pneumonia, but dissemination is not a common feature of sarcomata of the salivary glands.

2. Chondrifying Sarcomata of the Submaxillary Gland.—These tumours are far less frequent in the submaxillary than in the parotid gland. They are encapsuled and, as a rule, shell out easily. They grow slowly, and occur in the young as well as in adults. Glandular tissue is often associated with the cartilage.

Fig. 57.—Chondroma of the submaxillary gland which had been slowly growing forty-four years. It was successfully removed.

The slow course which some of these tumours pursue is illustrated by the example represented in Fig. 57. The patient, a woman aged 74 years, was under my care in the Middlesex Hospital. At the age of thirty she detected a tumour under the jaw about the size of a cherry; it caused no pain and continued slowly growing during forty-four years, then became so cumbersome that she willingly submitted to operation. The tumour consisted of pure hyalin cartilage, with a large softened area in its middle.

Chondrifying Sarcomata of the Lacrimal Gland.—Tumours containing cartilage are very rare in this gland. Butlin has described an example removed by Vernon from the orbit of a man twenty-eight years of age. The tumour had been growing nine years; it was easily shelled out of a tough capsule, and measured 6 by 4 cm. Seven years later the man was free from recurrence.

The most remarkable features of sarcomata of the salivary glands, and of the parotid in particular, are these:—

An individual may have a tumour in one of these glands which will grow to a certain size and be stationary for ten, fifteen, and even forty years; then without any warning it begins to enlarge and infiltrate the gland, cause pain, and disseminate, and destroys life in a few months. In another class of case the tumour will make its appearance, grow quickly, ulcerate, and destroy the patient in six or nine months; the microscopic structure of the tumours in both cases being similar.

Chondrifying tumours of the lacrimal gland are rare. Mackay gave me an opportunity of examining one microscopically, which he removed from a woman in whom it had existed eighteen years; it then began to grow quickly, and necessitated operation. After removal, the tumour quickly recurred and killed the patient, so that the clinical course of such tumours in the lacrimal gland is much the same as in the parotid and submaxillary glands.

Until pathologists agree in regard to the nature of these tumours it will be wiser to class [illegible] among the sarcomata on clinical grounds.

Sarcomata of the Prostate.—It is a curious fact that the prostate, like the kidney, ovary, and testis, is more prone to sarcoma in the early years of life than in the adult; to judge from the records, sarcoma is five times more frequent during the first ten years of life than in all the remaining period. It may occur as late as the sixtieth year. The disease begins insidiously, and there is rarely any suspicion of trouble until the urethra becomes obstructed. In the specimen (Fig. 58), though the tumour is relatively large, the real cause of obstruction of urine, which led to the discovery of the tumour, was a bud-like

process of the sarcoma which played the part of a valve at the vesical orifice of the urethra.

Very little accurate knowledge exists as to the relative frequency of sarcoma and carcinoma of the prostate, because in clinical work the two conditions are classed under the common heading, "Malignant Disease."

Fig. 58.—Sarcoma of the prostate in sagittal section. From a boy aged nine years.

Sarcomata of the Mammary Gland.—The mamma is occasionally the seat of a sarcoma, and when we take into consideration the large amount of connective tissue which it often contains, it is somewhat surprising that these tumours are not more frequent: of one hundred consecutive examples of malignant tumours of the breast, two were sarcomata. As is the case with sarcomata growing in the parotid gland, these tumours, originating in the connective tissue of the breast, usually entangle the ducts and

acini in their immediate neighbourhood: such incorporated glandular structures occasionally give rise to cystic spaces, which, when viewed in section under the microscope, exhibit a regular lining of epithelium. Such tumours are often called "adeno-sarcomata." This is a misuse of the term sarcoma, and it has unfortunately been extended so as to include many adenomata of the breast.

This gland is liable to round- and spindle-celled sarcomata. Those of the round-celled species rapidly infiltrate the organ and invade adjacent structures, giving rise to brawny indurated tumours. They recur very quickly after removal, and grow with fearful rapidity in young women and in those who are suckling.

Spindle-celled sarcomata grow slowly, and in the few reported cases the tumour had attained the proportions of an orange before removal. In the breast, as in the case of the salivary glands and testis, such tumours occasionally contain tracts of hyalin cartilage and bone.

Examples of chondro-sarcoma of the mammary gland have been recorded by Bowlby, Battle, Bruce Clarke, and Morton. In some of the cases the cartilage had calcified, and in one the calcification was so extensive that a saw was needed to divide it. The whole tumour was about the size of a small cocoanut (Bruce Clarke).

Sarcomata of the Genital Glands.—So much new work has been carried out in regard to malignant tumours of the ovary and the testis that it has been found convenient to consider them in a separate section.

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CHAPTER IX.

SARCOMATA OF THE KIDNEY AND ADRENAL.

RENAL SARCOMATA.

A CRITICAL analysis of a very large number of records demonstrates that sarcomata of the kidney exhibit a peculiar age distribution. Thus, during the first five years of life they are common; then follows a period of comparative immunity.

The second period of liability is from thirty to fifty. Of course, sporadic cases occur between childhood and thirty, but they are relatively infrequent. It is also very remarkable that the tumours in the infant and adult periods of life not only differ remarkably in structure, but arise in different regions of the kidney; for the renal sarcomata of infant life are lodged in the pelvis of the kidney, and those of adult life originate mainly in connection with its capsule.

Sarcomata of Infants.—During the first five years of life the kidneys are exceptionally liable to sarcomata possessing peculiar characters: they originate in the connective tissue of the renal sinus, and gradually distend the cortex until the tumour is surrounded by a thin capsule formed of expanded secreting tissue of the kidney. On this account these tumours are described as being encapsuled, but it is a spurious encapsulation formed partly by renal tissue and in part by the true capsule of the kidney (Fig. 59). On section, such sarcomata are yellowish-white, and the cut surface is often dotted with groups of small cavities, due to secondary changes, especially when the tumour is very large.

The base of such sarcomata is connective tissue containing cells of various shape and size: some are round or oat-shaped, and others are spindles. In a fair proportion of specimens many of the spindle cells present the cross striation so characteristic of the fibres of voluntary muscle,

and they lack a sarcolemma. When these cells are present the tumour is sometimes termed a myosarcoma.

A careful microscopic study of these tumours, as well as a critical analysis of the descriptions published by others, indicates that when the striped cells are very abundant the tubules are, as a rule, absent. In examples containing many tubules (Fig. 60), as well as those in which striped spindles are numerous, the round, oat-shaped, and spindle sarcoma cells are equally abundant. It has been suggested by Paul that, as the most typical

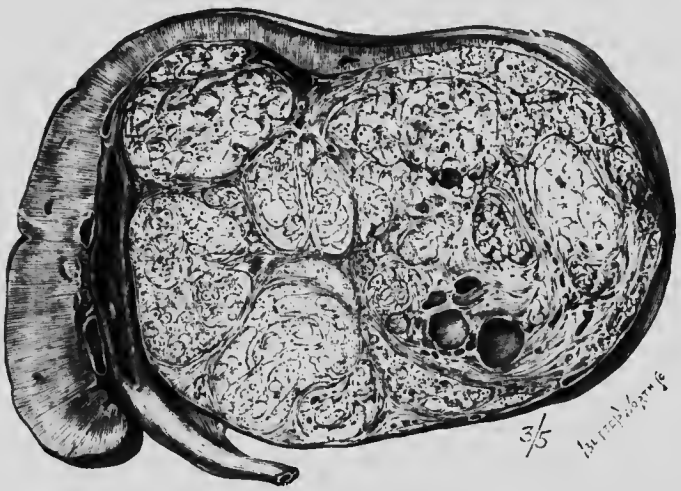

Fig. 59.—Renal sarcoma in section; removed from a child aged 20 months.

myosarcomata are more sharply delimited from the other varieties, the tubular elements may be derived from the kidney. I did not at first acquiesce in this view, but a more extended inquiry leads me to accept it. This is a matter worth consideration, because a study of the fœtal kidney demonstrates very clearly that the renal sarcomata of infancy arise in the connective tissue of the renal sinus. The epithelial cylinders are due to the entanglement of uriniferous tubules, in consequence of the sarcoma invading the cortex, whilst the striated spindles are derived from the muscle-tissue of the renal pelvis, which is an expansion of the hollow muscle known as the ureter.

Thus the doctrine of tissue prototypes is abundantly exemplified and satisfied by the normal tissues, without any need of invoking assistance from misplaced segments of adjacent mesoblastic somites, a theoretical mode of

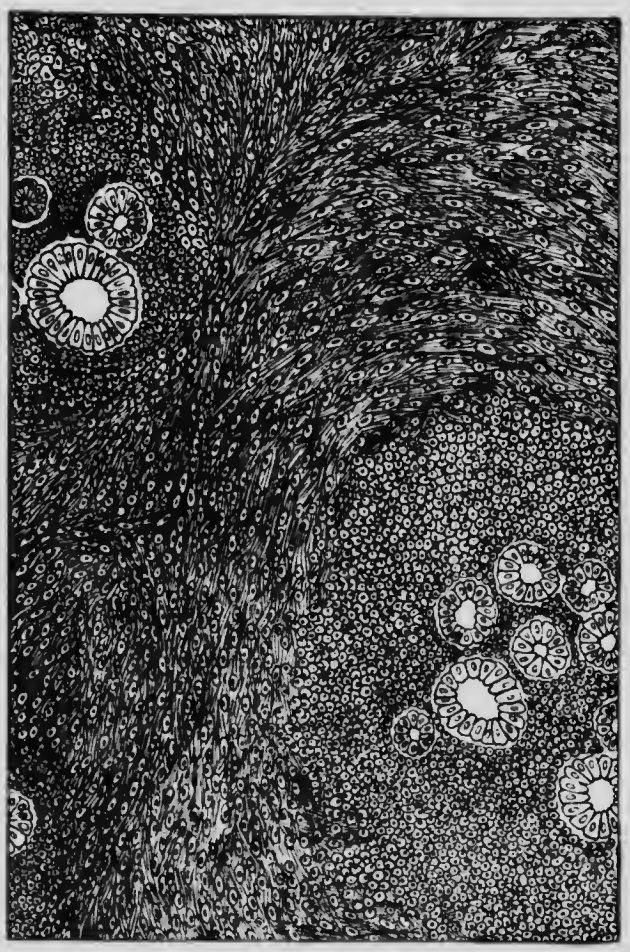

Fig. 60. Microscopic characters of a renal sarcoma. (From an infant of 20 months.

origin which never commended itself to my mind. These studies demonstrate in no uncertain way that the so-called renal sarcomata of infants are extrinsic in origin, and strictly non-renal. This view is now held by all who have carefully looked into the matter: and it is worth

mention that in 1857 Van der Byl exhibited at the Pathological Society, London, a large renal tumour, from a boy aged eight years, which measured 82·5 cm. (33 inches) and weighed 31 lb.; and in the description of the specimen in the catalogue of the Middlesex Hospital Museum, it is

Fig. 61. A boy aged eight years with a renal sarcoma which weighed 31 pounds.

definitely stated that the growth appears to have sprung from the concavity of the kidney, and a narrow band of renal tissue can be traced round a great part of the circumference of the kidney. The general appearance of this boy in such dreadful circumstances is shown in Fig. 61. It is

characteristic of these sarcomata that the ureter is rarely obstructed. This extraordinary freedom of the ureter from invasion explains the rarity of hæmaturia in these cases, and, perhaps, what is otherwise remarkable, the painlessness of these tumours in children, for there is no pressure from accumulated urine. Certainly a child with a very large renal sarcoma has been absolutely free from pain, and amusing himself with his playmates in the garden three days before he died. Indeed, many mothers, when the gravity of a renal tumour of this kind is explained to them, will express their astonishment that a child, apparently in excellent health and spirits, could be in such serious straits as the surgeon would have them believe.

Though the ureter so constantly escapes invasion, yet the veins are always implicated; and this constitutes one of the most peculiar as well as most dangerous features of renal sarcomata in children. The tumour tissue extends into the renal vein, and often projects and even runs for a long distance into the inferior vena cava; portions are detached and carried to the pulmonary circulation, and are arrested in the capillaries of the lung, and originate secondary deposits. The intravenous apex of such an outrunner is usually cone-shaped and smooth. Occasionally a large fragment is detached, and this has been known to block the right auriculo-ventricular orifice (Osler). Such a gross embolus is uncommon. Plugging of the vena cava by an outrunner is by no means rare, and gives rise to œdema of the lower limbs. In a case under my own care the inferior vena cava was completely obstructed from its origin to its termination by a sarcomatous extension of this kind.

It is a singular and well-established fact that when certain paired viscera, such as the kidneys, ovaries, eyeballs, and crura cerebri, are in early life attacked by sarcomata, in a very large proportion of cases, perhaps half the number, the disease is bilateral. In relation to this matter, Abbe recorded a very important observation. He successfully extirpated a kidney for sarcoma in a child of one year and two months. Four and a half years later the little patient again came under his care with a

sarcoma in the remaining kidney. In 1893 I collected and tabulated in the first edition of this book twenty-one complete records of renal sarcoma in infancy which had been submitted to nephrectomy. In the list of twenty-one cases, twelve patients died as a result of the operation: of those which recovered all died of recurrence within a year. Since the publication of that table a large amount of interest has been aroused in the question of the results of nephrectomy for sarcoma, and it is now an easy matter to collect a hundred records. The analysis of a large number of these reports shows that nephrectomy for renal sarcomata in children under six years of age has a mortality of over 50 per cent. Of the fifty that recover, forty-five die from recurrence at periods varying from two months to a year. In the remaining five, life may be prolonged, as shown in the adjoining table: –

RENAL SARCOMATA IN INFANTS.

Table of Cases in which life was prolonged beyond one year by nephrectomy.

Reporter	Age	Result.
Hicquet	6 months	Died 1½ years after operation. (*Acad. Roy. de Méd. de Belgique*, Jan. 28, 1882.)
Schmidt	6 months	Alive and well three years later. (Dr. Emily Lewi. *Arch. of Pedriatics*. vol xiii., p. 97.)
Abbe	2 years	Alive and well five years later. (*Annals of Surgery*, 1894.)
Abbe	1 yr. 2 mths.	Patient died 4½ years later from sarcoma in remaining kidney. (*Annals of Surgery*, 1894 and 1897.)
Malcolm	"	Alive and well 10 years later. (*Trans Clin. Soc.*, vol. xxvii., p. 94, and private letter.)

It is very certain that a child with a renal sarcoma runs an enormous risk of losing its life when submitted to nephrectomy, and at the same time the chances of prolonging life are more slender than in any other surgical operation. It must, however, be borne in mind that the disease is surely fatal within a very limited period when allowed to run its own course.

Sarcomata of Adults.—These differ in many important particulars from the sarcomata of infancy. In the first

place, a sarcoma in the adult arises in the cortex, usually in connection with the capsule, and then gradually invades the true tissue of the kidney. The relation of renal sarcomata to the capsule is of some importance, because similar tumours arise in the connective tissue in which the kidney is embedded; these are perirenal sarcomata, and, as far as my observations go, this is a more frequent position for them than those which we term renal sarcomata. A careful comparison of these tumours leads me to believe

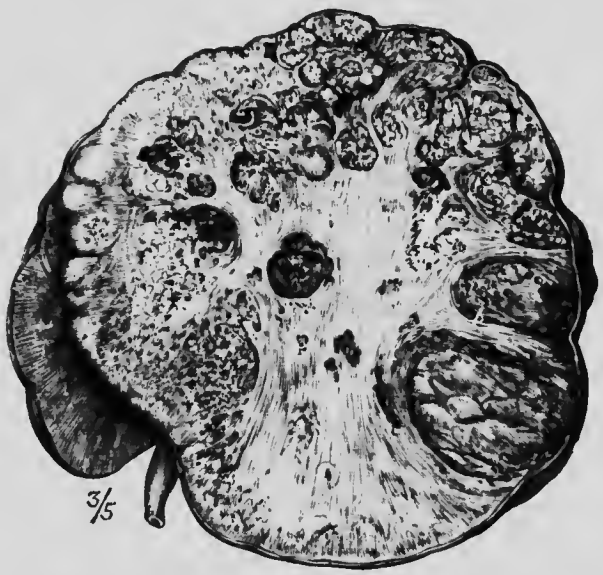

Fig. 62. – A kidney in section with a sarcoma invading its cortex. From a man 51 years of age. (*Museum, Middlesex Hospital.*)

that, in the adult, sarcomata of the type represented in Fig. 62 have their origin in the renal capsule, whereas the sarcoma of childhood arises, as already pointed out, in the connective tissue of the renal sinus. This is a subject of some interest, because a critical comparison of the mode of origin of sarcomata in viscera similar to the kidney, *e.g.* the spleen, thyroid gland, and prostate, shows that such tumours are not only uncommon, but are often closely connected with the connective tissue investments of such organs.

Rare as a sarcoma of the adult kidney is, and especially

if we exclude the clearly perirenal forms, we find that they occur much more frequently than in the liver, the spleen, or the prostate, even when we take into consideration the fact that the kidney has a double liability from the circumstance that it is a paired organ.

The whole question has assumed a new aspect since Grawitz showed that many renal sarcomata occurring in adults exhibit, on microscopic examination the structure

Fig. 63. An accessory adrenal beneath the capsule of the kidney. (*Museum, Royal College of Surgeons.*)

of the zona fasciculata of the adrenal. This view has excited wide interest, and, whether true or not, it has led to a keen investigation of the microscopic structure of the malignant tumours of the adult kidney.

It has long been known that accessory adrenals are found beneath the capsule of the kidney (Fig. 63), as well as on the under surface of the liver: they are also found in the retro-peritoneal tissue in the course of the spermatic artery, in the spermatic cord, simulating fatty tumours (Andrewes), and,

strangest of all, on the anterior layer of the mesometrium near the ovary "rests" have only been met with in the fœtus near, or at, full time. Eastwood has recently described a large tumour removed from the uterus of a woman 48 years of age which he believed to arise in an adrenal "rest."

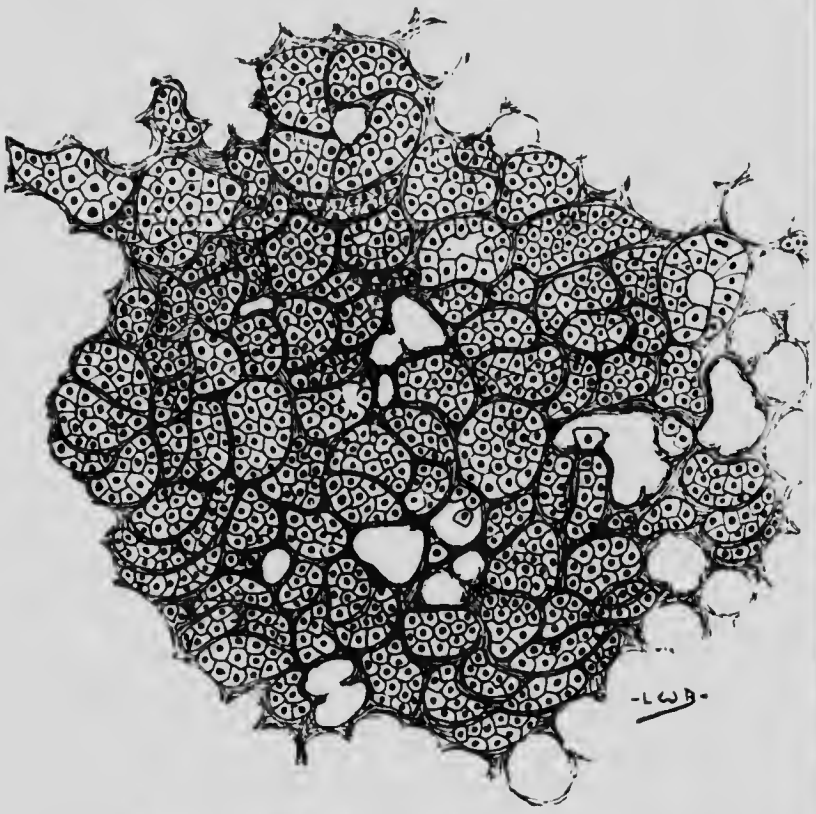

Fig. 64.—Microscopic characters of a renal tumour supposed to arise in an adrenal "rest." The tumour was removed from a woman 58 years of age. She survived the operation three years, and died of bronchitis. There was no evidence of dissemination.

In addition to the topographical and histological features of these tumours, stress is laid by some observers on the presence of glycogen in the cells, inasmuch as it supports the view that they arise in embryonic tissues.

It has long been known that the adrenal may be transformed into a large tumour in the same way that a thyroid

gland becomes a goitre, and the analogy is so striking that Virchow years ago proposed for these adrenal tumours the term "struma suprarenalis." In recent years this analogy has been further justified by the fact that some of these adrenal tumours, as well as those which arise beneath the capsule of the kidney, and exhibit the adrenal structure, disseminate and mimic the extraordinary phenomenon known as "general thyroidal malignancy," in which

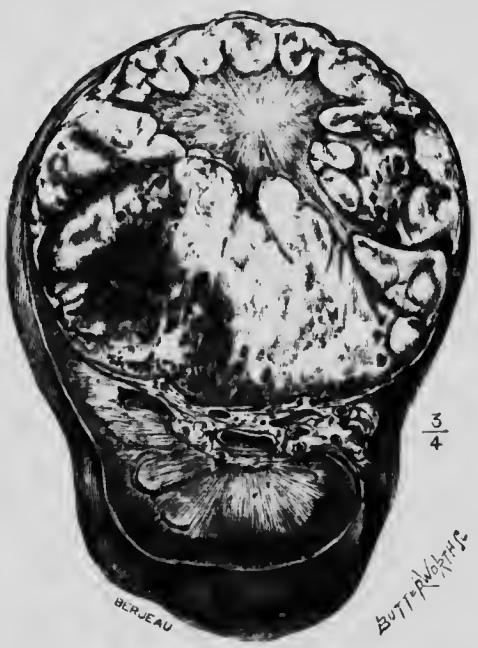

Fig. 65.—Sarcoma of the kidney supposed to arise from an adrenal "rest." Removed from a woman aged 42 years, during pregnancy. She was in good health five years later, in spite of having borne a child.

tumours, exhibiting all the microscopic features of thyroid gland, appear in the bones, especially the skull, vertebræ, and femur, as well as in the viscera, in association with what appears to be a simple adenoma of the thyroid gland.

Whatever view may be taken of the tissue in which these tumours arise, it is quite certain that they exhibit peculiarities of structure which distinguish them from the ordinary round- and spindle-celled species of sarcomata (Fig. 64). That they are malignant is equally beyond

question, for they not only recur after removal, but give rise to secondary nodules, especially in the lungs, these nodules exhibiting the characteristic features of adrenal tumours. The frequency with which the lungs are implicated is due to the tumour invading the renal vein or its branches. Though these tumours are very vascular, and their central parts are often destroyed by extravasations of blood, they do not give rise to hæmaturia, because the tumour does not invade the renal pelvis. This is the most striking fact in their clinical history.

Treatment.—As in the case of visceral sarcomata generally, the only available treatment for sarcoma of the kidney is early excision, but this is rarely of much service. The mortality of the operation is nearly as great as in renal sarcomata of infancy, for about half the patients submitted to nephrectomy for malignant tumour of the kidney die. Of those who recover, in nearly all recurrence takes place within a year, and in most of them within a few months.

It is an interesting fact, and one to which I have devoted great attention, that in the very few recorded cases in which adult individuals have survived nephrectomy for sarcoma more than a year, the tumour belonged to the variety which imitates the structure of the adrenal (Fig. 65).

TUMOURS OF THE ADRENALS (SUPRARENAL CAPSULES).

The adrenals are liable to tumours many of which have been described as sarcomata, some as carcinomata, and for others a particular name has been coined, hypernephromata.

The adrenals, like the kidneys and other paired organs, are liable to tumours at two distinct periods of life, namely, in childhood and in adult life.

Adrenal Tumours in Children.—Our first knowledge of these tumours which were in the main described as sarcomata was derived from post mortem observation, and the evidence showed that tumours of the adrenal in children were rare, and that they occurred in the early years of life, and attacked one or both organs, and sometimes attained the size of cocoanuts. It was also established that they became

disseminated and gave rise to secondary deposits, particularly in the liver.

Observers like Greenhow, Hale White, Dalton, Ogle, Dickinson, Colcott Fox and others not only gave careful descriptions of the tumours, but some of them drew attention to the peculiar coloration of the skin, unlike the bronzing of Addison's disease, the abnormal development of hair, and in some instances precocious development of the sexual organs.

Many carefully described examples have since been published, and Bulloch and Seqneira have collected twelve cases in which the ages of the patients varied from 1 to 14 years. The majority of the children were girls under four years.

This combination of pigmentation, precocious development of the sexual organs, and a tumour of the adrenal is so remarkable that it is necessary to give brief details of two well-marked examples:—

Dr. Seqneira's patient, aged 11 years, looked like a stout little woman of forty. She was four and a half feet high and weighed eighty-seven pounds, a brunette with coarse skin, and a copious development of hair on the lips and chin. The pubic region and axillæ were covered with long hair, and her mammæ resembled those of a sexually mature woman. The abdomen was distended with fluid (hydroperitoneum), and a large tumour could be felt in the left hypochondrium. She died a few months after coming under observation. The left adrenal was replaced by a tumour weighing three pounds. The liver and lungs contained secondary deposits. The microscopic structure of the tumour and the secondary deposits resembled that of the cortical portion of the adrenal. This girl up to the age of 10 years had been to all outward appearance normal.

The case recorded by Adams is equally remarkable. The patient, a boy aged 14 years, developed normally to the tenth year, then he became pubic, this change being accompanied by marked muscular development, and the growth of a beard so abundant that he had to be shaved almost daily. His appearance was that of a sturdy little

man. His complexion became dusky, and a tumour became obvious in his abdomen. An attempt was made to remove the tumour, but it proved inoperable: the boy died eighteen months later. The tumour weighed eight and a half pounds and adhered to the left kidney. No trace of the left adrenal could be found. The liver was thickly dotted with secondary deposits, some of which were as big as walnuts. Microscopically the tumour presented an alveolar arrangement and was regarded as a hypernephroma, taking its origin in the cortex of the left adrenal.

It is also clear that tumours arise in the adrenals of children unaccompanied by cutaneous or sexual changes, and the writers last mentioned have collected fourteen cases which were observed in children at ages varying from a few weeks to six years. In some of these cases attempts had been made to deal with the tumour surgically but without success.

Adrenal Sarcomata in Adults.—The accounts of tumours believed to be primary sarcomata of the adrenals betray a large amount of confusion in the minds of surgeons. Since the publication of Grawitz's observations, that certain renal sarcomata probably arise in accessory adrenals, there has been a tendency to assume that some of these tumours arise in the adrenal and gradually become incorporated with the adjacent parts of the kidney.

There are at present no facts to support such an assumption, and those who have advanced this view have failed to take steps to determine the presence or absence of the adrenal in such cases, and their efforts have only served to increase a literary rubbish-heap of false facts already far too big.

It is worth remembering that the source of the well-known lymphatic cysts in the necks of children (cystic hygroma) was supposed to be the intercarotid gland, till Julius Arnold had an opportunity of dissecting a case in which he demonstrated the presence of the normal intercarotid gland and a so-called cystic hygroma.

A careful inquiry on the same lines is much needed to determine the presence or absence of an adrenal in an individual with a supposed primary adrenal sarcoma

invading the kidney. It should also be remembered that the kidney is occasionally embedded in a large sarcoma arising in the subperitoneal tissue.

It, is, however, a fact that sarcomata arise in the adrenals of adults and sometimes attack both organs; and they also display the usual features of malignancy, inasmuch as they grow rapidly, disseminate, and quickly destroy life.

In describing cases of sarcomata of the adrenal in infancy,

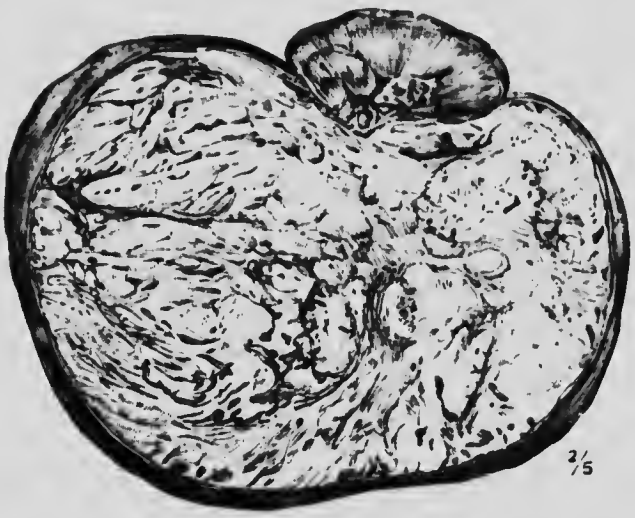

Fig. 66.—Adrenal tumour, with kidney *in situ*. (*Museum, Royal College of Surgeons.*)

mention was made of the occasional occurrence of abnormal general hairiness, and a remarkable case of this kind has been recorded by Knowsley Thornton (Fig. 66). He removed from a lady 36 years of age a large sarcoma of the left adrenal. The patient was covered "with long, silky hair, and had to shave her face just like a hairy man." Dr. Keith had performed oöphorectomy upon her six or seven years previously. The adrenal sarcoma was removed in April, 1889, and in November of the same year she wrote that she was like her old self, and had "all the external appearance of other women."

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CHAPTER X.

PIGMENTED TUMOURS.

This chapter will be mainly devoted to the consideration of the tumours known as melanomata on account of the black pigment they contain. The majority of these melanotic tumours exhibit the structure and clinical features of sarcomata (melano-sarcomata), but some which arise in the eye are carcinomata.

There are other tumours associated with pigmentary changes, and some forms of pigmentation unassociated with tumours, which will be noticed. These are—Chloroma (green cancer); pigmentation of the skin associated with tumours of the adrenals (suprarenal capsules); the small red plaques on the skin known as "De Morgan spots"; xanthoma; and ochronosis. (See also Lutein Cysts.)

MELANOSIS AND MELANOMATA.

In the majority of mammals there are certain epithelial and connective tissues which normally contain pigment. Among pigmented tissues the skin and epithelial layer of the retina hold the first place. In skin the pigment is chiefly contained in the deeper layers of the reto mucosum; and hair, being derived from the cells of this layer, is pigmented also. In many mammals other tissues contain pigment, such as the mucous membrane of the roof of the mouth of the dog, and the blue coloration of the vaginal mucous membrane of the vervet monkey.

In man the amount of pigment varies greatly, so that we may pass gradually from individuals whose skins are intensely black to others who have no trace of cutaneous pigment.

It is a noteworthy fact that animals with no pigment in the skin also lack pigment in the uveal tract of the eyeball. A familiar example of this is the white rabbit with pink eyes.

Such a condition is termed **albinism**, and colourless animals, or **albinos**, occur among all classes of animals, vertebrate and invertebrate. Excessive development of black pigment in the skin is known as **melanism**; this is much rarer than albinism.

Abnormal distribution of pigment is common; in man it gives rise to the condition termed leucoderma when it affects the skin, and unequal distribution of pigment in the retina is known as retinitis pigmentosa. Irregular patches of black in the skins of horses cause them to be described as piebald, and when disseminated in small dots and irregular tracts they are said to be grey.

In the white races of men the pigment granules are almost entirely confined to the cells of the rete mucosum, but when the pigmentation is very marked it will be found distributed in the other tissues of the skin. The pigment, or melanin as it is called, lies within the cells in the form either of black or of brown granules, or they may be uniformly stained by it. It is stated that white skin transplanted on to a negro soon becomes pigmented, and that the skin of a negro grafted on to a white man undergoes depigmentation. It has long been known that leucocytes carry pigment.

In amphibians and fishes pigment occurs in the branching cells (Deiter's cells) situated beneath the epidermis. These cells are filled with black melanin granules, obscuring the nucleus. On exposure to light these protoplasmic processes retract, and the pigment is concentrated in the cell body, but when kept in the dark the processes are protruded and the pigment is diffused in the surrounding structures.

The most remarkable example of pigment formation is found in cuttle-fishes (octopus and sepia). These invertebrates possess an ink-bag from which, when irritated, they eject a black pigment (sepia) in such abundance as to colour the surrounding water to the extent of a cubic yard or more, and under cover of this dark cloud they escape from their enemies.

Melanosis is sometimes produced by parasites. This variety of melanism is rarely seen in man, but is fairly frequent in other animals (Fig. 67).

Pigmentation in this form is not uncommon in the lungs of mammals, but it must not be confounded with the irregular black patches so common in the lungs of those who dwell in densely populated and smoky towns. Small nodules surrounded by a zone of intensely black pigment are not uncommon in the skins of dogs; the central nodules usually contain an encysted parasite.

Pathological pigmentation in its most serious forms is found in connection with certain tumours arising in the skin or within the eyeball; the colour is due to the presence of a

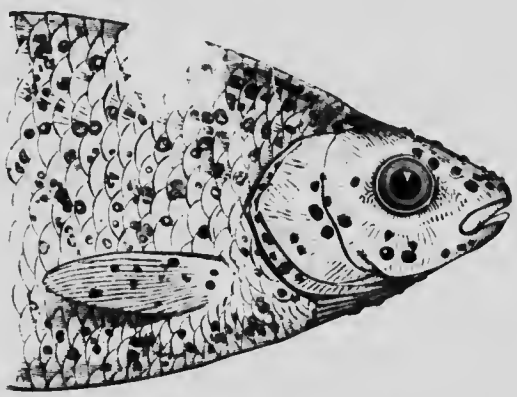

Fig. 67.—Anterior portion of a dace, each black spot contains a central white dot representing an encysted parasite.

black pigment known as melanin, and the tumours are in consequence termed melanomata. The amount of melanin in these tumours varies greatly: in some the quantity is so small that the tissue presents merely a brown coloration, whilst in others it is so abundant as to make them as black as ink. The pigment particles are lodged not only in and among the characteristic cells of the tumours, but in and among those of its fibrous matrix, even in the walls of its blood-vessels. The primary tumour may contain very slight traces of pigment, sometimes so slight as even to raise a doubt whether it should be called melanotic; yet the secondary growths and the lymph glands infected by it will be inky black. The intense blackness of the secondary deposits leads to their ready recognition, and doubtless accounts for the belief that this species becomes more widely

disseminated than other malignant tumours; but an equally wide distribution of secondary nodules in unpigmented tumours will sometimes be found when the organs are submitted to a rigorous search.

Exceptionally, the secondary deposits from a melanoma may contain so little pigment as to appear almost colourless to the naked eye.

Melanin.—This occurs as fine, irregular, amorphous granules varying from light brown to intense black. It is soluble in ether, alkalies and strong acids, and is bleached by chlorine, a fact which is useful in examining the microscopic features of melanomata.

The urine of patients with melanotic tumours often contains black pigment (melanogen), usually in solution but occasionally suspended in the form of granules. The urine is as a rule clear when first voided, but blackens on exposure to the air, and becomes intensely black when submitted to oxidising re-agents, *e.g.*, a mixture of sulphuric and hydrochloric acids to which a few drops of ferric chloride have been added.

A more sensitive test is the addition of bromine water to the urine, which yields a yellow precipitate turning black on exposure to light. I made several observations on the urine of patients suffering from melanomata, in the hope that some opinion might be formed as to the gravity of the patient's condition according to the amount of melanin present. In two cases the patients died within three months of the observation, although the urine was free from black pigment, but on the whole I am inclined to believe that an abundance of melanin is of the gravest import.

In the rare anomaly known as alkaptonuria the urine when passed is clear, then becomes brown, and finally black on exposure to the air. (See Ochronosis, p. 130.)

Primary Melanomata of the Skin.—These tumours arise in the skin in several ways; the common source is pigmented moles and warts. Rarer examples of the disease arise in the fingers and toes, especially in the pigmented patches sometimes found near the matrix of the nails (melanotic whitlows). Another source is the dark skin of the external

genital organs in both sexes and that around the anus. Melanotic tumours may also arise independently of birth-marks on any other pigment anomaly of the skin. I have seen two instances in which the disease arose in the skin under the heel, following in each instance an injury from a nail in the boot. The disease in these patients ran a rapidly fatal course.

As pigmented moles and warts are the common source of primary cutaneous melanomata it will be necessary to consider these defects of the skin.

Moles.—These are pigmented and usually hairy patches growing on the skin (*nævus pilosus*). They are congenital or appear during infancy. The patches vary in size: many are no larger than a split pea, others are as big as the palm, and in some instances cover an extensive area of the trunk, face, or limbs. Fifty or more moles may be present on an individual. The colour varies; in some it is brown or of a coffee-colour, others are as black as ink. The hair on a mole may be short like that on the body generally, or as long as that on the scalp. (See Chapter XI.) Some black blemishes are glabrous (*nævus spilus*).

Moles sometimes bleed freely when their surfaces are abraded or incised: they are liable to ulcerate spontaneously, and the ulcer bleeds.

The most striking feature in the histology of a mole is the alveolar arrangement of the tissue immediately underlying it (Fig. 68). The nerves in the subcutaneous tissue beneath a large mole often exhibit the condition known as a plexiform neuroma. (See p. 150.)

Melanomata arise quite as frequently from a black hairless blemish (*nævus spilus*) as from the hairy nævus; another source is the pigmented wart or congenital papilloma. This kind of wart appears in two forms: the most frequent is the large solitary wart which stands up on the skin, usually of the trunk, like a mulberry with a stalk. This variety of wart is either congenital or appears in childhood; it is always solitary, and contains black pigment. After middle life it may become active, ulcerate, stink, and, in a certain proportion of the patients, infect the system with melanomatous nodules.

The rarer form consists of an area composed of a number

—twenty or more—of flat-topped, sessile, soft warts. These may be intensely black. Without any obvious reason this wart-field increases in size, infects the glands, and melanin appears in the urine. A striking case of this came under the writer's care in a girl aged fifteen years; it is the earliest age at which he has seen a melanoma. The primary tumour was seated on the left mamma.

A pigmented mole may remain quiescent throughout a very long life and never cause the least inconvenience; in other instances, fortunately rare, as life advances the mole ulcerates,

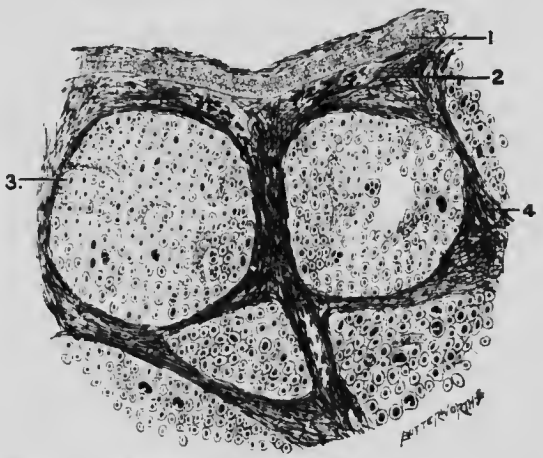

Fig. 68.—Microscopic characters of a melanoma arising in a mole (Acton). 1, Epidermis; 2, Corium; 3, Round cells with an alveolar arrangement; 4, Intra-alveolar stroma.

perhaps bleeds freely, and may even become partially healed: but coincident with the onset of ulceration the adjacent lymph glands enlarge, become charged with pigment and sarcomatous tissue, spaces filled with inky fluid form in them, and finally the overlying skin ulcerates. The infection may not proceed further than this; recurrent hæmorrhages from the fungating glands, or a furious bleeding should a large vein or artery become broached by ulceration, carries off the patient. In many cases the morbid material is transported into distant parts, secondary knots form in the liver, lung kidney, or brain, and death arises from interference with the functions of these organs.

In other cases the mole, instead of ulcerating, is observed

to become more prominent, and finally forms a tumour of some size standing out prominently from the skin. In due course the lymph glands, in anatomical relation with the part from which the tumour arose, enlarge, and secondary deposits occur in the viscera, bones, or skin.

It does not necessarily follow that in all cases of melanomata occurring in moles secondary deposits are formed in the viscera. In some cases, which, however, are very rare, the tumour seems to become mainly a source of pigment, large quantities of which enter the circulation, to be discharged

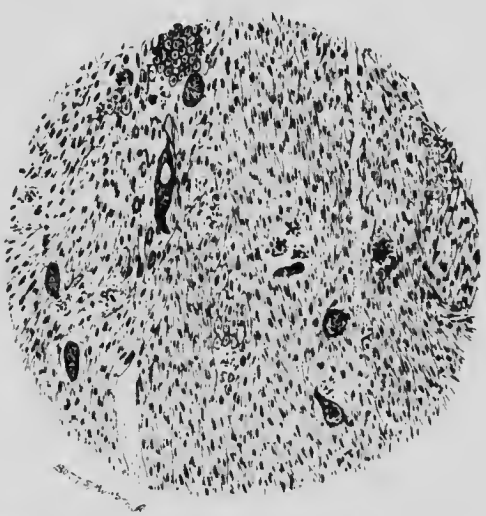

Fig. 69.—Microscopic appearance of a melano-sarcoma. (*After Acton.*)

with the urine, in which it is recognised as melanin. Exceptionally the skin will assume a dusky tint.

The hairy mole (dermoid pterygium) which occasionally grows on the conjunctiva is not, as far as my observations extend, liable to become the seat of melanoma.

Melanosis in connection with the **fingers** and **toes** assumes two forms: it may occur as a deep pigmentation of the skin, usually in the immediate neighbourhood of the nail, often involving the matrix, and even the nail itself; or a small pigmented nodule will arise in the nail matrix or in the adjacent skin. These nodules quickly ulcerate, and dissemination follows.

The hallux is the digit most prone to be attacked by melanomata, and several examples have been carefully recorded, most of the patients being women. These cases are arranged in the following table:—

Fergusson .	M.	36	Hallux . .	*Lancet*, 1857, i. 290.
Hutchinson	F.	60	Hallux . .	*Trans. Path. Soc.*, vol. viii. 104.
Nunn . .	F.	50	Fifth Finger	*Ibid.*, vol. xxxi. 299.
Ledlard . .	F.	40	Index Finger	*Ibid.*, vol. xxxix. 307.
Bowlby . .	F.	55	Hallux . .	*Ibid.*, vol. xli. 314.
Barnard . .	F.	60	Index Finger	*Brit. Med. Jn.*, 1902, vol. i. 457.

Apart from abnormal deposits of pigment such as moles and warts, melanomata are occasionally found in those parts of the body where the skin is more deeply pigmented than usual, namely the external genitals in both sexes, and the skin around the anus.

The greater **labia** are liable to melano-sarcoma, and I have seen two examples: in each the disease ran the usual course. In one instance I have observed a spindle-celled melanoma of the **anus** in a woman of fifty years. Melanoma of the penis has also been observed. (Fischer, Payr.)

Primary melanoma of **mucous membrane** is very rare, and it is odd that the recorded cases have been observed on the muco-periosteum of the hard palate. Treves, in recording an example, reminds us of the fact that the mucous membrane in this situation is charged with pigment in certain mammals. This is the case with dogs.

The theories relating to the connection between abnormal patches of pigment, moles, and melanomata have recently been carefully summarised by Fox.

Intra-ocular Melanomata.—The commonest situation of these tumours is the uveal tract, and the lamina fusca: the seat of origin accounts for the presence of pigment. Their distribution in these tissues is curious, for a melanoma of the choroid is ten times more common than in the ciliary body, and a pigmented tumour of the iris is excessively rare: moreover, those which arise in the ciliary body are carcinomata.

Melanomata of the uveal tract are most frequent between the fortieth and sixtieth year, but they have been observed

as early as the fifteenth and as late as the eighty-fourth year.

In structure they may be round-celled, spindle-celled, or mixed-celled, the size of the cells varying greatly in different tumours. The amount of pigment in intra-ocular melanomata varies greatly; in some specimens it is so abundant that the tumour is coal-black; in others it is only sufficient to impart a grey tint. Occasionally the pigment is so irregularly distributed that some parts of it are almost colourless.

The tumour remains for a time restricted to the interior of the globe, but it tends to escape therefrom in three directions: (*a*) along the course of the venæ vorticosæ, appearing outside the sclerotic in the situations where these veins emerge; (*b*) the presence of the tumour leads to an increase in the intra-ocular tension, and finally to sloughing of the cornea; (*c*) the growth may invade the optic nerve.

Melano-sarcomata are very apt to recur after removal, and to become disseminated. The most frequent situation in which to find secondary deposits is the liver; but any organ may contain them, even the bones. It is surprising, considering that the eyeball is near to and in such close relation with the brain, by so large a nerve trunk as the optic nerve, that the brain should be rarely implicated. It is a fact that when the brain is a seat of deposit it is rarely the result of extension along the nerve. The amount of dissemination varies greatly; in some cases secondary knots occur in almost every organ; in others they will be limited to the liver. The lymph glands adjacent to the orbit are rarely infected. It is curious that in most cases death results more often from the secondary growths, involving important organs, than from the local effects of the primary tumour. A rare complication of melanotic tumours is pigmentation of the skin.

The *duration of life* in patients with intra-ocular melanomata rarely extends beyond three years. A careful analysis of a large number of cases shows, however, that in many instances life may be indefinitely prolonged by early removal of the globe, and cases are known in which patients have been reported alive and well five, six, eight, nine, sixteen and eighteen years after the operation. In the majority of cases that recur the recurrence takes place within three years of

the operation. Collins and Lawford, calculating cases in which recurrence does not take place within three years of operation as recovery, come to the conclusion from an analysis of seventy-nine cases, of which they were able to obtain complete records, that the rate of recovery is twenty-five per cent., but they point out that patients have died from recurrence or secondary deposits after a much longer interval than three years. Dissemination has been deferred for so long a period as eleven years after excision of the eyeball. (Hutchinson.)

Melano-carcinomata.—Several writers, who have devoted attention to intra-ocular tumours, describe some of the pigmented tumours as carcinomata, using the term in the definite sense in which it is employed in this work. Much new light has been thrown on this question by the interesting investigations of Treacher Collins. This ophthalmologist has demonstrated the existence in the ciliary body, in the space extending from the root of the iris to the ora serrata, of a number of small tubular processes composed of epithelial cells with the free ends projecting towards the ciliary muscle (Fig 70). Collins succeeded in demonstrating the existence of these processes by bleaching the cells. The ciliary glands are interesting in connection with melano-carcinoma, for Collins discovered among the intra-ocular tumours, preserved in the museum of the Moorfields Hospital, two examples from the ciliary body, which were epithelial in character. In examining them he adopted the bleaching method, to which reference has already been made.

We must agree with his observation, that melano-carcinoma is unknown except as a primary tumour arising in the ciliary body.

Melano-sarcomata are of fairly common occurrence in horses: the regions most affected are the tail and the parts about the anus, where they form large mushroom-like excrescences, with little disposition to ulcerate. The tumours in some cases attain large proportions, and have been known to weigh forty, fifty, and even sixty pounds. When a large tumour grows from a horse's tail it becomes a great encumbrance, which the veterinarian removes by amputation. It

occasionally happens that in the operation a portion of the tumour is left behind, and its cut surface heals like other tissues. These pigmented tumours are very prone to disseminate, and secondary nodules occur in almost all the viscera; yet, in spite of this, melano-sarcoma does not appear to be such a malignant affection in horses as in men.

Although most common in grey, it also occurs in white, and occasionally in black horses, and it certainly occurs in cows. Next to the anus and tail, the udder is the most frequent seat of the primary tumour, and it may spring up in

Fig. 70.—Bleached section of the glands of the ciliary body. (*After Collins.*)

the subcutaneous connective tissue in any part of the trunk. Horses may be attacked at any age from four years upwards. In structure, melano-sarcoma of the horse resembles a hard uterine fibroid rather than a sarcoma. In these animals melano-sarcoma of the uveal tract is very rare.

Sarcoma Idiopathicum Multiplex Hæmorrhagicum.—This rare disease, described by Kaposi, has been most frequently seen in Polish Jews. It attacks the feet and hands and gradually extends up the limbs. The skin involved in this disease in the most typical cases is bluish-red, and the nodules, which tend to become confluent, vary in size from a split pea to a hazel nut. The tumour-nodules are very vascular, and on microscopic examination resemble spindle-

celled sarcomata. The coloration is due to blood, so that this disease is quite different from melanoma.

De Morgan Spots (Canceroderms).—It is not uncommon to find on the skin, especially of the abdomen and chest of patients debilitated by cancer, numbers of small raised red spots looking like nævi. These are often called "De Morgan Spots," after Campbell De Morgan (1872), who regarded them as almost pathognomonic of cancer: they are patches of pigment and not nævi.

These spots have been carefully studied by Brand and Leser. Their conclusions are of interest, for they point out that the "spots" do not appear in healthy subjects, or in persons suffering from other diseases in early or middle life, and never even in old age in large numbers. When these spots are plentiful there is every reason to suspect cancer. I have made careful observations of these spots for twenty-five years in regard to their association with cancer, and find that they are as common in the non-cancerous as in those afflicted with this disease.

Ochronosis and Alkaptonuria.—For many years after Virchow, in 1866, drew attention to the peculiar discoloration of the cartilaginous tissues of the body under the designation ochronosis, it may be said to have remained a pathologic curiosity, until Albrecht (1902) drew attention to the occasional relationship which exists between this disease and the curious and rare condition of the urine known as alkaptonuria.

The condition termed ochronosis scarcely amounts to a disease, as it in no way shortens life, and in the early cases the changes, which consist of blackening of the costal cartilages, the gristly parts of the pinna and sclerotic, were only discovered at a post-mortem examination. In cases subsequently reported, such fibrous structures as the intervertebral discs, and the chordæ tendineæ, have been found discoloured, and in a remarkable case, recorded by Pope, the rib cartilages were blue-black, the ears were blue, and there were black patches on the inside of the lips, and the skin of the face had brown patches not unlike the pigmentation of Addison's disease. On microscopic examination of a patch of pigmented skin from a patient with ochronosis the pigment

particles were found in the elastic tissue of the skin, but not in the rete Malpighii. Osler has reported a case in which there was skin pigmentation.

Alkaptonuria has been particularly investigated by Garrod: its essential features are as follow:—The urine, though of normal appearance when passed, acquires a deep brown colour and ultimately becomes black on exposure to the air. The brown colour is intensified by alkalies. The urine reduces Fehling's solution with the aid of heat, and actively reduces ammoniacal silver nitrate solution in the cold. Fabrics moistened with alkaptonuric urine become deeply stained on exposure to the air.

This anomaly often dates from infancy, and in one case, at least, staining of the napkins by the urine was noticed the day after birth.

Garrod, in his classical analysis of this disorder, states "that homogentisinic acid is a constant constituent of alkapton urines, and plays the chief part in the production of alkaptonuria."

In regard to the relationship between ochronosis and alkaptonuria, Garrod writes:—"There are very strong grounds for believing that in later life alkaptonuric subjects tend to develop the characteristic pigmentation of cartilages: in other words, that alkaptonuria is *a* cause but not the *only* cause of ochronosis."

Chloroma (Green Tumours).—This is an exceedingly rare disease in which sarcoma-like masses form on the bones of the skull and face, especially in the neighbourhood of the orbits, and infect other organs secondarily. After death the colour of the tumour-like masses is grass green. The nature of the disease is obscure: some writers regard it as a form of leukæmia. It has been carefully studied by Melville Dunlop.

Xanthoma.—This, with its many synonyms, is a curious, harmless pigment disease, especially liable to appear in the skin of the eyelids near the inner canthus. Histologically it consists of a fibrous and fatty tissue containing yellow pigment and connected with the corium. In the eyelids the disease is usually symmetrical and occasionally congenital. These early cases have led some observers to regard the disease as allied to nævi.

Xanthoma may occur on any part of the skin (X. multiplex), and in many instances is associated with jaundice and disturbance of the liver.

The orange-coloured pigment is interesting from a physiological point of view in connection with the oil gland of the rhinoceros hornbill (*Bucorvus abyssinicus*). In this bird the gland secretes an orange-coloured material with which it preens its feathers.

The only normally pigmented tissue found in the human body resembling the yellow and orange of xanthoma patches is the lutein tissue found in the corpus luteum and the walls of lutein cysts arising therefrom.

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CHAPTER XI.

MOLES.

Moles are pigmented and, usually, hairy patches growing on the skin. They are congenital, or appear during the first few weeks after birth. These patches, as is remarked on p. 123, vary greatly in size; many are no bigger than split peas, others cover an extensive area on face, trunk, or limbs.

The common variety consists of a slightly raised brown patch: it is sometimes quite black, and is, as a rule, covered abundantly with hair, which is commonly short; occasionally, however, it is as long as that naturally found upon the scalp. The hairs are furnished with sebaceous glands, and sweat glands are often present. The amount of pigment varies; occasionally it is so abundant as to produce an inky blackness. Moles are very vascular, but the most striking feature of their histology is the fact that the tissue immediately underlying them is arranged in alveoli (Fig. 68). The most important change to which they are liable is to become later in life the starting-point of melanomata, some of which are very infective, and quickly destroy life. (See p. 122.)

When very large moles occur on the trunk the hairy part is sometimes very sensitive, almost hyperæsthetic (Fig. 71). In large moles pendulous skin-folds are sometimes present; these folds are large in the young, but, as a rule, they shrink and become quite small in the adult. As many as fifty moles may be present on one individual. When a mole is extensive, and occurs in an exposed situation (Fig. 72), it is a serious disfigurement. The relation of moles and plexiform neuromata is described on p. 150.

Small hairy moles do not, as a rule, cause much inconvenience even when they occur on the face, in which situation they are known as "beauty spots." A small hairy mole on a fair cheek is regarded often as an additional charm rather than a disfigurement, if we can trust the taste of Persian story-tellers and poets.

In the Arabian Nights the allusions are many; thus the youth in the Eldest Lady's tale says: "Persian poets have a thousand conceits in praise of the mole." Some of these allusions are certainly exquisite. Here is an example:

"A nut-brown mole sits throned upon a cheek
Of rosiest red beneath an eye of jet.

Fig. 71.—An extensive hairy mole. (From a picture in the Museum of the Middlesex Hospital.)

English writers often refer to moles. Marlowe, in his powerful tragedy *Dr. Faustus*, when he causes Alexander and his paramour (Act iv. sc. i.) to appear before Charles, Emperor of Germany, makes the Emperor say:—

"I have heard it said,
That this fair lady, when she lived on earth,
Had on her neck a little wart or mole."

There are numerous references to moles scattered in Shakespeare's plays. In *Cymbeline* all who have read the play will remember the subtile use Iachimo makes of the fact that she had

> "On her left breast
> A mole cinque-spotted, like the crimson drops
> I' the bottom of a cowslip."

Fig. 72.—Extensive hairy mole upon the face of a boy a year old.

In the *Comedy of Errors*, Dromio of Syracuse, in his comic account of the kitchen wench, tells his master that she knew what private marks he had about him, such as "the mole in my neck, the great wart on my left arm," etc. (Act iii. sc. ii.)

The occurrence of moles and other varieties of mother-marks has always been a subject of great speculation among matrons and the superstitious of all countries and all times. Peculiarly marked bull calves (apis bulls) were particularly

venerated by the priests at Memphis, and when they died were accorded remarkable sepulchral rites. Moles are more particularly related to the "longings" of pregnant women, who believe that if these are not appeased the child will appear with the wished-for article, usually flowers or fruit, marked on its skin. Though these matters receive no support from the scientific investigator there is no belief more deeply rooted in the mind of matrons, young or old. The tradition comes to us from remote antiquity, and the way in which Jacob turned it to advantage is well set forth in his crafty management of Laban's flock (Genesis xxx. 37).

The case of Esau, who "came out red all over like a hairy garment" (Genesis xxv., 25), which curiously fascinates biblical commentators and matrons, had a parallel in a girl born at Pisa, hairy all over. In this instance, the mother attributed it to the fact that during her pregnancy she had gazed at a picture of John the Baptist. This is a good example of the circumstantial and plausible way women endeavour to account for these things. The belief even survives the ridicule of Charles Dickens, for he represents Mrs. Gamp telling about a man six-foot-three "marked with a mad bull in Wellington boots upon the left arm," because his mother took refuge in a shoemaker's shop when frightened by a mad bull during her pregnancy ("Martin Chuzzlewit," chap. 46).

Hairy patches on the Conjunctiva (Conjunctival Moles).—The mucous membrane (conjunctiva) on the ocular surface of the eyelids and adjacent portions of the eyeball occasionally presents a patch of skin which in appearance and structure resembles a hairy mole. Such a patch is called a *dermoid pterygium*.

These dermoid patches occur most frequently at the margins of the cornea, and usually in the line of the palpebral fissure—that is, directly in the equator of the cornea; but they are by no means confined to these situations. Usually they are limited to the conjunctiva covering the sclerotic, or trespass but little on the cornea. Sometimes, however, they involve a considerable extent of the corneal surface (Fig. 73). Wardrop described one in a man fifty years of age; it was congenital. Twelve long hairs grew from its middle, passed between the eyelids, and hung over the cheek.

These hairs did not appear until the sixteenth year, at which time the beard began to grow.

Occasionally a mole will be found on each side of the cornea in the line of the palpebral fissure. A rare variety

Fig. 73.—Dermoid pterygium—common variety.

is limited to the caruncle: this is simply an excessive development of the delicate hairs that normally beset the caruncle (Fig. 74).

These moles are occasionally associated with malformations of the eyelids, especially the one known as coloboma of the upper eyelid. When this association occurs, the defect in the lid corresponds to the cutaneous patch on the conjunctiva. This combination is of some importance, as it

Fig. 74. Excessive growth of hair on the caruncle, associated with an eccentric pupil. (*After Demours.*)

is used as evidence in support of an explanation that has been put forward in regard to these moles, based upon the development of the eyelids.

In the embryo the tissue covering the outer surface of the eyeball, which ultimately becomes the conjunctiva, is

directly continuous and in structure identical with the skin at the margin of the orbit. Very early, cutaneous folds arise and gradually grow over the surface of the eyeball, and come into apposition at a spot corresponding to the future palpebral fissure. These folds ultimately become the eyelids. The surfaces of the folds, which are continuous with the covering of the eyeball, become converted into mucous membrane, and are termed conjunctiva. In every

Fig. 75.—Conjunctival mole associated with coloboma of the eyelid, a mandibular tubercle, and accessory tragus. (*Cavell's case.*)

normal eye the conjunctiva bears evidence of its transformation from skin, inasmuch as the carmncle at its inner angle is furnished with delicate hairs. It is reasonable to suppose that, as the occlusion of the proper covering of the eyeball by the eyelids is the cause of the conversion of the conjunctiva into mucous membrane, if from any cause a part, or even the whole of it, were left uncovered, the exposed part would persist as skin. This is precisely what occurs. When the eyelid is in the con-

dition of coloboma (Fig. 75)—a defect due, in all probability, to the imperfect union of the embryonic eyelid to the skin covering the fronto-nasal plate—a piece of conjunctiva persists as skin, and forms a mole occupying the gap in the lid. Moles occur on the conjunctiva unassociated with coloboma, but in nearly every instance they are situated on the cornea in the line of the palpebral fissure. This circumstance would indicate that during development the conjunctiva was imperfectly covered by

Fig. 76.—Dermoid pterygium in a sheep.

the developing lids. In a few very exceptional cases the eyes have been found completely covered with skin without any traces of eyelids. Such a condition is known as **cryptophthalmos**, and the explanation offered concerning it is, that in these cases the eyelids have failed to appear, and in consequence the conjunctiva has persisted as skin.

Conjunctival moles have been observed in horses, sheep, oxen, and dogs, and are furnished with air or wool, according to the nature of the tegumentary covering of the mammal in which they occur (Fig. 76).

CHAPTER XII.

NEUROMATA AND ALLIED CONDITIONS OF THE NERVOUS SYSTEM.

Neuroma.- This may be defined as a tumour growing from, and in structure resembling, the sheath of a nerve.

The term neuromata is often used, especially in clinical work, as signifying tumours on nerves, but as they are sometimes composed of fibrous, fatty, or even sarcomatous tissue, it would be better to speak of them as lipomata of nerves, sarcomata of nerves, and so on.

The tumours which most strictly correspond to my definition are those known as neuro-fibromata, and it will be convenient to include the curious nodule known as the "painful subcutaneous tubercle."

A neuro-fibroma is usually fusiform, and grows from the side of a nerve: when large, it may spread out the fasciculi of the nerve; exceptionally the nerve-fibres will traverse the tumour. The long axis of the neuroma coincides with that of the nerve from which it grows.

In size neuro-fibromata vary greatly: some are no larger than lentils, others may be as big as eggs; larger specimens are very exceptional. They occur on the cranial as well as on the spinal nerves, and form on their roots, trunks, branches, or the terminal twigs. Neuro-fibromata form smooth swellings, which are mobile, and when situated in the subcutaneous tissue glide easily under the skin; they are encapsuled, and may be easily enucleated: are extremely liable to become myxomatous, and in large specimens this change leads to the formation of cavities in the tumours. These changes account for the various names applied to them, such as myxoma, myxo-fibroma, myxo-sarcoma, and the like.

Painful Subcutaneous Tubercle.—This term was applied by Wood in 1812 to a small discrete nodule which forms in the subcutaneous tissue. It is usually of the "size and

form of a flattened garden pea," but it very rarely exceeds the size of a coffee bean. When examined by the finger it feels like a small shotty body slipping about immediately beneath the skin. Structurally the "tubercle" consists of fibrous tissue very like that which constitutes the bulk of the nodules in molluscum fibrosum; it is rare that a nerve-fibril can be traced to it.

The interest of these bodies is due to the "very severe and excruciating pain" associated with them. The pain is paroxysmal, and usually increases in severity and in frequency according to the length of time the disease has existed. If the "tubercle"—for it is usually solitary—is struck, or even touched, acute pain is produced.

They occur much more frequently in women than in men, and are commonly met with in early adult life; and though a "tubercle" may form on any part of the body, it shows marked preference for the lower limb. Excision of the little body at once, and permanently, arrests the pain.

Ganglionic Neuroma.—This is a tumour composed of nerve-cells, nerve-fibres, and neuroglia. They are extremely rare tumours. Klebs described a tumour of this kind which grew from the floor of the fourth ventricle near the calamus scriptorius. The tumour was nearly as large as a walnut. It has been thought that some tumours described as gliomata may have been ganglionic neuromata; on the other hand, however carefully the histologic features of these tumours have been described, there has always been a doubt lest normal brain tissue became included in the tumour. However, this cloud has been dispelled by the observation that tumours containing ganglionic tissues occur in connection with the great cords of the sympathetic system as well as in the subcutaneous tissue.

In one of the most remarkable cases, recorded by Knauss, a girl eight years old had sixty-three tumours in the subcutaneous tissue of the trunk and thighs (Fig. 77); they varied in size from a pea to an orange, were firm and elastic, and not painful. Microscopically these tumours were found to be composed of ganglionic nerve-cells,

medullated and non-medullated nerve-fibres. Knauss believed that these tumours were derived from the minute ganglia on the finest terminal fibres of the sympathetic system

Fig. 77.—Girl, eight years of age, with sixty-three ganglionic neuromata in the subcutaneous tissue of the trunk and thigh. (*Knauss.*)

which accompany the blood- and lymph-vessels. Knauss's description of the microscopic characters of the tumours, which clinically resembled lipomata, is accompanied by careful drawings.

Fig. 78.—Multiple molluscum fibrosum.

Neuro-fibromatosis.—Under this heading it is now necessary to describe several affections which were formerly regarded as being quite distinct. These are multiple

Fig. 79. A native of Sierra Leone, [illegible] 30 years, with molluscum. The tumours, which were congenital, varied in size from a pea to a billiard ball. (*Lawprey.*)

neuromata, molluscum fibrosum, plexiform neuromata, myxomata of nerves, and glioma. I will endeavour to state a few facts concerning each of these conditions before describing their intimate relationship.

It has long been known that [illegible] sometimes

or on nerves in extraordinary numbers. The remarkable case of Michael Lawlor, described by Smith's classical monograph, was in all probability an example of this combination. It was estimated that the man had at least 2,000 tumours. There were 450 tumours counted on the nerves of the right lower limb, and 300 on the left. There were 250 tumours on the right and 100 on the left upper limb. The peripheral nerves and their branches

Fig. 80.—Native of Bengal with molluscum fibrosum of the arm; there were also discrete nodules on other parts of the body. The man belonged to the cow-keeper caste. (From a photograph sent by Dr. Maddox, Bengal.)

possessed 60 tumours, some of large size. The remainder were on the trunk.

Several cases of this kind have been carefully described, but probably in no individual has a greater number of nodules been detected.

In 1882 Professor von Recklinghausen published an important monograph, in which he demonstrated not only that multiple neuromata were sometimes associated with molluscum fibrosum, but that the two conditions were closely related, and

he urged that the molluscum bodies of the skin are formed on the cutaneous nerves, and are as truly neuromata as the tumours on the epineurium of the larger nerves.

In typical cases of molluscum fibrosum the skin of the trunk and limbs presents numerous small tumours, consisting

Fig. 81.—Multiple molluscum nodules on the scalp, nose, and fingers. The nodules on the fingers were in the course of the digital nerves.

mainly of fibrous tissue springing from the subcutaneous connective tissue. These tumours are of various sizes, some being no larger than a pin's head, whilst many are as big as a filbert, and a few even larger. The majority are about the size of a small pea. Many are sessile, and others are distinctly pedunculated, but all are covered with skin. These tumours

are mobile, soft to the touch, and of the consistence of firm fat. Sometimes the disease affects a broad area of skin on the head, trunk, or limbs, causing it to hang in pendulous folds. Exceptionally the pendulous and nodular lesions occur in the same patient.

In its mildest form molluscum fibrosum appears as a single pedunculated tumour, a frequent situation being the labium majus. (Fig. 82.)

Fig. 82.—Pedunculated molluscum fibrosum from the labium majus of a woman 50 years of age: it had existed many years.

The structure of these solitary tumours is the same as the nodules in the multiple forms and the pendulous skin-folds. An unusual situation is the mammary areola (Fig. 83) or the nipple. When these nodules grow from the nose they are apt to be confounded with the condition commonly but erroneously called "lipoma nasi."

Concerning the cause of molluscum fibrosum, nothing is known. The disease is not confined to any climate or race, for it has been observed in North America, the British Isles,

India, Germany, and the West Coast of Africa. (Figs. 78, 79, 80, 81.)

Under the term pachydermatocele, Mott described and figured several good examples of the pendulous form of molluscum fibrosum which were successfully submitted to operation, and the early volumes of the Transactions of the Pathological Society, London, contain descriptions and figures of this disease under a variety of names. The frontispiece to Virchow's "Die Krankhaften Geschwülste" is a representation

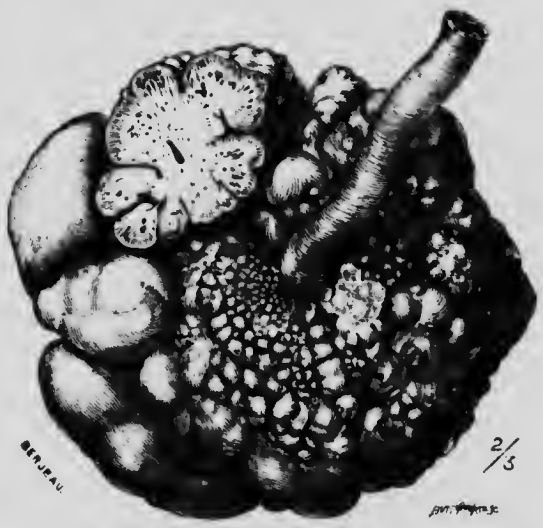

Fig. 83.—Pedunculated molluscum fibrosum from the nipple of a woman. (*Museum, Middlesex Hospital.*)

of a woman with pendulous folds and a multitude of cutaneous nodules, under the title "fibrosum molluscum multiplex." The disease appears to be equally common in men and in women.

An important feature connected with the typical generalised neuro-fibromatosis is the liability of the patients to sarcoma; this may develop primarily, or arise as a malignant change in a molluscum nodule which has existed very many years. Sarcomata of this kind do not, as a rule, disseminate.

In the generalised neuro-fibromatosis, death often results from gradual exhaustion, due to ulceration, septic changes, or

sloughing of the pendulous portions of the skin. In many cases some intercurrent malady supervenes, such as pneumonia: in the patients with multiple nodules on the roots of the spinal nerves, one of them may so enlarge as to press on the cord and produce fatal paraplegia.

In regard to sarcoma supervening in the so-called molluscum nodules, it is necessary to remember that spindle-celled sarcomata arise primarily in nerve-trunks, especially in the great sciatic and its branches, quite apart from the existence of neuro-fibromatosis, localised or general. A sarcoma of a nerve recurs after removal or amputation of the limb, but dissemination is not frequent, and is probably deferred to quite late stages.

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CHAPTER XIII.

NEUROMATA AND ALLIED CONDITIONS (*continued*).

The Plexiform Neuroma.—The peculiar condition to which this term has been applied is essentially a fibromatosis confined to a particular nerve or plexus of nerves. Although it is a rare condition, a sufficient number of cases have been carefully observed and recorded to enable a fairly complete account of the disease to be written. A plexiform neuroma, instead of forming a distinct tumour as in the case of the solitary neuro-fibroma, appears as if the branches of a nerve distributed to a particular area of the skin became enlarged and elongated. The overlying skin becomes stretched, thinned and raised over the thickened nerves, and is often pigmented, the usual colour being brown, like that characteristic of the hairy mole. Occasionally the skin is coarse and thick, as in the case of a molluscum nodule.

The tumour feels like a bag containing a number of tortuous, irregular vermiform bodies, soft to the touch and mobile. These bodies vary in thickness from a crowquill to that of the thumb; manipulation does not produce pain, though the lumps themselves are sensitive. When the skin covering the tumour is reflected these elongated bodies will be found to lie in the direction of the nerve distributed to the part. Thus on the back they will run in a transverse direction (Fig. 84), whereas on the scalp they will trend to the vertex, and so on.

When these thickened nerves are divided the enlargement will be seen to be due to the presence of a gelatinous tissue, and the appearance of the cut surface reminds one of the umbilical cord. Microscopic examination shows that this thickening is due to overgrowth of the connective tissue of the nerve-sheath, and especially that part of it known as the endoneurium—that is, the delicate connective tissue between the individual fibres of a nerve bundle. The enlargement is by no means uniform, so that the so-called

multiple neuromata are really due to local irregularities in a diffuse overgrowth of the connective tissue of the nerve-sheath. This is shown in Fig. 85, which represents in transverse sections portions of the great occipital nerve

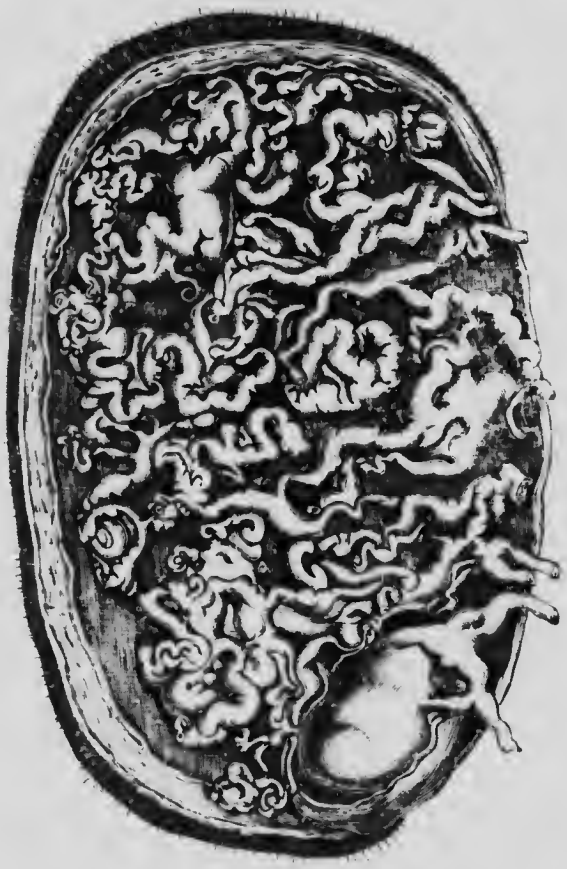

Fig. 81.—Plexiform neuroma from the back of a youth aged 19 years. The skin was the seat of a brown hairy mole. (*Braus.*)

of a girl twenty-one years of age affected with a plexiform neuroma. The scalp covering the affected nerve was transformed into a brown hairy mole. Widely different opinions are held by equally competent observers in regard to the effects of these changes in the sheath upon the axis-cylinders of the nerves. Some maintain that degeneration occurs, and

others that they are not affected. This question requires careful investigation.

The diffuse character of the enlargement in plexiform

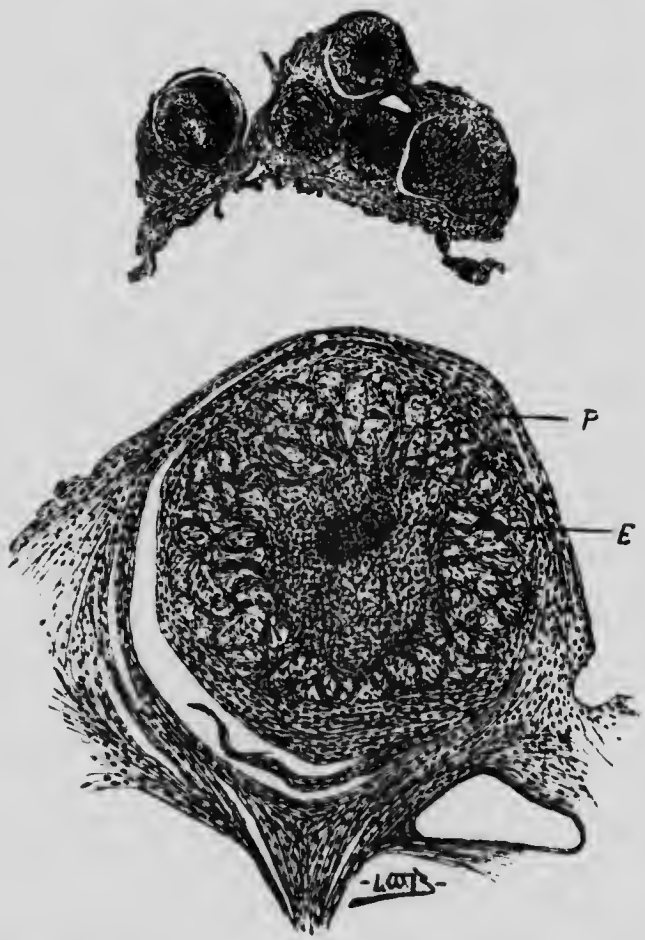

Fig. 85.—Microscopic characters of a nerve from a case of plexiform neuroma affecting the great occipital. The upper figure represents the natural size of the affected nerve. The lower one shows a single nerve-strand highly magnified. E. Endoneurium. P. Perineurium.

neuromata is well shown in a remarkable specimen preserved in the Middlesex Hospital Museum (Figs. 86, 67). A man forty-five years of age was admitted into the hospital with well-marked paraplegia. At the post-mortem examination

Fig. 86.—Plexiform neuromata affecting the roots of the chorda equina and anterior crural nerve.

a large number of small tumours were found on the roots of the nerves. Many of the roots were so beset with these tumours as to resemble strings of beads. In the cervical region there was a tumour as large as a nut, which had compressed the cord and produced paraplegia. There was a large neuroma on the anterior crural nerve, there were smaller examples on the branches of the lumbar plexus. When these nerve-roots are carefully examined they present the annulated appearance so characteristic of the root of the ipecacuanha plant, and it is clearly seen that the nerve-roots are thickened throughout, and that the nodosities are local exaggerations. The details of this case were recorded by Sibley in 1866.

Any nerve, cranial or spinal, is liable to this disease, but among the cranial set it shows marked preference for the vagus and the trigeminus. It may affect parts of several nerves, or be limited to certain branches of a single nerve.

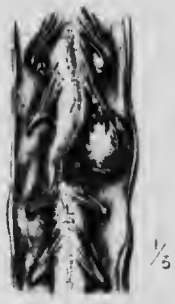

Fig. 87.—The cervical segment of the cord represented in the preceding figure. A nodule on one of the cervical roots compressed the cord and led to fatal paraplegia.

The roots of nerves and terminal twigs may be attacked as well as their

trunks: and the branches of nerves within the muscles may display nodosities. The sympathetic nerves do not escape, for the great lateral cords as well as the visceral branches may be nodular with this disease. (Alexis Thomson.)

In one instance, the nerves involved included the facial, hypoglossal, motor portion of the fifth and its lingual branch. The enlargement of the lingual and hypoglossal nerves produced macroglossia in a child aged four years, for which Abbott excised the protruding part of the tongue. Shattock investigated the diseased organ, and the outcome was an admirable paper of great value and interest.

As examples of the disease limited to part of a nerve,

Fig. 88. Arm in which the musculo-spiral nerve and its branches were transformed into a plexiform neuroma. (*After Campbell de Morgan.*

reference may be made to some cases in which the ophthalmic division of the trigeminus has been affected, leading to enlargement of the upper eyelid and proptosis, necessitating excision of the eyeball, and in one patient with fatal consequences (Friedenwald, Rockliffe and Parsons, Treacher Collins and Batten).

The so-called sarcomata neuromata of the optic nerve (p. 160) are very probably examples of fibromatosis.

In the limbs any nerve may be attacked, and the disease is usually limited to one nerve, and follows it out to its final ramification.

One of the most remarkable specimens known is preserved in the Museum of the Middlesex Hospital, in which the musculo-spiral nerve is affected. The patient, a girl of 15 years, suffered amputation of the arm by Campbell de Morgan. (Figs. 88 and 89.)

The musculo-spiral nerve is as thick as the thumb; it looked gelatinous, like an umbilical cord. The cutaneous branches of the nerve are very thick and irregularly

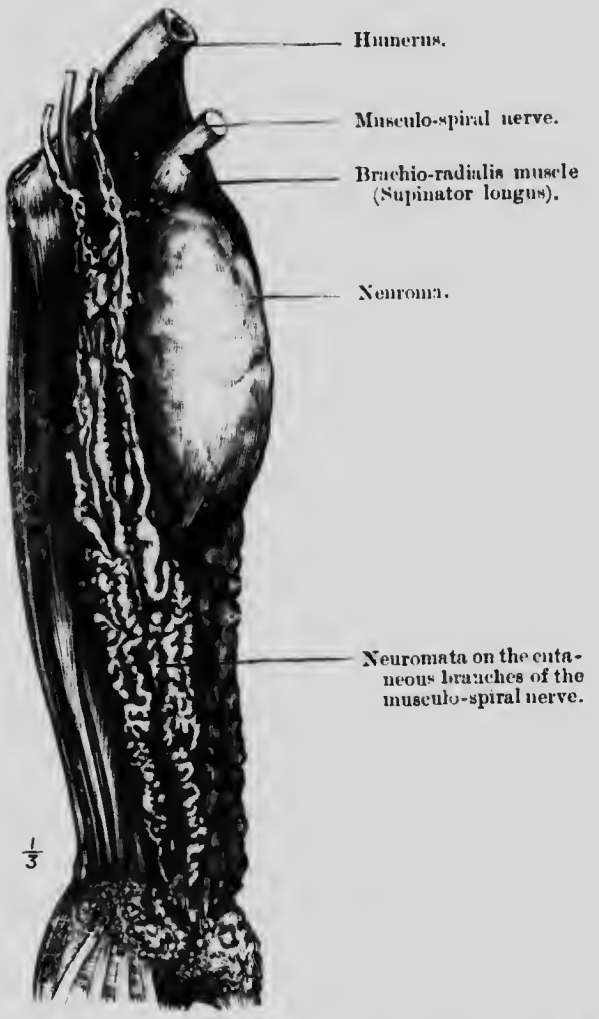

Fig. 84.—The arm represented in the preceding figure dissected: the musculo-spiral nerve and its branches are transformed into a plexiform neuroma.

nodulated. The microscopic changes in the musculo-spiral nerve are identical with those found in the thickened nerves of a plexiform neuroma underlying the pigmented mother-marks. An interesting feature of this specimen is the large,

smooth, ovoid tumour which occupies the bend of the arm, and is attached to one of the branches of the musculo-spiral nerve.

Clinical Features.—Neuromata are in the majority of cases innocent tumours; they very rarely recur after complete removal (Sarcomata of Nerves, p. 72). In exceptional environment a neuroma will cause death, and many examples have been observed in which even small neuromata on the roots of spinal nerves have produced paraplegia with a fatal ending (p. 153). Smith refers to a woman who complained of severe pain in the course of the right trigeminal nerve: this pain was so much increased by mastication that she ate but little, and speaking aggravated it to such a degree that she remained silent unless interrogated, and even on these occasions she often preferred to reply by signs. She died after enduring severe and uninterrupted pain during four and a half months. At the autopsy a neuroma as large as a walnut occupied the situation of the right Gasserian ganglion. With modern methods of surgery no person would be allowed to suffer in this awful manner.

The pain produced by the painful subcutaneous tubercle has already been discussed. When a neuroma involves the roots of a spinal nerve pain is a prominent symptom until the tumour is big enough to compress the cord and produce paraplegia: these signs are not peculiar to neuromata of the roots of the spinal nerves. Neuromata on the nerves of the limbs are usually solitary, ovoid, the long axis of the tumours coincides with that of the limb and produces pain; when pressed the painful sensations radiate throughout the distribution of the nerve below the point of attachment of the neuroma.

In a remarkable case recorded by Semon, an ovoid tumour, in all probability a neuroma of the internal branch of the superior laryngeal nerve, projected into the ventricle of the larynx of a woman 40 years of age. The tumour was noticed in 1888, and it caused very little trouble except when pressed or handled (then coughing and retching occurred immediately) until 1891, when it was necessary to perform tracheotomy. In 1904 Semon removed the tumour through an incision in the neck with success, following the plan adopted

by Paul von Bruns in a similar case, which occurred in a boy of 13 years.

Treatment.—A solitary neuroma in an accessible position is easily removed, care being taken during the enucleation not to damage the fibres of the nerve. It sometimes happens that the neuromatous nature of a tumour is not recognised until after its removal with a segment of the nerve. In the limbs, such breaches in the continuity of a nerve trunk have been repaired by grafting fragments of nerves from amputated limbs, or from dogs and rabbits; it is, however, always better to avoid this accident by careful surgery than to remedy it by secondary measures, however brilliant. Persistent facial palsy has followed the removal of a neuroma lodged in the parotid gland. Neuromata within the spinal canal have been successfully excised. A neuroma of the optic nerve usually necessitates excision of the eyeball.

Multiple neuromata, especially when associated with molluscum fibrosum, are beyond the art of surgery.

Plexiform neuromata have several times been successfully excised: exceptionally, when affecting a limb, amputation has been found necessary. This form of neuroma in the nerves of the tongue has produced enlargement of the tongue resembling macroglossia: the condition was remedied by excision of a portion of the tongue.

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CHAPTER XIV

NEUROMATA AND ALLIED CONDITIONS (*Concluded*).

GLIOMA OF THE BRAIN; OF THE RETINA AND OPTIC NERVE; AND OF THE SPINAL CORD.

Glioma of the Brain.—Ever since I became practically acquainted with the changes in the nerves constituting a plexiform neuroma, it seemed to me that they were akin to the localised neuroglia overgrowth in the brain known as glioma, and I was sufficiently convinced of this to draw attention to the likeness in the first edition of this monograph (1894).

A glioma of the brain occurs as a translucent swelling imperfectly demarcated from the surrounding tissue; the gliomatous tissue may have the consistence of the vitreous, or be as firm as the tissue of the pons. Microscopically it has the characters of an overgrowth of neuroglia.

Virchow pointed out that when a glioma is situated near the surface of the cerebral cortex it appears like a colossal convolution. Should it grow in the tissue of an optic thalamus, this structure will bulge into the third ventricle as though overgrown, and a glioma of the occipital lobe will project into the descending cornu like an additional thalamus. The best illustrations of this indefiniteness, so characteristic of gliomata, come out very strikingly when the pons and the cerebral crura are occupied by this form of tumour.

A glioma occasionally occurs in the pons, and forms a tumour of considerable size (Schorstein). It may be confined to one side, and extend into the adjacent cerebellar crura. In a case described by Cayley, which occurred in a child two years of age, a glioma as large as a walnut occupied the right half of the pons and extended along the superior cerebellar peduncle of that side, reaching as far forward as the corpora quadrigemina. The gliomatous mass formed a

prominence on the corresponding half of the floor of the fourth ventricle, and obstructed the Sylvian aqueduct.

In some cases both sides of the pons are involved, and the overgrowth of neuroglia extends forward into the cerebral crura and the cerebellar peduncles, and involves the corpora quadrigemina. In a few it extends downwards into the medulla, and may even involve the cervical portion of

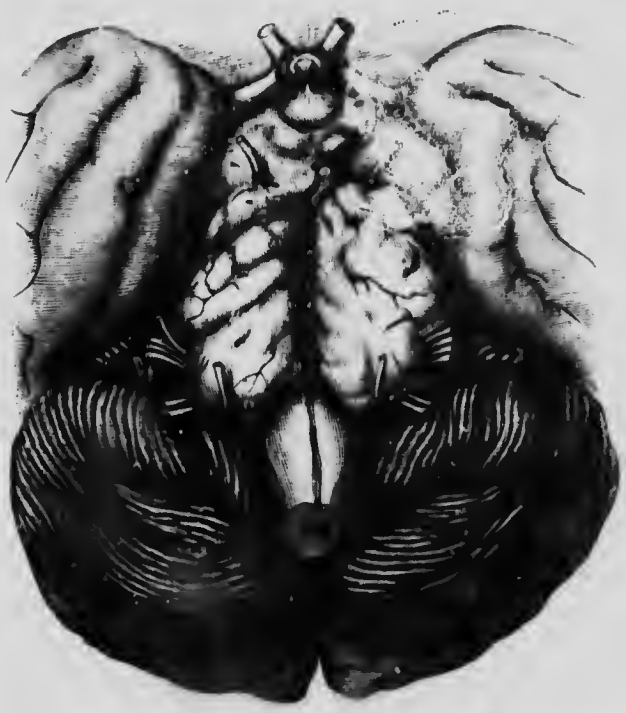

Fig. 90.—Bilateral gliomatous enlargement of the pons and crura cerebri. (*Angel Money.*)

the cord (Whipham). Sometimes the gliomatous tissue is so abundant as to produce an enlargement of the pons and cerebral peduncles. (Fig. 90.)

The appearance of such brains is very peculiar: the basilar artery and its branches appear as though sunk in deep furrows, which cause the parts to resemble "a soft package tightly corded" (Dickinson). Such cases are rare and in nearly all instances the patients have been under

twelve years of age (Percy Kidd, Gee, Angel Money, and Goodhart). A case has been observed in a man of 32 years (Schulz). The relations of a glioma to the surrounding tissues are best seen in recent specimens. On examination soon after death the diseased parts are abnormally large, and on section exhibit a characteristic pale blue colour; in thin sections the tissue has a delicate translucent appearance. The tumour itself is very soft, and imparts to the fingers a sensation like fluctuation. When the parts are immersed in alcohol the tissue becomes firm, opaque, and white; under these conditions it is particularly difficult to determine the limits of the tumour.

Gliomatous tumours of the brain are purely local; their growth appears to be limited by the cerebral membranes, and they do not disseminate. They vary greatly in structure, for some consist mainly of round cells and others are composed of spider cells; in some the cells are spindle shaped. They are in no way related to sarcomata.

Sarcomata of the Optic Nerve.—Tumours of the optic nerve are very rare. A careful analysis of recorded cases does not afford much clear information on the pathologic aspect of these tumours, and they are described under titles such as glioma, myxoma, myxosarcoma, fibroma, and sarcoma.

The recorded clinical facts are sufficient to prove that tumours of connective tissue with malignant characters do arise from and in the optic nerve. They are unilateral, and more frequent in the young than in adults. The greater proportion are met with before the age of twenty, and of these by far the larger proportion occur before the tenth year of life.

The optic nerve is a complex structure, and in the embryo it is preceded by an outgrowth from the brain known as the optic stalk; this is hollow, and consists of epithelial cells. This stalk is ultimately replaced by a fibrous nerve, the nerve elements of which are in part derived from the retina and in part, perhaps, from the brain (Robinson). Thus the early tissue of the optic stalk is identical in structure and continuous with the sustentacular tissue of the embryonic retina.

These facts are of importance because in some cases, especially in adults, sarcomata arise from the sheath of the nerve, and do not primarily involve the nerve fibres. Pockley has excised a tumour from the optic nerve, and saved the nerve and the globe. The patient was a boy of 19 years. The tumour is described as an encapsuled round-celled sarcoma. Some recently recorded cases which have been very carefully investigated point to the conclusion that many of the tumours arising within the sheath of the nerve, especially in children, are particularly connected with the pial sheath, and in construction are closely allied, if not identical, with the retinal (glioma) sarcoma of infancy. The malignancy of optic nerve sarcomata, though pronounced, is not excessive.

Tumours of the optic nerve are usually ovoid in shape, with their long axes coincident with that of the nerve. Their surfaces are usually smooth, and in size they vary greatly, but rarely exceed a pigeon's egg. They do not tend to invade the globe, but they are apt to creep through the optic foramen and involve the intracranial portion of the nerve. As the fibres of the nerve are early implicated, vision is soon interfered with: there is proptosis, but the movements of the eye are free, and there is no pain, even on manipulation.

Much of the confusion relating to the nomenclature and structure of tumours of the optic nerve is due to their rarity, and those interested in this question will do well to study the careful work of Treacher Collins and Devereux Marshall.

Glioma of the Retina.—In structure these tumours mimic the granular layer of the retina, and Treacher Collins has drawn attention to the great similarity which exists between the cells composing the retina of the fœtus at the third month, when its layers are undifferentiated, and the tissue of a retinal glioma.

This tumour occurs exclusively in children; exceptionally it has been detected at birth, more commonly it makes its appearance during the first four years of life; it is very rare after the seventh year, and is almost unknown after the age of twelve. In a certain proportion of cases

(20 per cent.) both retinæ are affected, either simultaneously or after a brief interval. This is always an indication that the tumour is highly malignant. In the early stages there is, as a rule, no pain or symptom denoting the presence of a tumour: gradually the pupil dilates, and a peculiar reflex is noted at the fundus (this is often termed cat's-eye), and, on testing, the eye will be found quite blind. As soon as the existence of a glioma is discovered by the surgeon, the eye is, as a rule, promptly excised. In cases where treatment of this kind is refused or deferred, the following changes occur. The tumour, continuing to increase, pushes forward the intra-ocular structures and induces great pain as the result of the increased intra-ocular pressure it produces, until the cornea yields and the tumour bursts forth, and, growing very rapidly, soon makes its way between the eyelids, which become swollen and everted, and then, in consequence of exposure, assumes a dusky red fleshy appearance, whilst from its surface a sanious fluid exudes which may form crusts on the surface of the tumour. Should the parts become excoriated or handled, they bleed freely. A fungating tumour of this kind will sometimes attain a very large size before it destroys the child's life.

After excision of an eye for retinal sarcoma the disease is very prone to recur, and the recurrent tumour may attain very large proportions before it destroys life. When the operation has been long delayed, the growth may have burst through the sclerotic and invaded the orbital tissues: in a larger proportion of cases it has infiltrated the optic nerve, and it is in this structure that the disease reappears. The frequency with which sarcoma returns in the stump of the optic nerve is, in all probability, due to the intimate lymphatic relations of this nerve with the intra-ocular lymph spaces.

In regard to the question whether "glioma" may "run" in a family, there is little evidence to guide us. Fuchs has recorded a case where two children were affected in one family, and two very extraordinary reports have recently come from Australia. Earle Newton states that in a family of sixteen children ten died from retinal glioma,

three of the cases were unilateral and seven bilateral. All the affected children, with one exception, died about the third year. Maher tells of a family of four children of whom three died of glioma, and in two it was bilateral.

Dissemination of retinal sarcomata is exceptional. The common situations for secondary deposits are the brain, the lymph glands about the jaws, and the periosteum of the skull bones.

The treatment for retinal sarcomata is removal of the eye, and the importance of promptness in this matter is indicated in the careful inquiry conducted by Lawford and Collins. They prove very clearly the following points:—

The quicker an eye is removed after the discovery of the disease, the better the prospect of cure. In the majority of cases the disease returns in the orbit, and in a very small proportion of cases secondary deposits occur in other parts. When recurrence takes place it is rarely delayed beyond nine months; but one undoubted case has been reported in which the disease returned three years after the primary operation. If three years elapse and there is no recurrence, the recovery may be regarded as permanent. Out of fifty-four cases in Lawford and Collins's list, eight patients were alive and free from recurrence three years after the removal of the eye for retinal glioma. It is significant to note that in seven of these cases the disease affected one eye only. This shows the almost hopeless condition of the patient when both eyes are affected.

Other statistical inquiries have been conducted with the view of obtaining the percentage of cures in this disease, and they work out at about the same proportion as in the paper mentioned above.

Gliomata of the Spinal Cord.—A glioma of the spinal cord is a very rare tumour, and, judging from the scanty records, it would appear that a glioma in the brain is twenty times more frequent than in the cord. The tumour is imperfectly demarcated from the nervous tissue, and often causes a general enlargement of the cord, producing an effect upon it like gliomatous disease of the pons, crura, and medulla. It was pointed out in connection with this disease

of the medulla that it sometimes involves the adjacent segment of the spinal cord.

Resinger collected and epitomised the records of nineteen cases of glioma of the spinal cord, and added a full description of a case which he observed; the report is accompanied by an account of the morbid anatomy of the parts by Prof. Marchand.

The disease may attack any part of the cord, but is most frequent in the cervical enlargement. In a few instances the tumour was seated in the lumbar region. It appears most frequently between the seventeenth and thirtieth years, but it has been observed as late as fifty. Sharkey has published an interesting account of a spinal glioma which occurred in a man fifty years old, and he uses it to demonstrate the clinical fact that when a tumour arises within the cord, as gliomata always do, it disturbs its functions from the commencement: but, as the nerve substance appears to be elastic, and to allow a good deal of gradual stretching without serious interference with its functions, a tumour may continue to grow for a long time before it produces striking pathologic phenomena. When a tumour grows in the spinal canal outside the cord it may produce but few symptoms until it presses the cord against the resisting walls of the canal; after this has taken place the course of the disease is naturally very rapid, as the cord is quickly flattened by the constantly increasing demands for growing-space which are made by the tumour.

The peculiar relation of the gliomatous tissue to the nerve tissue of the cord precludes any surgical interference.

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CHAPTER XV.

ANGEIOMATA, LYMPHANGEIOMATA, AND ENDOTHELIOMATA.

ANGEIOMATA.

An **angeioma** is a tumour composed of an abnormal formation of blood-vessels.

This genus contains three species: 1, Simple nævus; 2, cavernous nævus; 3, plexiform angeioma.

1. **Simple Nævus.**—This is the most common species of nævus, and in its typical form affects the skin and subcutaneous tissue. A nævus may appear as a superficial discoloration of the skin, and is either a lively pink or a deep blue: these are known as "port-wine stains." Such nævi may involve an area of skin 2 cm. square, or extend over a large portion of the face, or half the trunk, or be restricted to a limb.

A very common variety of nævus is that often referred to as *telangeiectasis*; it consists of an abnormal collection of arterioles situated in the skin and subcutaneous tissue: it may be present at birth, but much more frequently appears in the course of the first few weeks of life. Sometimes a nævus appears as a red spot no larger than a split pea: then suddenly it grows actively, and in two or three months will involve an area of skin 4 cm. square. When the nævus consists of arterioles it will be of a bright pink colour; when composed mainly of venules it will be of a bluish tint. Lymphatics are often present. Structurally, nævi are composed of minute blood-vessels embedded in fat; usually two or more large vessels establish a communication between the nævus and an adjacent artery or vein. The vessels of the nævus are often sacculated. When gently compressed, the blood is driven from the nævus, which at once loses its colour; but the colour returns as soon as the pressure is relieved.

Simple nævi are common enough in the skin of the face, scalp neck, and back. They are less frequent on

the limbs. They also occur on the labia, the lips, tongue, and conjunctivæ.

Nævi of small size frequently disappear spontaneously; more often they gradually increase in size, and may become converted into cavernous nævi.

2. **Cavernous Nævus.**—This is the species to which the term erectile tumour is most applicable. In structure it is comparable to the spongy tissue characteristic of the cavernous tissue of the penis. Cavernous, like simple nævi are most frequently seen in connection with the skin, where they form distinct tumours of a red or blue colour, rising above the general surface; sometimes they display the peculiar tint so characteristic of fluid contained in thin-walled cysts, for which a cavernous nævus is often mistaken, especially when situated near the outer angle of the orbit. In most cases the blood can, by firm and steady pressure, be squeezed out of a nævus, but the swelling quickly reappears after the compression is removed. The surface of a nævus may be over-warm, and sometimes the tumour pulsates, the movement being appreciable to the finger, and occasionally perceptible to the eye.

Structurally, cavernous nævi are made up of variously shaped spaces and sinuses, the walls of which are merely fibrous septa, lined with endothelium. Some of these nævi consist in part of vessels and in part of cavernous spaces. When an angeioma consists entirely of irregular blood-containing spaces, a dissection round its periphery will reveal the existence of vessels, sometimes of considerable size, conveying blood to it from adjacent arteries. Cavernous, like simple nævi are, as a rule, congenital, but a nævus which during infancy is small and inconspicuous may later in life become converted into a cavernous nævus of large size, and one that will, under certain conditions, jeopardise life. Very large cavernous nævi have been observed in the breast in the male as well as in the female.

Cavernous nævi occasionally occur in the **tongue**; as a rule, they are situated near the surface, and form slightly elevated patches of a deep blue or livid colour. Such nævi rarely give rise to any difficulty in diagnosis: their colour, general appearance, and the fact that firm pressure suffices

to drive the blood out of the tumour are sufficient to indicate their nævoid character. Many lingual nævi are congenital, but a fair proportion originate late in life. It must also be borne in mind that a small and inconspicuous nævus may, as years run on, develop almost silently into a dangerous erectile tumour.

In some instances lingual nævi cause very little inconvenience unless they bleed, and this accident may arise at any time, either by abrasion from hard food or from accidental bites, or in consequence of rubbing against jagged teeth. Under such conditions the hæmorrhage is sometimes very alarming, and so oft-repeated that it is in some instances imperative to excise the implicated half of the tongue. Except in the tongue and rectum cavernous nævi are very rare in mucous membranes.

Cavernous angeiomata are sometimes found in **voluntary muscles**. Several interesting examples were collected and described by Campbell de Morgan in 1864.

Examples have been observed and carefully recorded in the following muscles: the semimembranosus, semitendinosus, and deltoid, and Eve has removed one involving the triceps and anconeus. The Museum of the Royal College of Surgeons contains an example removed by Stonham from the gracilis.

Ran has described a cavernous angeioma which occupied the wall of the right auricle; the patient was fifty-six years of age, and the tumours equalled in size a small cherry, and occupied the deep layers of the endocardium.

Cavernous angeiomata are of very rare occurrence in the **larynx**: nevertheless they have been observed in this situation, and the careful descriptions of some of the cases place the nature of the tumour beyond doubt. They have been observed springing from the vocal cords (Percy Kidd), the ventricular bands, and from the ventricle. The most striking examples arise in the sinus pyriformis. Usually such tumours are sessile, but are occasionally pedunculated; they may be bright red or purple. Laryngeal angeiomata may be smooth or nodulated like a mulberry: they are rarely larger than a haricot bean. The colour of these tumours is the most striking clinical feature.

An extremely rare situation for a cavernous nævus is the **subperitoneal** tissue (Lane); another is the synovial membrane of the knee-joint, simulating tuberculous disease of that joint (Eve).

The **liver** is not an unusual situation for cavernous nævi of small size. Nævi are not uncommon in the livers of cats and feline mammals in general, but they appear to be harmless tumours.

3 **Plexiform Angeioma.**—The angeiomata which will be included under this denomination are those usually designated as "aneurisms by anastomosis," or "cirsoid aneurisms." The former term appears to have been introduced by John Bell, but the expression "aneurism by anastomosis" has come to be used so vaguely that its suppression is a matter of necessity.

A plexiform angeioma consists of a number of abnormal blood-vessels of moderate size arranged parallel to each other, as in the rete mirabile of the fore-limb of the sloth or the tail of a spider monkey. Such angeiomata may consist of arteries only (arterial retia) or of veins (venous retia) or of arteries and veins in equal proportions (duplex retia). In some the vessels are very tortuous, a disposition more common with arteries than veins. Tortuous vessels are not infrequent in retia—for example, the arterial retia in the intercostal spaces beneath the pleura of cetaceans, and the rete in the pituitary fossa of oxen and sheep; and the renal glomerulus.

Plexiform angeiomata are very rare: the largest that has come under my notice occurred in the perineum of a lad nineteen years of age the corpus spongiosum was surrounded by a number of arteries as large as the coronary branches of the facial, and veins as big as the cephalic. The arrangement resembled that of a duplex rete.

Müller has recorded very carefully the clinical history and an account of the subsequent dissection of a very unusual example of plexiform angeioma. The patient, a man of twenty years, stated that his parents noticed a red spot on the left half of the forehead when he was a year old: this gradually increased in size, and at the age of twelve it had become an obvious tumour. When the patient was

sixteen it not only grew rapidly, but began to "buzz." At the age of twenty the tumour exhibited all the characters of a plexiform angeioma, the pulsation being attended by a whirring sound. P. Bruns ligatured the right external carotid and the left common and external carotid. The patient became hemiplegic on the second, and died on the third day after the operation. Death was due to embolism

Fig. 91.—Dissection of a plexiform angeioma of the forehead. (*After H. Müller.*)

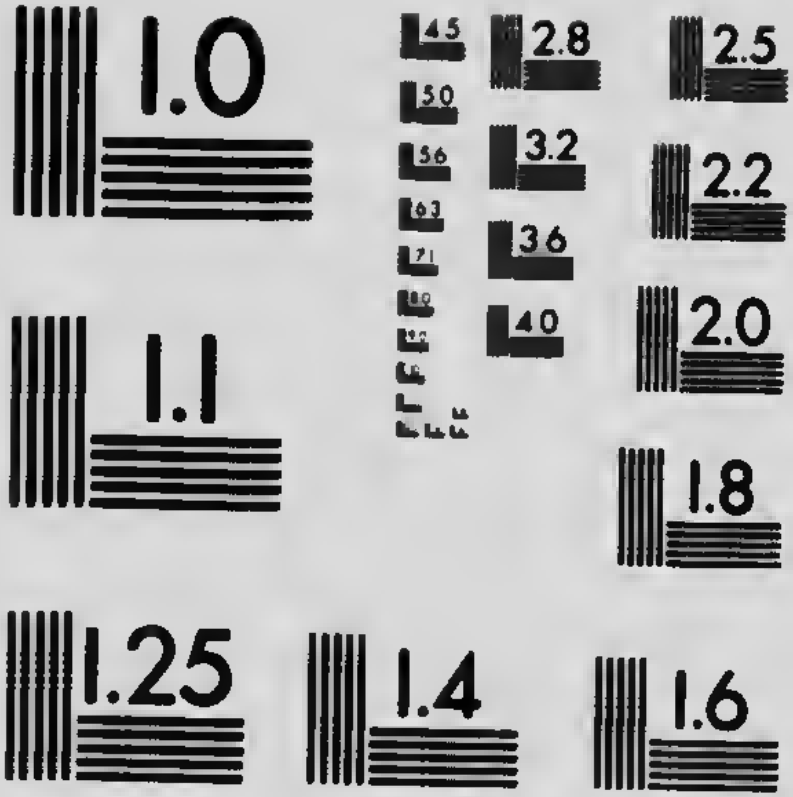
and thrombosis of the left middle cerebral artery. The parts were injected and dissected (Fig. 91): the angular arteries were large and very tortuous.

Plexiform angeiomata occur in connection with the cerebral arteries. They have been observed on the surface of the right anterior lobe of the cerebrum, fed mainly by the anterior and middle cerebral arteries. In two cases reported by Drysdale, one patient was a lad 17 years of age, and the other a woman aged 26 years. The woman

was an epileptic. In another patient, a man aged 20, the angeioma was situated over the angular gyrus: the patient died from hæmorrhage from the tumour, which produced the typical signs of pressure on the motor region of the cortex (D'Arcy Power).

Treatment.—This varies with the character of the angeioma: for instance, the diffuse species known as "port-wine staining," when extensive, does not admit of treatment, but a stain of this character the size of a crown-piece may be successfully destroyed by electrolysis if it occurs in a conspicuous situation. The common species of nævus comes under observation almost daily; in such cases it is usual to watch the child in order to ascertain whether the nævus is growing or not; many nævi disappear, but when they become active and grow, they need prompt treatment. No method is so safe and effectual as excision, whenever it can be carried out, remembering always **to cut the nævus out, not cut into it**. I have excised nævi, simple and cavernous, from the skin over an unclosed fontanelle, the eyelids, the tongue, labium, and other parts of the body in more than one hundred children, and never had the least untoward symptom. It is infinitely preferable to treatment by electrolysis, nitric acid, ethylate of sodium, and the ligature. The chief reason for excising nævi when they evince signs of activity is to prevent them from assuming such proportions as to pass beyond the limits of justifiable surgery. Many examples have been recorded in which a nævoid fleck in an infant has become a formidable tumour in the adult.

It is impossible to advise in regard to the treatment of plexiform angeiomata. Each case exhibits special features which will modify the operation, and the particular method employed will depend on the enterprise, experience, and skill of the surgeon in charge of the case. Several cases of plexiform angeioma of the limbs have been recorded in which it has been necessary to resort to amputation. When the leg is involved this operation is attended with unusual risk of life. The operative difficulties and dangers in connection with large plexiform angeiomata of the head and orbit are very great.



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LYMPHANGEIOMATA.

A **lymphangeioma** has the same relation to lymphatics that an angeioma bears to hæmic capillaries.

There are three species of lymphangeiomata:—

(1) Lymphatic nævus; (2) cavernous lymphangeioma; (3) lymphatic cyst.

1. **Lymphatic Nævus.**—This species of lymphangeioma is, as a rule, colourless, but when it contains a fair number of hæmic capillaries, then the nævus appears as a pale pink patch slightly raised above the level of the surrounding skin. When composed entirely of lymphatics it is yellowish-white; when pricked, lymph (sometimes mixed with blood) issues from it. Occasionally several nævi occur in the same individual; they vary greatly in size—some are as small as shot, others may have a diameter of 2 cm. or more. In many instances they are noticed a few months after birth; occasionally they seem to be acquired. This is probably explained on the ground that during infant life they are small, and their want of colour saves them from detection until their increase in size later in life makes them conspicuous.

Lymphatic nævi may occur in the skin on any part of the trunk or limbs, and have been especially studied in the mucous membrane of the tongue and lips.

In connection with the tongue the affections may be localised to a definite area and give rise to a **lingual lymphangeioma**; this takes the form of a pale pink papilla, or clusters of smooth papillæ, projecting from the mucous membrane. Sometimes one half of the dorsum of the tongue will be beset with small rounded projections. These projections consist of clusters of dilated lymphatic vessels.

There is a very rare disease of the tongue to which the name **macroglossia** is applied. Clinically the condition manifests itself as a congenital enlargement of the tongue implicating mainly its anterior two-thirds. As the child grows the tongue increases so disproportionately that the mouth accommodates it with difficulty, and at last the tip of the organ protrudes from the mouth and, in severe

examples, becomes so big as to extend far beyond the margins of the lips (Fig. 92).

The increase in the size of the tongue is not due to an overgrowth of its muscular substance, but is caused, as Virchow pointed out, by the formation of a lymphangeioma in connection with the lingual mucous membrane.

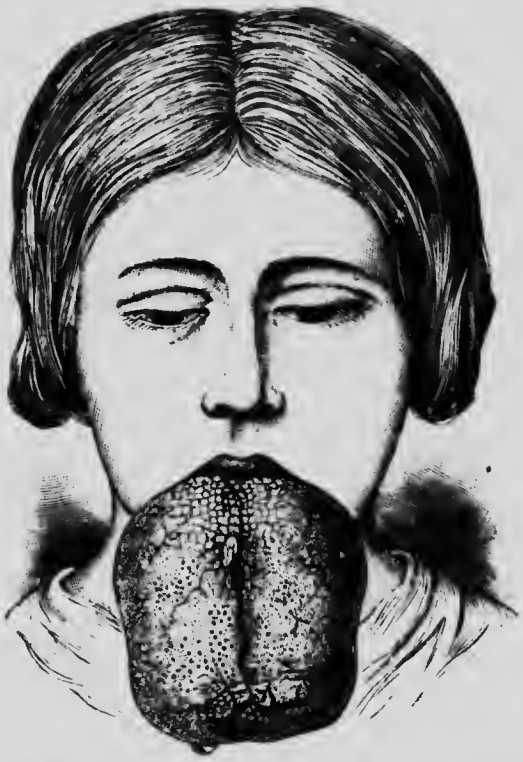

Fig. 92.—Macroglossia in a girl aged 11 years. (*After Humphry.*)

Recent observations have shown that there is another cause of macroglossia, namely, plexiform neuroma affecting the lingual and hypoglossal nerves (see p. 154).

2. **Cavernous Lymphangeioma.**—This species in its naked-eye characters resembles a lymphatic nævus, but on microscopical examination it will be found to be identical in structure with the cavernous nævus, with the difference that its cavities are filled with lymph instead of blood.

Treatment.—This is conducted on the same lines as for

angeiomata. In the case of macroglossia, excision of the enlarged and protruding parts of the organ has been followed by permanent good consequences.

3. **Lymphatic Cyst.**—This appears as a congenital swelling in the neck, axilla, and adjacent parts of the thoracic wall; it was formerly classed under the title "hydrocele of the neck."

Lymphatic cysts are easily recognised. They are always

Fig. 93.—Lymphatic cyst of the neck in a child two years of age.

congenital; even at birth they are sometimes of very large size, and exhibit a preference for the anterior triangle. In some instances they extend into the axilla and superior mediastinum, or project into the posterior triangle (Fig. 93). Their upward limit is, as a rule, indicated by the hyoid bone, but they have been known to reach as high as the parotid gland. The cyst may be unilateral or bilateral; it may consist of a single cavity, or be multilocular, and the various chambers may intercommunicate. In size they vary greatly: some equal a fist, others are bigger than the head of the patient. When the walls of the cyst are thin and the

overlying skin is stretched, the tumour is as transluccent as a thin-walled hydrocele of the tunica vaginalis testis.

These cysts originate below the deep cervical fascia, but a portion may make its way through this membrane and become subcutaneous.

Perhaps the most remarkable fact in connection with them is the tendency they exhibit to shrivel and disappear: they are exceptionally liable to inflame, and several cases have been recorded in which the cyst has been ruptured by the child falling upon it. Their proneness to spontaneous cure explains the rarity of such cysts after puberty.

It has been many times observed that the spontaneous effacement of these cysts is preceded by a sudden increase in their size; they become hot, tender, and pass into a state of inflammation, and as this subsides the cysts slowly disappear.

The walls of lymphatic cysts are often composed of tissue so vascular as to merit the term nævoid: it is probable that some of them have arisen in large cavernous nævi which have been converted into cysts (Fig. 94).

It is important to remember that lymphatics are often very abundant in the ordinary forms of cavernous nævi. It is also a fact of some interest that a lymphatic cyst in the neck and well-marked macroglossia have been observed in the same individual.

ENDOTHELIOMATA.

This is a genus of tumours which has received much attention at the hands of German pathologists. The endotheliomata arise in connection with the blood and lymph vessels, hence there are two chief varieties; namely, those which have their origin in lymph vessels and are called **lymph-endotheliomata**; and those starting from blood-vessels, the **hæmendotheliomata**. There is also a variety which has its origin in the perivascular lymphatics, the **peritheliomata**. In their general characters the endotheliomata resemble the carcinomata and sarcomata, but though many are malignant, they run a slower course than the typical sarcomata. Some of the most characteristic examples

Fig. 94.—Child with a lymphatic cyst on the side of the thorax which probably arose in an angeioma.

of the lymph-endotheliomata may be regarded as malignant lymphangeiomata, and the same is true of many hæmendotheliomata.

Some of the best examples of endotheliomata arise in the

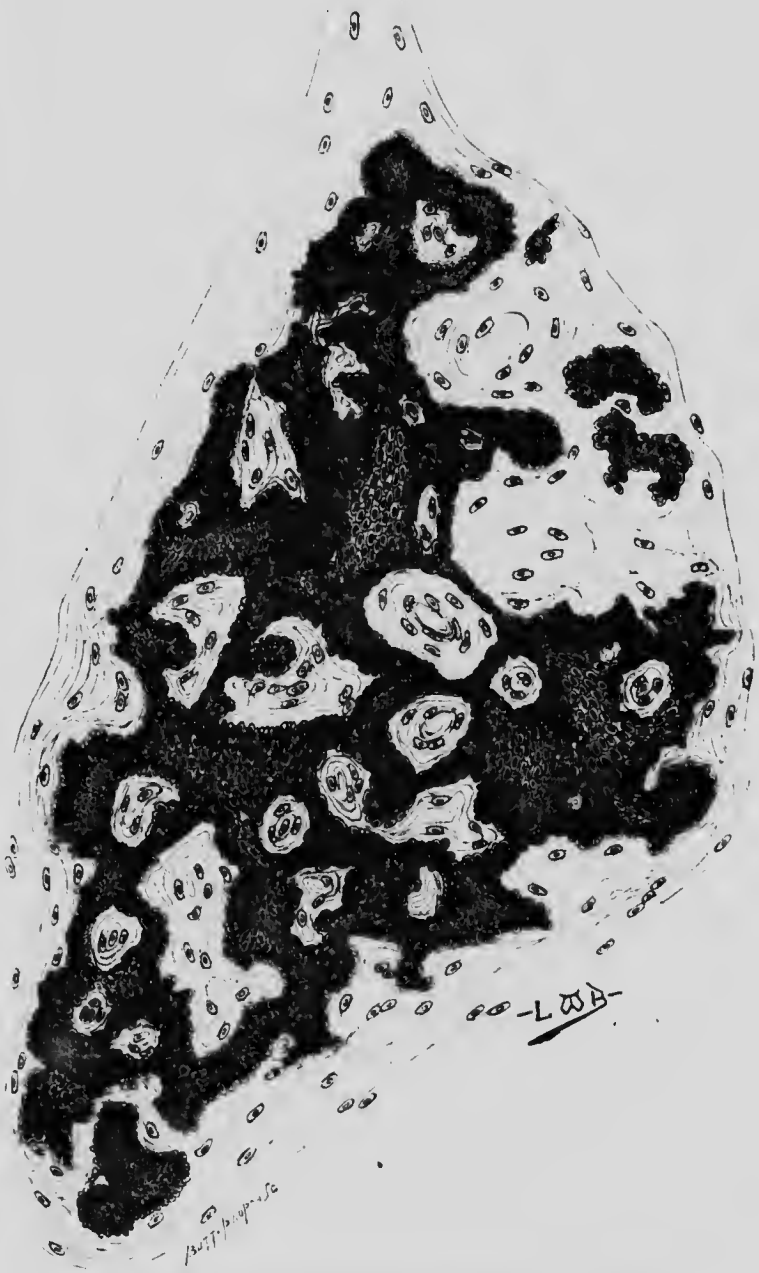

Fig. 95.—Microscopic characters of an endothelioma of the gum.

buccal and nasal mucous membrane, and in the parotid gland (see p. 97). Those which arise on the gums (Fig. 95) resemble, in their general features and microscopic structure, the cystic epithelial tumours of the jaws (see Chapter XXI.). Endotheliomata have also been observed in the mammary gland, in the skin associated with moles and warts, and especially those tumours with an alveolar structure formerly classed as alveolar sarcomata; they also arise on serous

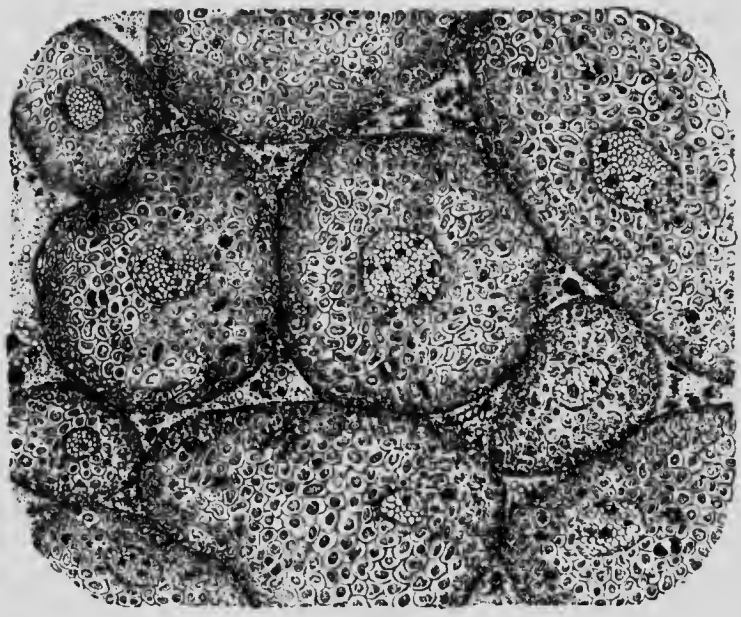

Fig. 96.—Perithelioma of the thyroid gland. (*After Ziegler.*)

membranes, *e.g.*, the pleura, peritoneum, and the dura mater of the brain and spinal cord.

Peritheliomata.—This variety includes the rare tumours styled angeio-sarcoma (Ziegler). The tumours on microscopic examination resemble superficially the lobules of the liver (Fig. 96), and their peculiar characters seem to depend upon a cellular overgrowth in the perivascular sheaths of the small vessels.

Psammomata (Dura-endotheliomata).—This is an important variety of endothelioma growing in connection with the pia mater of the brain and cord. They are called psam-

momata, or sand tumours, on account of the presence in varying quantity of earthy matter like that in the pineal body. Cholesterin is also present, and often in such quantity that the tumour assumes a pearly lustre when exposed to light. A very

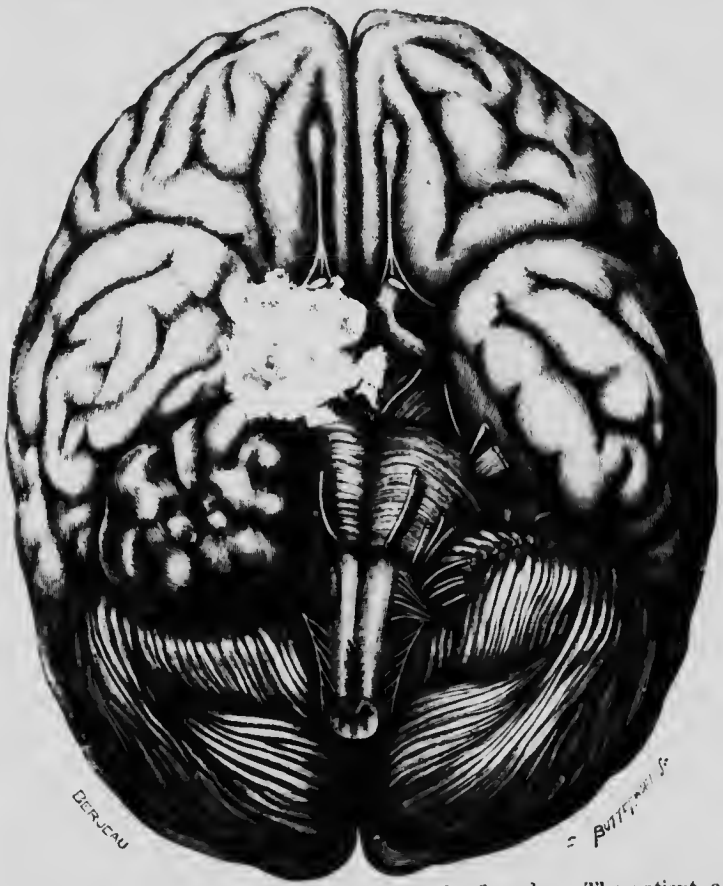

Fig. 97.—A psammoma lying in relation with the flocculus. The patient, a man aged 36 years, died from an attempt made to remove this tumour. The chief symptoms were deafness, pain, vomiting, giddiness, and nystagmus.

remarkable example of this is preserved in the museum of the Royal College of Surgeons, London. The tumour, which fills the fourth ventricle, has an average diameter of 10 cm.; it looks like a solid pearl disparting the two halves of the cerebellum, and projects between the inferior vermiform process and the medulla. The catalogue contains an interesting clinical history furnished by Miss B. Knowles.

A psammoma rarely exceeds in size a shelled walnut, and when growing in connection with the choroid plexuses of the cerebral ventricles these tumours may be bilateral: when large they form deep bays in the adjacent brain tissue and when growing in the immediate vicinity of important nerves cause severe and disastrous consequences (Fig. 97).

The structure of a typical psammoma (Fig. 98) shows its intimate relation to bloodvessel; each concentric body has a vessel for its centre.

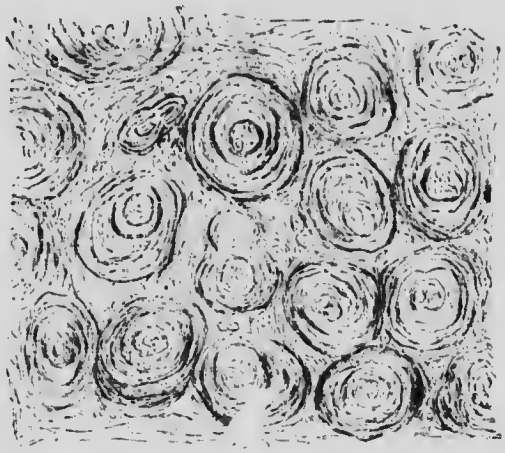

Fig 98.—Microscopical appearance of a typical psammoma.

A common place for a psammoma is the immediate neighbourhood of the flocculus. In this part of the cranial cavity they are often bilateral, and for many years I have believed that in this situation they arise from the processes of chorionic villi belonging to the fourth ventricle which at this spot emerge from the cornucopia.

It is easy to understand that tumours growing in close relation with important nerves, as the trigeminal, facial, vagus, etc., would soon lead to symptoms and surely attract attention, and, as a matter of fact, a large number of examples have been recorded under a variety of names, such as sarcomatous tumours of the fifth and seventh nerves; fibro-sarcomatous tumours of the flocculus; symmetrical tumours of the medulla, and the like.

A man with bilateral tumours of this kind was violent,

blind, deaf, and suicidal (Strahan). In another a psammoma measuring 7·5 by 6 cm. growing from the membranes immediately covering the median lobe of the cerebellum in a lad, caused headache, vomiting, blindness, optic neuritis, priapism, opisthotonos, and other disturbances ending in death (Beevor).

Psammomata of the spinal membranes lead to far more serious results than tumours of a similar size in the lateral

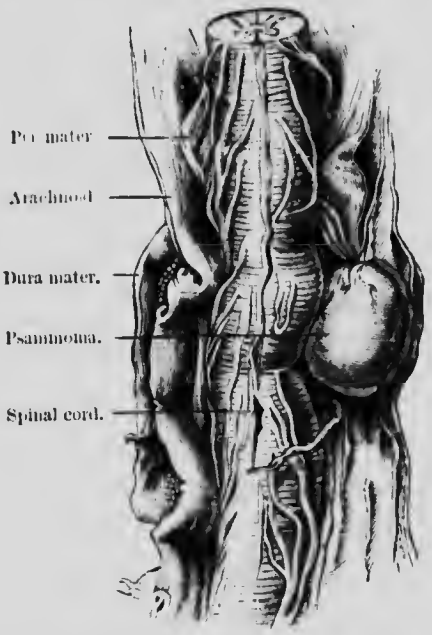

Fig. 99.—Portion of the spinal cord with a psammoma situated at the level of the intervertebral disc between the tenth and eleventh thoracic vertebræ. From a woman 46 years of age. (*Museum, Middlesex Hospital.*)

ventricles, and are as dangerous when seated high in the spinal canal as psammomata near the flocculus. In the spinal canal these tumours do not attain a large size—indeed, in the few recorded cases there is singular uniformity in their shape and dimensions (Fig. 99).

Treatment.—Psammomata of the spinal membranes have been successfully removed by surgeons. In the cranial cavity the accurate diagnosis and localisation of such tumours has been accomplished: they have also been removed, even when

lying in the vicinity of the flocculus, in spite of their subtentorial situation, but rarely with success.

Psammomatous bodies are fairly common growing in the choroid plexuses of the lateral ventricles of horses. In this situation they may attain the size of walnuts before disturbing the function of the organ. Large growths produce grave and even furious symptoms. The pressure effects alone will kill the horse; but in some of the reported cases the animals have destroyed themselves by wild plunges made during attacks of delirium. Such tumours in horses are very vascular; some are soft and contain little grit, others are hard. Nearly all contain a large amount of cholesterin. Probably they are inflammatory in origin.

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CHAPTER XVI.

UTERINE FIBROIDS.

The tumours of the uterus known as fibroids, myomata, or fibro-myomata, are extremely common, and on account of the difficulties and dangers which arise from them directly and indirectly, their pathological and clinical aspects have been studied with very great care. Before minutely describing the structural peculiarities of fibroids, it will be of some advantage to study their topography and gross anatomy. Though fibroids arise in every part of the uterus, including its ligaments, they are more common in the body of the organ than in its neck. Those which arise in the cervix offer peculiar features, and demand separate consideration.

Fibroids of the Body of the Uterus.—Tumours originating in the uterine walls may be single or multiple. In their early stages they resemble in section knots in a piece of wood. These tumours are distinctly encapsuled, and are firm and often hard to the touch.

For clinical purposes it is convenient to divide them into three sets, according to the part of the uterus in which they arise:—

1. In the true tissues of the uterus: such are termed interstitial or intramural (Fig. 100).
2. In the endometrium: these are said to be submucous.
3. In the layer of muscle tissue subjacent to the peritoneum: these are termed subserous.

Fibroids may arise in and remain confined to any one of these situations, or all the varieties may be seen in the same uterus; and there is no limit to their number. I have counted one hundred and forty fibroids in one uterus; they varied in size from a dove's egg to that of a duck.

It not infrequently happens that when a fibroid is confined

to one wall of the uterus and appears as a single tumour externally, it will be found on section to consist of two or more tumours growing in association, but each possessing its own capsule. Such may be conveniently called **conglomerate** fibroids.

1. *Interstitial Fibroids.*—This variety may occur singly or in multiple. Such tumours in their early stages resemble in

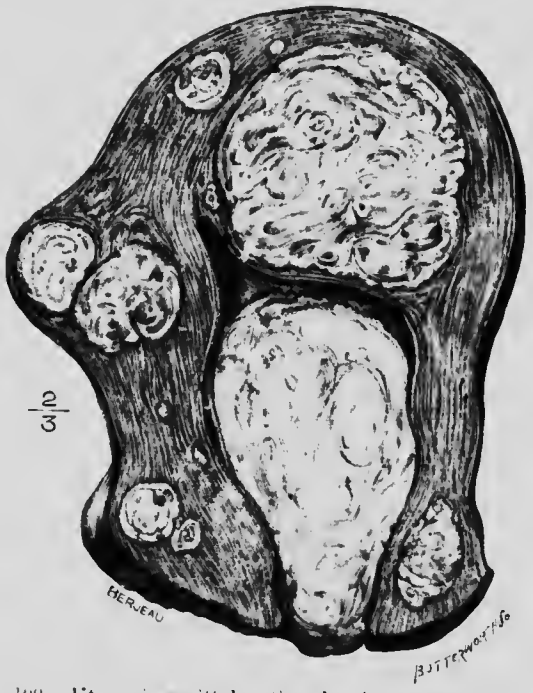

Fig. 100. Uterus in sagittal section showing interstitial and submucous fibroids.

section knots in wood; they have distinct capsules, and are firm and even hard to the touch. The bundles of spindle-celled tissues are usually interwoven in such a manner as to present a very characteristic whorled appearance. There is no limit to their growth, and they sometimes attain a large size, and may weigh upwards of twenty and even thirty kilogrammes.

2. *Submucous Fibroids.*—These tumours arise in the deeper parts of the endometrium, and when they attain an appreciable size project into the cavity of the uterus and give

rise to one variety of "fleshy polypus of the womb." Submucous fibro-myomata are at first sessile and invested on that surface which projects into the cavity of the uterus with mucous membrane. As they increase in size they dilate the uterine cavity and tend to become pedunculated.

Fig. 101.—**Very vascular fibroid in section.** (*After Virchow.*)

The presence of the tumour within the uterus leads to great thickening of the walls, accompanied by increased vascularity, which is often manifested by irregular hæmorrhage from the uterus, or at least by profuse menstruation. Submucous fibroids are sometimes so vascular as to resemble a cavernous nævus on section (Fig. 101).

The pedicle of a submucous fibroid may become sufficiently elongated to allow the tumour to pass through the cervical canal into the vagina and even protrude at the vulva. When this happens an interesting change takes place in the epithelium

of the protruded part. So long as the tumour is contained within the cavity of the uterus, the epithelium covering it is indistinguishable from that lining the cavity of the uterus. When the tumour enters the vagina the columnar epithelium stratifies on the protruded surface, but that lining the glandular recesses remains columnar and retains its cilia (Fig. 102).

3. *Subserous Fibroids.*—These arise from the uterine tissues

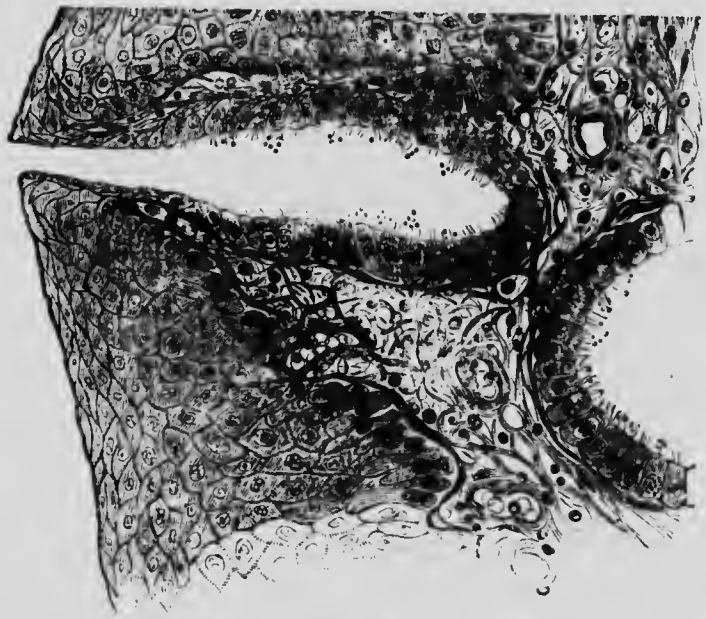

Fig. 102.—Microscopic characters of the epithelium covering the protruded portions of a submucous fibroid; it shows the mutation of columnar ciliated into stratified epithelium as a result of pressure. (*Gerris.*)

subjacent to the peritoneal covering. When numerous they rarely attain large proportions. When the number is limited to three or four, one or more of them may attain moderate proportions; like the submucous variety, they often become pedunculated, and when numerous they cause the uterus to assume a characteristic tuberous appearance. Sometimes as many as fifteen or twenty of these protuberances may be counted on a uterus, and they vary in size from a pea to a large walnut. In such cases, even when no intramural tumours are present, the walls of the uterus are thicker than natural. Subserous fibroids of this character rarely cause any inconvenience, and

are often found after death in individuals in whom they have never produced the least inconvenience during life, or in whom their presence has not been even suspected. The largest subserous fibroid I have removed weighed sixteen kilogrammes.

In some rare instances the endometrium may be thickly beset with small fibroids varying in size from a mustard seed to a dove's egg, the tumours being entirely confined to the tissues of the endometrium. I have seen three examples of this variety of the disease, and in each the number of fibroids exceeded one hundred: in one of them several of the larger fibroids projected into the cavity of the uterus, and by mutual compression facets had been produced on their surfaces, so that on section of the organ, after hardening, the cut surfaces of the fibroids occupying the uterine cavity resembled in outline a section through the bones of the carpus. In each instance the patients suffered from long-continued, profuse, and exhausting metrorrhagia.

Latent Fibroids.—If a number of uteri be examined from women between the twenty-fifth and fiftieth years by the simple means of sectioning them with a knife, in a large proportion of these uteri a number of small rounded fibroids resembling knots in wood will appear, their whiteness being in strong contrast with the redness of the surrounding muscle-tissue: these discrete bodies, in many instances no larger than mustard seeds, are in histologic structure identical with the fully-grown tumours. A uterus may contain ten or more of them without the least distortion of contour or alteration in its size. These seedling fibroids may never cause trouble, may never pass beyond this stage, and often calcify in old age, but they may at any time grow and become formidable tumours.

A careful consideration of the great frequency of seedling fibroids, and their multiplicity when compared with the number of fibroids which attain a size sufficient to render them clinically appreciable, makes it undeniable that a large portion of them remain latent. They may be compared to latent buds in trees (knots) and plants, on the ground that they may remain quiescent a number of years and then assume active growth without any known cause.

Latent fibroids have an important practical bearing; it is

not an uncommon experience for an operator to dilate the uterine canal and abstract two or more submucous fibroids. However carefully the procedure may be conducted, and however thoroughly the walls of the cavity may be examined for minute fibroids, no honest assurance can be given to the patient that other fibroids will not grow.

Fibroids of the Neck of the Uterus.—These tumours do not arise so frequently in the neck as in the body of the uterus, but they are fairly frequent, sometimes attain large proportions, and possess peculiar features (Fig. 103).

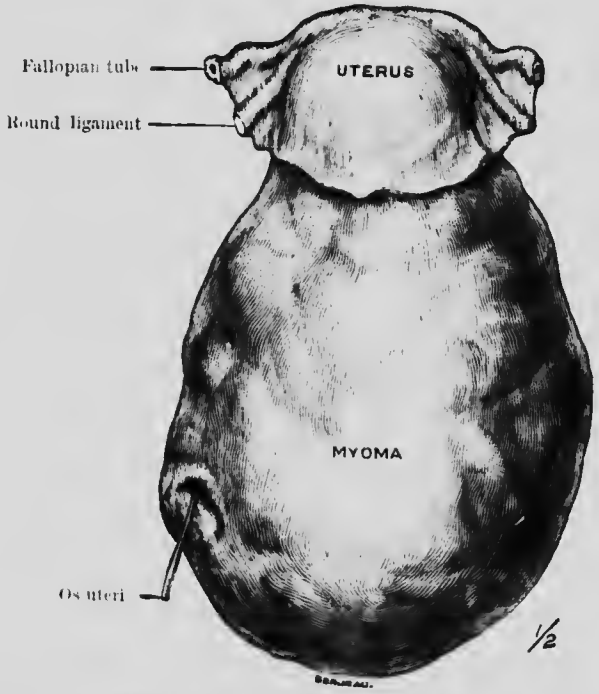

Fig. 103.—An intracervical fibroid from a sterile married woman 40 years of age. The fundus of the uterus reached the level of the umbilicus.

In the early stages of growth cervical, like the common forms of uterine, fibroids are more or less globular, but when they exceed this size they tend to become ovoid. Fibroids may grow from any part of the cervix; commonly they arise from its walls in such a way as to occupy the cervical canal (Fig 104). These are known as intracervical or submucous

cervical fibroids. Less frequently they grow from the periphery of the cervix and do not invade the canal, but burrow under the peritoneum on the anterior or the posterior aspect of the uterus (Figs. 105 and 106). These are known as subserous cervical fibroids.

The oval character of the cervical fibroid is best displayed in the submucous variety, for as it grows it pushes the body of the uterus, which is perched on its upper pole, high into the abdomen, and in the case of very large tumours the fundus of the uterus can be detected as high

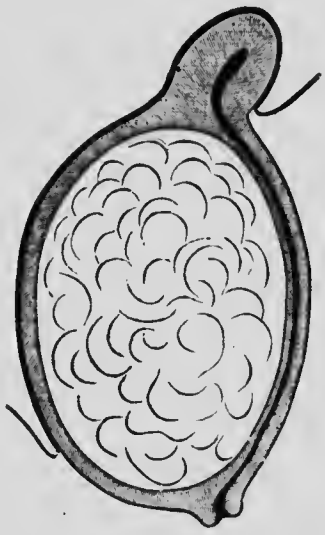

Fig. 104.—Diagram to show the relation of an intracervical fibroid to the cervical canal.

as the navel. The topography and shape of this kind of tumour are best displayed when the parts are sectioned in a sagittal direction. The ovoid shape of cervix fibroids is determined by the osseous boundaries of the true pelvis. In a normal female pelvis the pelvic diameter at the level of the middle of the cervix measures, with the soft parts in position, about ten centimetres (four inches): thus the lower segment of a large cervix fibroid is a solid cast of the true pelvis. In one of my specimens the minor (transverse) axis of the tumour measured 12·5 centimetres, this excessive measurement being due to the slow but steady

expanding effects of the tumour on the bony walls of the pelvis. It is well to bear in mind that the oval condition of the vaginal pole of a large cervix fibroid corresponds with the shape of the occiput of a recently delivered fœtus at term. The ovoid shape is also attained by subserous cervical fibroids when they grow from the posterior aspect of the cervix (Fig. 105). This kind of tumour as it increases in size pushes the body of the uterus high out of the pelvis on its upper pole, but its relation to the cervical canal is worth some attention. The intracervical fibroid (Fig. 104) uniformly expands the cervix, and in very large specimens its

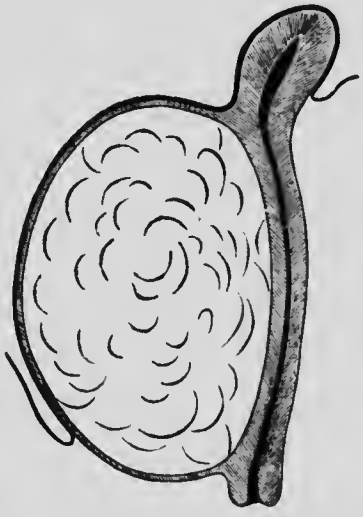

Fig. 105.—Diagram of a fibroid growing from the posterior wall of the cervix, showing its relation to the peritoneum.

tissues form a thin covering to the tumour; but a fibroid of the posterior aspect of the cervix elongates it without expanding the canal, and is really situated between the cervix and the peritoneum. This is a topographical distinction of some importance in connection with the clinical aspect of these tumours.

Fibroids on the anterior aspect of the neck of the uterus remain more or less globular, and do not distort the shape of the cervix as a rule; when of large dimensions they push their way upwards between the peritoneum and the anterior abdominal wall, and may reach as high as the umbilicus. It

is a noteworthy feature of the cervical fibroid that in more than two-thirds of the cases the tumour is solitary. All varieties of cervix fibroids are furnished with a distinct capsule; the tumour tissue on section presents the characteristic whorled arrangement of the common form of uterine fibroid, and is microscopically identical with it. Fibroids of the neck of the uterus when they do not cause menorrhagia are very insidious, and rarely give rise to serious symptoms until large enough to fill the pelvis and to exert pressure on the urethra, the vesical segments of the ureters, and the

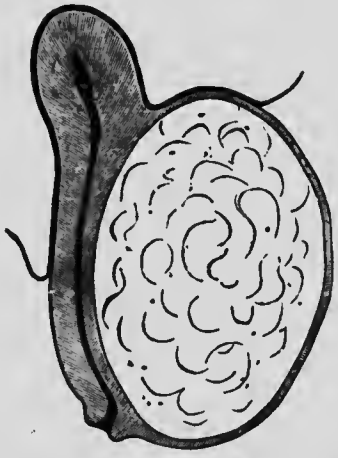

Fig. 106.—Diagram of a fibroid growing from the anterior wall of the cervix, showing its relation to the peritoneum as it passes from the anterior wall of the uterus to the bladder.

rectum. In some cases, especially when the tumour is connected with the anterior aspect of the cervix, there is direct pressure on the bladder. The frequency of micturition, dysuria, retention of urine, which are such common concomitants of all varieties of cervix fibroids, are due to the bladder being dragged upwards by the uterus as this organ is pushed out of the pelvis by the growing tumour.

In one example under my care, a woman 32 years of age sought relief on account of a cervix fibroid which filled the vagina and prevented coitus; it was successfully enucleated by the vaginal route.

The largest intracervical fibroid known to me is a specimen (Hunterian) preserved in the Museum of the Royal College of

Surgeons of England. It measures 20 cm. in length and 12·5 cm. in width. Unfortunately it is without history. The largest cervix fibroid I have removed (Fig 107) weighed seven pounds.

Fig. 107.—An intracervical fibroid in sagittal section.

Fibroids of the Mesometrium (Broad Ligament).—The connective tissue of the mesometrium contains a quantity of plain muscle tissue directly continuous with that which directly underlies the peritoneal investment of the uterus.

This muscle tissue is occasionally the source of tumours identical in structure with uterine fibroids. In the early stages these tumours are ovoid, encapsuled, and often bilateral; they do not cause much inconvenience until they attain the size of cocoanuts; even then they can be easily enucleated. They sometimes grow with great rapidity, and in a few months form tumours weighing as much as ten kilogrammes, and, rising out of the pelvis, carry the uterus and its appendages with them.

Some of the large globular tumours of the mesometrium are spindle-celled sarcomata (see p. 58). Doran has described some interesting cases and collected the literature, and he points out that they have been observed as early as the twentieth year. The majority occur, according to my observation, after the thirty-fifth year. They are formidable tumours to deal with, but fortunately they enucleate easily. The largest specimen under my own care weighed thirteen kilogrammes and was successfully enucleated.

Fibroids of the Round Ligament of the Uterus.—This structure, like the ovarian ligament, is practically a process of the muscular tissue of the uterus, and tumours in all respects like the fibro-myomata of the uterus arise in this ligament, not only in the segment which lies in relation with the anterior layer of the mesometrium, but also in the terminal portion which traverses the inguinal canal. Tumours arising from the pelvic section of the round ligament are often very big. Their microscopic structure is rather that of a spindle-celled sarcoma than of the typical uterine fibroid. The largest example which has come under my notice weighed 14 pounds. I removed it from a woman aged 28 years: it grew from the round ligament about 3 cm. from the uterine course, and its pedicle measured 1 cm. in diameter.

Fibroids of the Ovarian Ligament.—It is no uncommon thing to find a fibroid the size of a cherry in the ovarian ligament, when the uterus itself is occupied by a crowd of fibroids; otherwise it is very rare to find a tumour in this process of the uterus, and especially one large enough to be obvious on clinical examination.

Fibroids of the Utero-sacral Ligament.—Occasionally a fibroid is found burrowing under the posterior layer of the

mesometrium and simulating a primary tumour of this structure, but when enucleated it is found attached to the side of the cervix near its junction with the body of the uterus by a very narrow, tendon-like stalk. It is probable that such a fibroid arises in the tissue of the utero-sacral ligament. In two examples under my own care the fibroids had a diameter of 12 cm.

Fibroids in Malformed Uteri.—Fibroids not only grow from uteri of normal shape, but they have been observed in double uteri of various kinds, and even growing from the rudimentary cornu of the so-called "unicorn uterus." (Doran, Bland-Sutton and Routh.)

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CHAPTER XVII.

UTERINE FIBROIDS (*Continued*).

Uterine fibroids differ much in texture: some are as hard as cartilage, and a few, when calcified, resemble porous stone; others are as soft and succulent as a ripe orange, and occasionally some are like jelly. Between these extremes every degree of hardness or softness occurs: but they all agree in one particular—namely, in the possession of a well-developed capsule, a structure of vital importance to a fibroid, as its life depends upon it. Hard fibroids are yellowish-white on section, softer specimens resemble the normal colour of the uterus. Soft tumours, as a rule, grow quickly, and are very vascular, but the hardest and the gelatinous fibroids are poorly supplied with blood.

It is by no means uncommon to find a uterus possessing many fibroids (twenty or more), some of which are very hard; one or more may be calcified, others are of the same density as the wall of the uterus, whilst one or more are soft and even diffluent.

Attention has already been drawn to the fact that the only structural feature fibroids have in common is a well-mark capsule, of fibrous tissue, which completely isolates tumour proper from the uterine tissue. Even in completely calcified fibroids a thin capsule can be demonstrated, and occasionally the only solid representative of the fibroid is the capsule, the originally solid parts of the tumour having slowly liquefied (Fig. 108). Fibroids changed in this way are often referred to as "fibro-cystic" tumours. In some instances the capsule of a fibroid calcifies and encloses the tumour in a more or less complete shell. Fibroids in this condition are dead, and on section exhibit the dirty yellow colour of chamois leather, and equal it in toughness.

The most typical variety of "fibroid" not only resembles the wall of the normal uterus in toughness, but is similar to it in microscopic structure, and consists of unstriped muscle tissue, which has a remarkable tendency to be arranged in whorls (Fig. 109).

The very hard fibroids are composed of tissue which

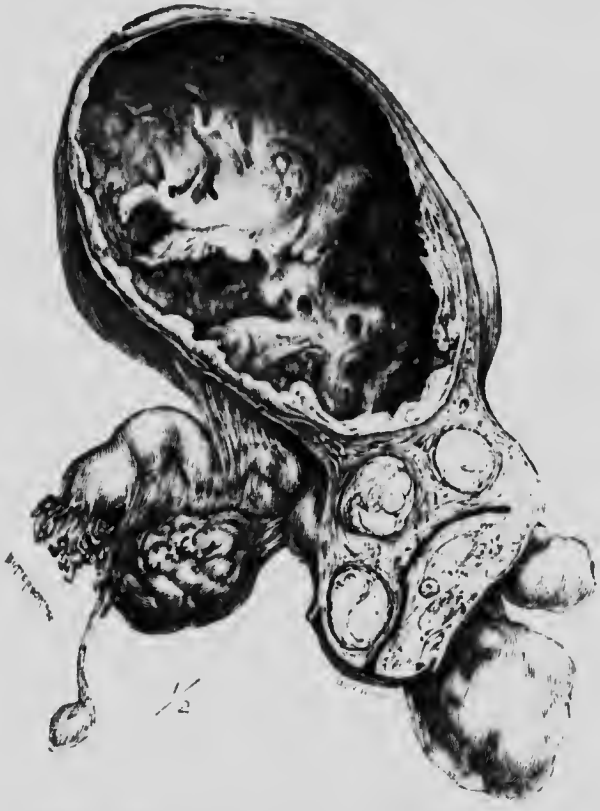

Fig. 108.—A sessile subserous fibroid which has undergone extensive mucoid degeneration. From a sterile married woman 37 years of age.

microscopically resembles dense fibrous tissue, with here and there strands of cells resembling unstriped muscle-cells. This variety is often called **fibro-myomata**, and its members display the whorled arrangement in a very striking manner. The fibro-myomata are very liable to calcity. The deposit of earthy salts does not take place in an irregular manner, but follows the disposition of the fibres, and the

whorled arrangement is seen when the sawn surface is examined (Fig. 110). When incompletely calcified tumours are macerated, and the decayed tissue washed away, the calcareous matter remains as a coherent skeleton of the tumour. Such changes have taken place whilst the tumour remained in the living uterus: they were formerly termed "womb stones." Occasionally, in old women the uterus attempts to

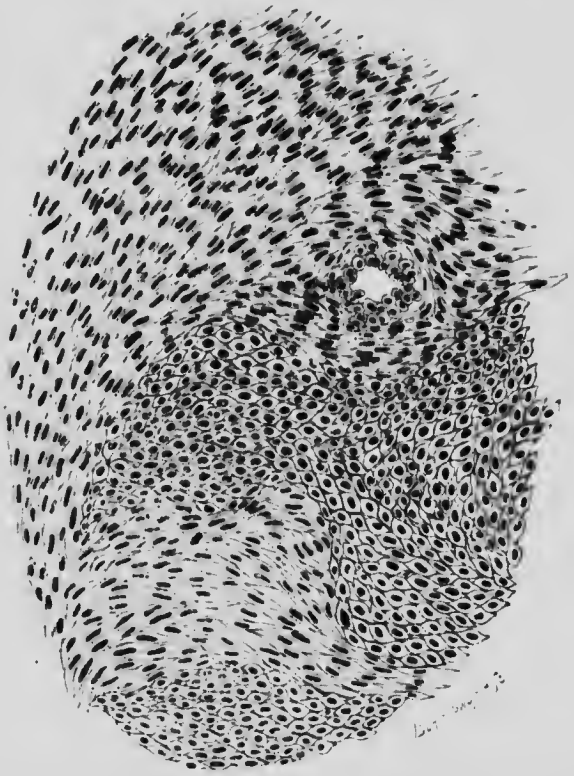

Fig. 109.—The minute structure of a young uterine fibroid: the circular cells are spindle cells cut at right angles. This figure represents a complete section through the equator of a seedling fibroid the size of a mustard seed.

extrude a calcified fibroid; when the tumour is large the result, if left to the efforts of nature, is as a rule disastrous. The extraction of such a tumour by art is difficult and tedious. When "calcified fibroids" have been found in coffins, in old burying-grounds, they have been mistaken for vesical calculi

The soft, jelly-like fibroids are, in the majority of cases, due to secondary (myxomatous) changes in tumours which were originally hard. This is proved by the fact that patches of softening are found in hard tumours, and occasionally fibroids come to hand in which the very hard, calcified, gelatinous and diffluent tissues co-exist. However, it is important to remember that these changes do not always depend on the age of the tumour, for a very large proportion of uterine fibroids which occur before the thirtieth year are myxomatous, and what is more important, these soft (almost liquid) fibroids are locally malignant—that is, they recur if enucleated, and this sometimes happens very quickly. In 1898

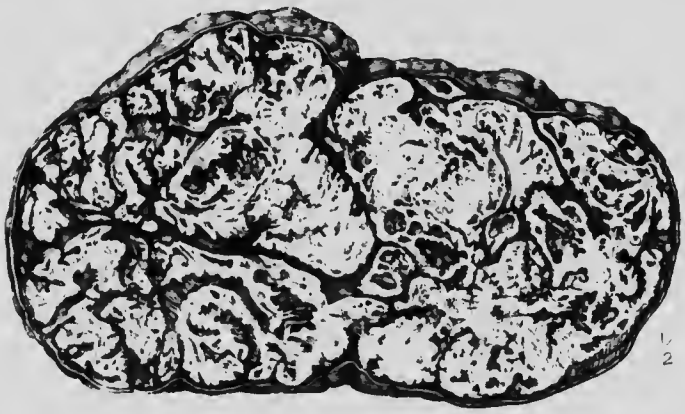

Fig. 110.—Calcified uterine fibroid in section. (*Museum, Middlesex Hospital.*)

I removed through the vagina a jelly-like fibroid, as big as an orange, from the uterus of a woman forty-five years of age, and was careful to remove the whole capsule. In six months she returned with a tumour in the uterus occupying the position of the original fibroid, but twice its size. Hysterectomy was performed, and the uterus contained a large myxomatous fibroid. She remains free from recurrence.

Women with hard fibroids rarely complain of them, but when the fibroid is soft like jelly the health of the patient is markedly impaired, quite apart from the anæmia due to menorrhagia.

Red Degeneration (Necrobiosis).—This change in fibroids

is best studied in specimens which are complicated by pregnancy. It is considered on p. 218.

Malignant Changes in Fibroids.—It is believed by many that a sarcomatous change may arise in uterine fibroids. The matter has been carefully considered by competent men, and a critical examination of the evidence makes it clear that in a very large proportion of the cases described as "sarcomatous degeneration of a fibroid" the changes were due to septic infection. In all future records published as evidence in this direction there must be a careful account of the minute structure of the tumour by a competent pathologist. The great defect in nearly all the recorded cases in which the malignant change has been suspected is the absence of any description of the mode of death where the patient survived the operation. Sarcomata are so prone to disseminate, that any patient who has died in consequence of malignant degeneration of a fibroid would be expected to have secondary nodules in the lungs at least.

The most convincing case which has come under my notice occurred in a woman fifty-nine years of age: she died in the Middlesex Hospital under the care of Dr. Finlay. I made the *post-mortem* examination. The uterus contained a fibroid as big as a child's head, attached to the fundus of the uterus: it was adherent to and had penetrated the bladder and intestine. Secondary nodules were found at the base of the right lung, on the wall of the left cardiac ventricle and in the left kidney. The microscopic characters of the uterus were those of a myoma and a spindle-celled sarcoma. The secondary nodules displayed the same structure.

Griffith and Williamson have recorded in detail the case of a woman, aged 56, who died in St. Bartholomew's Hospital with a sarcomatous fibroid. The uterus contained several fibroids, and secondary nodules were found in the lungs.

In many cases, reported as fibroids undergoing malignant change, the tumours were in all probability sarcomatous from the beginning. They should be called sarcomatous fibroids.

An attempt has been made by Piquand to formulate the symptoms and diagnostic features of sarcomatous disease of the uterus. He attempts to arrange the disease under three headings, thus:—Sarcoma of the interstitial tissue of the

nterns: Sarcoma primary in the endometrium; and Sarcoma of the neck of the uterus.

Of these three groups, the racemose sarcomata of the neck of the nterns is the most distinctive and easiest of recognition, clinically and microscopically (see p. 57). In regard to sarcomata of the body of the nterns and the endometrinm there is great difficulty. As a matter of fact, there is every gradation from the hard fibroid and the typical myoma to the soft

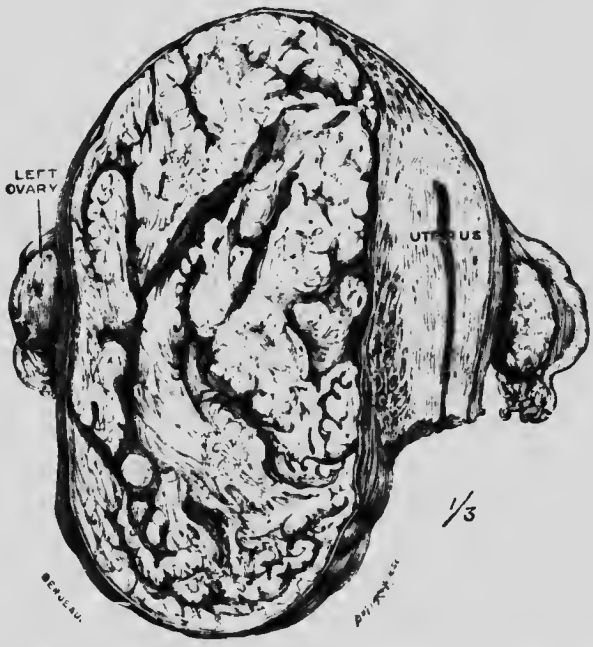

Fig. 111.—The body of the uterus in coronal section, showing a large fibroid traversed by narrow tortuous canals—probably lymph spaces.

diffhent myxoma. Among the softer forms we meet with the spindle-cell sarcoma (the recnrrent fibroid of older writers), which snrgeons fail to recognise nntil the patient comes nnder observation with signs of local recurrence. In this particnlar histology fails us, in spite of its triumphs.

Fibroids Complicated with Cancer of the Uterus.—This sinister combination is discnssed in Chapter XXXVIII.

Lymphatics in Fibroids.—It is not nncommon, when removing large nterine fibroids by coliotomy, to find lymph vessels on the broad ligaments as big as the radial, or even

of the size of the axillary vein. Occasionally a firm fibroid will present on section numerous irregular tortuous channels (Fig. 111). These are probably lymph spaces. It has happened to me on several occasions when operating on subserous fibroids to find the tumour adherent to the great omentum, and the arteries, veins, and lymphatics in the adherent portions of the omentum were so enormously developed as to form a mixed *rete mirabile*; the arteries being in many instances as big as radials, the veins equal to the cephalic, and the lymphatics of the size of goose-quills. The contrast of the maroon tint of the arteries, the deep blue of the veins, and the light yellow of the thin-walled lymphatics formed an anatomical picture scarcely likely to be forgotten by one who has had to deal with such a condition.

Rate of Growth of Fibroids.—On this subject there are very few facts forthcoming. In general terms it may be stated that soft fibroids grow quickly, the hard ones increase very slowly; those fibroids grow most quickly which soften, and it is a remarkable fact that when the myxomatous change is established in one of these tumours it will often increase in size with astonishing rapidity.

The only observation I have been able to make with any accuracy in regard to the rate of growth of fibroids is the following:—

In 1896 I enucleated by means of an abdominal incision from the uterus of a woman twenty-three years of age (I obtained a copy of her birth certificate) a fibroid measuring 15 cm. in its major and 5 cm. in its minor axis. The patient, already mother of one child, was delivered of a healthy baby eight months after the operation: it was reasonable to believe that she had become pregnant immediately before coming into the hospital.

Three years later (1899) this woman again came under my care on account of a pelvic tumour: this was watched for three months, and it increased so much that it became necessary to perform hysterectomy. The uterus contained twenty tumours varying in size from a ripe currant to a hen's egg. The largest tumour occupied the cervix. There were no signs of these tumours when the patient was submitted to celiotomy in June, 1896.

Nature of Uterine Fibroids.—No very satisfactory explanation of the nature of fibroids is forthcoming, although their structure has been studied with very great care. The large amount of new light which has recently been shed on molluscum fibrosum and neuromata led me to investigate anew the histology of very small fibroids, thinking it quite possible that they might bear the same relation to the nerves of the uterus that the neuromata bear to nerves in other regions of the body. In 1900 I removed a very remarkable uterus from a woman thirty years of age, which, though only about twice the average size, contained one hundred and twenty tumours, some of them the size of a pigeon's egg, but the majority no bigger than mustard seed. Portions of this uterus were carefully prepared for histological examination, but I failed to detect any nerve elements in association with them; in all there was the most intimate association with arteries: indeed, the relation of the arteries to the cell elements of these seedling tumours was such as to convince me that the muscular coats of these vessels are the primary source of "fibroids." *Thus it would appear that some uterine fibroids bear much the same relation to the terminal branches of the uterine arteries that neuromata bear to the epineurium of nerves.*

I have made many efforts to confirm Von Recklinghausen's observations that some fibroids arise in remnants of the Gartnerian and Wolffian ducts, but so far without success.

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CHAPTER XVIII.

UTERINE FIBROIDS (*Continued*).

It is too true that fibroids are the commonest of all the species of tumours to which women, whether married, single, fruitful or barren, are liable. It is also a fact that the uterus may contain one fibroid or many and cause neither inconvenience nor suffering—indeed, the individual owning them is ignorant of the existence of tumours in her womb: but it is equally true that they are often the source of much suffering, and occasionally cause death in insidious ways, some of which will be considered.

Hæmorrhage.—This is the commonest of all the inconveniences which fibroids cause, but it is confined to those which implicate the endometrium. The bleeding occurs under two conditions: most commonly it takes the form of excessive loss at the normal menstrual periods (menorrhagia). The most serious hæmorrhages are associated with septic changes in the tumour. It is a fact of some importance that a small submucous fibroid will induce such profuse bleedings at the menstrual p[illegible]d as to place life in imminent peril: whilst a large i[illegible]al tumour, even though it project into the uterine cavi[illegible]arcely influ[illegible]es the loss.

When a woman with a fibroid bleeds excessively between, as well as at the normal menstrual periods, it often indicates that the tumour has become septic.

It is important to realise that oft-repeated losses of blood continued over a long period not only lead to profound anæmia, but also to grave changes in the heart-muscle, which frequently end in sudden death, as well as greatly adding to the operative risks when such individuals submit to surgical procedures. These changes have been carefully described by Wilson.

Septic Infection.—This is, perhaps, the most serious complication of a fibroid, and even when it does not cause death is always attended with dangerous consequences. Infection of a fibroid may arise in a variety of ways—*e.g.* the extrusion of a submucous tumour into the vagina exposes it to injury, and micro-organisms gain access to it through abrasions in its capsule. Infection may be due to injury from the uterine sound or dirty dilators, or septic changes supervening on labour or miscarriage; occasionally it is due to intestinal gases when bowel adheres to the tumour. An infected fibroid is a soft, dark-coloured stinking mass, which

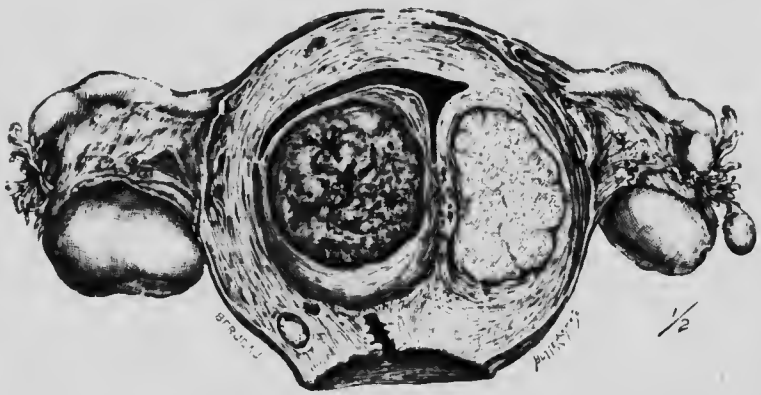

Fig. 112.—Body of the uterus in section showing two sessile submucous fibroids. The capsule of one has ulcerated and the tumour become gangrenous. The patient suffered from excessive and almost continuous bleeding.

bleeds freely when touched. In the early stages of the infection it appears on section œdematous, and exhales a sickly odour. On microscopic examination the muscle cells are separated by multitudes of inflammatory cells, and colonies of pathogenic micro-organisms can by special methods be demonstrated among the inflammatory cells.

When a large fibroid becomes septic it gives rise to severe constitutional disturbances (septicæmia), like gangrene of other organs, and will, unless promptly removed, inevitably destroy life (Fig. 112).

Small fibroids when septic, though they give rise to serious trouble, do not so urgently threaten life, but they work great mischief, for the infection is sure to involve the adjacent

endometrium (which sometimes sloughs) and creep into the Fallopian tubes; the septic matter in some cases becomes imprisoned in the tubes by occlusion of the colomic ostium; this is a fortunate event. Occasionally it leaks directly into

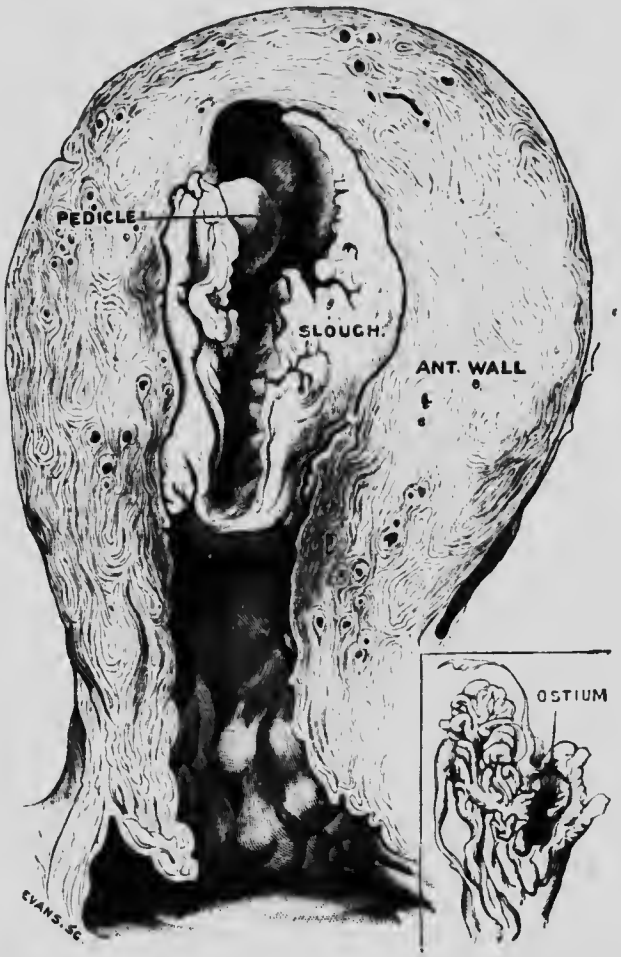

Fig. 113.—Section of a uterus from which a sloughing fibroid had been removed. The mucous membrane was gangrenous, and infective material had leaked into the colom through the unclosed ostium.

the peritoneal cavity through an unclosed ostium, and establishes fatal peritonitis (Fig. 113).

An extruded fibroid often becomes septic, for when the tumour passes beyond the external orifice of the uterus, the

part lying within the canal is firmly grasped by the uterine walls bounding the internal orifice. Should the tumour be very vascular the venous circulation is interfered with, and the projecting part becomes œdematous. Should the compression continue, the extruded parts become congested, and may even necrose, and as the dead tissue is in a situation easily accessible to air, and consequently to putrefactive organisms, gangrene, with all its attendant evils, is the result.

It is always necessary in examining fibroids projecting into

Fig. 114.—Partial inversion of a uterus due to a fibro-myoma.

the vagina to be careful to distinguish between the fundus of an inverted uterus and a fibroid extruded from the uterus, and at the same time to remember that a submucous fibroid will occasionally invert the uterus (Fig. 114).

Sepsis plays an important part in hæmorrhage associated with cervical fibroids. Professional opinions on this matter are very divergent, and after a careful study I am able to state that menorrhagia and metrorrhagia are only associated with the intracervical variety of cervix fibroids and bear no relation to the size of the tumour: but hæmorrhages only occur with the intracervical fibroids when the uterus has made attempts to extrude, or has succeeded in extruding, the tumour wholly

or partially into the vagina. The corollary is obvious. An extruded or partially extruded fibroid quickly becomes septic,

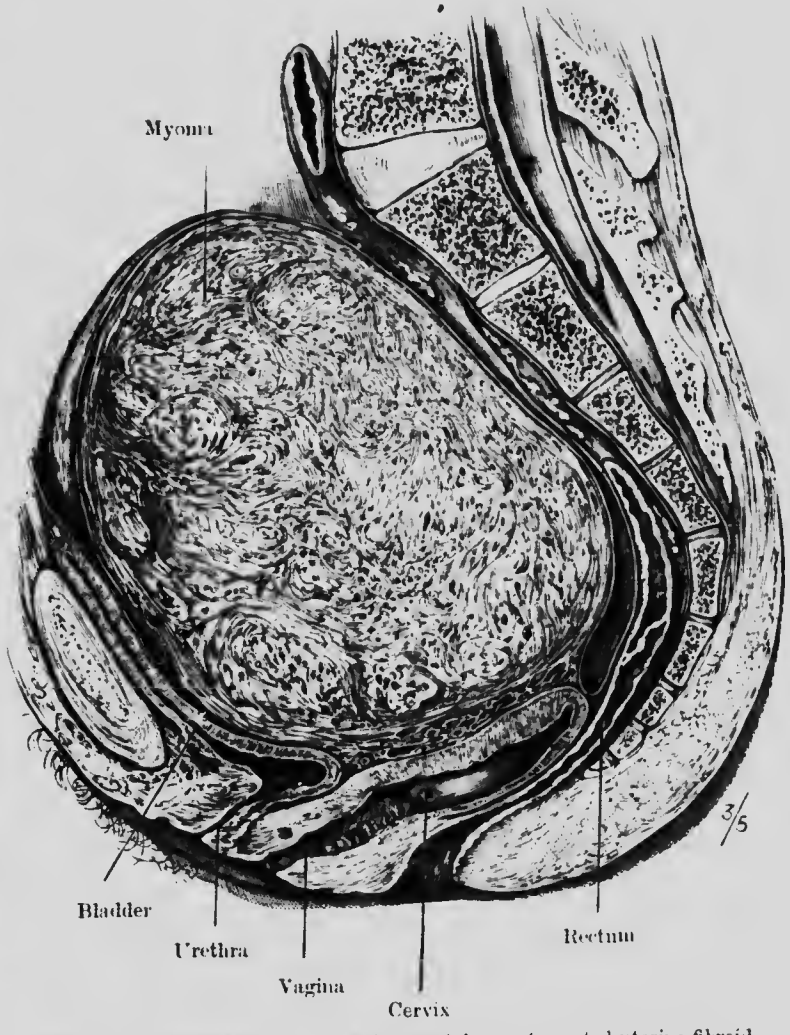

Fig. 115.—Frozen section of a pelvis containing an impacted uterine fibroid.

and as surely as this happens menorrhagia and metrorrhagia are unfailing consequences, whether the fibroid be large or small. When the orifice of the cervical canal remains a "mere dimple," menstruation is normal, and the patient is usually a spinster, or if married, barren.

Impaction and Its Effects.—A fibroid is said to be impacted (or incarcerated) when it fits the true pelvis so tightly that the tumour cannot rise upwards into the belly. All varieties of fibroids may become impacted, and as the complication is of great clinical importance, it needs detailed consideration.

A subserous fibroid growing from the fundus will often produce retroversion of the uterus, and the tumour occupies the hollow of the sacrum. As the tumour grows it appropriates the available pelvic space, and in due course exerts pressure on the rectum and urethra, interfering with defecation and micturition (Fig. 115).

A solitary intramural fibroid may be small enough to rest in the true pelvis without pressing unduly on the urethra or ureters. Presently it increases to such a point that the turgescence which precedes the menstrual flow will cause it to press the urethra against the symphysis, and set up retention of urine. When menstruation occurs the turgidity of the tumour subsides, and the urethra is set free. Frequent recurrence of this pressure permanently damages the bladder and kidneys. Very vascular tumours yield a loud murmur or hum, on auscultation, a sign of very great value in differential diagnosis. In many cases I have been able to demonstrate the existence of a loud murmur for a few days before menstruation, but it disappeared with the flow of blood, and remained in abeyance until a few days before the succeeding period.

The most insidious, and therefore the most dangerous, variety of impaction is that which occurs with cervix fibroids. It has already been mentioned that when one of these tumours attains a transverse diameter of 10 cm. (4 inches) it has practically used up the spare pelvic space and exerts injurious pressure on the rectum, ureters, urethra, or bladder. Most commonly it presses on the neck of the bladder and causes retention, leading to frequent and painful micturition. It is one of the most striking features of the cervical fibroids that they rarely cause bleeding except when they extrude from the mouth of the uterus and become infected, and only cause inconvenience when they interfere with the bladder. Herein lies the danger, as grave

injury is often wrought on the pelvis of one or both kidneys before the existence of the tumour is even so much as suspected. It is an important fact to remember that *when a woman between thirty-five and forty-five seeks relief because she suffers from retention of urine for a few days preceding each menstrual period, it is almost certain that she has a fibroid in her uterus.*

Axial Rotation.—The method by which fibroids under certain conditions accommodate themselves in the pelvis is worth further note. It has already been mentioned that a tumour in the posterior wall will produce retroflexion of the uterus, and if the fibroid continues to grow or the woman becomes pregnant, impaction is sure to occur. There is also a curious form of impaction accompanied by rotation. When a growing fibroid occupies the posterior wall of the uterus and another its anterior, so long as the total antero-posterior diameter of the uterus with its tumours does not exceed 10 cm. it may occupy a normal position. When this diameter increases the uterus slowly rotates, and the larger tumour will occupy the transverse diameter of the pelvis. If growth continues, it gradually fills up the available pelvic space, and impaction slowly but surely ensues. As a rule the tumour of the posterior wall lies in the recto-vaginal fossa, but occasionally the uterus will be so rotated that the tumour in the anterior wall occupies the space in the true pelvis, and that in the posterior wall projects into the hypogastrium. I have twice seen this unusual condition.

A subserous fibroid with a long and slender stalk is liable to rotate and twist its pedicle, a movement which causes very great pain. Some small calcified pedunculated fibroids may be so twisted that they become detached. A loose body of this kind has been found in the sac of an inguinal hernia.

Although it is unusual to meet with subserous fibroids possessing stalks so slender as to render axial rotation a factor of clinical importance, it is nevertheless an event to bear in mind in estimating the value of pain in diagnosis.

Intestinal Obstruction.—Uterine fibroids may obstruct the intestines in three ways, thus:—

A pedunculated subserous fibro-myoma, especially if its stalk be long and narrow, may entangle a loop of small

intestine and lead to fatal obstruction. This may happen with small as well as with large tumours. A very large fibroid rising high in the abdomen may rest upon the pelvic brim in such a way as to obstruct the sigmoid flexure. Lastly, an impacted fibroid may press upon the rectum and lead to obstinate constipation and chronic obstruction, with all its inconveniences and evils.

Apart from the various modes already mentioned in which fibroids cause death, they may destroy life in unexpected ways, of which the following is a remarkable and very unusual example recorded by Arnott: A maiden lady of seventy-two years was knocked down by a large dog, and fell forwards on the pavement. She was seized with severe pain in the belly, and died in thirty-four hours. At the autopsy a circular orifice was found in a coil of ileum which lay between the anterior abdominal wall and a calcified tumour of the uterus. There was extravasation of faeces and intense peritonitis. The tumour, which was as large as a child's head, apparently originated in the anterior wall of the uterus. Several small tumours, also calcified, were attached by pedicles to its capsule.

A woman aged seventy-five years, who was known to have had a fibroid at thirty-five, exhibited the signs of intestinal obstruction such as are associated with cancer of the descending colon. I operated upon her, and removed a calcified subserous fibroid which had become firmly impacted in the pelvis and compressed the rectum. The patient recovered, and was known to be alive a year later.

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CHAPTER XIX.

UTERINE FIBROIDS (*Continued*).

THEIR RELATION TO MENSTRUATION, CONCEPTION, PREGNANCY, PUERPERY, AND THE MENOPAUSE.

THERE is nothing in oncology better established than the fact that all uterine fibroids arise during the menstrual period of

Fig. 116.—Pregnant uterus with multiple fibroids; removed by operation. After the uterus had been removed, an incision was made in the uterine wall, and as *rigor mortis* supervened in the organ, the embryo in its amnion was extruded.

life. In Great Britain this period has an average of thirty years, from the fifteenth to the forty-fifth year. There are,

however, few reliable records of fibroids being found in the uterus before the twentieth year. Submucous fibroids have been removed by cœliotomy from girls of eighteen years (Scharlieb and Madden). Many examples have been observed between the twentieth and the twenty-fifth years.

Between twenty-five and thirty-five, fibroids are fairly common, but the maximum frequency is attained between the thirty-fifth and the forty-fifth years.

The interval between the twenty-fifth and thirty-fifth years is the great child-bearing period, with an average length

Fig. 117.—Gravid uterus with fibroids: removed by operation.

of twelve years. The menstrual epoch of a woman's life may be divided into three periods in relation to pregnancy and fibroids, thus:—

1. From fifteen to twenty-five, in which, assuming the environment to be favourable, a woman is infinitely more liable to conceive than to grow a fibroid.

2. From twenty-five to thirty-five; during this period her liability to pregnancy is greater than in the preceding period, but her liability to fibroids is also greater.

3 From thirty-five to forty-five: in this the liability to conception is greatly diminished, but the liability to fibroids is immensely increased.

Not only is it true that fibroids arise during menstrual life,

but it is equally certain that they influence menstruation, and I have operated on many cases in which this disagreeable phenomenon has been as profuse between fifty and fifty-five, and even at sixty, as it was at twenty. It is questionable whether the fluxes of blood in women with uterine fibroids after the age of fifty years should be regarded as menstruation in the proper acceptation of the term.

If the conclusion is correct that the interval from twenty-

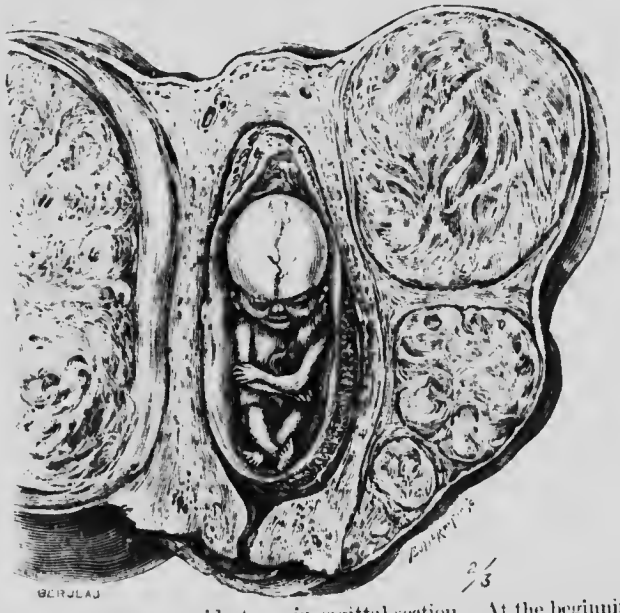

Fig. 118.—A myomatous gravid uterus in sagittal section. At the beginning of the third month impaction occurred; this was relieved, and as the uterus with its tumours was too long to lie in its natural position, axial rotation occurred. The antero-posterior length of the distorted organ was 20 cm. Only a portion of the large tumour is shown in the figure.

five to thirty-five is the great child-bearing period of a woman's life, it follows as a corollary to the three deductions in the preceding section that, when pregnancy and fibroids co-exist, the subjects of such a combination should be women past thirty, and these should, as a rule, be those who have either married late in life, or, if married early, have remained many years sterile. It is universally admitted by writers who have devoted careful attention to the matter that the presence in the uterus of a submucous or of a large interstitial fibroid is very unfavourable to conception. A fibroid in

these situations, or even in the neck of the uterus, is by no means a bar to conception, or even to successful pregnancy, but such a combination is very dangerous to the mother and to the child. Two facts may be stated with a fair amount of accuracy thus:

1. When the uterus of a parous woman begins to grow a fibroid, she usually ceases to conceive.

2. When a woman whose uterus contains a fibroid con-

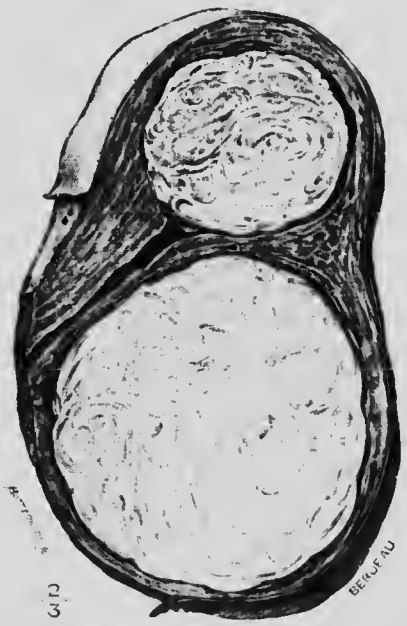

Fig. 119.—Uterus in sagittal section; its neck is occupied by a large intracervical fibroid. There is also a submucous fibroid. (From a barren woman aged 11, who had been married many years.)

ceives, this event is usually preceded by a long period of unfruitful wedlock. A large subserous fibroid does not influence conception, but is occasionally a serious complication of pregnancy as well as of delivery and puerpery.

It might be imagined that a fibroid in the neck of the uterus would offer an effectual obstruction to conception, especially as such a tumour not only lengthens, but often distorts the cervical canal (Fig. 119), but this is not so, as the specimen represented in Fig. 120 demonstrates. This uterus was removed from a woman thirty-five years of age who

knew she had a uterine fibroid, but did not suspect that she was pregnant. Severe abdominal disturbance and signs of miscarriage led to the detection of the complication, and the patient's life became imperilled: the uterus was removed, but she lost her life.

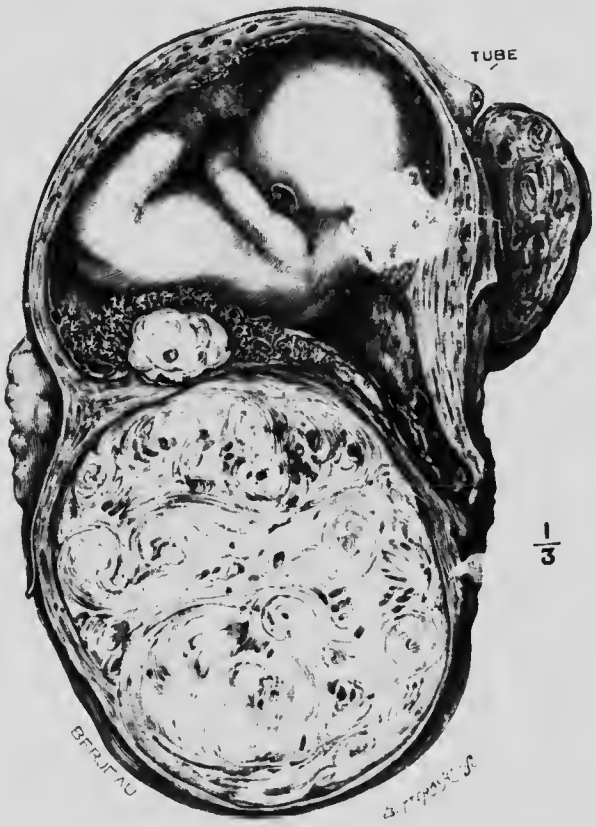

Fig. 120.—A pregnant uterus deformed by fibroids; the largest grew in the neck of the uterus.

It is admitted by all practitioners who have had experience in midwifery, that the most serious obstruction which arises in connection with uterine fibroids is caused by a large tumour in the neck of the uterus, and this is illustrated by the specimen shown in Fig. 121. In this case I performed total hysterectomy with success after labour had begun. Rutherford Morison has had a similar experience.

Fig. 121.—A gravid uterus in sagittal section. The patient miscarried at the seventh month, and the arm presented. Delivery being impossible on account of a large cervical fibroid, the uterus and its cervix were removed. The œdema of the presenting arm is well shown. The specimen is in the *Museum of the Royal College of Surgeons.*

Inimicality of Pregnancy and Uterine Fibroids.—The banefulness or harmfulness of the association of pregnancy is of three kinds.

(1) *Obstructive.*—The harm which may arise from the

obstruction offered by a fibroid to a gravid uterus sometimes occurs early in the pregnancy because it may lead to impaction and even slow torsion of the uterus. If the fibroid be pedunculated the upward movement of the uterus may

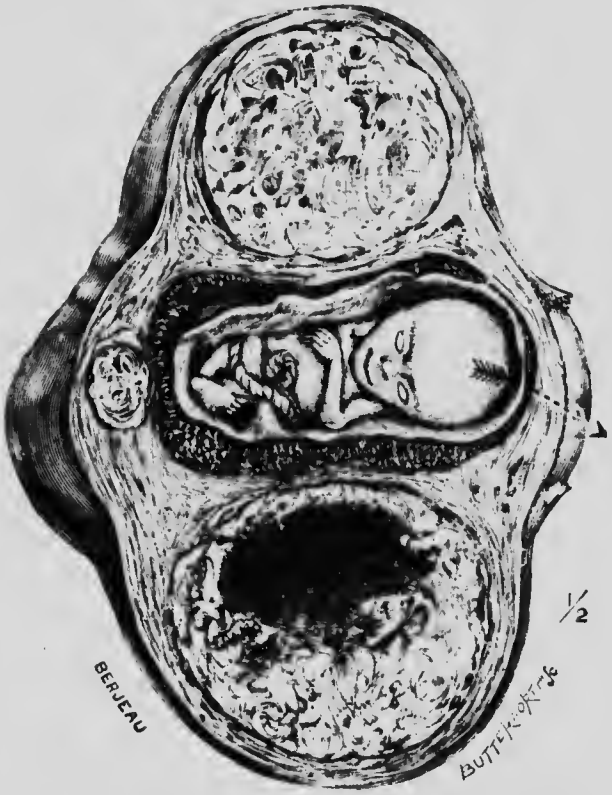

Fig. 122.—Gravid uterus deformed by fibroids which were soft, red, and one was diffluent. Removed from a woman aged 28 on account of pain, impaction, and rotation of the uterus. The arrow lies in the cervical canal.

cause it to rotate and twist the pedicle; occasionally it will be incarcerated by the uterus.

(2) *Septic infection.*—An interstitial or a submucous fibroid may be infected from careless attention to antiseptic details following miscarriage or delivery at term: many puerperal women have lost their lives from this cause. Occasionally a submucous fibroid may be extruded into the vagina during delivery, but this is rare. A subserous fibroid may become œdematous, and when the uterus expels the fœtus the tumour

may become septic and set up peritonitis, which may destroy the patient or lead to the formation of dangerous adhesions.

(3) *Degeneration of the fibroid.*—This is an insidious danger, and one which has not been fully appreciated by obstetricians, for it is a condition often associated with pregnancy apart from septic infection, or from mechanical injury which the tumour may receive in the course of the gradual

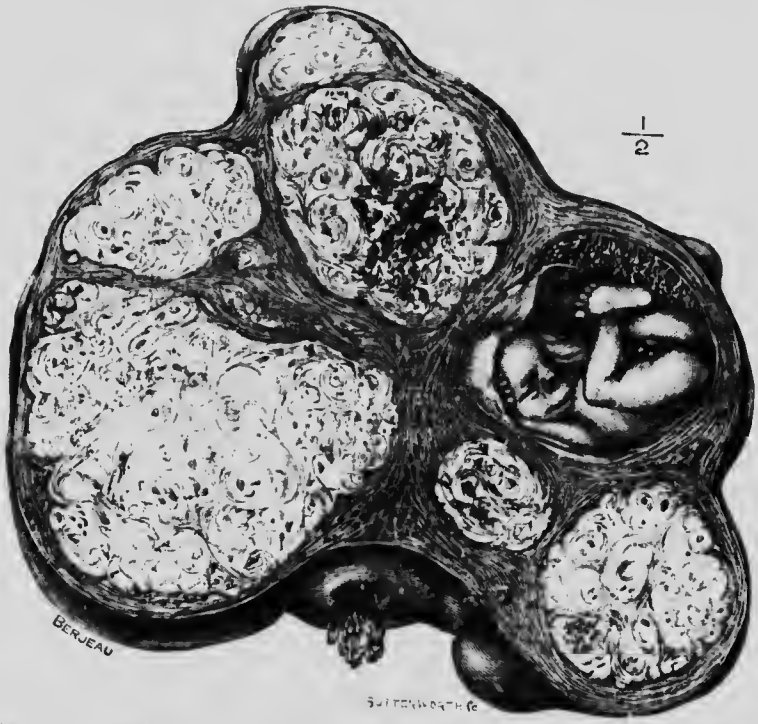

Fig. 123.—Uterus distorted with fibroids, and containing a fœtus of four months development. From a woman aged 12 years.

enlargement of the uterus, or during its sudden diminution after delivery. Moreover, the change which pregnancy induces in fibroids has interested me for many years, and I have been able to collect a large number of facts from personal observation.

The usual colour of a uterine fibroid is pale yellow; in many degenerating and necrotic fibroids this colour deepens. In the course of pregnancy a fibroid, especially one of the interstitial kind, assumes a deep red or mahogany tint. In

the early stages the tumour exhibits the colour in streaks, but as the pregnancy advances it permeates the whole tumour. Occasionally, even in the mid-period of pregnancy, this necrotic change may be so extreme that the central part of the tumour is reduced to a red pulp.

In 1903 Fairbairn wrote an excellent paper on this necrotic change in fibroids, and it is now becoming familiar as the "red degeneration." Until Fairbairn began to accumulate the material for this paper I held the opinion that this change was only seen in association with pregnancy, but he soon convinced me that it occurred in spinsters, and I have myself since seen well-marked examples in women who have never been pregnant. At the same time it must be stated that the largest number, the best marked, so far as colour goes, and the most extreme examples of this red degeneration occur in association with pregnancy.

In the early cases which came under my notice, the redness of the cut surface of these tumours so strikingly resembled beefsteak that it suggested to me, and appears to have done so to other observers, that the change in colour might be due to an increase in the muscle fibres in consequence of the physiological enlargement of the uterus. The microscope, however, dispelled this illusion, showing the colouring material to be blood pigment diffused through the necrotic tissue of the tumour.

This red degeneration is of interest outside the pathological laboratory: it is of clinical importance, because fibroids which are undergoing this peculiar change are often painful and extremely tender. This tenderness is a valuable diagnostic sign.

Reflections on the complications resulting from the presence of fibroids in the walls of a pregnant uterus make it obvious to any thoughtful practitioner that it may be described as a malicious combination.

Fibroids and the Menopause.—It was formerly taught and believed that uterine fibroids cease to be troublesome with the cessation of menstruation. It is quite certain that this opinion requires reconsideration. Uterine fibroids stand alone among tumours in the peculiarity of their age distribution, for, as has already been mentioned, they only arise

during menstrual life (15 to 45), but they stand absolutely alone among tumours in possessing another remarkable character: as a rule, they cease to grow after the menopause, and in some instances they undergo a marked diminution in size. Some writers are of opinion that they may disappear. This must be a very exceptional phenomenon, hard to prove and very difficult to believe: therefore, as a concession to superstition, it may be described as an event about as rare as the "advent of a comet."

Though fibroids, as a rule, cease to grow after the menopause, it must not be forgotten that they *sometimes take on unusually rapid growth at this period*; and, apart from this, they are often sources of great peril to life by co-existing with other serious diseases of the uterus, tubes, and ovaries; while the very fact that they are apt to diminish in size is occasionally a source of danger. Apart, however, from these considerations, the fibroids are themselves sources of trouble on account of the degenerate and septic changes to which they are liable. It is also very essential to bear in mind that the existence of a fibroid in the uterus has in a very large proportion of cases a malicious influence in delaying the menopause. The uterus has often been removed from patients between the fiftieth and sixtieth years in whom monthly fluxes of blood were as regular as but much more profuse than in women of twenty years. On the other hand, occasionally a woman may have her menopause at the forty-second or forty-fifth year, though a large fibroid is connected with the uterus.

The fact that a fibroid may shrink after the menopause is in itself frequently a source of danger, especially when it is pedunculated, for the tumour may be so big that its size prevents it from tumbling into the pelvis, but after the shrinking consequent on the menopause, such a fibroid may fall into the true pelvis and become impacted. It is a rare complication, but it does happen.

The most frequent and most dangerous alterations in fibroids after the menopause are necrotic and septic changes. During menstrual life fibroids generally enjoy an abundant blood supply, and in some instances they are almost as vascular as naevi. On the occurrence of the menopause, the cessation of the menstruation is accompanied by a remarkable abatement

in the blood supply, and the tumour not only ceases to grow, or even shrinks, but the very fact that its nutritive irrigation, so to speak, is arrested leads to degenerative changes, and the fibroid becomes in many instances a dead, sequestered body, which may become calcified, and so long as septic organisms are denied access it will remain inert. When, from various causes, putrefactive organisms gain access to these essentially dead tumours, the results are often dire in the extreme.

It is far easier to prove that putrefactive organisms obtain access to dead or dying fibroids than to tell how they get to them. There is, however, one mode of access which is undeniable. The fibroids which give rise to most trouble after the menopause are those of the submucous variety, and there seems a strong tendency, when the uterus passes into its resting stage and the fibroid is shrinking and dying, for the organ to attempt the extrusion of the tumour. A careful study of the cases which have come under my observation teaches me that a fair proportion of troublesome post-menopause fibroids have undergone partial extrusion, or the mouth of the womb is widely dilated and facilitates the ingress of germs.

It has already been pointed out that one of the greatest perils which can happen to a woman with a fibroid in her uterus is to become pregnant, but after the forty-fifth year she is beset with a danger of quite another kind—namely, cancer of the corporeal endometrium (see Chapter XXXVII.).

A study of the post-menopause behaviour of uterine fibroids and the perils they entail indicates in no uncertain manner that even in obsolescence they are often mischievous and insidiously lethal.

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CHAPTER XX.

UTERINE FIBROIDS (*Concluded*).

THEIR CLINICAL CHARACTERS AND TREATMENT.

Clinical Characters.—Uterine fibroids, though exceedingly common, are unknown before puberty, and rarely attract attention before the twentieth year; they are most common between the thirtieth and fiftieth years. In a large proportion of patients the earliest indication of the presence of a fibroid in the uterus is excessive menstruation (menorrhagia); this is often the only symptom which leads the patient to seek advice, and on examination a large pelvic tumour may be detected. In many cases there is no obvious enlargement of the uterus; the fibroid, though big enough to cause severe bleeding, is not large enough to be detected until the cavity of the uterus is explored through a dilated cervical canal. In many instances, when the patient seeks advice, the tumour is actually presenting at the mouth of the womb.

Fibroids large enough to rise out of the pelvis usually occupy the hypogastrium, but when stalked they may lie laterally and simulate ovarian tumours. On palpation fibroids may be smooth, but when their surfaces are tuberous it is a valuable sign. Auscultation sometimes furnishes useful evidence, for soft, rapidly growing fibroids often yield a loud hum synchronous with the pulse, like the murmur heard during pregnancy. This venous hum is most frequently detected shortly before the onset of a menstrual period.

On vaginal examination, the tumour may be found closely associated, and often incorporated, with the uterus. When the tumour occupies the cervix, the whole organ feels like a globular body, and the mouth of the womb is indicated by a mere dimple. The diagnosis of a fibroid in the uterus is often rendered difficult by complications such as pregnancy,

uterine, tubal, or even cornual; the co-existence of ovarian cysts and solid tumours; tubal conditions such as hydrosalpinx and pyosalpinx and primary cancer of the Fallopian tube; tumours of the pelvic bones and connective tissue.

When a woman has a tumour suspected to be a fibroid, and there is reason to believe that it is rapidly increasing, it is worth while to remember—

1. *That she may have conceived, so that the enlargement is due to the progress of the pregnancy.*
2. *The tumour may have become septic, or secondary changes may have led to the formation of cyst-like spaces.*
3. *The diagnosis may be erroneous, and the suspected fibroid may be really an ovarian tumour.*
4. *Ovarian tumours and uterine fibroids often co-exist.*
5. *An over-distended bladder has many times been mistaken for a rapidly growing pelvic tumour.*
6. *Hydrosalpinx, pyosalpinx, primary cancer of the tube, and even tubal pregnancy sometimes complicate fibroids.*

Even this list does not exhaust the possibilities, for a *myomatous uterus may become impacted in consequence of conception, and when the impaction is relieved, axial rotation may occur.*

Treatment.—All attempts to cure fibroids by drugs or by means of electricity have been conspicuous failures, so that patients whose lives and usefulness are threatened by these tumours are obliged to seek the aid of surgery.

It is true that fibroids often occupy the uterus for years and cause no trouble, but many give rise to severe bleeding, and place life in great jeopardy. Recurrent bleeding is the most common condition which leads women with fibroids to seek medical advice. Pelvic pain, due to pressure of the tumour on the urethra, bladder, or bowel is common, and inimical to health. Inflammation (infection) and gangrene are dangerous conditions. Fibroids, complicated with tubal and ovarian disease, demand careful attention. The chief indications for surgical interference may be summarised thus:—

1 A stalked tumour protruding at the mouth of the

womb is readily detached by seizing it with a volsella and twisting the stalk; or the pedicle may be divided by scissors.

2. The presence of a submucous fibroid is often conjectural; then the cervical canal is dilated and the interior of the uterus explored with the finger. Small fibroids thus discovered are easily removed. Larger tumours require enucleation.

3. Submucous fibroids with a diameter exceeding 5 to 6 centimetres usually require removal of the uterus (hysterectomy).

There is a consensus of opinion among surgeons and gynæcologists that hysterectomy for fibroids may be recommended in the following circumstances:

(1) When the fibroids cause profuse and long-continuing menorrhagia.

(2) When the fibroid is septic and gangrenous.

(3) Impacted and irreducible fibroids causing pain and retention of urine.

(4) Fibroids which are growing rapidly and those which are degenerate and softened (cystic).

(5) Cervix fibroids too large to permit of removal by the vagina.

(6) Fibroids complicating pregnancy, delivery and puerpery in certain circumstances.

It is admitted by most writers that the ideal method of dealing with fibroids requiring removal by coeliotomy is to remove them either by ligature or by enucleation, and in certain circumstances by actually opening the uterine cavity, extracting the tumour, and then suturing the incision as after a Cæsarean section, an operation to which I applied the term *hysterotomy*. In actual practice this ideal operation of removing the tumours and leaving the uterus and ovaries intact can only be carried out in a small proportion of cases, probably in less than 10 per cent., and it is fair to state that enucleation and hysterotomy are often more troublesome and serious operations than hysterectomy: also the preservation of the uterus is not always an advantage to the patient.

When a woman is submitted to hysterectomy for fibroids we can assure her that the tumours will not recur, but after

a myomectomy or enucleation performed during the productive period of life we cannot give her this assurance, for she may have in her uterus many "seedlings" or what I prefer to call "latent fibroids," and one or several of these may grow into formidable tumours.

In the case of a young woman contemplating matrimony or a married woman anxious for offspring, myomectomy is a justifiable operation. Experience, however, teaches this stern lesson: *After the enucleation of a fibroid in the procreative period of life a woman is twenty times more likely to grow more fibroids in her womb than to conceive successfully.*

Another legitimate class of case in which myomectomy is a very safe undertaking is in patients at, or after the menopause where a stalked fibroid gives trouble by twisting its pedicle, or by shrinking to such a size that it falls into the true pelvis and becomes impacted: or more rarely, the pedicle of such a tumour may entangle a loop of small intestine and obstruct it.

There are two methods of removing the uterus in the radical treatment of fibroids, namely, Vaginal Hysterectomy and Abdominal Hysterectomy.

Vaginal hysterectomy is only applicable when the tumour is small or septic.

There are two methods of removing the uterus by the abdominal route. One known as subtotal hysterectomy, in which the body and a variable portion of its neck is removed; and total hysterectomy, in which the body and neck of the uterus are completely removed.

Subtotal hysterectomy is a simpler operation than removal of the whole uterus. When carefully performed, within a few weeks of the operation the stump is movable, and the vaginal vault free and undamaged, and the condition of the parts is such that by digital examination or inspection it would be difficult to determine that the patient had lost her uterus. The disadvantage urged against this method is the liability of the stump to be attacked by cancer.

Total hysterectomy is a severe procedure, and attended often with more shock than the subtotal operation: it is also

attended with risk of injury to the vesical segments of the ureters.

Experience teaches that subtotal hysterectomy in spinsters or barren married women, when the uterus has a long narrow neck and an undilated cervical canal, is as safe as any major operation in surgery.

Total hysterectomy should, as a rule, be reserved for those who have had children, and in whom the cervical canal is patulous, perhaps septic, and in many cases large and hard, or large and spongy. If there be the least suspicion of malignancy associated with the tumour, then complete removal of the cervix with the uterus is imperative.

Group II.

TUMOUR-DISEASES OF TEETH.

CHAPTER XXI.

ODONTOMATA AND DENTAL CYSTS.

An **Odontoma** is a tumour composed of dental tissues in varying proportions and different degrees of development, arising from teeth-germs, or teeth still in the process of growth.

The species of this genus are determined according to the part of the tooth-germ concerned in their formation.

1. Epithelial odontoma: from the enamel organ.
2. Follicular odontoma
3. Fibrous odontoma
4. Cementoma
5. Compound follicular odontoma

   } From the tooth-follicle.

6. Radicular odontoma: from the papilla.
7. Composite odontoma: from the whole germ.

1. **Epithelial Odontomata.**—These tumours occur, as a rule, in the mandible, but they have been observed in the maxilla. They have a fairly firm capsule, and in section display a congeries of cysts of various shapes and sizes; but the loculi rarely exceed 2 cm. in diameter. The cysts are separated by thin fibrous septa, sometimes ossified. The cavities contain brown mucoid fluid. The growing portions of the tumour have a reddish tint (Fig. 124).

Histologically, an epithelial odontoma consists of branching and anastomosing columns of epithelium, portions of which form alveoli (Fig. 125). The cells occupying the alveoli vary; the outer layer may be columnar, whilst the central

cells degenerate and give rise to tissue resembling the stellate reticulum of an enamel organ.

These tumours have been investigated by Eve (who gave them the name of multilocular cystic epithelial tumours) and by Falckson and Bryck. Some of these tumours, as those observers think, may arise in persistent vestiges of enamel organs.

A careful re-examination of a few of the specimens described as multilocular cystic epithelial tumours of the jaws, and a study of the descriptions of others, especially those occurring in individuals past middle life, has satisfied me that many of them were endotheliomata (see p. 175): some of the most typical examples of these tumours arise in the

Fig. 121. Epithelial odontoma. (*Nat. size.*)

gums. It will be instructive from this point of view to compare Fig. 125 with Fig. 95 on p. 177.

This view of the matter is confirmed by the fact that some of these cystic tumours of the jaw supposed to arise in belated rudiments, or vestiges, of enamel-organs display malignancy, inasmuch as they recur after removal. Moreover, these tumours occur in individuals at, or after, mid-life, whereas if they arise in epithelial vestiges of the enamel organ they ought, theoretically, to be met with in the young, which is not the case. A careful perusal of the clinical histories of the cases collected by Heath convinces me that in the majority of instances these tumours arise in connection with the mucous membranes of the jaws.

2. **Follicular Odontomata.**—This species comprises those swellings often called dentigerous cysts, a term which has come to be used so very loosely that it should be discarded

in the necessity for precision. Follicular odontomata arise commonly in connection with teeth of the permanent set, and especially with the molars: sometimes they attain large dimensions, and produce great deformity, especially when they arise in the upper jaws and happen to be bilateral. Rarely follicular odontomata occur in connection with supernumerary teeth.

The tumour consists of a wall of varying thickness, which represents an expanded tooth-follicle: in some cases it is thin and crepitant, in others it may be 1 cm. thick. The cavity of the cyst usually contains viscid fluid and the crown or the

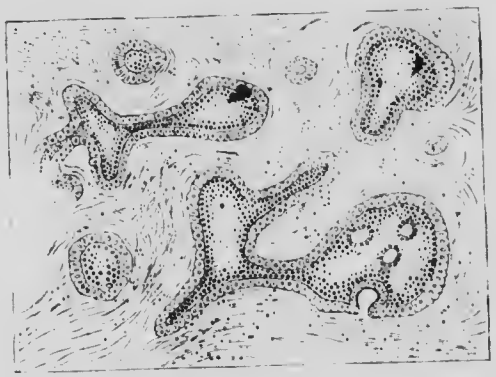

Fig. 125. – Microscopical characters of an epithelial odontoma.

root of an imperfectly developed tooth: occasionally the tooth is loose in the follicle, sometimes inverted, and often its root is truncated (Figs. 126 and 127): exceptionally the tooth is absent, or represented by an ill-shaped denticle. The walls of the cyst always contain calcific or osseous matter: the amount varies considerably. Some observers have noted the presence of an epithelial lining to the inner walls of follicular odontomata: it is a point which requires further elucidation. In two recent specimens I failed to find an epithelial lining.

These tumours are not unknown in other mammals; I have seen them in sheep, pigs, and porcupines. In sheep they are common, and generally affect the incisors, and are thus limited to the mandible: as a rule they are bilateral.

The amount of fluid in a follicular odontoma varies, and the size of the tumour depends in the main upon this. Occa-

sionally the fluid may measure as much as two ounces, and this may lead to the wide separation of the inner and outer plates of the body of the mandible, and the odontoma may occupy the whole length of the bone. (Fearn's case preserved

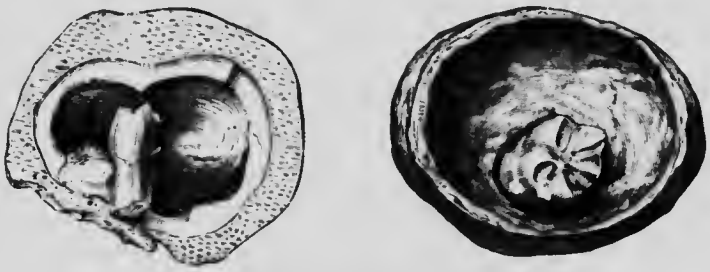

Fig. 126.—Follicular odontomata from the mandible.

in the museum of the Royal College of Surgeons is a good example of this condition).

Hopewell Smith found that a tooth from a follicular odontoma had no Nasmyth's membrane, and suggests that the fluid within these tumours is probably formed from the degeneration and liquefaction of the stellate reticulum.

Tomes has suggested that this species of odontoma is

Fig. 127.—Follicular odontoma from the right half of a mandible: removed from a boy aged 14 years by Wormald, 1850. (*Museum of the Royal College of Surgeons.*)

probably due to the excessive formation around a retained tooth, between it and the wall of the follicle, of a fluid which is normally present after the complete development of a tooth. Many teeth are retained without forming a follicular

odontoma, so that something beyond mere retention of a tooth is necessary for the production of such odontomata.

3. **Fibrous Odontomata.**—In a developing tooth, a portion of the connective tissue in which it is embedded is found to be denser and more vascular than the rest; it also presents a fibrillar arrangement. This condensed tissue is known as the tooth-sac, and when fully developed presents an outer firm wall and an inner looser layer of tissue. At the root of the tooth the follicle-wall blends with the dentine papilla, and is indistinguishable from it. Before the tooth cuts the gum it is completely enclosed within this capsule. Under certain conditions this capsule becomes greatly increased in thickness, and so thoroughly encysts the tooth that it is never erupted

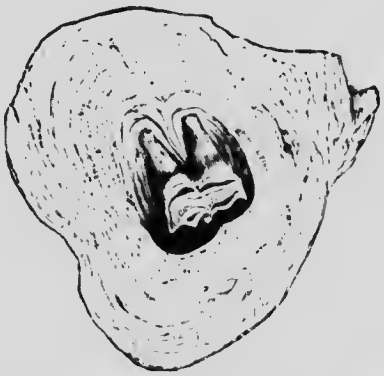

Fig. 128.—Fibrous odontoma from a goat. (*Nat. size.*)

(Fig. 128). Such thickened capsules are mistaken for fibrous tumours, especially if the tooth be small and ill-developed. Under the microscope they present a laminated appearance, with strata of calcareous matter. To these, the term fibrous odontomata may be applied. They are more common in ruminants than in other mammals, and are especially frequent in goats. As a rule they are multiple, four being by no means an unusual number. They occur in marsupials, bears, and lions, as well as in man.

There is good reason for the belief that rickets is responsible for some of these thickened capsules. Certainly, in some of the most typical examples which have been observed in human beings, the subjects were rickety children; the

bilateral tumours, in some cases, being erroneously described as myeloid sarcomata.

4. **Cementomata.**—When the capsule of a tooth becomes enlarged, as in the specimens just considered, and these thick capsules ossify, the tooth will become embedded in a mass of cementum. To this form of odontoma the name cementoma may be applied. Tumours of this character occur most frequently in horses, and sometimes attain a large size. Broca has described and figured specimens from horses. Tomes has described one which weighed ten ounces, and I have given an

Fig. 129.—Cementoma from a horse. (*Half nat. size.*)
(*Museum of the Royal College of Surgeons.*)

account of another which weighed twenty-five ounces (Fig. 129). When divided, three teeth could be made out, embedded in cementum. The periphery of the tumour was cautiously decalcified in hydrochloric acid, and sections were prepared for the microscope. The structure of the decalcified mass was very instructive, for the periphery of the tumour exhibited the laminated disposition seen in fibrous odontomes.

The largest cementoma from a horse known to me is preserved in the museum of the Royal Veterinary College, London: it weighs seventy ounces, and though excessively dense, is nevertheless very vascular. Its chief structural peculiarity is the presence, in enormous numbers, of large, richly branched lacunæ.

I have been able to study one tumour from man with the characters of a cementoma. The patient was under the care of Mr. W. A. Maggs, at Guy's Hospital: the tumour occupied the position of the right lower molar, and a rudimentary tooth (denticle) is seen on the tumour. The boy presented unmistakable evidence of rickets (Fig. 130).

5. **Compound Follicular Odontomata.**—If the thickened capsule ossifies sporadically instead of uniformly a curious condition is brought about, for the tumour will then contain a number of small fragments of cementum, or dentine, or even ill-shaped teeth (denticles) composed of three dental elements—cementum, dentine, and enamel. The number of teeth or denticles in such tumours varies greatly, and may reach a total of four hundred.

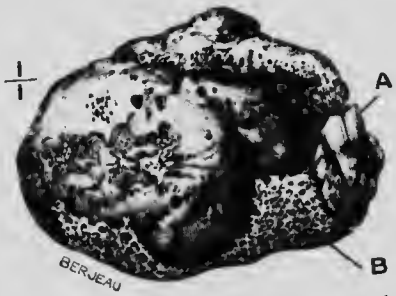

Fig. 130. Odontoma (cementoma) from the mandible of a rickety youth aged 19 years. A, denticle; B, portion of the outer wall of the jaw.

Tumours of this character have been described in the human subject by several observers. Amongst the most noteworthy are the following:—

Tellander, of Stockholm, met with a case in a woman aged twenty-seven years. The right upper first molar, biens-pids, and canine of the permanent set had not erupted, but the spot where these teeth should have been was occupied by a hard, painless enlargement, which the patient had noticed since the age of twelve years. Subsequently this swelling was found to contain minute teeth. There were nine single teeth, each one perfect in itself, having a conical root with a conical crown, tipped with enamel; also six masses built up of adherent single teeth. The denticles presented the usual characters of supernumerary teeth (Fig.

131). About a year afterwards a tooth appeared in the spot from which this host of teeth was removed.

A similar case has been recorded by Sir John Tomes, the details of which were communicated to him by Mr Mathias, on medical service in India. A Hindoo, aged twenty, had a large tumour in his mouth containing a

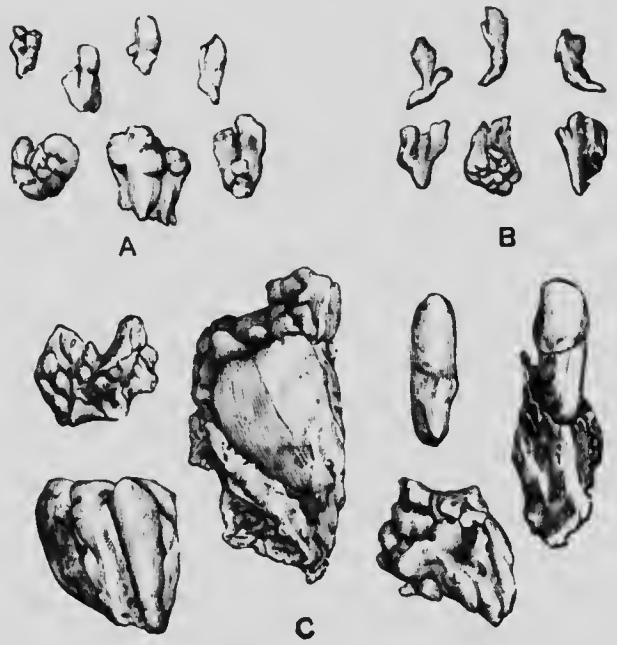

Fig. 131.—A, Denticles from Tellander's case. Total number, twenty-eight.
B, ,, from Windle's case. Total number, forty.
C, ,, from Mathias's case. Total number, fifteen.

number of ill-formed teeth: fifteen masses of supernumerary teeth and bone were removed from it. The soft parts rapidly healed, the deformity disappeared, and subsequently the only peculiarity noticeable was the absence of the central and lateral incisors. The canines occupied their usual position.

A third example of this remarkable condition has been recorded by Windle and Humphreys. The tumour was found in the mouth of a boy aged ten years; neither the deciduous nor the permanent right lateral incisor or canine had erupted. The space thus unoccupied was filled by a

tumour with dense unyielding walls. From this tumour forty small denticles of curious and irregular forms were removed.

Hildebrand and De Roaldes have observed similar cases. Logan reported an example from the maxilla of a horse containing four hundred denticles; and in a Himalayan goat the writer found one of these singular tumours in each upper jaw containing nearly three hundred denticles. This

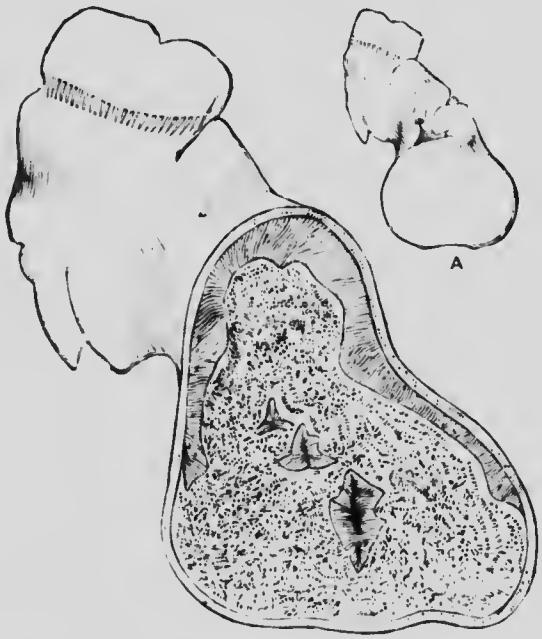

Fig. 132.—Radicular odontoma from human subject. A represents the natural size of the specimen. (*After Salter.*)

specimen is preserved in the Museum of the Royal College of Surgeons.

6. **Radicular Odontomata.**—This term is applied to odontomata which arise after the crown of the tooth has been completed, and while the roots are in the process of formation. As the crown of the tooth, when once formed, is unalterable, it naturally follows that should the root develop an odontoma, enamel cannot enter into its composition; the tumour would consist of dentine and cementum in varying

proportions, these two tissues being the result of the activity of the papilla.

As a typical radicular odontoma we may choose the well-known specimen described by Salter, Fig. 132, in which the

Fig. 133.—Radicular odontoma. (*Nat. Size.*)
(*After Sir John Tomes.*)

tumour is clearly connected with the roots. The outer layer of the odontoma is composed of cementum; within this is a layer of dentine, deficient in the lower part of the tumour, and inside this is a nucleus of calcified pulp.

Mr. Hare removed from the upper jaw of a man aged forty-one, the odontoma represented in Fig. 133. This specimen was originally described by Sir John Tomes in 1863, and

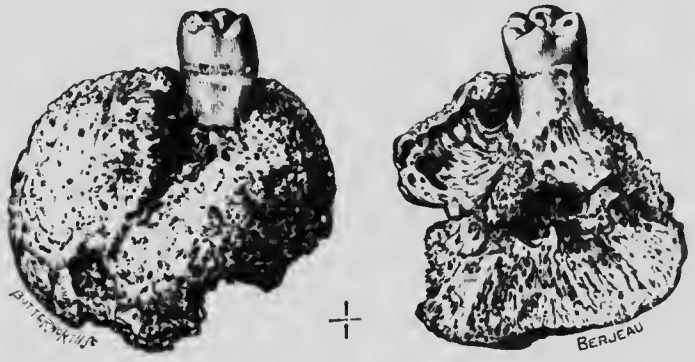

Fig. 134.—A. Odontoma surrounding the second mandibular molar of a boy aged 15 years.

B. The odontoma in section, showing the relation of the roots to the tumour tissue.

redescribed by Mr. Charles Tomes in 1872. The mass is invested by cementum; inside this casing is a shell of dentine; the tubules radiate outwards and are disposed with some regularity: this dentine was deficient at the distal end

of the tumour; its interior was filled with an ill-defined osseous material.

The tumour represented in Fig 134 I removed from a boy fifteen years of age. An accurate diagnosis was made

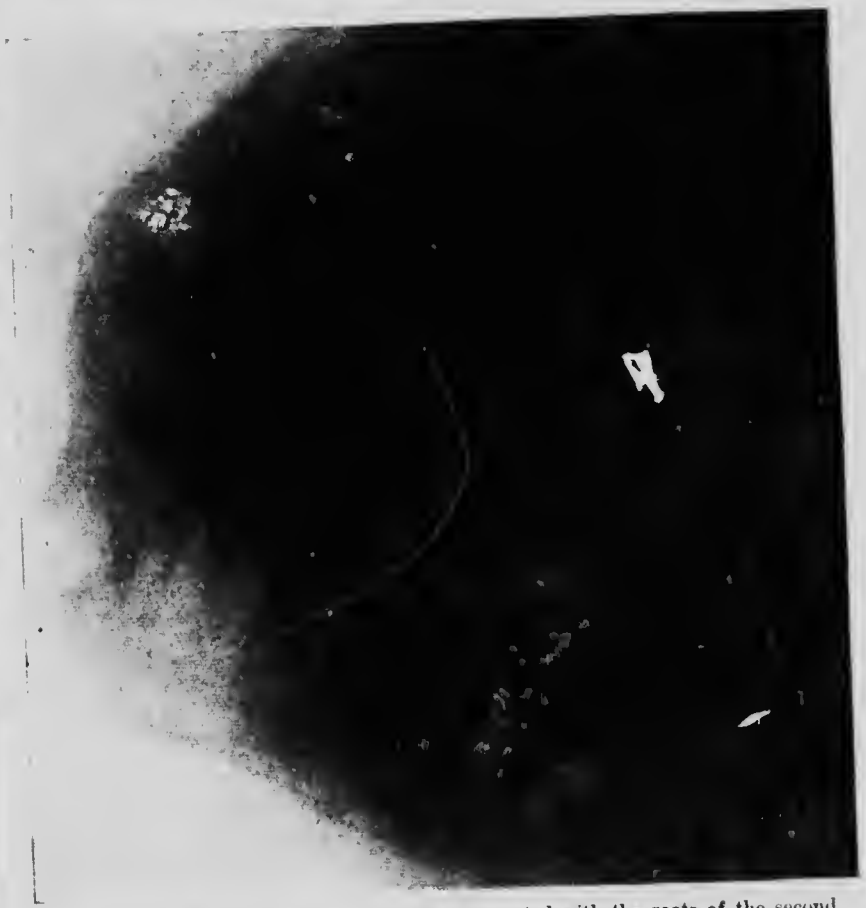

Fig. 135.—Skiagram showing an odontoma connected with the roots of the second left mandibular molar, in a boy aged 15 years.

before the operation with the assistance of the X-rays (Fig. 135). In this instance the tumour consisted of bone resembling that which forms the alveolar borders of the jaws, embedded in fibrous tissue. As shown in the drawings, the second left mandibular molar below the neck of the tooth seems to expand and become gradually incorporated with the tissue proper of the odontoma.

It is probable that some radicular odontomata in man are due to inflammatory changes: for example: the tumour-like swelling enveloping the roots of the two molars (Fig. 136) supports this view. The roots are embedded in an ossific ball

Fig. 136.—Ossific ball in which the roots of two molars are embedded. The crown of one tooth is carious. A. The tumour entire. B. In section. (*Museum of the Middlesex Hospital.*)

which microscopically resembles a calcified and partially ossified inflammatory exudate. The crown of one of the teeth is carious, and the pulp chamber widely exposed. This tumour was removed by Mr. Murray from the mandible of a youth aged twenty-one years.

The most remarkable radicular odontoma that has come under my notice is depicted in Fig. 137. This tooth was

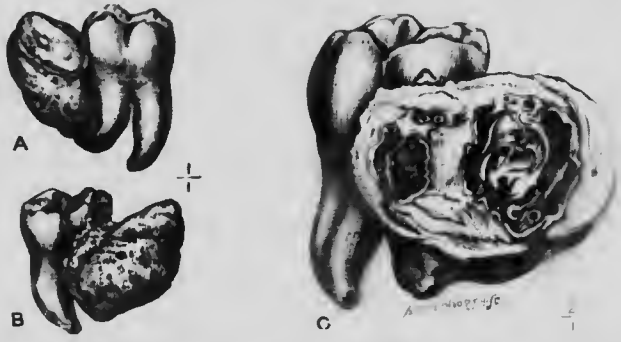

Fig. 137.—Second right mandibular molar of a Chinaman aged 19 years, with tumour possessing the characters of a composite odontoma.
A and B. The tooth of natural size.
C. The tooth enlarged and the tumour shown in section.

extracted "with no little difficulty" from a Chinese student aged nineteen, by Mr. Davenport (Hankow): it had caused trouble until two months before the extraction. There was

swelling around the tooth supposed to be due to an abscess. On a casual examination the lump on the root of this second lower molar appears as a radicular odontoma, but on section it presents the complex structure of a composite odontoma.

Fig. 138.—Left lower [illegible] molar with a large radicular odontoma connected with the [illegible] (Y. y.c.)

The clinical report contains the significant statement that there were no signs of the lower permanent tooth.

Radicular odontomata have been observed in the marmot, guinea-pig, agouti and the boar (Figs. 139), and in elephants.

It is probable that many, perhaps most, of these so-called tusks in boars and elephants and the

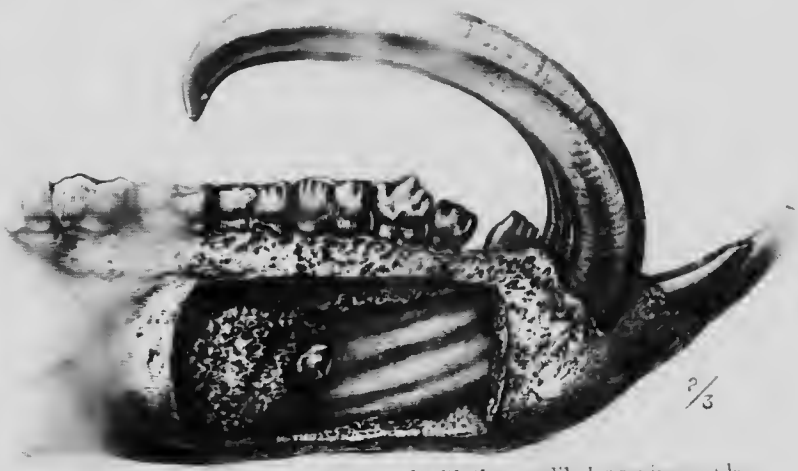

Fig. —Radicular odontoma connected with the mandibular canine [illegible]

incisors of rodents are due to inflammatory changes in the pulps.

7. **Composite Odontomata.**—This is a convenient term to apply to those hard tooth tumours which bear little or no

resemblance in shape to teeth, but occur in the jaws, and consist of a disordered conglomeration of enamel, dentine, and cementum. Such odontomata may be considered as arising from an abnormal growth of all the elements of a tooth-germ—enamel-organ, papilla, and follicle.

Not only is this species of odontomata composite in that the tumours comprised in it originate from all the elements of a tooth-germ, but they are composite in another sense: many of these tumours are composed of two or more tooth-germs indiscriminately fused. But they differ from the

Fig. 140.—Composite odontoma. (*Nat. size.*) (*After Forget.*)

cementomata containing two or more teeth in the fact that the various parts of the teeth composing the mass are indistinguishably mixed, whereas the individual teeth implicated in a cementoma can be clearly defined.

Forget's classical case belongs to this species. The patient was twenty years old, but the disease had been noticed since the age of five years. Behind the first bicuspid no teeth were seen, but the jaw as far back as the ramus was the seat of a smooth, unyielding tumour (Fig. 140), which consisted mainly of dentine; its surface was in places covered with enamel.

It was long believed that composite odontomata occurred only in the mandible: now we know more about them it is clear not only that they arise as frequently in the maxillæ,

but that they attain a far larger size in the upper than in the lower jaw. In the mandible these tumours may attain a large size: of these the largest is shown in Fig. 141. It was removed by Mr. Brothers, of Cape Town, from a Kaffir boy aged fourteen years. The parents of the boy stated that they "noticed a swelling when the boy was six months old." He ran about the village with part of the odontoma sticking out of his mouth: it was extracted by a strong elevator. There was much swelling, and suppuration, and the breath was very fœtid (Morton Smale).

Many large odontomata removed from the antrum have

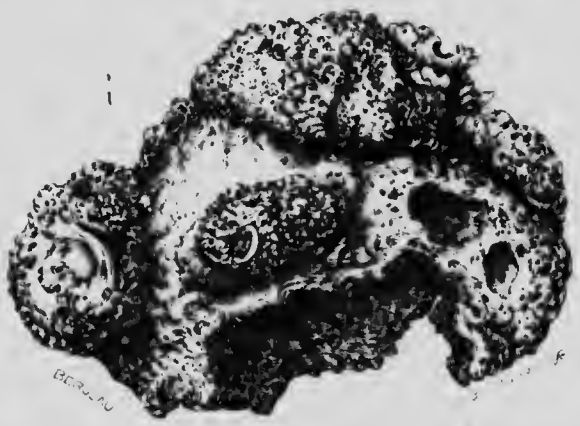

Fig. 141.—Composite odontoma from the mandible of a Kaffir boy 14 years of age (850 grains). (*Museum, Royal Dental Hospital, London.*)

been described as exostoses. Thus M. Michon removed from the antrum of a Frenchman, aged nineteen years, at the Hôpital de la Pitié (without an anæsthetic) an odontoma weighing 1,080 grains. The operation, which may be described as a "surgical struggle," lasted upwards of an hour and a quarter. The tumour is described as an exostosis, but fortunately Michon's account is accompanied by some excellent figures which show clearly enough that the tumour is of dental origin. The cut surface exhibited a laminated disposition. Microscopically it was composed of tissue presenting many parallel tubules having the appearance of exaggerated dentinal tubes.

A tumour almost parallel with this has been described by Dr. T. Ihka, by whom it was removed from a Mahome-

dan woman, aged twenty-six, at Monghyr, Bengal. The woman had for six years suffered from a muco-purulent discharge from the right nostril, and was now anxious for relief. The case was regarded as one of necrosis, but after a "surgical struggle" lasting nearly an hour (without chloroform), the tumour (Fig. 142) was withdrawn from the antrum. It had no connection with the surrounding tissues. The tumour, which was regarded as an exostosis, was submitted to a committee of the Pathological Society. In its report the committee states that the bone tissue differs in character from that ordinarily seen in exostoses. An examination of the tumour, which is preserved in St. George's

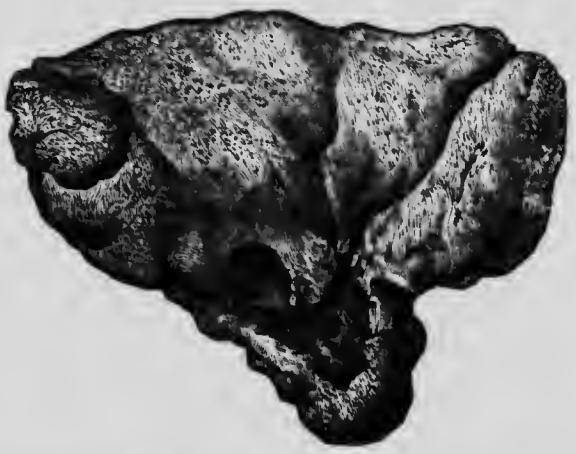

Fig. 142.—Composite odontoma from the upper jaw. (*Nat. size.*)

Hospital museum, and inspection of the figures illustrating the report mentioned, show clearly enough that it is a composite odontoma. Dr. Duka, in his account of the case, states that Dr. Allen Webb was of opinion that the nucleus was formed by a tooth-follicle escaping into the antrum of Highmore. This was a guess, but one not far short of the truth.

The largest odontoma known to have grown in the human antrum, and which Hilton described as an exostosis, is preserved in the museum of Guy's Hospital (Fig. 144). It has an extraordinary clinical history:—

A man, aged thirty-six years, had a large osseous tumour occupying the antrum. The pressure of this

Fig. 143.—Group of odontomata.

A. Upper jaw (Brock).
B. Lower jaw (Rushton Parker).
C. Upper jaw (Jordan Lloyd).
D. Lower jaw (Windle).
E. Radicular odontoma (J. G. Turner).

tumour had caused the front wall of the antrum, with the integument and soft tissues covering it, to slough. The trouble was first noticed thirteen years before: as the cheek enlarged the eyeball became displaced and finally burst. For a long time the surface of the tumour was exposed, the suppuration being copious, and occasionally pieces of bone irregular in shape came away: at last, to the man's astonishment, the bony mass dropped out, leaving an enormous hole

Fig. 144.—Large odontoma which was spontaneously shed from the antrum; weight, nearly fifteen ounces. (*Museum, Guy's Hospital.*)

in his face. It weighed nearly fifteen ounces, and measured 27.5 cm. (11″) in its greatest circumference. I have had an opportunity of investigating this tumour; it is remarkably hard, presents on section an ivory-like surface, and, on close scrutiny, a number of closely-arranged concentric laminæ (Fig. 145). Sections ground thin and examined under the microscope show large numbers of lacunæ and canaliculi arranged in a very regular manner.

On looking over a long series of composite odontomata it is curious to find the great variety in shape as well as in the

disposition of the hard dental tissues which they present. The specimen represented in Fig. 146 is one of the oddest in this respect, for it in no way recalls in its shape a tooth, yet the whole of its convex surface, for it is shell-like in form, is covered with well-marked enamel-covered projections resembling small supernumerary cusps on teeth. This tumour came from an old woman, an inmate of a workhouse: she had been troubled with it very many years, and one day she "spat it out."

Clinical Characters.—The germ of any permanent tooth may develop into an odontoma, and occasionally two or more teeth may be involved in the one tumour. Odontomata occur with equal frequency in the upper and lower jaws, and the

Fig. 145.—Section of tumour, Fig. 141, showing concentric lamination.

follicular species is very apt to be multiple, and four have been found concurrently in the jaws of the same patient. The composite species ranks next in frequency with follicular odontomata, and in the upper jaw an odontoma may invade the antrum and attain the size of a child's fist: in the mandible they rarely exceed a dove's egg in size, but the specimen represented in Fig. 141 shows that in this situation an odontoma may attain a good size.

There is a clinical point in the natural history of odontomata of some importance. A careful examination of the clinical history shows that in nearly all cases the tumour has remained quiescent, and then there comes a period in which, like teeth, they seem to erupt and make their way above the gum, and cause very often profound constitutional disturb-

ance, mainly of a septic character. In some reported cases it is stated that the patients have been so ill as to be near death. This phenomenon usually happens between the twentieth and the twenty-fifth years. In a fair number of cases relief has come to the patient, and the illness has ended by the odontoma loosening spontaneously. In several instances it is said that the patient "spat it out." This happened with the specimens, Figs. 143D and 146. One of the largest odontomata known, after producing hideous deformity of the face and sloughing of the cheek, fell out of its own accord. The large odontoma, Fig. 141, caused the

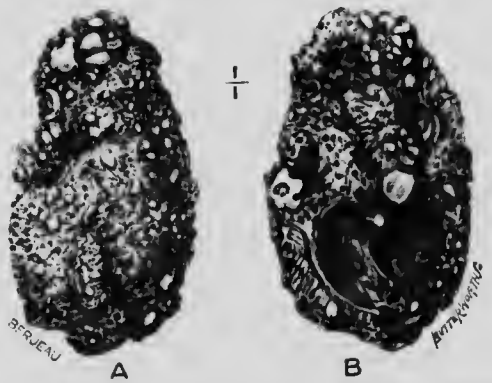

Fig. 116.—Composite odontoma from the mandible: A the upper, B the lower view. (*Museum of the Middlesex Hospital.*)

boy so little inconvenience that he ran about a village with part of the tumour sticking out of his mouth.

The diagnosis of these tumours has been a matter of great difficulty in the past. In many the swelling has been regarded as a myeloma, or a sarcoma, but in the majority of cases, especially where there has been free suppuration around the odontoma, it has been regarded as a piece of dead bone. The X-rays have been serviceable in enabling a correct diagnosis to be made (see Fig. 135).

Treatment.—A study of the literature relating to the treatment of odontomata is very instructive, because it reveals that operations unnecessarily severe have been undertaken in ignorance of the nature of the disease by surgeons of high reputation and wide experience. In several instances it is known that a great portion of the mandible has been

excised under the impression that the tumour was malignant in nature. In some very large odontomata of the upper jaw the tumour has been removed without an anæsthetic, the procedure being described, in the words of the operator, as "a surgical struggle" (Duka, Michon). In some of the cases dentists succeeded in removing the odontoma with forceps, thinking they were dealing with unerupted (buried) teeth (Davenport). In others, the nature of the tumour has been suspected, and in the course of its excision

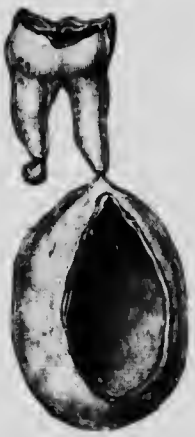

Fig. 117.—Dental cysts at the roots of a dead lower molar.

the mandible has been broken and remained permanently ununited (Fig. 130).

In the case of a tumour of the jaw, the nature of which is doubtful, particularly in a young adult, it is incumbent on the surgeon to satisfy himself before proceeding to excise a portion of the mandible or maxilla that the growth is not an odontoma, for this kind of tumour only requires enucleation. In the case of a follicular odontoma it is very essential completely to remove the sac.

Dental Cysts.—It occasionally happens in extracting permanent teeth that a small fibrous bag is found at the apex of the root, often no larger than an apple pip, though sometimes it may be as big as a bantam's egg, filled with fluid, and often containing crystals of cholesterin. These sacs, or dental cysts, occur in connection with the dead roots of

mandibular and maxillary teeth, especially molars and premolars. They sometimes attain a considerable size in the upper jaw when they invade the antrum, and some of these cysts are sufficiently large to simulate an abscess of that cavity Dental cysts are often bilateral, and occasionally multiple.

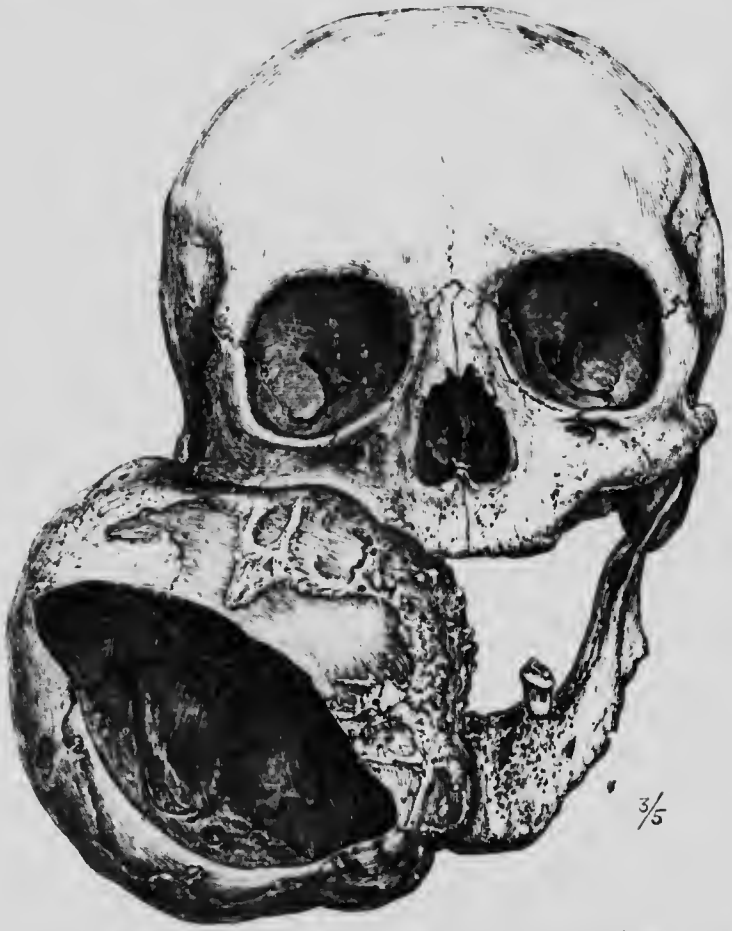

Fig. 148. - Large cyst connected with the mandible; it is probably an unusually large dental cyst. (*Museum, St. George's Hospital.*)

The constant association of these cysts with the dead roots of permanent teeth has led many observers to regard them as pus sacs with thick, fibrous walls. Mr. J. G. Turner has carefully investigated their structure, and demonstrated the existence of an epithelial lining in many of these

cysts. He believes that they arise in the "rests" detected by Malassez and known as paradental epithelial remnants. They are derived from a prolongation of the enamel organ which precedes and determines the formation and shape of the dentine and the root of the tooth

I have had several dental cysts examined microscopically, and can confirm Turner's observation that they possess an epithelial lining.

The restriction of these cysts to the roots of the permanent teeth is explained by the fact that the roots of temporary teeth as well as their alveoli are absorbed.

The majority of dental cysts are met with accidentally in extracting dead permanent teeth or their roots. Large specimens, however, resemble in their clinical signs tumours of the jaws or antrum (Fig. 148). Even cysts of the size of a dove's egg in relation with the lower molars and premolars will so expand the outer plate of the mandible as to yield parchment-crackling on being firmly pressed with the finger. When a painless smooth tumour of the jaw is associated with a carious tooth, especially of long standing, a dental cyst should be borne in mind. The association of these cysts with carious and dead teeth is sufficient to prevent them from being mistaken for follicular odontomata.

Treatment.—The roots must be extracted, and the cyst wall thoroughly enucleated and the cavity stuffed with sterilised gauze, and allowed to granulate. If any part of the cyst wall be allowed to remain it will lead to a persistent and usually troublesome sinus.

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Group III.

EPITHELIAL TUMOURS.

CHAPTER XXII.

PAPILLOMATA (WARTS).

In the group now to be considered, epithelium is not only present, but is the essential and distinguishing feature. Epithelium is so disposed in the bodies of complex animals as to serve many functions; in some situations it acts as a protective—*e.g.*, the epidermis, where it becomes modified into hair, nail, horn, or into the hardest of all animal tissues—enamel; in others, epithelial cells dip into the underlying connecting tissue to form secreting glands; some of them are simple—*e.g.*, the tubular glands of the intestine; others are very complex—*e.g.*, the liver, mamma, and kidney. Whether a gland is simple or complex, the principle of construction is identical—namely, narrow channels lined with epithelium, resting upon a connective-tissue base, in which blood-vessels, lymphatics, and nerves ramify.

Each epithelial recess of a gland is known as the acinus, and each acinus is in communication with a free surface, either directly by its own duct, as in the case of sebaceous and mucous glands, or indirectly by means of a number of main ducts, as in the case of the mamma; or by a common duct, as in the pancreas. To this rule there are three notable exceptions: the thyroid gland, the pituitary body, and the ovary. It is important to bear in mind the fact that, with the three exceptions mentioned, secreting glands are in direct communication with free surfaces, and are therefore accessible to all kinds of micro-organisms.

The various members of the epithelial group of tumours

fall readily into three genera:—1, Papillomata (warts); 2, Adenoma; 3, Carcinoma (cancer).

PAPILLOMATA.

A **papilloma** or **wart** consists of an axis of fibrous tissue, containing blood-vessels, surmounted by epithelium, projecting from an epithelial surface: it may be simple, and present a uniform surface, or be so covered with secondary processes as to look like a mulberry. When the processes are long the papilloma has a villous appearance.

Warts are most common on the skin, but they also arise from mucous surfaces covered with squamous epithelium. They occur singly or in multiples; occasionally they are thickly crowded on a restricted area of the skin, and form a wart-field. Warts are rarely painful unless irritated, when they are apt to ulcerate and bleed. Crops of warts are often seen on the hands of children. They are common in the region of the anus, vagina, and glans penis when these parts are irritated by foul discharges, especially those of gonorrhœal origin. A curious feature of multiple warts is that they sometimes appear on the hands or scalp almost suddenly, and after persisting many weeks, or perhaps months, disappear as if by magic. When warts are thickly crowded upon a limited area of skin—as, for example, the glans penis—they may be mistaken for a more serious disease, such as warty carcinoma. When warts appear in great number, they are due to local infection by micro-organisms.

Skin warts are overgrown papillæ, and on section the epithelium will be found to pass from one papilla to another in an unbroken line without invading the fibrous framework.

A solitary wart may occur on any skin-covered surface and persist. A wart of this character sometimes attains the size of a walnut, and in some cases is mottled with black pigment. Such warts, late in life, may become the starting-points of melanomata. Occasionally one or two sparse hairs may be detected on a wart, and some fun is made out of this fact by Cressida when her uncle Pandarus says concerning the glabrous chin of Troilus:—

"And she takes upon her to spy a white hair on his chin."

Cressida replies:—

"Alas, poor chin! Many a wart is richer."

Act I., Scene 2.

Solitary warts sometimes grow rapidly, and become so large that they are apt to be mistaken for malignant tumours. They are red, like the comb of a cock, and are smeared with purulent material, and sometimes become

Fig. 149.—Horn which grew from a wart on the cheek of a very old Welsh woman: it measured 21 cm. along its greater curve.

abominably fœtid. Billroth drew attention to large, rapidly growing tumours of this kind arising in soft warts of the face, and termed them plexiform sarcomata (see also McCarthy and Bland-Sutton).

Warts growing from the skin are covered with squamous epithelium, and the surface cells are liable to be transformed into horny material, and form what are called cutaneous horns. Some of these wart-horns have attained almost fabulous dimensions (Fig. 149). Warts are by no means uncommon in domesticated animals. They are frequent on the penis of horses and bulls, the lips of lambs, and the

pads on the feet of dogs and cats and cat-like mammals (*Felidæ*).

Warts similar in structure to those of the skin occur on mucous membranes with a covering of squamous epithelium, such as the lips, buccal aspect of the cheeks, vestibule of the nose, and the larynx. The œsophagus of the ox is occasionally the seat of a multitude of dendritic warts.

Laryngeal Warts.—In the larynx, warts most commonly spring from the mucous membrane covering the true cords;

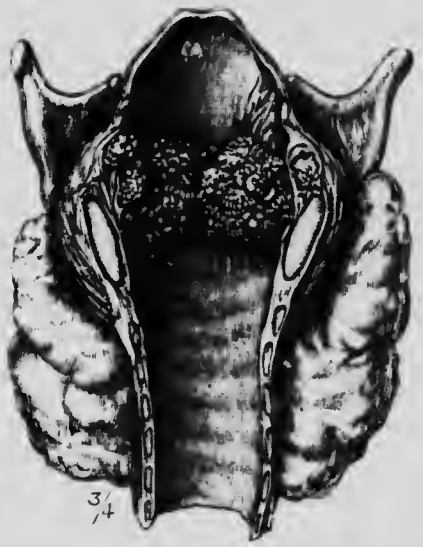

Fig. 150.—Larynx of a child opened posteriorly; it is full of warts. The child died from suffocation.

frequently they grow immediately beneath the cords, and a not uncommon situation is immediately beneath the point of attachment of the vocal cords to the thyroid cartilage. Exceptionally a large mulberry-like wart has been detected growing from the floor of the sinus pyriformis. In number laryngeal warts vary greatly. Often one is present; in other cases ten or more will be found. In size there is great difference; some warts are not larger than the head of a pin; they rarely exceed the dimensions of a small cherry, and as a rule they are no bigger than split peas. The warts may be sessile or pedunculated; in the latter case they sometimes possess great mobility, and get nipped between the vocal cords and

give rise to urgent dyspnœa, which occasionally ends in suffocation (Fig. 150). In colour they are of a delicate pink, sometimes of a whitish tint resembling that of the healthy cords. Hæmorrhage into their substance causes them to assume a deep red tint.

Laryngeal warts occur in children and in adults. A curious feature connected with them in children is their disappearance after tracheotomy. This is similar to the sudden manner in which warts on the skin sometimes vanish.

Intracystic Warts.—This variety of papillomata frequently grows in mammary cysts, especially those which arise in the sinuses of the galactophorous ducts. Warts of this kind are associated with the disease known as duct cancer of the breast (see Chapter XXVIII.).

The remarkably luxuriant papillomata which arise in the cysts of the hilum of the ovary are described in the section dealing with Tumours of the Genital Glands.

Papillomata grow in the small cysts formed by dilatation of sweat glands. They have been observed in the axilla (Robinson) and on the cheek (Rolleston).

Adams has made a careful histologic examination of the cysts which arise in the condition known as hydrocystoma. These cysts, which do not exceed in size barleycorns, are limited to the face, and arise from an abnormal dilatation in the coil of the sweat glands. The epithelial lining of such cysts is always very rich, and they sometimes contain intracystic growths.

Villous Papillomata.—These grow from the mucous membrane of the bladder, the renal pelvis, and the choroid plexuses of the ventricles of the brain. In the **bladder** the general appearance of the long, branching, feathery tufts recalls in a striking manner the delicate chorionic villi, and when viewed with the cystoscope in the living bladder, they are often exquisite objects. They consist of a connective tissue core traversed by delicate blood-vessels, the whole being surmounted by epithelium.

These villous growths sometimes have broad bases, but in other cases the points of attachment are so narrow that the tumours may be described as pedunculated. Usually villous tumours of the bladder occur singly, but two, three, or more

may be found in the same bladder. Occasionally there is one large villous tuft with several smaller masses of the size of peas. In some instances they occur at or near the orifice of the ureter, and, though small, the tumour will give rise to serious changes in the corresponding kidney by obstructing the flow of urine from the ureter. When the papilloma is situated near the neck of the bladder the long villous tufts will sometimes be carried by an overflowing current of urine

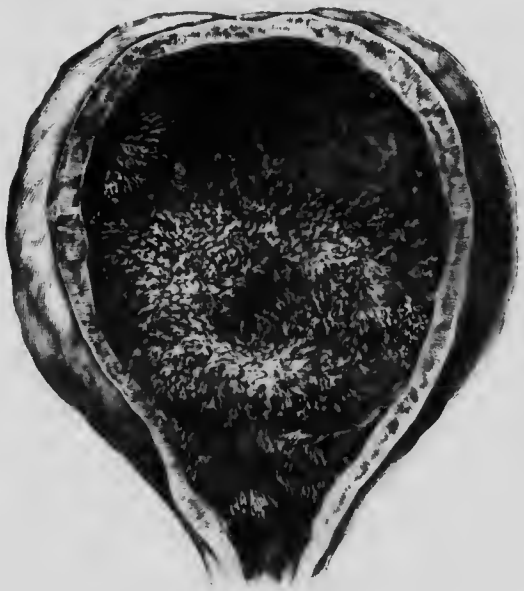

Fig. 151.—Villous papilloma of the bladder.

into the urethral orifice, and cause impediment to its free escape (Fig. 151). The delicate character of the villi and their vascularity are sources of danger, because the processes themselves are sometimes torn, and the haemorrhage is occasionally so severe as to place life in great peril.

Villous growths, in every way identical with those found in the bladder, are sometimes found growing from the pelvis of the **kidney** (Fig. 152). In one very striking case of this sort recorded by Murchison the pelves of the kidneys of a man sixty-five years of age were found thus occupied, and a singular feature of the case was the presence of two villous

tumours in the bladder, one at the orifice of each ureter. It is not improbable, from what we know of the habits of warts generally, that in this exceptional instance the vesical warts were due to transplantations of epithelium from the pelvis of the kidney to the mucous membrane of the bladder. The passage of detached villous tufts in passing down the ureter

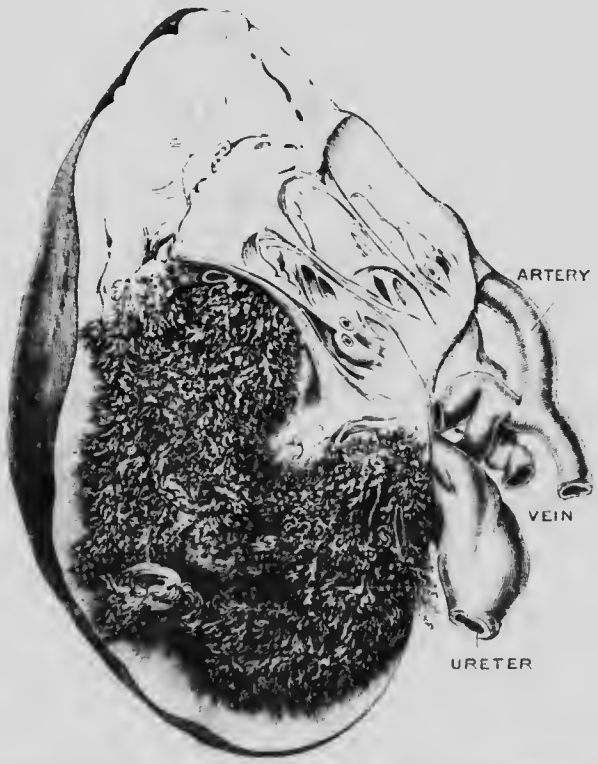

Fig. 152.—Kidney with a villous papilloma growing in its pelvis.

caused colic like a renal calculus in a man aged seventy-nine years. (Lendon.)

Villous papilloma of the renal pelvis is a somewhat rare affection, and the subjects are generally past middle life; the condition is often bilateral, and simulates cancer of the kidney. The reported cases have been collected by Nash and Savory. If care be taken to exclude cases of carcinoma of the kidney with villous tufts, true villous disease of the kidney will be found a rare condition.

There is an interesting variety of villous papilloma which arises from the **choroid plexuses** of the cerebral ventricles. These plexuses are fringed with tufts of epithelial-covered villi which occasionally grow luxuriantly and attain a size sufficient to give rise to unpleasant effects, particularly when the choroid plexus of the fourth ventricle behaves in this manner. Douty described a case of "villous tumour of the fourth ventricle" in which the tumour was as large as a bantam's egg; it obstructed the interventricular communications and led to distensions of the lateral and third ventricles; the aqueduct of Sylvius was dilated to the size of a quill. The patient was a boy seventeen years old, and the clinical features were such as to permit of accurate localisation of the lesion during life. I had an opportunity of examining this specimen. Similar cases have been reported by Clifford Allbutt, Ashby, and Brüchanow.

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CHAPTER XXIII.

HORNS.

Cutaneous horns in the human subject are of four varieties: 1, Sebaceous horn; 2, Wart horn; 3, Cicatrix horn; 4, Nail horn.

1. **Sebaceous horns** are very common, and arise in situations where sebaceous glands exist (Fig. 153). They are

Fig. 153.—Cutaneous horn: a "dame aux halles."

formed in consequence of the protrusion of the contents of a sebaceous cyst through a rupture in the cyst wall, or through the duct of the follicle, which becomes desiccated on exposure to the air; fresh material is added to the base of the horn, until at last a horn may be produced measuring in some instances 25 cm.

Sebaceous horns are extremely tough, and present a longitudinal fibrillation; when soaked in a weak solution of liquor potassæ they quickly soften, and the horny material comes away in flakes.

2. A **wart horn** is structurally identical with the sebaceous horn, and it is impossible to decide from an examination of a large horn whether it grew from a sebaceous cyst or from a wart. Sebaceous horns are more frequent on the scalp than elsewhere, whilst wart horns are most frequently

Fig. 151.—Sebaceous horn in a mouse.

found on the penis, and are not rare on the pinna. It is important to bear in mind that carcinoma is apt to originate in the skin around the bases of wart horns, especially in elderly patients.

The only means of deciding between a wart horn and a sebaceous horn is by dividing them longitudinally, and ascertaining the existence or otherwise of a cyst at the base of the horns. In the case of the mouse sketched in Fig. 154 some pathologists who examined it were of opinion that it was a wart horn, but on dissection a large sebaceous cyst was found to occupy its base. Horns of this character are not rare in mice, and have been seen on a mouse which lived in a church, and on one which was caught in Westminster Abbey (W. G. Spencer).

The most elaborate collection of cases illustrating cutaneous horns is contained in a small work published by Dr. Hermann Lebert. He gives accounts of one hundred and nine cases, with references, the earliest dating from the year 1300. The horns were found on the scalp, temple, forehead, eyelid, nose, lip, cheek, shoulder, arm, elbow, thigh, leg, knee, toe, axilla, thorax, buttock, loin, penis, and scrotum. In length they varied from 1 to 20 cm. Lebert, however, makes no attempt to discriminate between the variety of horns.

The most curious situation in which cutaneous horns

Fig. 155.—Head of an African rhinoceros with a large wart posterior to and in a line with its nasal horns.

occur is in ovarian dermoids, growing from sebaceous cysts in the skin lining the cavities of these tumours. The conversion of epithelium into horn in cases of sebaceous cysts and warts is something more than desiccation from exposure: it is doubtless akin to the change by which nail and horn are formed under normal conditions.

A good physiological type of a wart horn is presented by the nasal horn of the rhinoceros, for this formidable cutaneous appendage is nothing more than a gigantic wart. Professor Flower exhibited at the Zoological Society, London, a portion of the skin from the head of a rhinoceros (shot by Sir John Willoughby in Central Africa) furnished with three horns. The accessory horn is structurally a wart: it was 12 cm. high and 42 cm. in circumference (Fig. 155).

A physiological type of sebaceous horns is furnished by the curious patch of spines on the forearm of Hapalemur, (*Hapalemur griseus*). It is present only in the adult male. The spines are identical in structure with sebaceous horns, and are formed of hardened secretion furnished by a multitude of glands in the skin immediately underlying the

Fig. 156.—Head and leg of a thrush with cutaneous horns. The horns were cast each time the bird moulted.

patch of spines. The male ring-tailed lemur (*Lemur catta*) has a curious horn-like spur upon its forearm near the wrist; beneath this horny patch I found a collection of glands.

Cutaneous horns are sometimes found on cows, sheep, and goats. They may attain a large size. The museum of the Royal College of Surgeons contains a very large horn that grew from the flank of a ram. It is nearly a metre in length, and in its dried condition is 28 cm. in circumference at the base. This specimen is described, with others, by Sir Everard Home in an interesting paper in the *Phil.*

Trans., 1791. Rabelais tells us that the mare on which Gargantua rode to Paris had a little horn on her buttock.

Birds are liable to cutaneous horns; they grow very rapidly, and sometimes attain great lengths. They follow the rule with regard to the epidermic structures in this class generally, and are cast off when the birds moult (Fig. 156).

A good physiological type of wart horn among birds is furnished by the American white pelican, *P. trachyrhynchus*,

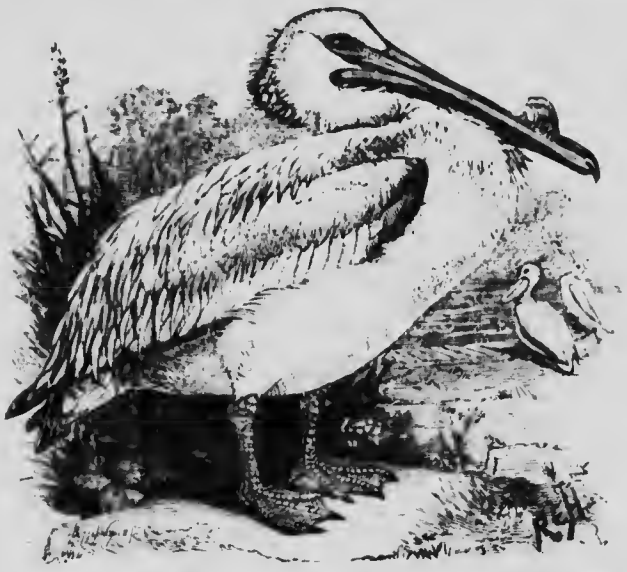

Fig. 157.—American white pelican, *P. trachyrhynchus*. (*From a specimen in the Zoological Gardens, London.*)

The beak of this bird is furnished with a horn structurally resembling the wart horns occasionally seen on other birds. This horn is shed in the autumn when the pelican moults, and is rapidly reproduced with the feathers. Mr. Spencer F. Baird states that Mr. Ridgway visited the breeding-ground of these birds on an island in Pyramid Lake, Nevada, and found the pelicans nesting by thousands. Towards the end of the season the ground became so strewn with these shed horns that they could be gathered by the bushel.

3. **Cicatrix horns.**—These are rare, and grow generally from the scar left by a burn. These scars, when extensive, are liable to ulcerate and then slowly heal again, but as they heal they become covered with a mass of scales, which some-

times form a horny outgrowth composed of hard desiccated tissue, often laminated like a pie-crust.

Cruveilhier described a very remarkable example of this kind of horn growing from a hand, probably deformed in consequence of a burn: the horny processes vary from 2 cm. to 20 cm. in length. Edmunds has described and figured a similar specimen. Cruveilhier states that horns of this kind came under his notice on the thighs of an old woman at the Salpêtrière; they grew from the scars of old burns caused by chaufferettes. When the horns became detached they left painful ulcers. Later observations show that as these ulcers heal, new horns form.

4. **Nail horns** do not call for much consideration. They are extremely common on the toes of bedridden patients, especially old women and those who are dirty. Although nail horns may grow on any of the toes, they are most frequently met with on the big toe. The horns may attain a length of 7 cm., and become twisted so as to resemble rams' horns.

Treatment.—Cutaneous horns are easily detached by a sudden jerk with the thumb and forefinger: if they are too firmly fixed to be removed in this way, then they may be excised. An exceptional case will demand amputation, and in a few instances surgeons have thought it necessary to remove the extremity of the penis when the skin surrounding the base of the horn has been ulcerated. When cancer attacks the skin at the base of a horn, it should, with the surrounding skin, be early and freely excised, and the lymph glands connected with it should be carefully dissected out.

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CHAPTER XXIV.

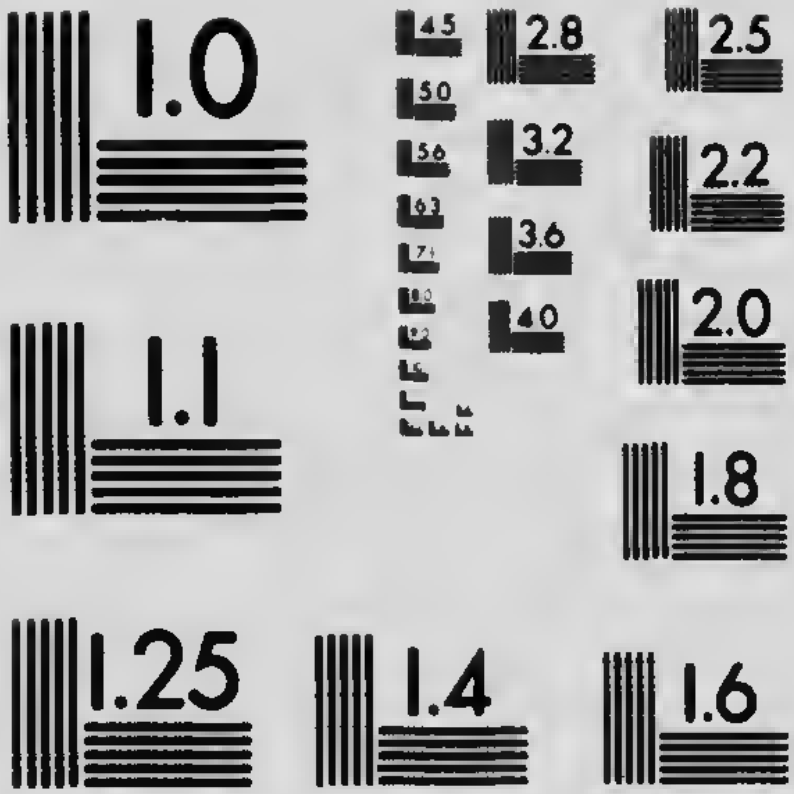
ADENOMA.

An **Adenoma** is a tumour constructed upon the type of, and growing in connection with, a secreting gland.

Adenomata occur as encapsuled tumours in such organs as the mamma and liver, and in glands like the parotid and thyroid; in the mucous membrane of the rectum, intestine, and uterus they are pedunculated. A single adenoma may be present, but two or more may exist in the same gland. In the case of the intestine a score or more may co-exist in the same individual. In size they vary greatly: some are no larger than peas, whereas in the mamma an adenoma will occasionally attain the dimensions of a man's head. Adenomata also occur in connection with the sebaceous and sweat glands.

The effects of adenomata depend mainly upon the situations in which they grow. The following statements are true for all:—When completely removed there is no recurrence: they do not infect neighbouring lymph glands, nor give rise to secondary deposits. When an adenoma causes death, it is in consequence of mechanical complications, depending on the situation and size of the tumour.

Although the distinguishing structural peculiarity of an adenoma is the presence of epithelium disposed as in a secreting gland, the connective tissue (stroma) entering into its composition must also be taken into account. In many adenomata the epithelial element is the most conspicuous; in others the connective tissue is out of all proportion to the epithelium, and occasionally preponderates to such a degree that the tumour from some writers receives the misleading name of "Adenosarcoma." When the epithelium-lined spaces are distended with fluid, the tumour is termed a cystic adenoma (adenocele). The source of this fluid is of some



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interest, because adenomata are similar in structure to the gland in which they arise (Fig. 158), yet they are unable to furnish the secretion peculiar to the gland. In the case of adenomata growing from mucous membrane—*e.g.*, the rectal and uterine adenomata—the glandular pits furnish a perverted secretion.

In the case of the thyroid gland, the adenoma is so en-

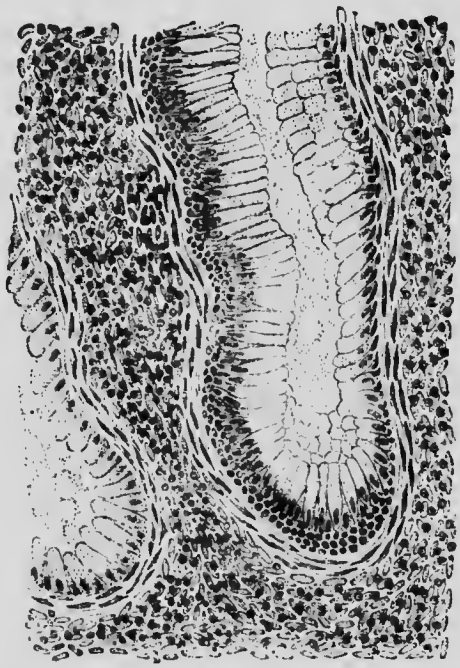

Fig. 158.—Section of an adenoma from a child's rectum. (*Highly magnified.*)

capsuled that the secretion furnished by the gland-tissue of the tumour cannot escape, and, slowly accumulating, converts the adenoma into a cyst. This occurs also in the mamma; but it will be shown in connection with adenomata of this gland that the fluid sometimes escapes by the natural duct.

Adenomata may arise at any point in the mucous membrane of the gastro-intestinal tract, and they do not, as a rule, attain big dimensions. The adenoma which Lexer removed from the stomach of an adult, which was as big as a child's head, is very exceptional; it grew by a stalk as thick as two fingers from the gastric mucous membrane, near the pylorus.

Adenomata exhibit peculiar characters, and give rise to disturbances which vary with the gland in which they arise: it will therefore be convenient to consider each variety separately. It will be useful to point out that although adenoma and carcinoma may, and often do, co-exist in the same gland, an adenoma never becomes transformed into cancer.

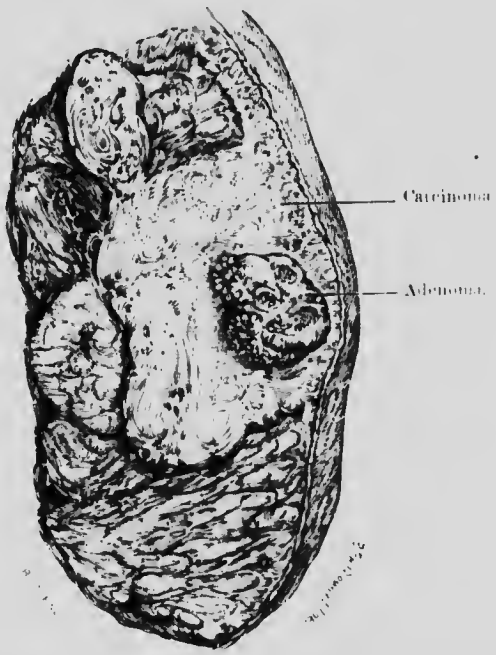

Fig. 159.—Mamma in section; it contains a fibro-adenoma surrounded by cancer. (*Museum, Royal College of Surgeons.*)

The best known instance of the combination of an adenoma and carcinoma in the same gland was observed by Hutchinson. In this instance the adenoma was embedded in a mammary carcinoma (Fig. 159), and the patient, a woman forty-six years of age, had been aware of the existence of a tumour for twenty years.

Adenoma of the Mamma.—There are two varieties of mammary adenoma:—1. **Fibro-adenoma**; 2, **Cystic adenoma.**

1. *Fibro-adenomata.*—These occur as spherical or oval tumours, furnished with capsules, lodged in the superficial parts of mammæ; exceptionally they may be situated deeply

in the breast substance. As a rule, they are firm and elastic to the touch, and slip about under the examining finger. It is not rare to find a fibro-adenoma in each mamma, nor is it unusual to find more than one tumour in the same gland. When occupying a superficial position they will even when small, project the skin so as to cause an irregularity in the contour of the breast; very exceptionally they may be pedunculated. Although the majority of mam-

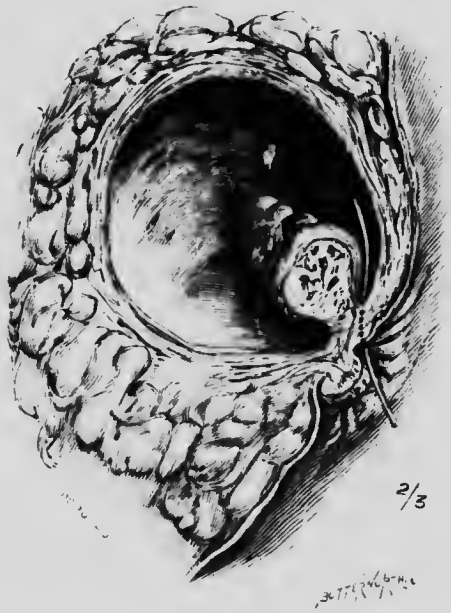

Fig. 160.—Cystic adenoma with a glandular process. The cyst communicated with a duct in the nipple.

mary adenomata do not exceed the dimensions of a walnut or of a Tangerine orange, some are as big as cocoa-nuts.

Structurally they consist of fibrous tissue in which glandular acini are embedded; the tumour itself is isolated from the surrounding gland tissue by a definite capsule.

Tumours of this character are commonly met with in the years succeeding puberty. It is rare to meet with them before the age of fifteen, but Patteson has published a careful description of two cases met with in girls of thirteen years. These are probably the two earliest cases yet recorded. The great rarity of fibro-adenomata of the breast before

puberty is due to the simple construction of the breast in the non-pubic girl. The gland elements are represented by epithelium-lined tubes which branch slightly, embedded in fibrous tissue. After puberty the gland elements multiply, and this activity is accompanied by a corresponding active growth of the fibrous tissue in the breast.

2. *Cystic adenomata.*—As women increase in age, and especially if the breast has an opportunity of fulfilling its function, then adenomata which arise in the gland contain much more epithelium and far less connective tissue. The epithelial cells are larger, and approach in character those of

Fig. 161. Dilated galactophorous duct with intracystic growth.

the active mamma. Adenomata of this kind form far larger tumours than those to which the term fibro-adenoma is usually applied. Occasionally the glandular acini become dilated with fluid and form cystic spaces; the tumour is then termed a cystic adenoma (or an adenocele). At times a cyst of this kind will retain its communication with the galactophorous duct (Fig. 160), and the secretion will sometimes escape at

the nipple. Indeed, it is at times possible, when examining a breast, by gently squeezing the tumour to force a jet of fluid from the cyst. This is a diagnostic sign of great value. It sometimes happens after removal of a large cyst of this kind that a bristle can be passed from the cyst along a galactophorous duct. In some adenomata the cystic portion largely preponderates, the glandular element merely projecting as a bud into the cyst. A sharp distinction, however, must be drawn between a cystic adenoma and a dilatation of a galactophorous duct with intracystic growth (Fig 161). This variety is closely allied to duct cancer and duct papilloma. Cystic dilatations of a galactophorous duct during lactation is known as a *galactocele*.

Some of the rarer but larger and more formidable kinds of mammary adenomata are those which combine all the characters of the preceding varieties. That is, they contain much fibrous tissue, numerous and fairly large cystic spaces, many of which are also almost completely occupied by intracystic processes. Mammary tumours of this kind sometimes attain very large proportions, weighing upwards of five or even ten pounds. These tumours have had a variety of denominations, such as sero-cystic tumours, adeno-sarcomata, and so on. However, clinically, they are quite innocent, and do not recur after removal.

It is a remarkable thing to remove a large complex adenoma of this kind and to find it completely encapsuled, whilst the breast lies like a small process quite isolated from the tumour.

The description of adenoma of other organs will be found in the succeeding chapters.

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CHAPTER XXV.

CARCINOMA (CANCER).

This term in the strict sense in which it is used by pathologists signifies a malignant tumour arising in epithelium. The disease is of very great importance on account of its insidious onset, and, in the earliest stages, painlessness; its progressive and irresistible destructiveness; the manner in which it infects lymph glands; the extraordinary effects produced in different organs on account of the dissemination of the growth in the form of secondary nodules; the helplessness, misery and pain it produces when fully advanced; and the inability of medical and surgical art to deal effectively with it, save in the earliest stages. Although this disease was recognised in the dawn of medicine, we not only remain ignorant of its cause, but, in many instances, the diagnosis of the malady is uncertain in the living. This is not due to supineness on the part of investigators, but to the absence of what is called "specific symptomatology."

Varieties of Cancer.—Epithelium plays two parts in the animal economy: *protective*, as on the skin; and *secretory*, where it is found in glands. When carcinoma arises from a surface covered with epithelium of the protective variety it is called *squamous-cell* cancer; and when it arises in the epithelium of glands it is termed *glandular cancer*.

The microscopic structure of a carcinoma is very simple and consists of columns of cells, so that when the columns are cut at right angles the section has the appearance of a number of alveolar spaces filled with epithelium (Figs. 162 and 163). The walls of these alveoli are composed of fibrous tissue, presenting various degrees of density, in which blood and lymph vessels ramify. These cell-columns are not always simple, but may branch in various directions and thus produce in some sections very complicated appearances, the softness or hardness of the cancer depending on

the amount of fibrous tissue between the columns of cells. This plan of structure underlies all the varieties of malignant epithelial tumours, even those which arise on surfaces covered with squamous epithelium. The cells composing the columns depend upon the character of the epithelium in which the cancer originates, and this feature is so striking that the histologist can often pronounce with certainty the particular gland in which a cancer arose, merely from studying a carefully prepared specimen under the microscope.

Stroma and Parenchyma.—Every tumour, whether it be innocent or malignant, except the chorionepithelioma (p. 412), presents a stroma and a parenchyma. These two elements are particularly observable in adenomata and carcinomata, on account of the striking difference in the characters of the connective tissue and the epithelium. In the case of carcinoma, as the epithelial cells multiply and intrude into the adjacent tissue, the intrusion is answered by a formation of fibrous tissue: this response is less marked in the rapidly growing tumours than in those which grow slowly. This response of the tissues to irritation has been termed the specific tissue reaction, but it is as obvious in many of the common forms of tissue irritants, such as micro-organisms, and especially foreign bodies. Some of the most striking examples of the formation of fibrous tissue capsules in response to irritation are those which form around an echinococcus cyst lodged in the great omentum. In the case of a sarcoma a kind of investment is furnished for each cell, but in a carcinoma for groups of cells producing in reality a fibrous-tissue maze.

Squamous-cell Cancer.—This may arise on any surface covered with stratified epithelium, but it is more common in situations where there is a transition from one kind of epithelium to another, and especially where skin and mucous membrane come in relation—*e.g.*, the anus, vulva, or lip.

It may make its appearance as a wart-like growth, more frequently as a small circular ulcer with raised rampart-like edges, or as a fissure, and it is particularly apt to arise on the scrotum of the chimney-sweep (Chap. XXXIV.).

Sweep's cancer usually begins as a wart which is familiarly known as a "soot-wart." A similar form of

cancer is described as arising in men who work in tar and paraffin.

Although the three clinical varieties of squamous-celled cancer look so different, they are identical in structure. When sections are cut so as to include the margin of the ulcer and underlying tissue, the surface-epithelium will be seen invading it in the form of long, simple, or ramified columns. When the cones grow rapidly, the cells become flattened, and some finally cornify. In this way the

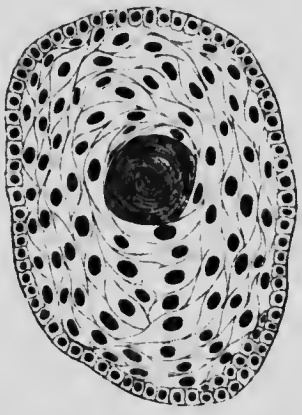

Fig. 162.—Section of an epithelial cone (*magnified*).

so-called epithelial pearls or nests are produced. When lateral pressure is made on a fresh specimen whitish plugs are forced out; these plugs are the cellular cones.

It is important to bear in mind that the three clinical varieties of squamous-celled cancer occur in most of the situations liable to this disease, such as the lips, tongue, cheeks, vulva, and glans penis. This disease is occasionally met with in the urethra, pinna, and the conjunctiva, especially when the mucous membrane has been injured by lime. Examples of squamous-celled cancer of the pinna have been described by Hulke, Bowlby, and Williams. The occurrence of cancer in relation with a conjunctival scar is interesting, because it sometimes arises at the edges of cicatrices of burns in other parts of the body, and also of lupus scars (Bayha, Berry). The ulcers caused by X-ray burns are not only very intractable, but are liable to become cancerous. Foulerton

considers that squamous-celled cancer occurring in connection with X-ray burns is merely an example of malignant epithelial over-growth starting from a chronic ulcer. The liability of chronic ulcers of the leg to become cancerous is well known, and the frequency with which leucoplakia of the tongue and long-standing syphilitic ulcers of this organ become cancerous is a well-established fact; the same is true in regard to leucoplakia of the vulva.

Local changes which clinical observation has shown to precede cancer are termed **precancerous conditions.**

A squamous-celled cancer, when left to follow its own course, may extend and involve extensive tracts of tissue, or fungate and form huge granulating dendritic masses. In both cases the superficial parts are continually cast off in a foul, fœtid discharge containing sloughs of tissue, cellular detritus, and blood. Vascular tissues, such as skin, muscle, and mucous membrane, are quickly infiltrated and destroyed: even bone is rapidly eroded. Cartilage resists invasion; this is seen in a striking way in those rare instances in which cancer attacks the pinna; the skin and soft tissues quickly disappear, whilst its cartilaginous framework stands prominently out amidst the surrounding ruin.

In whatever situation squamous-celled cancer occurs, it destroys life rapidly. The quickness with which it ulcerates and overcomes all resistance enables it to open large blood-vessels should any lie in its way. Hence death from hæmorrhage is frequent; when the cancer is near the air passages, foul material is inspired and initiates septic pneumonia.

Gland Cancer.—This variety arises in the epithelium of secreting glands: it is exceedingly common in some and rare in others, so it will be convenient to discuss the liability of the various glands separately; but the general features of this disease are the same in whatever gland it arises.

A striking feature of cancer is the fact that it does not form a circumscribed tumour. When examined clinically it is rarely possible to define the limits between the tumour and the surrounding tissues, and this indefiniteness is more obvious when, in the course of an operation, the surgeon cuts into it; but, what is more significant, when the periphery of a cancer is subjected to microscopic scrutiny the

searching eye of a competent pathological histologist is unable to discern with accuracy the limitation of the cancerous territory.

This illimitation of cancer constitutes one of the greatest obstacles in dealing with it surgically, for if with the aid of a microscope there is difficulty in defining its limits, it is clear how uncertain the surgeon must be in determining its extent with only fingers and eyes to guide him during an operation.

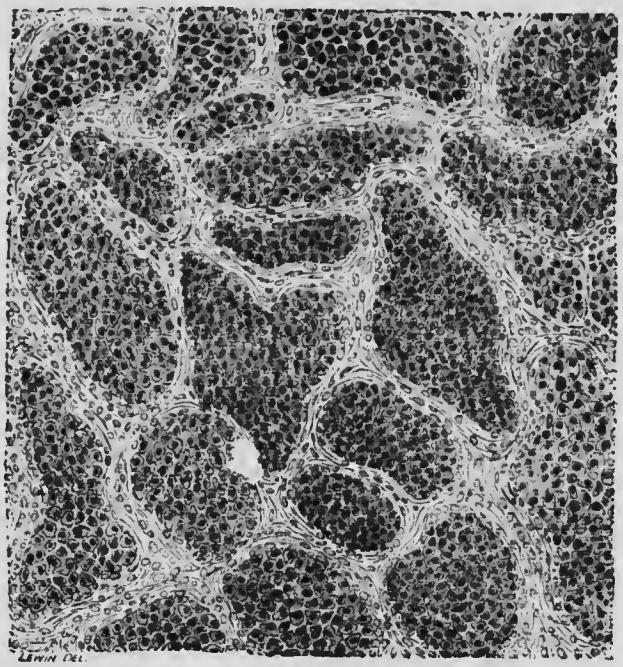

Fig. 163. Section from a mammary cancer (*highly magnified*).

This has led to the practice in recent years of complete extirpation, whenever possible, of cancerous organs. Although a cancer is for a time limited to the gland in which it arises, we have no means of distinguishing with any reasonable certainty, when the individual comes under observation, that the cancer is limited to the gland, for its outrunners quickly involve surrounding structures, whether skin, fat, mucous membrane, muscle, or bone. When adjacent parts are infiltrated or permeated in this way, it is convenient to describe them as being implicated in the cancer. This

implication of organs is a grave feature, and a common cause of death, and it is often a bar to operative intervention.

The insidious way in which fascia is permeated by carcinoma has recently been made the subject of a careful investigation by Handley (see p. 285).

Although cancers, like all epithelial structures, are in free communication with the lymph system, they are poorly supplied with blood: this leads to retrograde changes, which it is customary to describe as degeneration. The commonest of these changes is known as colloid degeneration, in which the epithelium in the cell-columns becomes changed into a structureless material resembling jelly: this change is particularly common in cancer of the stomach and breast. It is well known that a primary cancerous lesion may undergo retrogressive changes and almost disappear. The variety known as "withering cancer" or "atrophic cancer" of the breast is an example of this. Patients with this kind of cancer have lived ten, fifteen, and even twenty years. The not uncommon form of cancer found in the colon, especially in the sigmoid flexure, where the growth encircles and narrows the gut so tightly that it seems as if a piece of cord were tied around it, is really a primary carcinoma undergoing spontaneous cure; but it surely destroys life, if not from its mechanical effect in obstructing the colon, by infecting the liver and peritoneum.

Thus cancer manifests itself differently in the same organ, and its effects vary more widely in diverse organs. For example: primary cancer of the liver is always massive, and leads sometimes to enormous enlargement of this organ. This is also true of secondary deposits in the liver, for they attain a greater size in its tissues than elsewhere. Hillier suggests that, in addition to the large size of the liver, its small proportion of connective tissue, its blood supply, copious and rich with food products, may explain this; carcinomatous growths contain a large amount of glycogen, and its presence in the hepatic cells may have something to do with the way in which cancer flourishes in the liver.

Primary cancer of the pancreas seldom forms a large mass, and usually appears in the head of the gland as an ill-defined swelling.

The difference in the proportion of fibrous tissue in the liver and in the pancreas may offer some explanation of the variation of size in cancerous masses in the two organs.

Infection of Lymph Glands.—The surfaces of our bodies, whether skin or mucous membrane, are rich in lymphatics, and as the secreting glands are primarily derived from these surfaces, it naturally comes about that they are in free communication with the lymphatics and lymph glands. It follows that the lymphatics involved in the cancerous material convey the cancer elements to the lymph glands, and these may become so surcharged as to burst their capsules. Lymph glands enlarged in this way sometimes form very large masses, and it is not uncommon to find a primary carcinoma with a diameter of two centimetres associated with a collection of lymph glands as big as a fist. Lymph-gland infection varies in rapidity and degree; great differences occur not only in regard to cancer of particular organs, but also in relation to the same organ in different individuals. Sometimes lymphatic channels are so stuffed with cancerous material that they may be dissected from the connective tissue and traced to the lymph gland.

Occasionally the ducts from the lymph glands about the receptaculum chyli, the receptaculum itself, and the thoracic duct are stuffed with cancerous material (Fig. 164).

The relation of the growth to the wall of the duct shows that the implication of its structures is complete; it is not due to the mere blocking of its lumen with cancerous tissue, resembling the clot in a thrombosed vein, but its walls are infiltrated with the cancerous tissue in the way that sarcomatous tumours implicate the walls of large veins (p. 68).

Obstruction of the thoracic duct by extension of cancer has been noticed in association with primary cancer of the stomach, uterus, rectum; and careful descriptions of the conditions have been described by Unger, Weigert, Troisier, and Hillier, among others. Perhaps the most remarkable feature of the complication is the absence of any indication that this duct was obstructed, and in no case was chylous ascites observed.

The extent to which lymphatic infection has occurred is a matter which cannot be accurately defined in a given

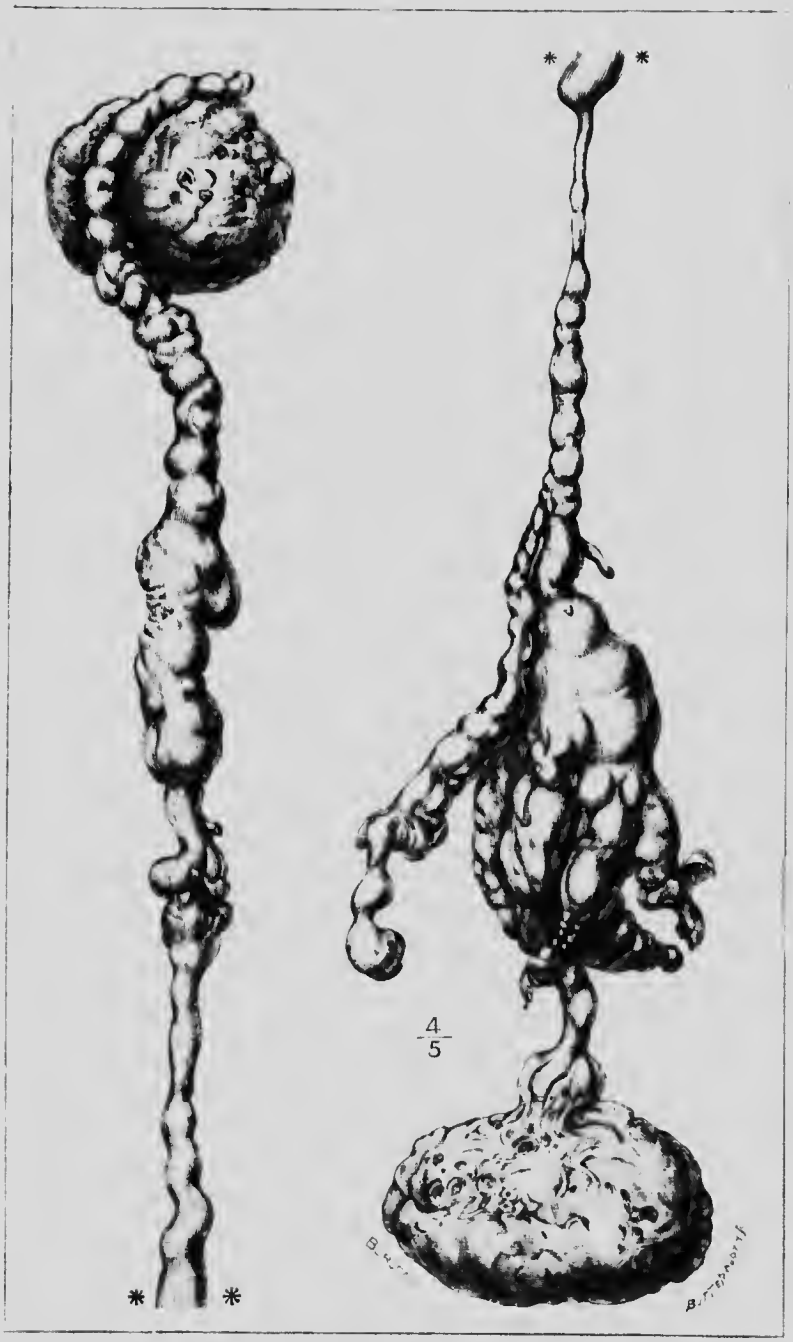

Fig. 164.- The thoracic duct and receptaculum, with some adjacent glands, stuffed with cancerous material secondary to cancer of the rectum. (*Hallier.*)

case of carcinoma, and this adds an additional factor of uncertainty in estimating the results and value of surgical procedure. Lymph-gland infection is always an element of danger. When the cervical glands are enlarged they interfere with the trachea and œsophagus; they also become firmly adherent to the sheaths of big vessels, and as the glands break down the ulcer opens up the jugular vein, or the carotid artery, while, in the inguinal region, the femoral vessels are opened up. Lymph glands, when enlarged and stuffed with carcinomatous cells, have a great tendency to soften in the centre and form spurious cysts. When the skin becomes implicated, extensive portions of the infected glands slough, and leave large, horrible holes, from which a fœtid fluid issues, whilst the edges of the chasm produced by the sloughing continue to extend and involve the neighbouring tissues.

The size of the cancerous mass produced by the infected lymph glands, and the tissue infected by them when they become so stuffed with cancer that they burst their capsules, is often, as has already been mentioned, out of all proportion to the initial lesion: indeed, in many instances the patients are so little troubled by the primary ulcer, which may be so small and inconspicuous as to escape observation until the enlargement of the lymph glands compels the patients to seek advice, which leads to a search for the primary lesion.

It is not uncommon when this focus is situated in a recess in the mouth or pharynx for the cancerous ulcer to be so small as to be completely overlooked, and then the cancerous gland mass in the neck is supposed to arise in epithelial vestiges of the branchial folds. It is also possible that the primary focus undergoes retrogressive changes and heals spontaneously, but the gland infection proceeds to the patient's destruction.

Dissemination.—Cancers are extremely prone to dissemination, which means the formation of secondary growths resulting from the deportation of minute fragments of cancer (cancer emboli), which may lodge in any organ or tissue. The cells that give rise to secondary nodules are transported by lymph and blood vessels, and by an insidious process known as permeation. When these minute emboli and cancer particles lodge in suitable positions they multiply, giving rise

to a growth which in its histologic features exactly resembles the parent tumour. So faithful is this reproduction that the nature of the primary tumour can often be correctly inferred from a microscopic examination of a secondary nodule.

The amount of dissemination varies greatly. In some cases secondary deposits will be found only in the liver, whilst in another and apparently identical case, in so far as the structure of the tumour is concerned, secondary knots occur in almost every organ of the body, including the skeleton. In the case of squamous-celled cancer it cannot be said that secondary deposits are rare, but dissemination certainly happens far less frequently, and never so extensively as in cancer arising in secreting glands. It is also noteworthy that the squamous-celled variety is in some situations more liable to disseminate than in others. For example, secondary deposits are rarely met with when this disease attacks the larynx, or the mucous membrane in relation with the mandible or maxillæ, or the œsophagus. The explanation sometimes offered of this peculiarity is that carcinoma in these situations usually runs a rapid course, and often destroys life so quickly that the period is too short to allow of the formation of secondary nodules. This is inadmissible, for in cancer of the scrotum dissemination is almost as exceptional as when the larynx is attacked.

Secondary deposits of cancers are not always so small as merely to merit the name of knots, but form occasionally tumours of some magnitude.

The vitality and power of independent growth possessed by cancer emboli is very remarkable. These minute epithelial emigrants not only live and grow, but reproduce the peculiarity of the primary cancer. It is astonishing to find a secondary cancerous deposit in the humerus with all the characters of the glands of the rectum; a multitude of secondary nodules in the skin with the structural features of gastric glands; nodules in the lungs exactly reproducing that peculiar form of hepatic carcinoma which arises in the biliary ducts; the familiar closed follicles of the thyroid gland reproduced in the body or spinous process of a vertebra; nodules resembling the structure of mammary carcinoma in the ovary, brain, or choroid coat of the eye; and a mass growing from

the frontal bone with all the characters of the prostate gland, secondary to cancer of that organ. It is one of the great triumphs of pathological histology that it has demonstrated that carcinoma takes its type of epithelium from the secreting gland in which it arises.

This power of independent growth possessed by the epithe-

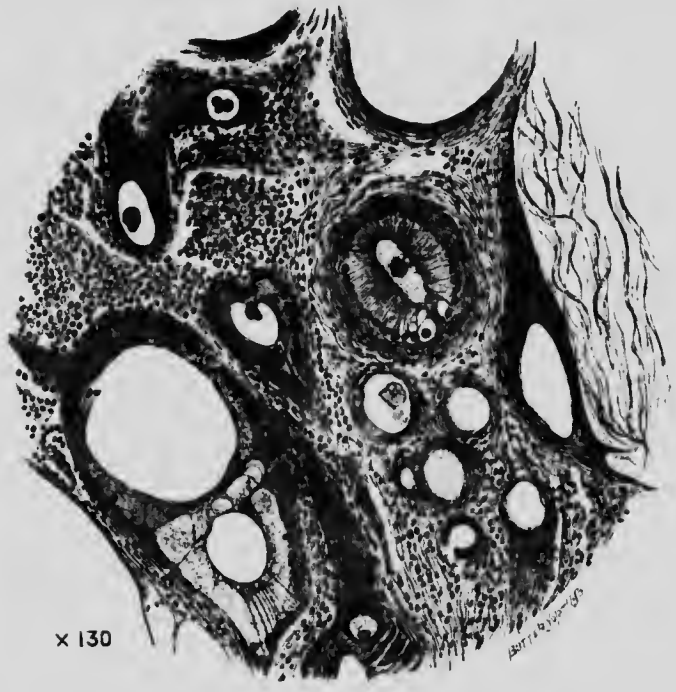

Fig. 165.—Section through a portion of an inguinal lymph gland infected with cancer: the primary disease was in the rectum. (*After Fowlerton.*)

lium of cancer is a very dangerous feature, and does not always need blood or lymph vessels for its manifestation. It sometimes happens that an abdominal viscus is attacked by cancer, and a small outgrowth makes its way through the peritoneal covering and bursts, and sheds its cells into the general peritoneal cavity; these are distributed by the peritoneal fluid and the movements of the bowels, and in a few weeks the whole of the serous membrane will be dotted with hundreds, and sometimes thousands, of nodules, each reproducing the type of the parent tumour. This mode of epithelial infection of the peritoneum I have found in cancer of the

gall-bladder, ovary, and especially in cancer of the body of the uterus: no form of dissemination gives rise to such innumerable secondary nodules as this, nor demonstrates in a more remarkable way the power of epithelium to engraft itself, to live, and to grow.

Secondary deposits of cancer may occur in any organ and tissue of the body; my own observations teach me that among the malignant epithelial tumours, cancers of the breast and of the pylorus give rise to the widest form of dissemination: thus cancer is very infectious to the individual affected with cancer, but not to others. The rarest of all tissues in which to find secondary deposits is voluntary muscle, and the rarest of all organs is the heart. Secondary deposits are even met with in the eyeball, and it is a curious fact that the great majority of cases occur in association with mammary cancer, and in one exceptional case both eyeballs contained secondary nodules. Secondary deposits in the globe have also been observed in connection with cancer of the stomach and thyroid gland. (Rowan and Devereux Marshall.)

Secondary Cancer of the Lung.—The extraordinary frequency with which the lung is infected with malignant disease, whether sarcoma or carcinoma, is due to the circulation. In the case of sarcoma the particles gain the circulation entirely through the veins, but in the case of carcinomata the cancer emboli may also enter the blood stream by the veins, but the most usual channel is the right lymphatic or thoracic duct, according to the situation of the primary focus of disease. In this event, of course, the migratory elements are discharged into the innominate veins, and as they are forced into the pulmonary vessels, they become filtered from the blood by the capillaries of the lungs, and after their arrest find in the vascular tissue an excellent soil in which to grow.

In discussing secondary deposits in the lungs due to cancer emboli, it must not be forgotten that cancer of adjacent organs, such as the mammary glands, the œsophagus, stomach, etc., may locally invade the pleura (permeation), and give rise to a widely scattered crop of miliary nodules on the pulmonary pleura. This mode of infection must be

distinguished from that in which the lungs are infected by emboli transported by the blood.

Much new light has been thrown on the way in which cancer implicates the chest wall and infects the thoracic as well as the abdominal organs, by the researches of Handley, who has especially studied the manner in which cancer cells slowly creep along the planes of fascia.

There are many points connected with the dissemination or generalisation of cancer which are not clearly explained. As we shall find later on, there are two views as to the manner in which secondary cancer forms in bone, namely, the embolic theory and the permeation theory (Handley). In regard to the almost universally accepted opinion that minute fragments of the primary tumour gain access to and suffer deportation by the blood, it has been stated that cancer cells which enter the blood stream are destroyed, and no one has actually recognised the cell particles of a carcinoma in the blood of cancerous patients. Many attempts have been made to find altered conditions in the blood of cancerous patients which might be specific for this disease (see Pryce-Jones).

In regard to secondary cancer of vascular organs, such as the liver, bones, and ovaries, reference may again be made to its massiveness as compared to the size of the primary focus: in these circumstances, indeed, the continual progress of the disease may be described as "ceaseless cell proliferation."

These large secondary formations are instructive from another point of view: primary cancer always arises on a surface to which air or intestinal gases have access, and therefore pathogenic micro-organisms. The result is ulceration, sepsis, and destruction of the growth, followed by septic infection, and its deleterious consequences.

Secondary deposits in the liver, ovaries, and bones are not so exposed in their early stages to local infection, and thus grow undisturbed until they attain proportions sufficient to cause ulceration of the skin, or involve the bowel and become infected; then death quickly follows.

As a matter of fact, cancer is a very chronic disease, save for accidental infections, and as in such chronic diseases

as tabes and the various sclerotic changes of nerves, blood-vessels, kidneys, and liver, death really ensues from a group of diseases known as *terminal infections*, such as uræmia, pneumonia, peritonitis, meningitis, and the like, due to the activity of many species of pathogenic micro-organisms.

Secondary Deposits of Cancer in Bone.—The distribution of metastatic cancer in bone has been made the subject of careful observation by Recklinghausen, Theile, Cone, and others. In the preceding section some reference was made to this phenomenon. The chief sources of cancer deposits in bone are primary cancer of the prostate, thyroid, and mammary glands: they also occur in connection with primary cancer of the stomach, œsophagus, uterus, and rectum.

Prostatic cancer shows an especial tendency to disseminate in bone, and Recklinghausen points out that the cancer cells lodge in the vascular channels of the marrow and form a deposit: as this grows, outrunners make their way through the adjacent foramina of the bone, and form subperiosteal deposits. A careful examination of the distribution of secondary cancerous deposits in bone bears this out, for they occur in greatest number where the foramina of bones are largest and most numerous, and a critical inspection of bones invaded by secondary cancer also shows that in many bones osseous tissue exists between the medullary cavity and the periosteum, so that the growth has not simply made its way through by erosion.

The effect of secondary deposits growing in bone is of three kinds:—

When growing slowly it may simply erode the osseous tissue, or may cause great expansion of the bone accompanied by osteoplastic changes: or there is marked infiltration of the bone without expansion, but with osteoplastic changes.

It has been suggested that the osteoplastic changes are due to chronic venous congestion on account of the multiplication of cancerous cells acting as a thrombus.

These observations seem to show that subperiosteal cancerous deposits are due to extension of intramedullary deposits through the foramina to the subperiosteal tissues, and are not primarily subperiosteal; the matter, however, admits

of another interpretation. Handley has made a very careful investigation of the mode in which cancer of the mamma disseminates, and shows that it spreads in the thoracic wall by **permeation,** a slow, progressive, centrifugal serpiginous process, which is an actual growth of the cancer along one or other lines of the parietal layers in continuity with the primary growth. He has carefully analysed the situation of secondary deposits in this disease, and points out that they appear in the near neighbourhood of the primary focus, and that as the disease advances the nodules appear at greater distances from the primary focus until at last, if death is unduly delayed, they appear in the trunk ends of the limbs. Hence the distal halves of the limbs enjoy an almost invariable immunity from the cancerous nodules. This applies to the bones of the limbs as well as to the skin. He believes these facts indicate that the superficial spread of cancer takes place by permeation of the deep fascia. Moreover, he has carefully studied and traced this infiltration of the deep fascia microscopically.

Handley believes that visceral deposits of mammary cancer do not arise from cells conveyed by the blood: according to his researches it occurs through the fine anastomotic lymphatics which pierce the parietes and then infect the subserous lymphatics of the pleura and peritoneum. Cancer cells then escape into the thoracic and abdominal cavities, implant themselves on the surface of the viscera, and give rise to deposits which terminate the life of the patient (see Chapter L).

Cancer Infection.—It has long been known that normal cutaneous epithelium, when accidentally engrafted into subcutaneous tissue, the cornea, or the iris, will live and grow. It has also been demonstrated beyond all cavil that when women have been ovariotomised, especially in cases of large ovarian adenomata, tumours have in some instances grown in the abdominal cicatrix; these on microscopic examination have displayed cysts furnished with the regular large mucin-bearing cells so characteristic of some varieties of ovarian tumours (adenomata). As these tumours in the cicatrix have been unassociated with any recurrence in the pelvis, or secondary nodules in the peritoneum or in the viscera, the

conclusion is irresistible that they were due to infection of the edges of the abdominal incision in the course of the ovariotomy. These cases are profoundly interesting, because they illustrate what often happens in the course of an operation for the removal of a cancer; and it is this local soiling of the wound with minute cancerous particles that constitutes the accident which I have called cancer infection.

A careful study of the clinical aspects of cancer, as well as the most critical inquiry in the post-mortem room, has convinced many that cancer exhibits peculiarities in regard to mode of growth, infection of lymph glands, dissemination, and the way it destroys life, according to the gland in which it arises. Even this only partly expresses the real truth, for not only is the course of carcinoma of the same gland widely modified by age and constitution, but the same disease in two patients, apparently alike in age and environment, will progress so differently that no surgeon can predict with any reasonable certainty the expectancy of life, result of operation, liability to dissemination, or the chances of recurrence. Therefore, in deciding whether it will be to the patient's advantage to have a cancerous organ extirpated, the surgeon is guided by the known peculiarities of the particular organ affected, the extent to which the adjacent tissues are implicated, the degree to which the associated lymph glands are infected, and the absence of signs indicating dissemination. In spite of every care, the operation is occasionally followed by such rapid local recurrence that the course of the disease is accelerated rather than retarded.

It is a fact which every surgeon who has had much experience in operating for cancer must have noticed that, in some instances where he has conducted carefully planned but extensive operations for cancer, the patient has had rapid recurrence, and the disease has manifested itself in a manner far worse than when left to run its natural course. This phenomenon, I believe, may be explained. In removing the affected organ the infected lymphatics and blood-vessels stuffed with the cancerous material are divided, and the cancer cells are let loose over the damaged tissues, which they infect, and lead to an extensive outbreak of local cancer. Knowledge of this kind is important, because it leads us to

exercise greater care in keeping well wide of the diseased area whilst removing it: and though we cut out the cancer with its implicated lymphatic ducts and infected lymph glands, we should exercise every precaution not to incise the diseased parts, and thus unwittingly scatter the diseased cells over the denuded surfaces.

I have more than once seen patients who had been submitted to operation for mammary cancer, and in whom the removal had been imperfectly carried out, present on both sides of the scar a series of cancer nodules at each stitch hole, due to infection by the needle and thread in the course of the operation.

Transference of Cancer by Contact.—Many cases have been reported which are supposed to prove that cancer may be transplanted by the direct contact of a cancerous surface either with another part of the infected person's body, or with another person. The examples of the first condition usually mentioned are the infection of the skin of the arm from contact with an ulcerating carcinoma of the breast; or, the infection of a labium by a squamous-celled cancer in the opposite labium. I have never seen the upper lip infected from contact with a cancerous lower lip, nor the cheek infected save by extension of the growth in the case of cancer of the tongue. It is also a matter of common observation that even in extensive cancer of the tongue, jaws, or pharynx, quantities of cancerous particles find their way into the stomach, but the mucous membrane of the gastro-intestinal tract escapes. Surgeons who are actively engaged almost daily in performing operations for cancer frequently cut or prick their fingers, but a cancer transplanted in this way is unknown; in contrast to this, it may be mentioned that there is probably no surgeon who has not infected himself in this way with some infective septic disease.

This should make us careful in accepting evidence in regard to what is sometimes called *Cancer-à-deux*, in which a man cohabiting with a woman suffering from cancer of the neck of the uterus has a cancerous ulcer appear on his penis, and *vice versâ*.

Heredity.—This is another difficult problem, or it would be better termed a vexed question in regard to cancer and

malignant disease generally, because so much that appears to be affirmative is founded on false facts, that is on circumstances that cannot be tested or proved. The statement that the father died of cancer of the prostate, and the mother of a sarcoma of the humerus, is scarcely a good explanation of the cause of a malignant dermoid or embryoma in their infant daughter. When several female members of a family die from cancer of the breast, it will, on careful inquiry, be found that they have lived in the same environment. The question of cancerous inheritance bristles with difficulties, many of which are at present insuperable.

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CHAPTER XXVI.

CONCERNING THE CAUSE OF CANCER.

The cause (pathogenesis) of carcinoma has for many years been a fascinating subject of inquiry and has led to much speculation, some of which has had great influence in directing research along particular lines. Great obscurity surrounds the cause of this disease, because our knowledge depends on observation alone; all attempts to elucidate the problem by experiment have been complete failures, therefore observation has been supplemented by theory. Among the hypotheses or guesses at truth in connection with this matter there are three which require consideration:—

1. The Embryonic.
2. The Parasitic.
3. The Biologic.

1. **The Embryonic Theory.** — Cohnheim attempted to ascribe the origin of malignant tumours to cells, or groups of cells, which are not utilised in the development of the body in its early or embryonic stages, and he assumed that these residues or "rests" retain potential powers of growth, and that later in life they suddenly and without obvious provocation assume active growth and become obvious as tumours.

This theory, unsupported by any concrete evidence, was advanced by Cohnheim as an explanation of the origin of connective-tissue and epithelial tumours. The great argument against it was to the effect that unutilised embryonic tissue or rests had not been demonstrated, but it suggested a line of enquiry in which observation proved the existence of tissue islands which in some instances could be regarded as potential sources of tumours belonging to the so-called innocent group. Experimental inquiry did not support the theory, and as an explanation of the origin of malignant tumours it has signally failed.

The term "rests" used in discussing the pathogenesis of tumours should be reserved for detached fragments of secreting glands and isolated portions of epithelium. Examples of this kind occur in connection with the spleen (splenculi); an accessory pancreas is well known, and it may be lodged in the wall of the duodenum or jejunum. Accessory thyroid glands and adrenals are by no means uncommon, and reference is made to them in the appropriate places of this book.

In addition to rests being represented by detached portions of an organ, it has been shown that they may occur as isolated portions of gland-tissue within the organ itself. Gland islands of this kind have been observed in the liver and in the mamma; it is possible that such sequestered portions of glandular tissue may be the source of encapsuled adenomata. Rests composed of epithelium have been detected in the line of the mesopalatine suture, and on the gums (see p. 249); but in the non-epithelial tissues they do not admit of ready recognition. The best examples are the islets of cartilage in the vicinity of the epiphysial lines of long bones in rickety children (p. 30). Such belated pieces of cartilage may be the source of chondromata.

Efforts have been made to extend Cohnheim's theory in regard to rests as an explanation of the origin of malignant tumours by supposing that islets of glandular tissue may be formed in organs as a result of inflammatory changes, such isolated tissues being supposed to acquire proliferative power and become tumours. In order to distinguish belated tracts arising in this way from the embryonic residues, it has been proposed to term them "post-natal rests." This extension of the embryonic hypothesis has not met with success.

Care must be taken not to confound rests with vestiges. The term vestige should be reserved for those organs which are of importance to the embryo and fœtus, but useless to the adult, such as the vitello-intestinal duct, the round ligament of the liver, the mesonephros, etc.; also the representatives of those organs which though utilised in the male are useless in the female, and *vice versâ*, such as Gartner's duct, the parovarium, etc. There are structures which, so far as we know, serve no useful purpose in any vertebrate at present living, but were doubtless of importance to their

ancestors. Examples of this are the central canal of the spinal cord, the cerebral ventricles, pineal eye, etc.

Cohnheim's theory has commanded much attention: it is in itself a brilliant generalisation, and has served a valuable purpose in leading to a great extension of knowledge in regard to vestiges and rests.

In regard to congenital defects of tissues as the subsequent sources of malignant tumours, the most obvious are those known as birthmarks or moles. Many hundreds of these blemishes come under the notice of trained observers yearly, but probably not one black mole in a thousand becomes the source of a melanoma, or an endothelioma.

2. **The Parasitic Theory.**—Many who are thoroughly acquainted with the clinical and pathological features of carcinoma feel strongly that this disease will ultimately come to be defined as *a chronic infective disease due to a micro-parasite which selects an epithelial cell.*

The brilliant results of microscopic inquiry during the last thirty years into the causes of disease have added to the number of parasitic diseases previously known to us.

It has become customary in describing the vegetable and animal parasites infesting man to speak of the Flora and Fauna of the human body. This application of a natural history expression is useful, perhaps even picturesque, and it is certainly an improvement on many of the dry and commonplace terms used in medical writings; moreover, the expression is true.

As the living things in a brook thrive best in certain haunts, so the vegetable and animal forms which infest animal bodies exhibit a marked preference for certain organs and tissues in which to live and grow. For example, the Demodex prefers the hair-follicles, whilst Ankylostomum selects the mucous membrane of the duodenum; the malaria parasite finds its way into an erythrocyte; filariæ swim freely in the liquor sanguinis; Coccidium oviforme finds its way into the epithelium of the biliary passages, and the embryo of Tænia echinococcus prefers subserous areolar tissue; whilst the adult form of this tapeworm chooses the mucous membrane of the dog's duodenum.

Among infectious diseases, the most extraordinary and

some of the deadliest are those in which the infecting agent gains access to the body by inoculation, that is, through abrasions, cuts, or punctures of the skin or mucous membrane. Familiar examples of this are tetanus, hydrophobia, leprosy, glanders, actinomycosis, and syphilis. The point of inoculation is known as the primary focus of the disease, and at this source the parasites multiply, enter the circulation and lymph stream, whence they may be distributed throughout the body, often to form secondary foci of disease which interfere with the functions of the organs in which they may chance to grow, as well as with the nutrition of the body by means of the toxins they brew and discharge into the blood, producing a form of slow poisoning.

The facts which support the parasitic theory of cancer may be summarised in the following way: In its initial stages the disease is purely local, then gradually it spreads to the adjacent tissues, and at the same time infects the lymph glands which receive the lymphatics from the affected area, and general infection of the body (dissemination) follows.

Some writers refer to the toxic effects (cachexia) exhibited by individuals with well-established cancer as evidence in favour of its parasitic origin; but Cooper believes that this toxic effect has been exaggerated, and points out that it is absent even in extensive cancer where no ulceration or external contamination is present. When micro-organisms gain access they find a malignant growth a favourable nidus for their development, and septic intoxication more or less rapidly ensues. This matter was discussed in the preceding chapter in relation with the manner in which death so often occurs in the cancerous by what are called *terminal infections* (see p. 284).

In many instances cancer seems to have a period of quiescence, and then to enter on a period of recrudescence exactly like a chronic infectious disease such as syphilis. The primary focus in this disease disappears after a time and leaves but little trace of its existence, so occasionally in carcinoma the primary focus may atrophy and become inconspicuous. The infectiveness and vitality of the cancer-cell have been already discussed, and form a strong argument for those who are seeking for a parasite; but to my mind the most

valuable evidence is supplied by the distribution of the initial lesions of cancer.

When cancer arises on those parts of the body easily accessible to observation, such as the lips and tongue, it is always preceded by a wound, chronic inflammation, or degeneration. It is also recognised that the disease occurs most frequently in situations where there is access of air, and on free surfaces, as in the case of the intestinal tract; and it is clearly established by a careful study of death-returns that in more than half the cases in which death is attributed to cancer the primary seat of the disease is in the digestive organs. The distribution of cancer in that part of the alimentary canal which occupies the belly is somewhat remarkable. For example, the stomach is not only the commonest primary seat of cancer when compared with other digestive organs, but it stands third in order of frequency among all organs, the breast (mamma) being first and the uterus second in order of liability. The small intestine (duodenum, jejunum, and ileum) is very rarely attacked by cancer, but in the rest of the canal (colon and rectum) it is a very frequent disease. Even in its attacks on the big bowel cancer exhibits a partiality at present inexplicable, for it is common to find it in the rectum and sigmoid flexure, but its appearance in the vermiform appendix and ileo-cæcal valve is phenomenal: and its presence in the cæcum may be fairly described as unusual. It is as difficult to explain the comparative immunity of the ileo-cæcal valve from cancer as to find an adequate cause for its excessive frequency at the pylorus.

Although the utmost vagary is exhibited by cancer in its topographic distribution in the alimentary canal, this is absolutely unfavourable to the embryonic theory, for the sites of the greatest events in its embryology are those which manifest the least liability to cancer.

The great feature which distinguishes carcinoma from all infective diseases is its property of producing secondary deposits which reproduce the structural details of the organ or tissue primarily affected. This is one of the most surprising facts in the whole range of pathology, and reference will be made again to this remarkable vitality of epithelium in dealing with malignant embyromata (see Chapter XLVIII.). In

the case of typical infective diseases like tuberculosis, the infective agents, the tubercle bacilli, are transported by the blood stream, and we are prepared to find a colony of the bacilli flourishing in the cancellous tissue of the calcaneum or the body of a vertebra, and these will cause a tissue lesion identical with those which would be formed if the primary tuberculous lesion was situated in muscle, brain, lymph gland, lungs, or kidney. This means that the bacilli are transported, but there is no actual transference of tissue.

The conclusion arrived at by the histological study of carcinoma has induced the majority of investigators to realise that the disease essentially originates in epithelial cells, and these elements of cancerous formations have been most perseveringly studied with the assistance of excellent microscopes and aniline stains. The method of cultivating the cells in nutrient media has been prosecuted with great ingenuity, but so far has been barren in results. From time to time hope has been raised that the micro-organism has been found, but only to end in disappointment.

3. **The Biologic Theory and the Cytologic Transformations observed in Malignant Tumours.**—Among the most important observations which have been recorded in relation to cells of malignant tumours, attention must be given to those made by Farmer, Moore, and Walker in relation to nuclear division.

It is known that in the production of sexual cells (gametogenic) in plants and animals, the forms of nuclear division differ materially from those exhibited by cells which compose the tissues of the body (somatic cells). The above-mentioned investigators have been able to trace in detail a number of definite and serial changes in the cells of invading and proliferating malignant tissues which are remarkably similar to those obtained during the maturation of the elements contained within the sexual reproductive glands, and this resemblance extends to minute points of detail.

These observations show that the various types of malignant growths present certain features in their cytological transformations common to all, and that these features are similar to those to be observed in the process of differentiation of reproductive cells from the preceding somatic tissue.

The evidence, the investigators believe, justifies them in correlating the appearance of these "gametoid" neoplasms with the result of a stimulus which has changed the normal somatic course of cell development into that characteristic of reproductive (not embryonic) tissue. These peculiar nuclear changes have not been observed in innocent tumours.

The same triad of investigators has succeeded in showing that the remarkable vesicular structures found in cancer cells, known as "bird's-eye inclusions" or Plimmer's bodies, occur normally in cells during the production of sexual elements in vertebrata. These bird's-eye inclusions consist of a well-defined wall enclosing a clear fluid in which is suspended one or more darkly-staining granules. In size they may be very minute, or may equal the nucleus. One or as many as twenty occur in the same cell; they commonly lie adjacent to the nucleus, which they frequently press, giving it a crescentic appearance. These bodies are very conspicuous, and were long regarded as peculiar to malignant growths; they acquired some notoriety on account of their resemblance to Plasmodiophora brassicæ, discovered by Woronin in 1876, as the cause of a disease of the edible Cruciferæ, especially cabbages: this relationship, however, has not passed beyond the bounds of speculation.

Now that Farmer and his co-workers have shown that the *archoplasmic vesicles*, as they have been called, appear during spermatogenesis in all vertebrates, and are to all appearance structurally identical with, and arise in a manner similar to, the "bird's-eye inclusions" in the cells of cancer (Plimmer's bodies), it rather weakens belief in their specificity for malignant growths.

The peculiar nuclear changes observed in the cells of malignant growths do not affect all the cell elements equally; those which show the changes in the highest degree are "situated in a zone behind the growing edge of the advancing neoplasm."

In the slow-growing tumours which produce a considerable amount of normal somatic tissue (fibrous tissue), cells showing the phases here referred to are far more difficult to find than in the rapidly growing tumours. In such growths, cells showing the figures of ordinary somatic division are numerous in

comparison with those showing heterotype figures. This would seem to indicate that the cells which are destined to form fibrous tissue never divide heterotypically.

These observers look upon this remarkable transformation as representing the immediate cause of development of the malignant growth, but the remote cause, the specific irritant, has yet to be found. Nevertheless, these interesting changes which they have detected constitute a valuable and interesting item in our knowledge of the cytology of malignant tumours.

Bonney has shown that a gametoid type of mitosis occurs in the cells of intracystic papillomata of the ovary and in the cells of the gonorrhœal wart.

In describing the histologic features of primary and secondary cancerous tumours, it was pointed out that the epithelium resembled that of the part in which the cancer arose primarily, and in the case of a carcinoma arising in a glandular organ, the cells not only resembled the cells of the gland, but the grouping of the cells, especially in the secondary deposits, was a mimicry, so to speak, of the gland itself. This peculiarity of carcinoma has attracted the close attention of all investigators who have made the structure of cancers a special subject of study, and this aspect of the matter has seemed to become more thoroughly established with each improvement and refinement in histologic methods, until it seemed to be a matter which did not admit of dispute.

The subject has been carefully investigated by Cooper, who points out in regard to it that no one has witnessed on the stage of a microscope the actual conversion of a normal into a malignant c d reminds us that cells of an embryonic type, and pos g considera le powers of reproduction, are normally present in our tissues throughout life, and play an important part in what may be called tissue maintenance; and he ventures on the suggestion that cancer cells are formed from the histogenic cells of the body, and are therefore most probably of a primary embryonic origin, but that they have departed morphologically and physiologically from the normal type of the histogenic cell. The cancer cell resembles its embryonic prototype from the fully formed, functionally active tissue-cell of the adult in the following particulars:—

(1) Its generalised shape, which, although variable and

irregular, inclines on the whole to be spherical; often, however, the natural shape is altered by pressure. (2) Its comparatively large nucleus, which often indicates evidence of division. (3) Its more or less homogeneous protoplasm and the large proportion of glycogen. The cancer cell differs from the normal prototype in several points, such as its simple method of cell division; powers of movement or migration; ability to engulf albuminous particles, and its proneness to undergo degeneration. These observations support the view that cancer cells are intrinsic to the body, and that they are derived from the pre-existing and presumably normal cells of the body.

The careful histological study of malignant tumours reveals in a decided way that in whatever kind of tissue a sarcoma arises, its malignancy may be fairly ganged according to the degree in which it departs from the normal towards the round-celled type of tissue: in the same way the greater the deviation of the epithelial cells of a cancer towards the spheroidal cell, and the more it caricatures in the arrangement of the cells the structure of the gland in which it arises, the more dangerous is it likely to be to the life of the individual in whom it occurs.

Perversions in type of this kind used to be expressed by the term *metaplasia*; but there is a tendency to restrict this name to express the mutation of epithelium from a columnar cell to the flattened or squamous kind.

The deviation of the tumour-tissues from the normal type towards the round cell in the case of connective-tissue tumours, and to the spheroidal cell in the case of epithelial tumours (carcinomata) is now conveniently expressed by the term *anaplasia*, and it is possible to express this structural alteration in the form of a law:—*The degree of anaplasia exhibited by a tumour represents the degree of its malignancy.* This is a scholastic form for expressing a fact long recognised, *that the more a tumour diverges from the type of its matrix the greater the malignancy.*

For many years after Virchow taught that every tissue in a tumour had a physiological prototype, it seemed difficult to find a satisfactory example of the erosive power of the cancer cells: but the researches into the remarkable tumour known

as chorion-epithelioma has taught that the trophoblast of the developing embryo resembles in this respect a malignant tumour, except that in health it affects a limited area of the maternal tissue; but when abnormal and excessive it exhibits malignancy in all its forms, recurrence after removal, wide dissemination and destructiveness (see Chapter XL).

The strongest argument against the parasitic theory is the failure to cultivate the cancer cell outside the body, and in this connection reference may be made to the important observations and experiments of Jensen on tame mice. It appears that mice are liable to tumours which run a malignant course. Jensen has been able to transplant portions of the tumour into other mice with success through nineteen generations. The original tumour occurred sporadically in a white mouse, and although the transplantations were successful with various kinds of mice except those known as blue mice, the experiments succeeded best with white mice. Jensen's experiments have been repeated in London by Dr. Bashford, and similar results have been obtained.

In order to emphasise the difficulty of what may be for convenience termed the cancer question, it is necessary to mention that competent pathological and bacteriological investigators who have devoted the most painstaking and laborious researches with the hope of discovering the cause of carcinoma and sarcoma are divided into two camps, namely, those who strongly believe that it is due to a microparasite, either a bacterium or some lowly animal form such as a protozoan; and those who think the disease is due to some altered conditions of the cells independent of parasites. The position for the non-expert in this matter is illustrated by the following lines from "Empedocles on Etna":—

> The gods laugh in their sleeve
> To watch man doubt and fear,
> Who knows not what to believe
> Since he sees nothing clear,
> And dares stamp nothing false where he finds nothing sure.

Whilst investigators are hunting for the *cause* of malignant tumours practical surgeons have to deal with the concrete disease.

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CHAPTER XXVII.

THE TREATMENT OF MALIGNANT TUMOURS.

With our present limited knowledge, the only method which affords any hopeful prospect to patients affected with cancer or sarcoma is *early and thorough removal of the affected part, and in the case of cancer it is also necessary to remove the associated lymphatics and lymph glands.*

This mode of treatment can be adopted when the patients seek advice at an early, and operable, stage. There are few organs in the body which have not been extirpated for this cause: *e.g.*, the breast, the eyeball, tongue, larynx, parts of the œsophagus, thyroid gland, stomach, long sections of the intestine, the cæcum and rectum: the kidney, penis, testis, prostate, and segments of the bladder, the ovary and uterus: the gall bladder and portions of the liver, and the entire spleen. There is nothing in the way of surgical ingenuity and enterprise that has been left undone, with the hope of affording relief to those suffering from malignant tumours. Yet they baffle surgical art by their insidious modes of growth, their indefinite limitations in the tissues and the infection of the lymphatic system, and, above all, by their property of quiescence, often for many years, and then of suddenly undergoing recrudescence and growing rapidly.

Inoperable Malignant Disease.—When cancer and sarcoma recur locally after operation, or, in their incidence, involve vital parts which cannot be subjected to operative interference, or affect an area of the body too wide to permit of removal, much can be done to make the patient's life more or less tolerable, and many methods have been devised with the object of checking their growth. Some of these will be considered.

Treatment of Inoperable Cancer of the Breast.—When cancer of the breast comes under the observation of the surgeon

after it has so widely implicated adjacent tissues, or infected the associated lymph glands to such an extent that it cannot be completely removed by operation or by caustics, it is said to be "inoperable"; and the same term is applied to cases in which the skin and internal organs are the seat of cancer nodules, and in patients with recurrent cancer infiltrating the chest wall, or implicating the large blood-vessels and nerves in the axilla. With the hope of doing good in these circumstances, Dr. Beatson, after careful reasoning on the effect which double oöphorectomy is supposed to exercise on the mammary glands, advocated the removal of the ovaries and Fallopian tubes, and the administration of the extract of thyroid gland; the object being to promote and hasten the fatty degeneration of the cancer elements.

The results in some instances where bilateral oöphorectomy has been performed have been astonishing. In some patients the disease has completely disappeared; in others the disappearance has been followed by recrudescence; and in one remarkable case under my own observation dissemination occurred after bilateral oöphorectomy, but the nodules subsequently disappeared. In many women the operation has temporarily checked the course of the disease, but in the majority it has had absolutely no effect.

Lett has recently published an analysis of ninety-nine cases of carcinoma of the breast treated by oöphorectomy, which practically confirm these conclusions. He points out that the best consequences occur when the patients are between the forty-fifth and fiftieth years, and that the operation has a mortality of six per cent.

It is at present impossible to state whether oöphorectomy is likely to take a permanent place in the surgical treatment of cancer of the breast.

Treatment by the X-Rays and Radium.—Great interest was aroused by the statement that the application of the X-rays has a remarkable deterrent effect on the growth of cancer. The matter has been tested in the most determined way by very competent men, and it may be stated that the effects of this mode of treatment are local, and only affect deposits of malignant disease which are exposed. It is impossible without injury to the skin to administer a

sufficiently strong exposure to modify growth in the viscera, although a moderate exposure relieves deep-seated pain. When superficial growths are exposed to the rays, pain is usually relieved, growth is retarded, and retrogressive changes induced which sometimes enable patients to resume an active life. (Lyster.)

The judicious exposure of rodent ulcer to X-rays or to radium not only heals the ulcers, but cures the disease, and, what is remarkable, leaves a scar which resembles the normal skin more nearly than any scar resulting from a surgical operation.

Drugs and Nostrums.—No drugs are known which in any way retard the growth of cancer. Periodically, remedies are vaunted and claimed as specifics in this disease, and are tried extensively by those affected with carcinoma. The drugs which have in recent years claimed attention more than others are Chian turpentine and salicylate of soda; in very exceptional cases some amount of improvement has been noticed in the rate of growth of large exuberant cancerous masses, and these drugs seem also to check the amount of discharge, but no real and permanent good has ever been recorded.

The list of things recommended as remedies by lay persons to their friends who suffer from cancer is almost inexhaustible, and includes powdered oyster shells, violet leaves, and things unmentionable, as well as incongruities such as the witches add to the stew in the famous cauldron in the opening scene of the fourth act of *Macbeth*.

The Toxin Method.—It had often been observed by surgeons that, when erysipelas attacked a cancerous breast, the growth of the cancer appeared to be checked for a time. It had also been noticed, especially by Campbell de Morgan, a former surgeon of the Middlesex Hospital, that when a cancerous breast had been removed and the wound became infected with erysipelas, a common event in those days (1870), recurrence would be delayed longer than in ordinary circumstances. These things existed as a kind of clinical tradition until Dr. William Coley traced out the subsequent history of a patient who had been under the care of Dr. Bull in the New York Hospital with a round-celled sarcoma of the neck

four times recurrent. Whilst in the hospital he had been attacked by erysipelas; during this attack the tumour disappeared, and Coley found the patient alive and well seven years later, 1891. This gave him the idea of curing patients with inoperable cancers and sarcomata by infecting them with erysipelas. He found it very difficult to inoculate cancerous patients with erysipelas, but he succeeded in those with sarcoma. From observation he satisfied himself that the streptococcus was the toxic principle. By further experiments he found that a mixed culture of the streptococcus of erysipelas and the bacillus prodigiosus was more controllable. Coley's original observations were published in 1891, and he has since given his latest results (1906) with a table of thirty-six cases treated by himself, and a table of sixty patients in which the method has been carried out by other surgeons. The results in some instances have been brilliant.

Some examples of spindle-celled sarcomata disappear by slow absorption; but the highly vascular round-celled type are more likely to degenerate rapidly, with the formation of sloughs. The more vascular the tumour the more likely is the injection of the toxin to be followed by severe reaction, which may be fatal.

The best results follow in spindle-celled sarcomata; the method has had no permanent result in melanotic sarcomata. The use of the toxin is not free from risk: its use is encouraging, but by no means certain.

In regard to the various methods advocated for the relief and "cure" of inoperable cancer, it may be stated that all the methods hitherto proposed are unreliable and uncertain. In the majority of cases they have no effect whatever, and even in the few instances in which the treatment has done good there has been no reliability as to the permanency of the improvement.

It is clear to the minds of all thoughtful men that no permanent advance can be made in the treatment of this dire disease until we know the cause of it, and then it is highly probable that we may learn how to prevent it. The cause of cancer and sarcoma remains a riddle, but let us hope that this riddle is one which will be read, and read

speedily: until then enthusiasts lean with great hope to the production of a serum with sufficient cytolytic power to induce rapid degeneration of the specific cells of these destructive tumours.

Palliative Treatment of Inoperable Cancer.—Apart from any hope of cure much may be done to make men's and women's lives endurable in the late stages of inoperable cancer, by keeping the fungating masses clean by frequent dressing; by checking the discharges by absorbent powders, and amending the horrible fœtor by the use of antiseptic solutions and ointments.

The careful use of purgatives and variations in diet are often of very great importance. The administration of alcohol in any form in a lavish and free-handed manner is a grave mistake, and as reprehensible as the unrestrained use of morphia.

Alcohol taken in the same moderation with food as the patient has been accustomed to in his usual manner of life is useful and harmless, and the administration of ten or fifteen grains of phenacetin twice daily is all that is necessary, even in cases of great and severe pain, and sufficient to give these patients comfort and keep them in that state of mind in which they can appreciate the visits of their friends, and take an intelligent interest in things around until death relieves them.

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CHAPTER XXVIII.

CARCINOMA OF THE BREAST.

CANCER arises in connection with the glandular elements of the mamma in two situations, namely, in the acini and in the ducts. The former, the most frequent and dangerous, is called *acinous cancer*; the latter, which will be dealt with in the next chapter, is known as *duct cancer* of the breast.

Acinous Carcinoma.—This variety presents much histological diversity, which has led to great confusion in surgical writings. In the most typical form it occurs as a solitary hard tumour, situated at the base of the nipple; but it may occur at any part of the gland, even at its periphery. When the tumour is near the areola it will often induce retraction of the nipple; when situated in other parts of the breast, it will lead to dimpling and puckering of the overlying skin.

On section such a tumour has the appearance and consistence of an unripe pear: microscopically, it will be found to consist of columns of epithelial cells, disposed like the lobules of the gland, and embedded in dense fibrous tissue. The tumour has no capsule, and fades away indefinitely into the surrounding tissues. When the parts beyond the tumour are examined, isolated collections of cells will often be detected.

In other cases the tumour is only moderately firm, and on section exhibits a succulent appearance. When microscopically examined it presents alveolar spaces lined with epithelium, here and there raised into irregularly shaped heaps. Such cases are difficult to distinguish from adenomata: but when the sections are attentively examined, parts will be found in which the alveoli are completely filled with irregularly shaped epithelial cells.

In many examples of mammary cancer the tumour, when bisected, appears to the naked eye merely like a tract of cicatricial tissue, and feels as hard as cartilage: when examined

microscopically, it will be found to consist of strands of fibrous tissue enclosing here and there a few epithelial cells. This variety is sometimes spoken of as "withering" or contracting cancer; it runs a much slower course than the preceding kinds, and gradually, by its contraction, causes the gland to shrivel, so that at length the patient presents an appearance

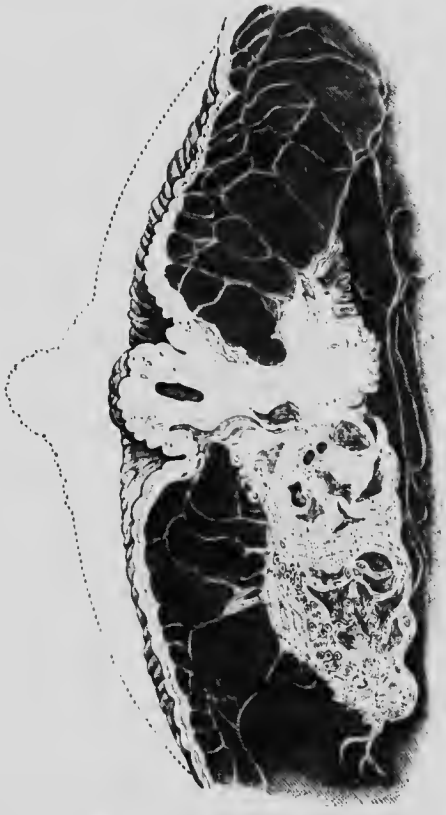

Fig. 166. Cancerous breast in section: the dotted line indicates the extent to which the nipple and areola have retracted.

as if the breast had been removed. Some of these cases have been known to last ten and even fifteen years.

Among unusual forms of cancer of the breast may be classed the rare condition in which it arises in a supernumerary mamma situated in the axilla. The best described example of this we owe to Paul.

Clinical Features.—Acinous cancer of the breast is never

manifest before puberty, and is rare before the age of thirty: it is most common between forty and fifty; after fifty it gradually becomes less frequent, and it is rare after seventy. I have seen it in a woman ninety years of age.

This variety of breast cancer occurs in the single as well as the married; in the sterile as well as in those who have had many children: in women who have nursed their offspring and in those who have never given suck. It also attacks the male breast. Mammary cancer is one hundred times more frequent in women than in men. Concurrent primary cancer of both breasts is not unknown, but it is an extremely rare event.

It is an important and well-established fact that cancer is more prone to attack a breast that has been the seat of previous disease (mastitis) than one that is obviously healthy, and Sir William Mitchell Banks has emphasised the importance of appreciating this fact in regard to successful treatment.

Cancer usually attracts attention as a circumscribed hard lump in the mamma; it never forms a large tumour—indeed, a mammary cancer rarely exceeds the dimensions of a fist. The rate of growth may be slow, often extremely slow, especially in old individuals. When cancer appears during lactation it progresses with frightful rapidity.

As the tumour increases in size it infiltrates surrounding tissues, becomes adherent to the fascia of the pectoral muscle, and even implicates the muscle. These infiltrated tissues shrink and cause the cancerous breast to become smaller, often much smaller, than its fellow (Fig. 166). The general shrinking of the breast is an important factor in diagnosis, and must not be confounded with *retraction* of the nipple, which is rarely of diagnostic import, as it occurs under a variety of conditions.

Lymph-gland infection occurs early in cancer, and is an important clinical sign. The glands of the axilla which run parallel with the free border of the greater pectoral are first affected, but the infection quickly extends to and involves the whole set, and in later stages the glands lying in the posterior triangle of the neck immediately above the clavicle enlarge.

It by no means follows that, because a tumour of the

breast is unassociated with large lymph glands, the tumour is not a cancer. By the time the glands are sensibly enlarged the tumour has made its way towards the surface, and at last the involved skin ulcerates. The advent of ulceration is heralded by a purplish or bluish appearance of the skin, which sometimes resembles a recent cicatrix with veins radiating from it, or the surrounding skin may be dotted with small knots of the size of a split pea or even larger.

After the skin breaks the ulcer tends to spread, and soon assumes the typical appearance of a cancerous ulcer: its edges are raised and rampart-like, and surround an irregular depression, the floor of which is formed of firm granulations, discharging a foul ichorous blood-stained fluid.

Nunn, in his work on cancer of the breast, gives some admirable and life-like pictures of the various stages of this disease.

Pain.—There is no symptom more variable in mammary cancer than pain. A large proportion of patients experience no painful sensations whatever, and are absolutely ignorant of the presence of any disease in the breast until their attention is arrested by some irregularity in its outline, or some marked difference in the comparative size of the two breasts. In some the pain is localised, but in others it radiates from the tumour to the surrounding parts. The pain in mammary cancer is usually a concomitant of the late stages of the disease. Pathology has totally failed to furnish an explanation why, in two patients of about the same age, temperament, and character, each having a tumour in the breast in corresponding situations, and in structure identical, one should suffer anguish too terrible to describe, and the other be absolutely free from pain, and often devoid of any feeling of discomfort.

Concurrently with, but more often subsequently to, infection of the lymph glands, secondary deposits occur in the viscera, especially the liver and lung; but any organ may be the seat of deposit.

When the liver is attacked it enlarges, and there may be hydroperitoneum, rarely jaundice: deposits in the lungs and pleurae set up pneumonia and pleurisy. When effusions occur in the pleurae, peritoneum, or pericardium, as a result of cancerous infection, the fluid is often blood-stained.

Secondary deposits in the brain give rise to mental alienation and coma. Deposits in the bones cause "spontaneous" fracture, and when the vertebral column is implicated paraplegia, preceded by acute suffering, is the usual consequence. Enlarged glands and secondary deposits may so involve large vessels and lymphatic trunks in the axilla as to produce solid œdema of the arm.

It must also be remembered that in the late stages of the disease the tissues covering the thorax may be infiltrated, and this local extension may implicate the ribs and directly infect the pleura.

One of the rarer effects of secondary deposits is when they break out in a great number of small knots over the skin on the front of the chest and both breasts, and induce such induration of the skin that it becomes so rigid as to resemble a firm leather shield, a condition which has earned for it the name of "cancer en cuirasse." In this extreme condition the skin is so firm and hard (pig-skin) that it is impossible to wrinkle it. This peculiar condition is probably due to cancerous invasion of the cutaneous lymphatics.

As the cancer extends locally and ulcerates, and more especially when there is evidence of secondary deposits, the patient's health begins rapidly to decline and the tissues to waste. It is astonishing how women with breasts infiltrated with cancer, or eroded by large and foul ulcers, will sometimes be able to get about and busy themselves with household matters; and this state of things will continue for many months, perhaps until the supervention of pleurisy, pneumonia, or some complication due to the dissemination of the cancer incapacitates them and extinguishes life.

Lymphatic Œdema.—This occasional complication of mammary cancer must be considered, on account of the inconvenience and distress it produces. It is a condition which cannot be mistaken. The œdema usually becomes manifest in the skin about the shoulder, and gradually extends to the skin of the arm, and in due course involves the forearm and hand; the skin covering the scapula is also implicated. The limb in typical cases has a swollen appearance, as though anasarcous: but when the skin is pressed

instead of pitting on pressure it will be found firm, brawny, and unyielding.

The limb grows extremely heavy, and the patient finds it necessary to support it in a sling; exceptionally the weight of the limb prevents the patient from taking walking exercise, and usually produces a moderate degree of lateral curvature of the spine. The connective tissue may be so infiltrated with lymph that the skin becomes sufficiently tense to prevent movement at the wrist, elbow, and shoulder: under such conditions the arm resembles a wax cast rather than a living limb, and is absolutely useless.

When the tissues of such a limb are examined immediately after death, it will be noticed that the increase in size is due to infiltration of the subcutaneous tissue with lymph, which causes the cut surface to resemble in colour and in texture the pulp of a succulent orange, and large quantities of lymph flow from the incisions. The muscles are smaller than natural and infiltrated with fat. In the character of the fluid which exudes from the limb, and in the firmness of the infiltrated connective tissue, it resembles the œdema characteristic of myxœdema.

In the condition we are considering, the obstruction to the lymphatic circulation of the upper limb is due to the pressure of lymph glands infiltrated with cancer, or to secondary nodules lying in the course of the main lymphatic channels at the apex of the axilla. Exceptionally it complicates the rare form of cancerous dissemination known as cuirass cancer.

Lymphatic œdema of the upper limb may supervene in patients with cancerous breasts who have never been submitted to operation, in those in whom the axillary lymph glands were removed when the breasts were amputated, and in those whose axillæ were not interfered with. Many more cases have come under my notice in the right than in the left arm. Pain is experienced in the limb by most of the patients, and it is often very severe. This is due not to the œdema, but to the enlarged glands or cancerous nodules pressing on the cords of the brachial plexus or their branches.

Treatment.—With our present knowledge, the only method of treatment which offers any hopeful prospect to individuals affected with mammary cancer consists in the removal of the

whole breast with its outlying lobules, of the skin overlying the breast, the pectoral muscle with its fascia, the lymphatics which run from the breast to the axilla, and the axillary lymph glands. Handley, who has carefully investigated the serpiginous way in which the cancer cells permeate the deep fascia, advises the wide removal of this fascia, especially in the direction of the epigastric region (Chapter L) in order to prevent the cancerous invasion of the abdomen.

Unfortunately the chief difficulty the surgeon finds in recommending this very clumsy though appropriate remedy arises from the circumstance that patients so often conceal the fact that they have a tumour until compelled by pain, discomfort, and often actual misery, induced by ulceration and sloughing of the cancer, to seek advice. There is, of course, a small proportion of women who absolutely refuse to submit to operation in the early hopeful stages, and wait until the skin becomes involved before they realise their unfortunate condition. When the tumour has been allowed to run its course and infect the axillary lymph glands or ulcerate, the chance of doing good by operation is seriously diminished.

Careful observations show clearly enough that those patients do best who have the cancerous mamma extirpated at the earliest possible date after the tumour is perceived. There is a consensus of opinion among surgeons who have had the largest experience in cancer that when a patient comes under observation with a nodule in the mamma which it is reasonable to regard as cancerous, it is the duty of the medical attendant to advise the removal of the breast. It is, however, a remarkable fact that mammary tumours, innocent and malignant, have been subject to observation for centuries, yet there is no organ in the body in which tumours give rise to more doubt or difficulty in diagnosis than in the mamma. This is so generally recognised that it is the duty of every surgeon, before amputating a breast, to make an incision into the swelling, in order to assure himself that he is really dealing with a malignant tumour and not a simple cyst, abscess, or localised inflammation.

The most favourable cases are those in which the cancer is limited to the breast, does not involve the skin, and has not produced any appreciable enlargement of the axillary lymph

glands. In such a case the removal of the whole breast, with the underlying fascia, lymphatics and lymph glands, is a proceeding which, if properly carried out, is devoid of operative risks: recurrence or dissemination is indefinitely delayed, and the patient may enjoy many years (five, ten, or even fifteen) of useful life.

When the cancer has been allowed to implicate the skin, or has ulcerated, and there is extensive infection of the lymph glands, then very wide removal of the tissues is imperative. This necessarily adds to the risks of the operation: and though in many instances patients have allowed the disease to advance in this way before coming to the surgeon, yet a fair proportion enjoy some years of immunity from recurrence, but their expectation of life is not great. The difficulty the surgeon has to contend with in this stage is uncertainty of the presence of secondary nodules in the viscera.

When cancer of the breast extensively involves the skin and has ulcerated deeply—and especially if it implicates the pectoral muscle and chest wall—then operation is useless.

Although it is extremely difficult to indicate even approximate rules as to the advisability, or otherwise, of operating in certain conditions of mammary cancer, there are cases in which it can be definitely laid down that operations are useless. For instance:—

1. When the supraclavicular lymph glands are enlarged. Such extensive infection of lymph glands indicates that the mediastinal set are probably involved.
2. When a large area of skin is implicated, and particularly in cases where it is brawny or beset with small nodules (cuirass cancer).
3. In every case where there is reason to believe that dissemination has occurred.

Perhaps one of the most extraordinary facts connected with mammary cancer is this:—Two patients may have their breasts removed for cancer; they may be alike in age, habit of body, and circumstances; the tumours may be alike as far as eyes, fingers, and microscopes can determine; the operations may be conducted by the same surgeon and by the same method, yet one patient may die in a few months with wide

dissemination, and the other may be spared ten or even fifteen years. Herein lies all our difficulty, for the surgeon, however wide his experience, cannot forecast from the clinical character of the tumour the future of his patient; neither can the morbid histologist predict the course of the case. Even when a competent knowledge of surgery and pathology has been combined in an individual operator, he rarely ventures to prophesy. It may be truly said that some cases for which surgery seemed to promise much have been tragic failures, and that some which seemed almost hopeless have given admirable results after operation. This state of things is not due to any supineness on the part of pathologists, for, as Rindfleisch has so pertinently written: "The tumours of the female mammary gland have been so often, and already at so early a period, the subject of earnest histological investigation, that in this sense we might not improperly call the mammary gland the nurse of pathological histology."

It has already been mentioned that cancer rarely attacks both breasts: it, however, occasionally happens that, after one breast has been removed for cancer, the disease appears in the other.

Recurrence.—It is now clearly established that local recurrence after removal of a cancerous breast is due to two causes, namely, incomplete removal and cancer infection. In respect to imperfect operations, Sir Benjamin Brodie, many years ago, wrote in regard to the removal of the whole breast:—"You may imagine this is a very easy thing to be done, but it is not so easy in reality; for in amputating the breast you will be very apt, in a thin person, if you are not very careful, to leave small slices of the gland of the breast adherent to the skin, and I have no doubt that the part or parts thus left behind in some cases have formed the nidus of future disease." We now know this is perfectly true. I have, in several instances, carefully examined microscopically small recurrent nodules, and found them associated with small fragments of gland tissue. A more serious form of recurrence is due to insufficient removal of the overlying skin: in this event, after the wound has healed, the skin around the cicatrix is often converted into a hard, brawny plaque.

Sometimes the surgeon removes a cancerous breast, takes

every care to keep wide of the tumour in making the skin incision, dissects out the gland tissue, removes the major and minor pectorals, and clears the lymph glands, with the surrounding fat, from the axilla. He closes the wounds, and congratulates himself on the completeness of the operation. Occasionally his industry is rewarded, but now and then these extensive enterprises are followed by rapid and wide recurrences, which often take the form of infiltration of the skin raised in the operation and of the underlying chest wall. This dire result is due to the distribution of cancer cells in the course of the operation; in short, to **cancer infection** (see p. 285).

The practice followed by many surgeons of rudely pulling out the axillary lymph glands one by one, especially if they be cancerous, is very liable to infect the connective tissue of the armpit, and lead to the formation of a hard, brawny induration of the axillary tissues.

For a long time I have been particularly careful, in clearing out the axilla when extirpating the mamma for carcinoma, to treat the adipose tissue with its lymphatics and embedded lymph glands as if they were one organ, and dissect these tissues from the chest wall with great care. The remote consequences of this proceeding have been very gratifying.

Broadly reviewing the whole subject of operation for the relief of cancer, we must admit that our present mode of treating it, namely, "to cut out the diseased organ or part affected," though extremely clumsy, is the only really effectual method as yet devised.

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CHAPTER XXIX.

CARCINOMA OF THE BREAST (*continued*).

DUCT PAPILLOMA AND CARCINOMA.

Towards the approach of the menopause the breast enters into a resting stage; its glandular structures shed their epithelium, atrophy, and nothing but ducts remain.

Breasts in this condition often present on their deep surfaces large numbers of cysts varying in size from a mustard seed to a cherry. These are often called *involution* cysts, and are filled with mucous fluid which causes them to assume a bluish tint when the breast is examined after its removal from the body. The cysts are most abundant on the deep surface of the gland.

Cystic breasts of this kind are most frequently met with between the forty-fifth and fifty-fifth years. In sterile women they occur somewhat earlier, and, as a rule, both breasts are affected. When cystic disease of this kind is more advanced in one breast than the other, it is apt to be mistaken for diffuse cancer. This variety of cystic disease is often accompanied with pain. Cystic mammary glands of this character require attentive study, because the walls of the dilated ducts are occasionally the starting points of cancer. In rare instances villous processes, or papillomata, sprout from the walls of such cysts, particularly when the cysts represent dilated lacteal sinuses.

When cancer arises in dilated mammary ducts, it is customary to speak of it as "villous or duct cancer of the breast." It is a rare variety of disease, and runs a less malignant course than the common or acinous type of mammary carcinoma.

In describing adenomata and cysts of the breast, it was pointed out that a galactophorous duct not infrequently dilates and forms a cyst of some size, and occasionally the terminal duct by which it opens on the nipple becomes patent and allows the pent-up fluid to escape from time to time. The

close relation of these cysts to the nipple, and the possibility of obtaining fluid by gentle pressure, are valuable diagnostic signs.

In some of these cysts epithelial processes or warts sprout from some part of the cyst wall, and occasionally they are so

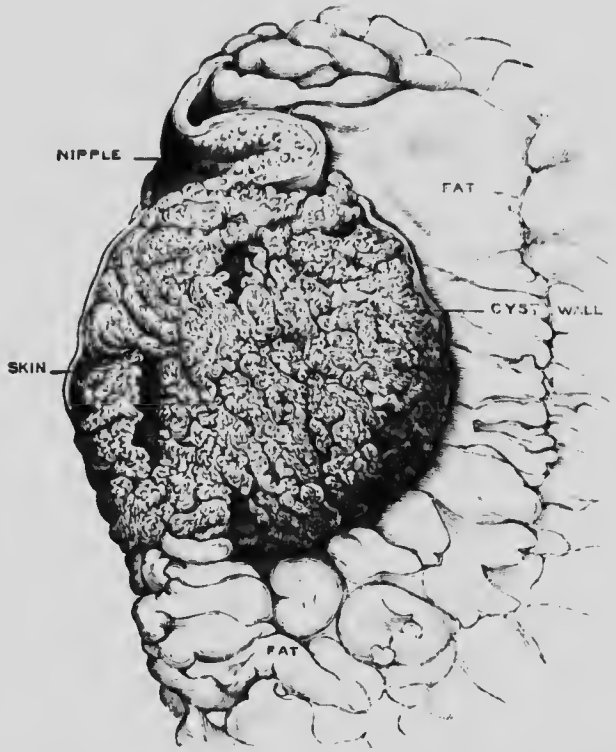

Fig. 167.—Section of a mamma with a dilated duct filled with villous papillomata. The nipple is inverted, not retracted. (From a woman 68 years of age.)

vascular that they bleed easily, and then the fluid escaping from the cyst is tinged with blood. The warty growths in such cysts may be firm and not bleed; in others, when they are very vascular, they resemble in colour and shape a ripe mulberry, projecting into the cyst. Rarely they sprout so luxuriantly as to fill the cyst with delicate papillomatous processes like the villous papillomata so common in the urinary bladder. The specimen depicted in Fig. 167 illustrates this. I removed this breast from a woman sixty-eight

years of age; before the operation it formed a tumour as large as a ripe plum, and of the same colour, by the side of the nipple, and the blood-stained fluid exuded in such quantity as to soak her clothes, and compel her to seek relief. Structurally, these villous processes resemble vesical papilloma, and this explains the readiness with which they bleed. A villous papillomatous cyst has been observed in the breast of a boy, and the specimen is preserved in the museum of St. Bartholomew's Hospital. (See also Robinson.)

The essential histologic difference between a wart and a cancer is, that in the wart or papilloma the epithelium merely covers its surface, whereas in a cancer it dips into the subjacent tissue. Clinical observations long ago taught surgeons that warts are liable to become the starting points of cancer, and the microscope has shown that this is due to the epithelium at the base of the papilloma, instead of remaining restricted to the surface, beginning to invade the underlying tissues, and becoming malignant. The cause of this invasiveness or aggressiveness we do not know, but it is the essence of malignancy as typified in cancers. The warts in papillomatous cysts of the breast behave like warts on the skin in this respect, and the result is what surgeons term "duct cancer." It must not be inferred from this that duct cancer is to be regarded as always beginning as a villous papilloma, subsequently becoming cancerous; it is quite certain that the disease may begin as a soft, smooth, round bud on the wall of a cyst without the least suggestion of a villous or a warty surface, but this bud contains epithelium-lined spaces. The specific character of duct cancer of the breast is this: the cancerous nodule is contained in a cyst. It is also noteworthy that in two patients in whom recurrence occurred after amputation of the breast—a rare sequel in this species of cancer—the recurrent nodules took the form of cysts the size of cherries, and each cyst contained a soft, sessile, purple wart bathed in blood-stained fluid, so that when the cysts were exposed in the course of removal, they resembled, in colour melanotic nodules.

Metastasis or dissemination of duct cancer is rare. I have never seen an example. Shattock made an interesting observation in relation to this: he found in the museum a rib

preserved on account of a secondary nodule of cancer which it contained. On microscopic examination this nodule presented the characters of a duct cancer of the breast. The history of the case was consulted, and it contained the statement that the patient, a woman aged sixty years, had suffered amputation of the breast a few weeks before her death, on account of a tumour it contained. "It is recorded that the breast was generally believed to be scirrhous, but that some of those who saw it had doubts on the point."

In the majority of instances duct cancer appears as a solitary tumour in the breast near the nipple, usually of the size of a walnut, but it may reach the size of a large ripe orange: exceptionally, two or more independent tumours may be present. There is no retraction of the nipple, nor implication of the skin.

Clinical Features.—Duct papilloma and duct cancer appear most frequently between the ages of thirty-five and sixty-five. The tumour is always softer than in the common or acinous variety. When seated near the skin it assumes a dark red or even purple tint, and has even been mistaken for a melanoma. The nipple is not retracted, but may be inverted (Fig. 167). This is, however, a sign of no value. In a very large proportion of cases there is an abundant discharge of blood-stained fluid from the nipple. The tumour grows very slowly, rarely implicates the lymph glands, and exhibits very little tendency to recur or to become disseminated. It is the least malignant variety of mammary cancer.

Treatment.—This consists in the free removal of the breast and the associated lymphatics and the axillary lymph glands, as well as the pectoral fascia. The results of this form of treatment, immediate and remote, are admirable.

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CHAPTER XXX.

EPITHELIAL TUMOURS OF SEBACEOUS GLANDS: AND RODENT CANCER.

The consideration of tumours connected with sebaceous glands naturally follows upon that of tumours of the mammary gland, because this is regarded as being a highly specialised sebaceous gland or group of glands.

Tumours connected with sebaceous glands are:—1, Sebaceous cysts or wens; 2, sebaceous adenomata.

1. **Sebaceous Cysts** (Wens).—The sebum resulting from the activity of a sebaceous gland escapes as it is formed on to the free surface. Should the orifice of the follicle become occluded, the secretion is retained, and the glandular acini, becoming distended, give rise to an appreciable swelling known as a sebaceous cyst. This is the usual description of the mode by which these cysts arise; but even a superficial examination of a number of sebaceous cysts will serve to show that in many there is no obvious obstruction—indeed, the duct may be widely open and the sebum exuding, so that obstruction of the duct is not an explanation that will cover all cases.

It has long been known that the sebaceous follicles often contain one or more examples of the Demodex folliculorum. It is usually stated that these arachnids are harmless, and their presence is merely an epiphenomenon. A good account of this demodex is given by Thudichum.

These cysts occur in all situations where sebaceous glands abound; an exceptionally common place is the scalp. The cyst may be single; sometimes many are present—indeed, sixteen or more may be counted on one scalp. In size they vary greatly; many are as large as walnuts; others are of the size of peas; they are rarely bigger than Tangerine oranges.

In most situations sebaceous cysts are readily recognised.

as they are distinctly circumscribed and lodged in the skin. On the surface of sebaceous cysts occurring in any part of the trunk and head save the scalp, close scrutiny will reveal either a black dot or a small dimple. This is the orifice of the follicle, and on picking off the black spot and squeezing the cyst, sebum will exude, and thus furnish positive evidence of the nature of the cyst. It is a curious fact that in wens of the scalp the orifice is rarely seen, except those which occur along the junction of the skin of the forehead with the hairy scalp. A sebaceous cyst, unless it has been inflamed, is easily

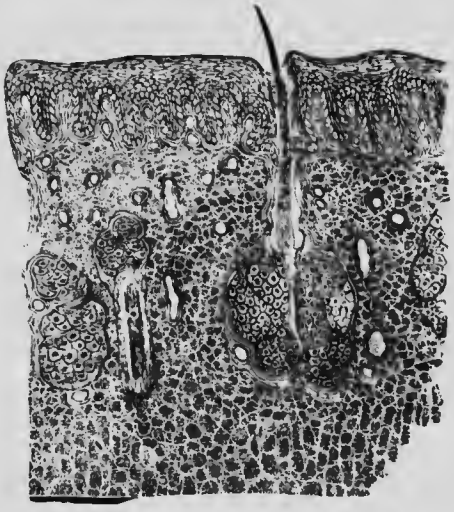

Fig. 168.—Sebaceous glands in the velvet of the antler of a stag (*Cervus elaphus*).

shelled out of its matrix. It then presents a capsule and contents. The capsule may be exceedingly thin and pliant, the inner surface presenting an epithelial lining; or it may be laminated, thick, and hard. The contents of the cyst may be pultaceous material, consisting of shed epithelial scales, fat, and cholesterin; or laminæ of firm, yellowish-white material, arranged like the layers of a bulb. These laminæ represent the epithelium of the lining wall that has been shed in successive layers. In rare instances the contents of sebaceous cysts calcify. Sebaceous cysts are sometimes mistaken clinically for dermoids, and *vice versâ*.

Sebaceous cysts occur in the "velvet" covering the growing antlers of deer. The "velvet" of a growing

antler is covered with fine downy hair furnished with large sebaceous glands (Fig. 168).

Sebaceous cysts, apart from the inconvenience their presence often causes, and their unsightliness when growing in exposed situations, become sources of discomfort when their contents decompose or the cyst inflames: they are liable to secondary changes, whereby they form peculiarly foul and fungating ulcers, or they may develop horns (see Chapter XXIII.). Each of these changes will be considered.

Decomposition of the Contents.—It has already been mentioned that the contents of a sebaceous cyst sometimes ooze from the orifice of the follicle. In some instances such cysts give rise to an extremely offensive odour. This is due to decomposition of the cyst contents in consequence of admission of air, and as the substance within the cyst contains a large proportion of fat and epithelium, the odour evolved is not difficult of explanation. Decomposition of the cyst-contents occurs independently of inflammation of the cyst, and is almost confined to sebaceous cysts occurring on the trunk.

Inflammation of the Cyst.—When sebaceous cysts grow in situations where they are exposed to injury, as for instance, on the side of the head, where they may be injured by the hat, or on parts of the body where they are liable to be rubbed by the clothes, they are apt to inflame and suppurate. An inflamed sebaceous cyst has a characteristic colour, and resembles the deep red of a ripe plum. Such inflammation may subside and recur. These recurrent attacks of inflammation cause firm adhesion between the capsule of the tumour and the skin, which renders its removal somewhat tedious. When it suppurates the wall thins, and at last bursts, unless this result is anticipated by the timely use of a scalpel. The suppuration often leads to its cure; but fragments of capsule may be retained and lead to the formation of a sinus. In some instances the cyst bursts, the pus escapes, and the point of rupture heals, the cyst wall being retained. When this is the case the cyst refills with sebaceous matter. Thus, in dealing with these cysts surgically, it is an important thing to remove thoroughly every particle of the cyst wall. Occasionally, especially in old persons, a sebaceous cyst inflames, suppurates,

and fungates, producing a foul offensive mass which is often mistaken clinically for a cancer (Fig. 169).

2. **Sebaceous Adenomata.**—It has been so customary to regard all tumours arising in connection with sebaceous glands as wens or sebaceous cysts, that it is quite an exceptional event for them to be submitted to microscopical examination. It has already been pointed out that there are two varieties of sebaceous cysts, one in which the cyst contains sebum and epithelial *débris*, and another in which the contents are arranged in thick laminæ. In addition to these, tumours

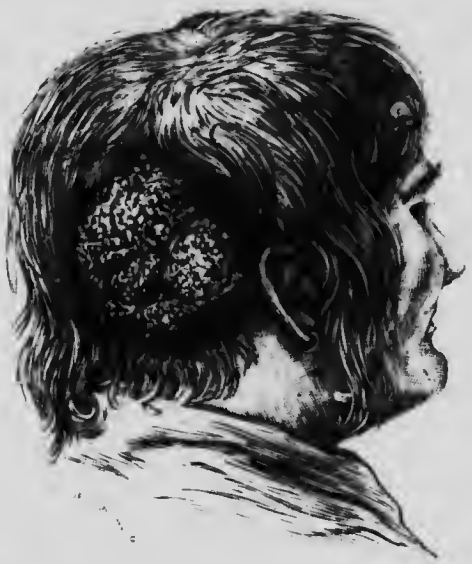

Fig. 169.—Fungating wen on the scalp of a woman 83 years of age.

occasionally occur in the skin and furnish the usual clinical signs of wens; but when removed and examined microscopically they are found to be composed of lobules, which structurally resemble the exuberant masses upon the nose that used to be called lipomata, but are now known to be due to overgrowth of the large sebaceous glands that occupy the skin in this situation (Shattock). These tumours are sebaceous adenomata, and they are liable to ulcerate, and exceptionally to calcify (Eve).

Treatment.—A sebaceous cyst is easily removed: when

the skin covering one is incised and the capsule exposed, the cyst usually shells out quite easily. When the cyst has been inflamed and is firmly adherent to the skin, some little dissection will be necessary to effect its removal.

A suppurating cyst can in many instances be dissected out. Often, however, the wall is so thin that the cyst is best treated as an abscess—that is by free incision.

Before surgeons appreciated the importance of extreme cleanliness, the removal of sebaceous cysts was often followed by septic inflammation. An excellent notion of the fears which surgeons entertained in regard to secondary complications after the removal of wens is furnished by the case of George IV., who had a sebaceous cyst on the top of his head. This formed the subject of a serious consultation, attended by Cline, Astley Cooper, Brodie, and others. Eventually Cooper, with Cline's assistance, removed the wen; and his anxiety lest erysipelas should supervene seems scarcely compensated by the baronetcy which the king bestowed upon him as a reward for the successful issue of the operation. (Life of Sir Astley Cooper, Vol. II, Chapter IX.)

Brodie refers to this case thus:—"Eventually the operation was performed by Sir Astley Cooper, in the presence of Sir Everard Home, Mr. Cline, Sir William Knighton, the King's physicians, Sir Henry Halford, Sir Matthew Tierney, and myself; making a very large assembly for so small a matter."

Cancer of Sebaceous Glands (Rodent Ulcer).—In British writings on surgery, it has been customary for many years to describe under the name of rodent ulcer a form of cancer which exhibits extraordinary clinical characters. In its common form a smooth, rounded knob of about the size of a split pea is noticed on the skin of the face, either on the nose, eyelids, orbital angles, or cheek. This knob may remain for years (seven, eight, or even twelve), and cause no inconvenience save unsightliness; then without obvious reason it may ulcerate and destroy the surrounding skin and underlying tissues, involving all tissues in its vicinity—skin, muscles, fat, cartilage, eyeball, and bone—and producing horrible destruction of the face, in some cases even destroying the base of the skull and meninges, and exposing the brain. To produce such terrible effects the disease requires sometimes five, ten,

or even more years. In its course it destroys everything, never cicatrises, and is painless.

In recent years the histology of the early knobs which mark the beginning of the disease has been investigated with great care. All observers agree that the disease begins as a solid growth beneath the epidermis. If in this stage the nodule is excised and sections are examined microscopically, it will be seen to consist of gland-ducts filled with epithelium, though sometimes they take the form of solid cylinders. In the later stages, when ulceration is in full sway, these appearances are lost.

The origin of the initial knob has been ascribed to the following sources:—1, Sebaceous glands; 2, sweat glands; 3, the hair follicle; 4, the outer layer of the root sheath of a hair; 5, epithelial remnants in the course of the facial fissures; 6, vestiges of the tear pits of ruminants; and occasionally a hairy mole. My own investigations induce me to ascribe its origin to the sebaceous glands.

Although rodent cancer arises mainly in the facial situations already mentioned, it may occur on the neck and the pinna: it has been met with on the trunk, but never, so far as I know, on the limbs. It occurs most frequently in advanced life, but is not uncommon between thirty and fifty. It has been recorded at the age of twenty, but never before puberty (fifteenth year). It is more frequent in men than in women. The extraordinary features which distinguish it from the common kinds of cancer are the following:—1, It does not infect lymph glands; 2, it does not disseminate; 3, though as a rule solitary, it may be, and often is, multiple; 4, its duration may extend over many years.

Treatment.—When exposed to radium the disease is rapidly arrested, and *the ulcer heals without leaving a scar.*

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CHAPTER XXXI.

EPITHELIAL TUMOURS OF THE THYROID GLAND.

Adenomata.—Two varieties of adenoma are met with in the thyroid gland; by most writers they are described as adenomatous goitre and cystic goitre or bronchocele, to distinguish them from the general enlargement of the entire gland known as "parenchymatous" goitre. A thyroid adenoma is an encapsuled tumour of the thyroid gland containing vesicles of the same character as those which make up the normal gland. The size of these adenomata varies greatly; many are no larger than cherries, whilst others are bigger than fowls' eggs. When both lobes contain an adenoma the gland will maintain its normal shape; when one lobe only is involved, the gland becomes unsymmetrical: exceptionally, an adenoma will develop in the isthmus. As the tumour increases in size the vesicles coalesce, the septa gradually disappear, and a thyroid cyst or bronchocele is formed. Bronchoceles sometimes attain very large dimensions, and six or more may grow concurrently in the same gland. Their capsules are formed of dense fibrous tissue, which may contain calcareous plates; in some old specimens the capsules are converted into calcareous shells. Small bronchoceles contain a thick peripheral stratum of glandular tissue; their central cavities contain colloid material or a thinner fluid of a reddish colour, due to hæmorrhage: not unfrequently the fluid is largely charged with cholesterin. In very large bronchoceles all traces of gland tissue disappear: nothing remains but a tough, more or less calcified, cyst-wall.

Aug. Reverdin recorded a case in which an old man of sixty-two years had a cystic adenoma of the thyroid 60 cm. in circumference. On its being punctured a large number of bodies, white in colour and crenate like mulberries, escaped with a large quantity of brown fluid. Reverdin stated that the composition of these bodies was like coagulated fibrin.

Bronchoceles sometimes attain great proportions. Bruns removed one which was so large as to reach as low as the navel, and its weight produced lordosis in the cervical and kyphosis in the thoracic regions of the spine (Fig. 170). The cyst was single-chambered; the walls were in part calcified. The tumour was so heavy that the woman was in the habit of resting it upon the table when she sat down.

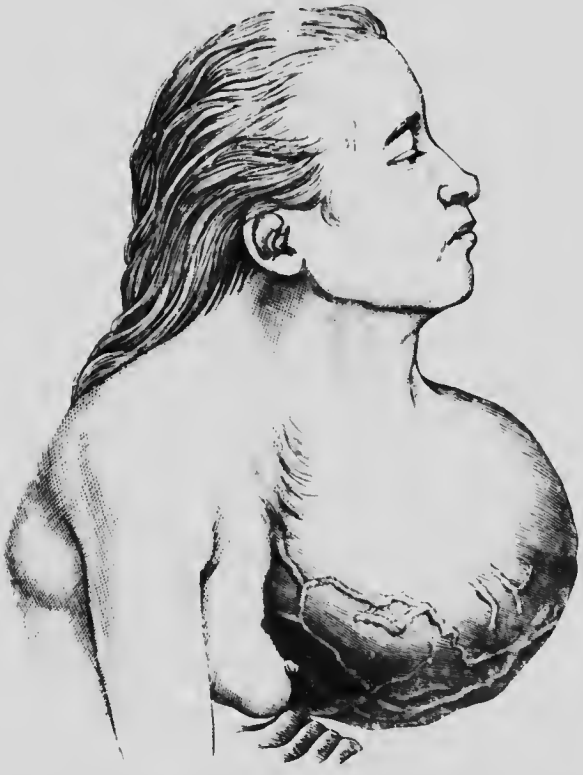

Fig. 170.—Bronchocele of unusual size in a woman aged 58 years: it was successfully enucleated. (*P. Bruns.*)

Mention must be made of a very rare form of thyroid cyst in which the walls are beset with papillomata. Cysts of this kind are apt to recur after removal (Barker and Pollard).

Treatment.—Adenomata of the thyroid gland and bronchoceles, when of small size, rarely cause trouble, and a unilateral bronchocele the size of a closed fist, though it appears unsightly, is often quite harmless. Large broncho-

celes sometimes cause pain, and when they press upon the trachea give rise to dyspnœa, which will in some cases become so alarming as actually to endanger life. There is a very rare variety known as **wandering goitre,** on account of its mobility. So long as the tumour restricts its excursions to the neck no harm results; but occasionally these tumours will descend as low as the thoracic inlet. When this happens, the bronchocele becomes squeezed between the manubrium of the sternum and the trachea. This impaction induces urgent symptoms of dyspnœa.

When, from unsightliness or other causes, it is deemed necessary to interfere with an adenoma of the thyroid or a bronchocele, it is safe practice to enucleate it. The affected lobe is exposed through a median incision, and the thyroid tissue incised until the capsule of the tumour is exposed. By means of a raspatory the adenoma can be shelled out of its bed quite easily. This method of treatment is quite as efficient as thyroidectomy, and the patient runs no risks of hæmorrhage, tetany, or myxœdema.

The success with which such operations can be carried out is demonstrated by the results recorded by Kocher, who has performed 555 consecutive operations for "colloid struma" with one death, and this was due to the anæsthetic.

The large bronchoceles, although very unsightly, are not so likely to lead to mischief as the small bronchoceles and the more solid adenomata which compress the trachea laterally, causing this air-duct to assume the shape of a scabbard (Fig. 3).

Carcinoma.—The thyroid gland is liable to carcinoma and sarcoma, but the clinical effects of the two diseases are so much alike that it is scarcely possible to determine between them.

Cancer of the thyroid is an extremely rare condition in England. Cancer is more liable to attack a diseased thyroid than one which is healthy, and this probably explains its frequency in goitrous districts.

Cancer of the thyroid usually occurs between the fortieth and sixtieth years. I had a case under my care in a girl seventeen years of age; the nature of the tumour was determined by microscopic examination of portions of the growth removed during life. In its early stages it resembles an ordinary goitre, but it steadily increases in size and becomes

very hard, and afterwards bossy outgrowths disturb the regular outline of the gland: this is always a suspicious sign, and when it is accompanied by pain and paralysis of the recurrent laryngeal nerve it indicates that the adjacent parts are being infiltrated; this is also indicated by the fixity of the enlarged thyroid. In the course of the case the internal jugular vein and the carotid artery may be implicated, and even the nerves of the brachial plexus, but the most serious local effect is due to the disease extending into the trachea. This is a very serious feature of the tumour, because the implication of the trachea not only induces dyspnœa, but when the intruding process ulcerates it sets up septic pneumonia, which is usually rapidly fatal. In the early stages of the disease the tumour may so resemble an ordinary bronchocele that the surgeon attempts to enucleate it: this happened to me on one occasion, but the free bleeding and indefiniteness of the tumour soon apprised me of the nature of the case. The patient recovered from the operation, but a huge fungating mass slowly made its way through the cicatrix and destroyed life in eight months. It is a significant fact that there is a very scanty literature in relation to the operative treatment of malignant disease of the thyroid gland, which is a clear indication of its comparative rarity and the hopelessness of operative treatment. There is a feature of carcinoma of the thyroid gland which must be referred to, and that is the infrequency with which it disseminates. That it occasionally gives rise to secondary deposits is beyond dispute, and the similarity of the structure of the secondary nodules to the closed follicles of the thyroid has been made the subject of much careful study.

General Thyroid Malignancy.—This term is applied to a rare but very remarkable form of disease, in which tumours structurally identical with the thyroid gland appear in the bones. The fact which invests them with more than ordinary interest is that they have, in nearly all instances, been associated with an obvious enlargement of the thyroid, which clinically is indistinguishable from the common kind of enlargement known as parenchymatous goitre. The earliest cases were observed by Cohnheim and Morris.

Since 1880 a score of cases have been described, and from

the records the following facts may be stated: The tumours occur most frequently in women (5 to 1), and are most common between the fortieth and sixtieth years, but one case has been observed as early as twenty-six. They show a striking preference for the skull, but have been observed in the femur, clavicle, sternum, humerus, and on several occasions in the vertebrae.

In some of the patients the secondary tumours are large, and pulsate. In the extraordinary case recorded by Cramer the secondary mass occupied the sternum, and pulsated so markedly and caused so much pain that it was mistaken for an aneurysm: this induced the surgeon to ligature some of the large vessels.

In England the chief cases have been observed and recorded by Haward, Coats, Horsley, and Lediard. Goebel has collected the German literature in an interesting paper, and has shown that in many instances these secondary tumours have been subjected to operative treatment, and on the whole with satisfactory results.

I think the explanation of this interesting condition may lie in the fact that in the early stages carcinoma of the thyroid is such an insidious disease, and mimics so closely the innocent bronchocele, that the primary disease is overlooked. This view receives some confirmation from the fact that a very similar condition of things is sometimes associated with carcinoma of the prostate.

The Pituitary Body.—The close functional and structural relationship of the glandular part of the pituitary to the thyroid body makes it desirable to describe tumours of this structure in sequence to those of the thyroid gland.

Adenomata of the pituitary body bear much the same relation to it that parenchymatous goitres do to the thyroid body; indeed, they are sometimes referred to as pituitary goitres. A few cases have been observed in man. Goodhart described an interesting case in a baboon, with its clinical history; and Sibley observed a specimen in a ewe.

These tumours are at first isolated from the general cavity of the cranium by the circular fold of the dura mater known as the *diaphragma sellæ*, and they generally produce erosion of the pituitary fossa.

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CHAPTER XXXII.

CARCINOMA OF THE LIPS, MOUTH, TONGUE, PHARYNX, AND LARYNX.

Cancer of the Lips.—In this situation squamous-celled cancer is common between the thirty-fifth and sixtieth years; it has been recorded as early as the twenty-fifth year and as late as the hundred-and-third (Jalland). A remarkable feature is the preference it shows for the lower lip. Thus out of 565 cases tabulated by Loos in Bruns' Klinik at Tübingen 534 arose in the lower lip. Of these, 467 of the patients were men and 67 women. It is also remarkable that though men are infinitely more liable to cancer of the lower lip than women, yet the liability is equal for both sexes in regard to the upper lip. Out of the 31 cases of cancer in the upper lip in Loos' total of 565, 16 occurred in men and 15 in women.

Cancer of the lip, when left to run its course, soon infects the lymph glands in the submaxillary region. Occasionally it will attack the right side of the lower lip, but infect the lymph glands in the left submaxillary region, and *vice versâ*. No anatomical explanation of this anomaly is forthcoming. The tissues of the lip are gradually destroyed and the mucous membrane covering the mandible is implicated and the bone itself eroded. In the later stages the lymph glands in the neck form huge masses, which gradually implicate the overlying skin, causing it to ulcerate, and at last the ulcer in the neck and the primary ulcer on the lip join, and as the underlying tissues slough a horrible chasm is formed in the neck, on the floor of which large vessels may be seen pulsating. Death is due to asthenia from repeated hæmorrhage, or from a single hæmorrhage, septic pneumonia, or œdema of the glottis. The average duration of life in untreated cases is two [illegible].

Treatment.—Cancer of the lip in the early stages [illegible] removed by the V-shaped method, or some one [illegible] of

many modifications. The submaxillary and submental lymph glands should be dissected out. When the disease has been allowed to extend until it involves the underlying bone and extensively infiltrates the cheek and neck, operative interference can rarely be undertaken with good prospects.

After the excision of cancer of the lip, **recurrence** may take place along the edge of the scar, but more frequently in the cervical tissues. The worst form of recurrence which begins near the angle of the mandible, and spreads up each side of the body of this bone in such a way as to resemble a periosteal sarcoma.

The early removal of cancer of the lip is more likely to be followed by good results than in any other part of the body. Occasionally the operation is followed by quick recurrence, even when the primary lesion was very small; but in a large proportion of cases recurrence is delayed two, three, or more years, and in a few cases a cure is brought about.

Cancer of the Tongue.—In this situation cancer is rare before the age of forty years, but it has been recorded in patients as young as twenty-five and in individuals of seventy-five years. It is three times commoner in men than in women. The predilection of this disease for the tongue of men is usually attributed to the habit of smoking. It generally makes its appearance on one side of the tongue, near its tip: in a fair proportion of cases it begins on the stump, but always distinctly to one side of the middle line, and the beginning of the disease is always at some spot in the anterior two-thirds of the tongue.

In a fair proportion of cases cancer of the tongue is preceded by changes known as **leukoplakia** and **ichthyosis**: surgeons who have had much to do with cancer of the tongue have noticed that chronic syphilitic ulcers of the tongue are very liable to become cancerous.

Ichthyotic patches upon the tongue do not necessarily become cancerous in every individual, and when cancer attacks an ichthyotic tongue it does not always begin in the ichthyotic patch, indeed, cancer is sometimes seen on one side of the tongue and ichthyosis on the other. Even after excision of a cancerous tongue the stump may become ichthyotic and the disease not recur in it.

When cancer attacks the tongue it usually destroys life quickly: the lymph glands in the neck are soon infected, and, as a rule, the disease runs its course in about a year. The average duration of life varies from six to twenty-four months.

Death ensues in a large proportion of cases from exhaustion, the result of pain, distress of mind, and difficulty in taking food: in some it occurs from septic pneumonia, the result of inhaling the fœtid discharges from the mouth; a few die early from hæmorrhage when the ulceration opens up the lingual or the carotid artery. Death is occasionally due to asphyxia. This may arise from two causes: the cancer may extend to the base of the tongue and infiltrate the epiglottis and its folds, producing œdema of the glottis, or a mass of enlarged glands in the neck may press upon the trachea and cause suffocation.

In addition to the tongue and lips, cancer may begin in the mucous membrane of the **cheek,** the **gums, soft palate, tonsils,** and **pharynx.**

In the case of the **cheek,** cancer is sometimes preceded by a patch of leukoplakia, as in the case of the tongue. The disease often starts close to the angle of the mouth, and extends backward into the cheek: or it begins in the fold of mucous membrane between the gum and the cheek; and occasionally it starts in the centre of the cheek, often on a level with the meeting-place of the crowns of the upper and lower molar teeth.

Squamous-celled cancer may begin in any part of the **gum,** but it appears more frequently in the mucous membrane covering the lower than in that covering the upper alveolar processes. The disease often starts near the *stump of a carious tooth*, and quickly infiltrates the adjacent mucous membrane; thus, whilst it is eroding the bone, it is creeping along the mucous membrane towards the cheek on one side and the tongue on the other. Similar effects may be observed when the disease attacks the gums in relation with the maxilla: as the alveolar process is destroyed the cavity of the antrum is exposed, and a foul ulcerating chasm formed. One of the facts connected with cancer of the mucous membrane of the mouth—and it matters little whether the disease begins on the tongue, cheek, hard or soft palate, or gums—is the

extraordinary size which the infected lymph glands in the neck sometimes attain, whilst the ulcer scarcely exceeds 1 cm. in diameter. This is worth bearing in mind, because an enlargement of the cervical lymph glands in individuals past middle age should always induce the surgeon to examine the various recesses of mouth and fauces for small, inconspicuous cancerous ulcers, as with every care they sometimes escape detection during life. It is necessary to emphasise this, because a good deal has been written about "branchiogenous cancer," or, as it is sometimes called, "malignant cyst" of the neck. The tumour is most commonly observed after the age of fifty, and is deeply seated in the neck, usually near the fork of the carotid: it grows with great rapidity, and in many cases softens in the centre and gives rise to fluctuation. The overlying skin becomes brawny and red, and the resemblance to an abscess is very striking. Gradually the implicated skin sloughs, and then a cancerous chasm forms in the neck. Some writers believe that these are primary cancers arising in remnants of branchial clefts. My belief is that, in most of the cases, these gland masses are secondary to cancer originating in recesses of the pharynx or naso-pharynx, and that the theory that they arise in remnants of branchial clefts is pure fiction. They run a rapidly fatal course: the average duration of life is about six months. These tumours resent interference, and in the few cases where patients have survived operation quick recurrence has been the rule.

Treatment.—The results of the operative treatment of cancer of the tongue stand in striking contrast to those which follow operations for this disease when affecting the lower lip.

The manner of removing a cancerous tongue is modified according to the situation and extent of the disease. The excision of the anterior portion of the tongue, or the right or left anterior fourth of the organ when the disease is localised to one side, is an operation devoid of risk or difficulty. When the disease deeply invades the tongue, involves the floor of the mouth, or extends so far backwards that, in order to get beyond the limits of the disease, the surgeon interferes with the pillar of the fauces, then the operation is often hazardous. The chief difficulty is connected with haemorrhage, and in order to obviate it a variety of methods have been advocated

for the excision of the tongue. A careful selection of cases, wide removal of the diseased tissues, and extirpation of the infected submaxillary lymph glands are the points to bear in mind.

It is an important point in operating upon the tongue to avoid the entrance of blood into the trachea, as it is then drawn, during inspiration, into the lungs, and gives rise to septic pneumonia. Should blood in considerable quantity get into the trachea, it may cause suffocation. To avoid these complications it is useful, in extensive operations on the tongue, to perform laryngotomy and administer the anæsthetic through a laryngotomy tube; and in order to prevent blood from getting into the trachea, the pharynx is plugged with a sponge.

The mortality of operations for the removal of cancerous tongues is not less than 10 per cent.: the chief causes of death are hæmorrhage, septic pneumonia, and asthenia.

Although after excision of the tongue recurrence in the stump or in the neck within a year of the operation is the rule, nevertheless it is in some cases delayed for five and even seven years. It is also useful to bear in mind that in some cases where the disease is advanced and too extensive to admit of removal, the pain may be relieved by division of the lingual nerve; and a few patients are rendered comfortable by ligature of the lingual and facial arteries.

It has been already mentioned that cancer occurring in the gums will afterwards invade the mandible or maxilla, according to its situation. Although in the majority of instances in which the maxilla is implicated the disease begins in the gingival mucous membrane, there is a small number of cases in which patients past middle life complain of pain in the jaw for which no adequate cause can be assigned. Gradually a slight fulness is observed in the infra-orbital region, with perhaps œdema of the eyelid, the skin becomes brawny, and at last a cancerous ulcer appears in the skin of the cheek, and the antrum is then found to be filled with a tumour. When such a case is submitted to operation and the skin of the cheek reflected, the inroads the disease has been silently making on the surrounding parts

are seen to be truly extraordinary. The greater part of the maxilla will be found to be destroyed, and outrunners from the growth will be seen in the orbit and among the pterygoid muscles. The skin of the cheek is usually so infiltrated that it must be removed. The successful treatment of such cases demands much boldness on the part of the operator, as he will find it necessary to sacrifice the eye and the orbital contents, the palatine aspect of the maxilla and a portion of the skin covering the cheek: as a result a large yawning cavern is left. Life is rarely prolonged, but the patients are spared much pain and discomfort.

Bolam has carefully studied the histology of primary epithelial tumours of the antrum, and has satisfied himself that some of them arise in the glands of the antral mucous membrane My independent examination of some of my own cases leads me to take the same view. Two diseases which in their clinical course resemble, and are often mistaken for squamous-celled cancer of the buccal and nasal mucous membrane, are actinomycosis and endothelioma (see p. 175).

Carcinoma of the Larynx.—When this disease originates in the mucous membrane of the ventricles, vocal cords, or ventricular bands, it is said to be **intrinsic.** When cancer arises in the aryteno-epiglottic folds, or the mucous membrane covering the arytenoids or the interarytenoid folds, it is said to be **extrinsic.**

In addition, the larynx may be implicated in carcinoma of the tongue, fauces, or upper part of the œsophagus. Both forms of laryngeal cancer are essentially diseases of adult life.

Intrinsic cancer of the larynx usually commences in one of the ventricles, and is almost invariably of the warty variety: it is particularly rich in cell-nests, and these are exceptionally horny. The papillomatous character of intrinsic laryngeal cancer must be borne in mind, or it may lead to grave errors in diagnosis. The laryngeal wart is essentially a disease of children and young adults, whereas carcinoma is an affection of adults, especially men who have passed the meridian of life. A wart-like growth in the larynx of an individual over 40 years of life should be viewed with

suspicion. Lymph gland infection and dissemination are not marked features of intrinsic laryngeal cancer.

Laryngeal cancer is usually rapid in its progress; death occurs in from twelve to eighteen months, and is rarely prolonged beyond two years. The fatal result is due to asthenia, which is intensified by the difficulty these patients experience in swallowing, and pneumonia. Actual suffocation is obviated early in the course of the disease by tracheotomy.

Extrinsic cancer of the larynx appears to be a far more formidable affection than the intrinsic form. It not only extends more rapidly and infects the lymph glands at a very early period, but implicates the surrounding parts far more extensively than the intrinsic variety; the duration of life is therefore shorter. Dissemination is extremely rare.

Treatment.—It is of great importance to recognise early the nature of this grave disease of the larynx. As a rule, there is little difficulty in appreciating the extrinsic variety, but the papillomatous nature of intrinsic cancer of the larynx makes the diagnosis somewhat dubious in the early stages Thus it is customary, when there is an element of doubt as to the nature of a laryngeal growth in an adult, to remove a fragment by means of laryngeal forceps and submit it to microscopical examination.

Acting on the principles that prevail in the treatment of cancer in other parts of the body, surgeons have in recent years (following the lead of Billroth, 1873) attempted to cure cancer of the larynx by excision. Unfortunately, there is very little to urge in favour of complete extirpation of the larynx; it has been abandoned by most surgeons in the extrinsic form of the disease, and even for the intrinsic form laryngectomy is fast falling into disfavour. The operation has an excessively high mortality: a very large proportion of the patients succumb to septic pneumonia, and the few that recover are often in a miserable and pitiable condition.

Excision of a lateral half of the larynx for intrinsic cancer is a much more successful operation; and this is also true of the operation known as thyrotomy, in which the thyroid cartilage is divided in the median line and the diseased soft tissues dissected out.

The reason that thyrotomy is more successful than laryn-

geetomy is due to the fact that the laryngeal cartilages are not very liable to be infiltrated by carcinoma. It is therefore a comparatively simple operation to split the thyroid cartilage in the middle line, thoroughly expose the interior of the larynx, and remove the affected tissues. In view of the great improvement in the details of this operation, its risks have been reduced almost to a vanishing point. In cases too advanced for thyrotomy, the needs of the patient are in most cases best satisfied by a simple tracheotomy.

For an admirable summary of the operative treatment of laryngeal carcinoma, see Semon and Gluck.

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CHAPTER XXXII.

CARCINOMA OF THE ŒSOPHAGUS, AND OF THE GASTRO-INTESTINAL TRACT.

In discussing the theories regarding the cause of cancer, attention has already been drawn (p. 294) to the great frequency with which the alimentary tract, and especially its gastro-intestinal section, is the seat of primary cancer. It is also of value in studying the distribution of primary carcinoma among the various sections, such as stomach, small intestine, large intestine, and rectum, to compare the regions vulnerable to this disease with the favourite sites of intestinal sarcomata (p. 74).

The Œsophagus.—The gullet is liable to two varieties of cancer: that which attacks its upper two-thirds is squamous-celled, whereas cancer of the lower segment is of the glandular type. This disease appears to be four times more frequent in men than in women, and is common between the fortieth and sixtieth years. It has been observed as early as the thirtieth year, and my oldest case was eighty-four. Certain parts of the œsophagus are more liable to be attacked than others: the usual situations are: 1, at the level of the cricoid cartilage; 2, where it is crossed by the left bronchus; 3, at its termination.

Nothing is known of the early stages of cancer of the œsophagus, as it produces few symptoms until neighbouring structures, such as the larynx, trachea, pleura, etc., are implicated.

The disease runs a very rapid course; most cases terminate fatally within a year from the time the patient comes under observation. Death occurs in a variety of ways: inanition and exhaustion are the results of obstruction to the passage of food; pleurisy and septic pneumonia are due to perforation of the pleura and trachea. In very rare instances an œsopha-

geal perforation into the pleura may establish a well-marked pneumothorax. A fistula between the trachea and œsophagus is common in this disease. Mediastinal abscess, which may perforate the pleura or pericardium, sometimes forms, and ulceration has been known to broach the aorta. When cancer

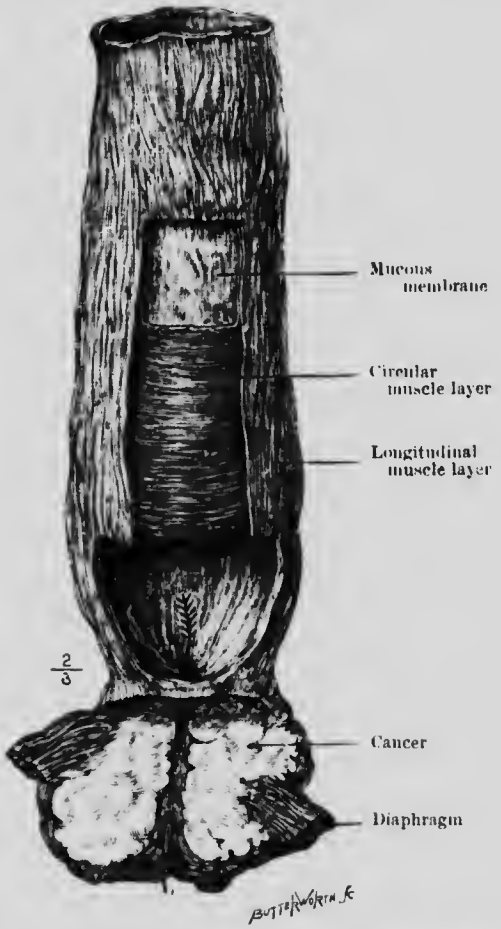

Fig. 171.—Cancer of the cardiac orifice of the œsophagus, from a man aged 48 years. The gullet has been dissected to show the great enlargement of the muscular layers.

begins at the commencement of the œsophagus, the recurrent laryngeal nerve is apt to become entangled and cause paralysis of the laryngeal muscles.

When the disease occupies the middle and lower parts of

the œsophagus, the lymph glands of the mediastinum and lumbar region enlarge. When the upper third of the tube is implicated, the mediastinal glands and those at the root of the neck are infected. It does not necessarily follow that the glands nearest the seat of disease are those most enlarged, for it occasionally happens that the neighbouring glands are apparently unaffected whilst those at some little distance are charged with cancerous material. For instance, in a case in which a man died from a large cancer of the middle third of the œsophagus, the mediastinal glands were slightly bigger than usual; but in the neck, immediately above the clavicle, there was one hard gland, the size of a bean, just beneath the skin. The enlargement of this gland was detected during life, and regarded, in the presence of other signs, as an indication of the malignant nature of the œsophageal stricture. The infection of this gland is probably due to the involvement of the cervical lymphatics secondary to infection of the thoracic duct (p. 277). Dissemination is rare.

When cancer attacks the œsophagus where it passes through the diaphragm, the tumour assumes the shape of a spool, and as the orifice becomes contracted, the muscle fibres of the gullet markedly hypertrophy (Fig. 171). This explains the great force with which patients under these conditions eject food and drink when they attempt to swallow.

Treatment.—Attempts have been made to remove cancer of the œsophagus when it has been situated high enough to be accessible in the neck. The results are not encouraging. When the disease so obstructs the gullet as to render the patient liable to starvation, gastrostomy has been found useful, and this is especially serviceable when the cancerous mass is high in the œsophagus, and causes liquid to trickle into the larynx in the act of swallowing.

The operative treatment of œsophageal cancer has little to recommend it, and it is satisfactory to find that some excellent results have followed the radium treatment of this disease.

The Stomach.—Cancer of the stomach is very common, and stands third, as we have seen, in the order of frequency among the organs, the mamma being first and the uterus second in order of liability. The disease arises in the glands

which are so abundant in the gastric mucous membrane. In carefully prepared sections the epithelium will be found to be of the columnar variety. One of the most striking features of gastric cancer is the readiness with which the cells undergo colloid change.

We have no precise knowledge of the manner in which the cancer begins; it is commonly situated at or in the immediate neighbourhood of the pylorus. "If a line be drawn from one inch (2·5 cm.) to the left of the œsophagus, to a point on the lower border of the stomach four inches (10 cm.) from the pylorus, the part to the left of this line will be found to suffer very rarely from cancer. The rest of the surface, the right and upper part, is the peculiar seat of cancer" (Wilks and Moxon).

Cancer arises at the cardiac orifice of the stomach in about 4 per cent. of cases. Occasionally this disease attacks the edges of chronic ulcers, and there is reason to believe that it may arise at the edges of the cicatrix of a gastric ulcer.

In the early stages the disease is limited to the mucous membrane; it then invades the muscular and, in a fair proportion of cases, the serous coats. The infiltration of the tissues about the pylorus leads to its obstruction, which is often so extreme that an ordinary probe can scarcely traverse it. The mucous surface of the tumour ulcerates, sloughs, and bleeds. Occasionally the pyloric branch of the hepatic artery is eroded, and the bleeding may be so profuse as to terminate life in patients whose strength has been reduced by small hæmorrhages, frequently repeated, from the ulcerating surface of the cancer. Whilst these changes are in progress on the mucous aspect of the tumour the subserous tissues become infiltrated, the overlying peritoneum is involved, and adhesions form between it and the omentum, the parietal peritoneum, liver, and occasionally the transverse colon.

The extent to which the disease infiltrates the surrounding parts varies greatly. In a large number of cases it remains restricted to a zone extended 3 cm. on each side of the pylorus; exceptionally it will implicate the duodenum as low as the orifice of the common bile duct. More often the disease creeps along the lesser curvature of the stomach. When the cardiac orifice is attacked, the cancer will extend

into the œsophagus and downwards along the lesser curvature.

For a time the disease remains restricted to the walls of the stomach, but later it spreads along the adhesions to such structures as the liver, pancreas, gall bladder, duodenum, colon, spleen, and diaphragm; then, as ulceration follows, it happens that the floor of the ulcer will be formed by the liver, the pancreas, or the spleen. When such parts as the colon or duodenum form the base of the ulcer, perforation occurs, and a gastro-colic or gastro-duodenal fistula is formed. These fistulæ are more common with cancerous than with the simple forms of gastric ulcers.

The lymph glands in the gastro-hepatic omentum are infected in more than half the cases; extensive enlargement of the lumbar glands sometimes happens, and those lying in the posterior mediastinum may be infected; the infection in exceptional cases may extend to the glands at the root of the neck, and occasionally the walls of the thoracic duct become cancerous and its lumen obstructed (Mathieu, Hillier).

Dissemination is the rule with cancer of the stomach. The secondary nodules usually make their appearance in the liver, lungs, and frequently in one or both ovaries (Chapter L.).

The walls of the stomach are occasionally so infiltrated with cancer that the organ becomes quite firm, and assumes the shape of a leather bottle. When the peritoneal surface of the colon is implicated, this portion of the intestine assumes a rigid leathery condition. (Nuthall and Emanuel have recorded some examples.)

There is a curious and somewhat rare condition of the omentum associated with cancer of the stomach. That it is little understood may be inferred from the variety of names applied to it—colloid or hydatid tumour; colloid cancer; myxo-sarcoma of the omentum. There can be little doubt that the uncertainty of knowledge concerning it is very largely due to its rarity. In typical cases the omentum is greatly thickened (5 to 10 cm.), and it may weigh upwards of ten pounds. The surface is flocculent, and on close inspection small rounded collections of gelatinous material may be seen in the midst of the villous processes; some of them are stalked and look like white currants. On microscopic exam-

mation the bulk of the omentum is found to be made up of myxomatous tissue: but here and there are collections of epithelial cells surrounded by incomplete capsules of fibrous tissue. The condition is due to infiltration of the great omentum from a cancerous stomach, and the cancerous material with the proper omental tissue undergoes colloid or myxomatous degeneration. The subject requires the close investigation of perfectly fresh material for its proper elucidation.

Attention has already been drawn to the extreme liability of cancer of the stomach to undergo colloid degeneration.

Clinical Features.—Cancer of the stomach is rare before the thirtieth year; it is most common between the fortieth and sixtieth years; it has been demonstrated as early as thirteen, near the cardiac end of the viscus, and the patient was a girl (Norman Moore).

Gastric carcinoma runs a very rapid course, life being rarely prolonged beyond twelve months from the time the disease is first recognised. Its rapidly fatal course, especially when the pylorus is implicated, is largely due to the obstruction offered to the escape of food into the duodenum; hence the food is retained in the stomach, which often becomes dilated into a huge sac, sometimes reaching as low as the pubes. Fermentation of the retained and partially digested food occurs, and the contents of the stomach are vomited at irregular intervals, mixed with altered blood which escapes from the ulcerated surface of the tumour.

When cancer involves the cardiac orifice, the stomach is usually contracted. Cancer of the stomach causes death in various ways. Of these, the chief are—exhaustion due to starvation and frequent haemorrhage; perforation into the general peritoneal cavity and fatal peritonitis. In exceptional instances, the diaphragm is perforated and fatal pleurisy ensues.

Treatment.—The only radical method for the relief of gastric cancer is wide excision. When the disease attacks the pylorus, this part is excised, and the cut edges of the stomach and duodenum (pylorectomy) are carefully sutured. When this is impracticable on account of the wide extent of the disease, or lymph gland infection and dissemination, then, in

order to obviate inevitable death by starvation, a fistula may be established between the stomach and jejunum (gastro-jejunostomy), a proceeding which has occasionally been followed by a small amount of success; but it is merely a palliative procedure.

Encouraged by the occasional success of pylorectomy, surgeons have extended their efforts, and in 1897 Schlatter removed the entire stomach from a woman aged fifty-six, for carcinoma. The patient survived the operation fourteen months, and died with local recurrence and dissemination.

The results of the operative treatment of gastric carcinoma have been ably summarized by Herbert J. Paterson, in his Hunterian Lectures on Gastric Surgery, 1906; he has collected seventeen cases, in which the total removal of the stomach (gastrectomy) has been followed by success, six of the patients being alive three years, and three five years, after the operation. Paterson also emphatically points out that the more radically cancer of the stomach is treated by operation, the better are the remote results for the patients; in this respect, the surgery of gastric carcinoma harmonizes with the results of thorough operations in the treatment of mammary cancer. He also points out that after the removal of the stomach, its functions are vicariously performed by other parts of the alimentary canal. For example, its function as a reservoir is supplied to a limited extent by dilatation of the lower end of the œsophagus; maceration of the food is replaced by careful dieting; the chemical functions, the secretion of pepsin, hydrochloric acid and rennin can be effectively replaced by the intestine. The function of rennin can be performed by pancreatic juice: the antiseptic action of the hydrochloric acid is carried on by the bile; and the peptones are absorbed by the small intestine.

The Rectum.—Carcinoma of the rectum becomes clinically recognisable as a hard tuberous mass in the mucous membrane, which slowly spreads at its periphery and gradually travels round the bowel and forms a thick circular diaphragm with a central perforation no wider than a crow-quill. In some specimens the lumen of the bowel is narrowed not so much by the exuberance of the growth as by the contraction it exercises upon the intestinal wall. Sometimes the tumour

will have a diameter of 2 cm. and less, yet its power of contraction is so great that it completely obstructs the bowel. This variety is more frequent in the colon than in the rectum.

In some cases the disease, instead of forming a localised tuber, tends from the first to infiltrate the muscular as well as the submucous tissues (Fig. 172), and even extends beyond

FIG. 172. Side view of the male pelvis in an advanced case of rectal cancer, to show its infiltrating tendency.

the confines of the gut to adjacent parts, such as the peritoneum, pelvic connective tissue, prostate, or vagina. Ulceration occurs early in this variety. Whilst in one case the cancer tends to penetrate the wall of the rectum, in another it will form large and exuberant masses, blocking up the gut and even protruding beyond the anus. It may in a third case be restricted to a narrow area of the bowel, and remain apparently indolent for a long period.

Rectal carcinoma consists of glandular recesses, lined with tall columnar cells, embedded in a stroma of dense connective tissue. In order to make out the nature of the growth, sections should be taken from the margins of the tumour, because the deeper parts are much altered by ulcerative and necrotic changes. As a matter of fact, in many cases of rectal cancer, judging merely from the appearances under the microscope, it would be difficult to determine whether the section was prepared from an adenoma or a carcinoma: but it must be borne in mind that the adenoma remains restricted to the mucous membrane, whereas in cancer we find the glands with their characteristic columnar cells interspersed among the muscular fasciculi of the gut wall. The proportion of connective tissue varies greatly. In some cancers the glands are closely set; in others they are ill-formed, arranged irregularly, and embedded in an abundance of connective tissue. Occasionally collections of lymphoid tissue are observed. When a rectal cancer invades the anus, the part of the tumour which involves the anus loses its glandular character and assumes the squamous-celled form (Harrison Cripps). Rectal cancer is very rare before the age of twenty; it is commonly met with between the thirtieth and fifty-fifth years.

The pelvic and lumbar lymph glands are first involved, then those glands lying in the course of the external iliac artery. Should the skin of the anus become infiltrated, then the inguinal lymph glands may be infected. The liver is the seat of secondary deposits in a large proportion of cases of rectal cancer. Occasionally widespread dissemination occurs, and nodules are formed not only in the liver, but in the lungs, kidneys and bones. Few things are more surprising than, on examining a cancer nodule from the liver, or from a long bone like the humerus, to find Lieberkühn's glands, with their tall columnar epithelium.

When rectal cancer invades the peritoneum, this serous membrane will sometimes become dotted over with minute elevations like sago grains.

The Intestine.—Cancer of the small and the large intestine is of the same structure, and has the same relation to the gut, as that which occurs in the rectum. The liability of the

various sections of the intestine to cancer varies greatly. In the duodenum, jejunum, and ileum this disease is very rare. When cancer attacks the duodenum it is apt to involve the common bile duct; in a fair proportion of cases it begins around the bile papilla. In the large bowel, excluding the rectum, cancer is fairly frequent, and exhibits a curious tendency to occur at the sigmoid, splenic, and hepatic flexures (Fig. 173).

A search through the home literature indicates that few

Fig. 173.—Cancer of the sigmoid flexure of the colon.

records of cancer of the **ileo-cæcal valve** exist, especially if care be taken to distinguish between cancer of the cæcum involving this valve, and primary cancer of the valve itself. In one remarkable case, cancer of the ileo-cæcal valve caused intussusception, and the valve appeared at the anus. The cancerous valve was cut away, and the vermiform appendix recognised as the peritoneum was opened. The patient, a woman of 75 years, died suddenly ten hours later (Ball). It is also necessary to mention that cases of cellulitis involving the cæcum are sometimes mistaken for cancer. Primary

cancer of the **cæcum** is rare, but not so rare as in the vermiform appendix.

The Vermiform Appendix.—Though primary cancer of this small portion of the alimentary canal has been recorded by many observers, the analysis of a number of reported cases collected by Rolleston shows that the disease described as cancer of the vermiform appendix differs in a very striking

Fig. 174.—Cancer of colon (constricting variety).

manner from cancer in other parts of the intestines in its slight degree of malignancy. He considers a case reported by Beger in 1882 to be the first incontestable example of cancer of the vermiform appendix. In some of the cases the diseased area was so small as to require a magnifying glass to see it. The cancer is spheroidal-celled; and the immediate prognosis as well as the freedom from recurrence

after operation is extremely good. Some of the examples of primary malignant disease of the appendix have been described as sarcomata and some as endotheliomata.

Clinical Characters of Carcinoma of the Small and the Large Intestines.—The symptoms to which cancer of the intestine gives rise are those of obstruction, and diagnosis is, in most cases, a matter of conjecture, mainly based upon the age of the patient and the gradual manner in which the signs develop, leading the surgeon to the conclusion that the trouble is due to cancer in some part of the large intestine. As far as I am aware, the diagnosis of primary cancer of the small intestine has not been made, for when seated in the small gut below the duodenum cancer usually gives rise to signs of acute obstruction. From this it follows that our knowledge of intestinal cancer is based upon a study of the disease in its advanced stage. One of its most characteristic features is the way it travels round the gut and forms a zone of hard material projecting into its lumen, and then, as it contracts, the diseased parts, as seen from the outside, look as if the intestine had been girt with a ligature (Fig. 174). In the later stages the lumen of the gut becomes so straitened that nothing but a narrow, tortuous channel traverses the cancerous mass. This allows the liquid faeces retained in the dilated segment of the gut on the proximal side of the tumour gradually to trickle through, but at times even this limited channel of escape becomes closed. Occasionally, after many days of complete obstruction, a portion of the cancer sloughs, and the obstruction is temporarily relieved. The enormous quantity of faeces that sometimes escapes on such occasions is almost beyond belief.

A large proportion of patients with intestinal cancer succumb from the effects of obstruction: in others death is brought about by other means. For example, the retention of the contents of the bowel leads to dilatation of the gut above the stricture: this may induce ulceration and gangrene, which terminates in perforation. In this event the effect depends on the part of the gut perforated. Should the opening allow faecal matter to escape into the peritoneal cavity, peritonitis is the consequence, and as a rule kills the patient in a few hours. In the case of the caecum the ascending and

Fig. 175.—A cæcum with the vermiform appendix and adjacent segments of the ascending colon and ileum. The cæcum is occupied with a cancerous mass, which has perforated its mesial wall and not only implicated the adjacent segment of the ileum, but has penetrated its lumen. The parts were successfully resected from a woman æt. 55. She was alive and in good health four years after the operation.

descending colon, the extravasation may take place behind the peritoneum and give rise to a faecal abscess. Such abscesses in connection with the right colon will point in the neighbourhood of Poupart's ligament (usually above, but sometimes below this band), or at the crest of the ilium. I have known pus from an abscess of this kind in connection with the descending colon to travel between the muscular planes of the belly wall as far as the linea semilunaris, and the intestinal gas caused the whole of the left half of the belly wall to be emphysematous.

In chronic intestinal obstruction due to cancer of the descending colon, the caecum becomes greatly distended with fluid faeces; this leads to ulceration of its wall, which occasionally perforates and sets up rapidly fatal peritonitis.

It occasionally happens that a distended coil of bowel immediately above a cancerous stricture will adhere to an adjacent piece of healthy intestine, which will be infiltrated by the cancer; sloughing follows, and a fistula forms between the implicated coils. Such an event rarely improves the patient's condition, as the communication almost always takes place with a piece of intestine on the proximal side of the stricture. It has happened to me on three occasions to meet with cancer in the loop of an omega-shaped colon. The convexity of the loop had in two instances come in contact with, and perforated into, the bladder. Uterine cancer sometimes perforates into the peritoneal cavity and implicates the colon; hence care is necessary in discriminating between a cancerous colon adherent to the uterus and a cancerous uterus implicating the colon. Cancer of the sigmoid flexure is, in a large proportion of cases, localised in that portion of the flexure in relation with the brim of the true pelvis, and it is a curious fact that in such cases the left ovary is often adherent to, and occasionally forms the base of, a cancerous ulcer in this part of the colon.

Briefly summarised, the modes of death in cancer of the intestines are:—Intestinal obstruction, intussusception, perforation into the peritoneal cavity, and suppurative nephritis when the disease is in the rectum and involves the ureters, also the complications which ensue from the general dissemination of the disease.

Treatment.—Cancer of the **rectum** can in many instances be easily and freely excised (proctotomy). A ready way in which surgeons estimate the suitability of a rectal cancer for excision is to introduce the index finger through the anus, and if the tip of the finger passes beyond the tumour it is taken as an indication that, so far as implication of the rectum is concerned, the disease admits of removal. The favourable cases are those in which the cancer is of such limited extent that it can be circumscribed by the finger, is mainly limited to the posterior wall of the gut, and does not involve the anus, prostate or vagina, according to the sex. When rectal cancer is too extensive for excision, patients are often rendered comfortable by inguinal or lumbar colotomy. The routine employment of colotomy for every case of rectal cancer that cannot be excised is to be deprecated.

In the case of the **colon** various methods have been advocated. The ideal operation consists in resection of the diseased area of the gut and sutural union of the cut ends so as to restore the continuity of the intestine.

In all patients that come under my care with intestinal obstruction supposed to depend upon cancer of the colon, and in whom no tumour can be localised by physical signs, I prefer to explore the intestines through an abdominal incision, and then perform colotomy or resection, according to the nature and situation of the cancer. In cases where the cancer is situated in the large bowel well above the rectum and too extensive to permit removal, the patient may be spared the misery of colotomy, for the ileum may be turned into the large gut below the obstruction (ileo-colotomy). In appropriate cases this is an excellent operation.

It is also a fact well worth bearing in mind that after the pressure upon a section of colon, straitened by cancer, is relieved by a timely colotomy, the obstruction after a time partially disappears and allows fæces once more to pass into the distal portion of the gut. Indeed, in some cases the passage through the cancerous segment becomes so free that patients allow the colotomy opening to close.

The various methods of performing resection of the bowel, and the results, immediate and remote, are discussed in the admirable works of Treves and Jacobson on Operative Surgery.

The Anus.—Cancer of the anus is of the squamous-celled variety, and is about equal in frequency to this disease in the scrotum and labia. It is more frequent in women than in men, and rarely begins before the fortieth year. In about half the cases the inguinal glands are affected on one or both sides. When seen in the early stages and its nature recognised, cancer of the anus admits of free and complete removal; care should be taken to remove the inguinal lymph glands either at the primary operation or, better, two or three weeks later. The results of such interference are admirable. In cases where the disease runs its course life is rarely prolonged beyond twelve months; whereas in cases where the growth is satisfactorily removed life has been prolonged several years (five to eight). When the disease cannot be extirpated, the patients are sometimes made more comfortable by diverting the course of the faeces (colotomy).

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CHAPTER XXXIV.

EPITHELIAL TUMOURS OF THE LIVER, GALL BLADDER, AND PANCREAS.

THE LIVER.

The histological characters of the liver render it possible for epithelial tumours, whether adenoma or carcinoma, to imitate the tubular arrangement of the bile ducts, or the disposition of cells characteristic of a hepatic lobule.

Adenomata.—Fully developed adenomata of the liver are

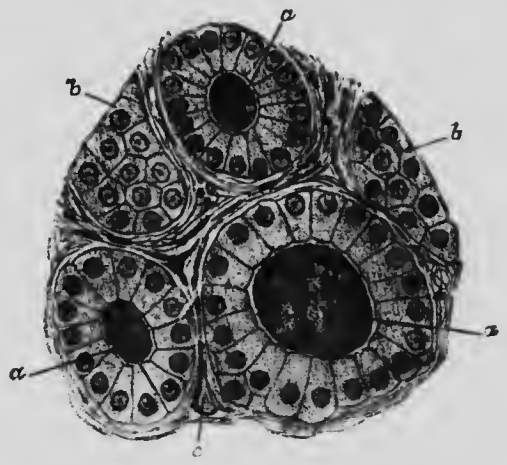


Fig. 176.—Adenoma of the liver. (*After Vaut.*)
a, section of blind duct filled with green fluid; *b*, liver cells; *c*, connective tissue.

encapsuled tumours of a spherical shape. they may be situated in any part of the liver. Hepatic adenomata vary greatly in size: a solitary adenoma may be no larger than a marble: when multiple they will be as big as Tangerine oranges. In colour some are bright green, others are dull white. The peripheral parts of the tumour consist of solid columns of cells, but on approaching the centre they gradually

acquire a lumen (Fig. 176). These blind ducts are lined with a single layer of columnar epithelium, and contain an inspissated green-coloured material. As the ducts make up the bulk of the tumour, it is clear that the olive-green colour of the tumour is due to imprisoned bile. In adenomata of this kind the columnar cells are so striking that some observers have described these tumours as columnar-celled carcinomata of the liver. In other specimens the cells, instead of being arranged in this tubular fashion, are grouped around a minute central lumen two or more deep.

So far as our knowledge at present extends, it would appear that hepatic adenomata as described above are of little clinical importance, and they have been found during the performance of a *post-mortem* examination when the liver has been sliced up in the course of the inspection. Keen, however, has successfully removed a hepatic adenoma, measuring 9 by 6 cm., from a woman thirty-one years of age. The circumstance that such tumours can be dealt with surgically will lead, in all probability, to an extension of knowledge concerning them.

Carcinomata.—Hepatic cancer varies greatly in its external appearance; sometimes it assumes the form of compact nodules of a white colour projecting from the surface of the liver and visible on every cut surface, the nodules varying in size from a marble, or ripe cherry, to tumours as large as and even exceeding the fist. Many of the surface nodules present a central depression or umbilicus.

In other cases the cancer assumes the form of an irregular infiltration of soft growth of an olive green; some of the tracts are yellow. In all cases the liver is enlarged, sometimes to twice its natural size. The surface is in most cases irregularly lobulated.

Dissemination of the cancer is the exception; secondary nodules have been found in the lung, and in enlarged lymph glands in the portal fissure; in one of the cases in which secondary nodules occurred in the lung, the mediastinal lymph glands were enlarged and infiltrated with cancer.

In point of structure hepatic cancer conforms to two types, the **tubular** and the **acinous**, but the imitation in the case of cancer is not so good as with hepatic adenoma.

Rindfleisch, in reference to the tubular species of adenoma, writes:—"The peculiar intention which is expressed in the whole foundation advances to a delusive imitation of a tubular gland." The difference between the tubular adenoma and the tubular carcinoma is that the imitation is still more delusive, and this is equally true of that which is called the acinous species.

Secondary Cancer of the Liver.—The liver plays the same part in the portal circulation that the lungs play in the pulmonary circulation when any viscus or organ drained by it is the seat of carcinoma—namely, to act as a filter and deprive it of cancer-emboli. Like the lungs, the liver also offers an extremely favourable territory wherein such emigrants may thrive. Secondary cancerous nodules in the liver attain larger proportions than in the lung. It is a curious fact that in many cases reported as primary cancer of the liver, the nodules were multiple. This is a very exceptional condition in other viscera, which renders it very important, in reporting a case as primary cancer of the liver, to make a thorough search of the whole intestinal tract, and particularly of the rectum and anus, when conducting a *post-mortem* examination, as well as to subject the hepatic nodules to a careful microscopic examination.

The cancerous nodules on the surface of the liver are usually umbilicated: this is due to degeneration of the central cells of the nodule, which then become compressed by the surrounding fibrous tissue.

Occasionally the secondary infection of the liver may assume the form of one large central mass of cancer, which may exceed in size the patient's head. Reference has already been made to the massiveness of secondary cancerous deposits in the liver, and some explanation offered as to the possible cause of their luxuriant growth in this organ (p. 276).

Clinical Features.—Hepatic cancer occurs equally in men and women, and is most frequent between the fortieth and sixtieth years. It is, however, liable to arise at a much earlier age; and Acland has published an excellent paper on this subject, and collected nine cases of primary cancer of the liver occurring in children under twenty years of age. All observers agree that primary cancer of the liver is very rare

and, as is the case with many rare diseases, there is very little reliable evidence forthcoming concerning it.

Cancer of the liver leads to enlargement of this gland and jaundice, which may be slight and transient or of great intensity; in a few cases this symptom has only been observed towards the termination of life. Ascites occurs in most cases. The available facts indicate that it runs a very rapid course.

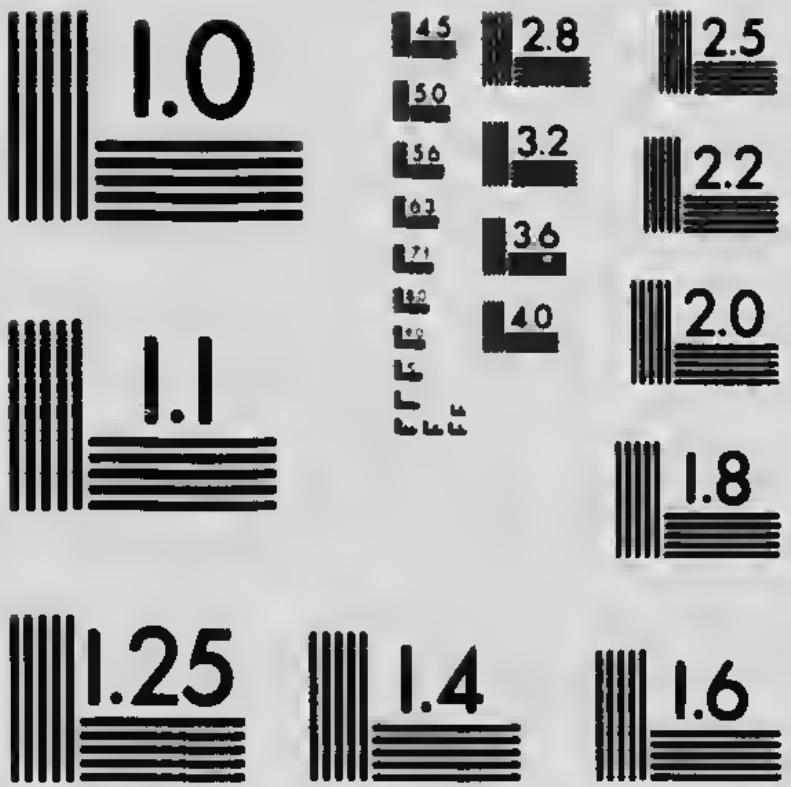
An important clinical feature associated with the rapid growth of secondary cancer in the liver, especially when the primary focus is in the large intestine, is fever. In such conditions the body temperature may rise to 101, 103, and even 105° Fahr.

Cancer of the liver is not amenable to art, either medical or surgical. In a few, very few, exceptional instances it has been possible to excise a cancerous segment of the liver, and with some success.

THE GALL BLADDER.

The gall bladder is lined with mucous membrane furnished with columnar epithelium, and beset with mucous glands. Recent researches in primary cancer of this receptacle prove, what would be expected from the normal structure, that in the majority of specimens, the carcinoma is of the columnar or the spheroidal-celled variety. The disease, however, so alters the normal relations of parts that it is usually difficult to decide whether the carcinoma arises in the glands or in the mucous membrane.

Cancer is more common in the fundus of the gall bladder than near or in the cystic duct, but it may arise in this duct. In many specimens the disease infiltrates the walls of the gall bladder and transforms it into a hard, solid body, so that it would be difficult often to determine the relation of parts, except by finding a central cavity occupied by biliary concretions (Fig. 177). In some specimens the disease projects into the cavity of the gall bladder in the form of villous processes. Occasionally the cancer may be localised to the fundus of the gall bladder, and I have known a process of the tumour to perforate the wall, and form a bud-like projection on the peritoneal coat no larger than a pea; yet the cells detached from this little process had been distributed throughout the



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peritoneal cavity, and given rise to innumerable tiny nodules on the peritoneum, from the diaphragm to the recesses on the floor of the pelvis. Dissemination of this kind is rare. Secondary deposits are more common in the liver. The lymph glands in the fissure of the liver are often infected, and the liver itself is sometimes extensively implicated by the primary tumour.

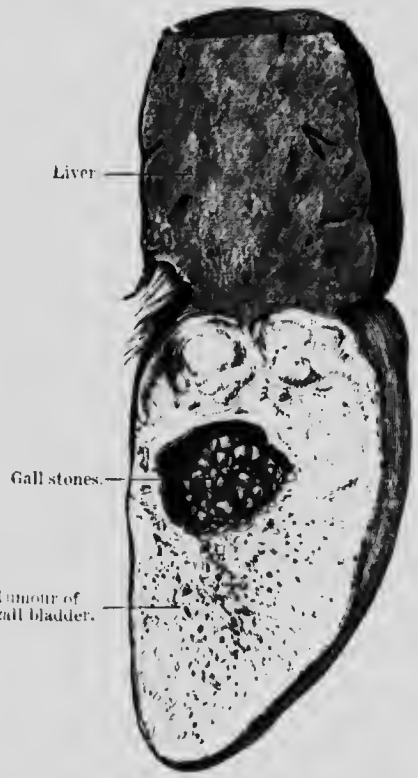

Fig. 177.—Cancer of the gall bladder in section. (*Museum of the Middlesex Hospital*.)

The most important feature connected with primary cancer of the gall bladder is its almost constant association with gall stones. Careful investigations have been made on this point, and prove that in at least ninety-five per cent. of the cases of cancer of this structure, gall stones are present also; and this has induced surgeons, and with justice, to consider the presence of biliary concretions in the gall bladder as a pre-

cancerous condition. The literature relating to the association of gall stones and cancer of the gall bladder has been collected by Kelynack. The histologic features of cancer of the gall bladder have been carefully studied by Rolleston; and a critical analysis of a series of cases has been conducted by Slade.

Primary carcinoma of the gall bladder is three times more common in women than in men: the age of greatest liability is from the fiftieth to the sixtieth year. It appears to run a very rapid course, and is usually fatal within six months of the onset of definite symptoms. The chief signs of the disease are the presence of a hard but tender swelling in the region of the gall bladder, accompanied by epigastric pain. Jaundice occurs in about one-third of the cases.

Treatment.—The operative treatment of cancer of the gall bladder has in some instances been carried out with success; but when a large number of hospital cases are analysed, the results cannot be considered encouraging. Out of eleven cases submitted to operation at the London Hospital, nine died (Slade).

Now that gall stones are recognised as a predisposing cause of cancer, it behoves surgeons, when removing gall stones, to excise the gall bladder (cholecystectomy), especially when this organ is thickened and disorganised, as the result of chronic inflammatory (infective) changes. I have long held this opinion, and practised it on many occasions.

The literature of the operative treatment of cancer of the gall bladder has been collected by Terrier and Auvray, Keen and Thompson.

THE COMMON BILE DUCT AND ITS PAPILLA.

Primary Cancer of this duct is an excessively rare affection, especially when care is taken to exclude the cases in which the duct is implicated by cancer of the head of the pancreas and primary cancer of the duodenum. But there are cases carefully observed and reported which prove that cancer may arise primarily in the common duct.

When primary cancer arises in the duodenum it is apt to surround the bile papilla. Halstead has recorded a case of this kind in a woman sixty years of age. He excised the cancer, the bile papilla, and adjacent section of the common

duct, and implanted its cut end into the duodenum. The patient recovered, but died several months later from recurrence of the cancer in the duodenum and pancreas.

THE PANCREAS.

Carcinoma of the Pancreas is an affection of peculiar interest because it is in itself very insidious, and rarely becomes clinically recognisable except from what may be called an accident in its environment, namely, the disease is very prone to attack the head of the gland and cause jaundice by obstructing the common bile duct.

The pancreas is a compound gland, for in addition to its own acini, it is occupied by the epithelial bodies known as the islands of Langerhans, which are at present regarded as duct-less glands furnishing an internal secretion. The pancreas contains three distinct sets of epithelial structures; these are its own acini, the islands, and its excretory duct, commonly known as the duct of Wirsung. Hillier and Goodall have conducted a valuable investigation concerning the histology and general features of carcinoma of the pancreas, and they have come to the conclusion that primary cancer of this gland may arise in each of the three epithelial structures which it contains. The common type is spheroidal-celled carcinoma with a large amount of fibrous tissue. It probably arises in the acini of the gland and is comparable to spheroidal-celled cancer of the breast. The second variety is columnar-celled and probably arises from the duct. In structure this kind resembles primary cancer of the duodenum.

The third variety is of interest, as there is good reason to believe that it arises in Langerhans' islands: "it consists of cells most irregular in size and shape, but on the whole much larger than in the other varieties of carcinoma, and possessed of nuclei which in some instances are enormous."

In connection with the relation of the islands to carcinoma, it is pointed out that in the ordinary varieties of cancer of the pancreas, the islands remain unaffected and may be seen in some instances surrounded by cancerous growth: on the other hand, when the pancreas is the seat of secondary cancer, the islands are among the first of the pancreatic structures to disappear.

Cancer of the pancreas attacks the head of the gland six times more frequently than the tail. In one unusual case a cancerous deposit was found in the head and tail of the same gland (Hale White). Hillier and Goodall observe that the site of origin for the head corresponds closely with the position of the junction of the ducts of Wirsung and Santorini.

Clinical Features.—The difficulty of recognising cancer of the pancreas is increased by the fact that the tumour is rarely large enough to be appreciated by manipulation through the abdominal wall. Occasionally the tumour will attain the dimensions of a fist.

The disease is rare before middle life, and it attacks both men and women. The chief manifestation, save in quite the late stages, is deep jaundice, often unaccompanied by pain. As the disease progresses and the jaundice deepens, an oval tumour is sometimes appreciable in the right lumbar region; this is the over-distended gall bladder, and it is painless to touch. In a certain proportion of cases a second swelling can be made out in the region of the head of the pancreas. This disease is rarely a source of pain, but in some cases the late stages of cancer of the pancreas are accompanied by much suffering, the pain occurring in severe paroxysms.

The most characteristic feature of cancer of the head of the pancreas is jaundice unaccompanied by pain, but the icterus in these circumstances lacks the yellowness which is seen when the common bile duct alone is obstructed, for it has a brown tint, not unlike the hue of the skin in Addison's disease. In cases where the jaundice has been relieved by diverting the bile into the colon this brown tint persists.

Glycosuria is an extremely rare complication of pancreatic cancer, and this may be ascribed to the fact that the islands of Langerhans enjoy considerable immunity from the disease. The jaundice is accompanied by irritation of the skin, great depression, slow pulse and emaciation. The wasting in a measure depends upon the altered digestion and malassimilation, due to the absence of the pancreatic secretion in the alimentary canal. Death as a rule results from coma, the result of toxæmia, and not unfrequently from septic phlebitis due to the implication of the large veins in the immediate neighbourhood of the cœliac axis. It is a curious fact that

though cancer of the head of the pancreas quickly involves the common bile duct, it rarely implicates neighbouring viscera such as the duodenum or the stomach. Lymph-gland infection is unusual, and dissemination occasionally occurs, the secondary nodules being found in the liver and lung.

Treatment.—The insidious character of the disease, the almost inaccessible situation of the gland, and the large blood and lymph vessels in its neighbourhood, do not favour surgical enterprise. On one occasion I diverted the bile into the bowel by anastomosing the distended gall bladder with the hepatic flexure of the colon in a case of pancreatic cancer with jaundice, hoping that if the biliary outflow could be re-established life might be prolonged. It was not successful. In the case of a man sixty years of age with primary cancer of the head of the pancreas, I succeeded in anastomosing the gall bladder into the ascending colon. The jaundice disappeared, but the brown tint of the skin remained and the disease ran its deadly course uninfluenced. The patient died a year after the operation.

In order to secure the full benefit of an operation upon a cancerous pancreas, it would be essential to remove the whole gland. This in itself would be physiologically disastrous, because experiments on animals demonstrate that complete extirpation of the pancreas is followed by diabetes.

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CHAPTER XXXV.

CARCINOMA OF THE URINARY AND EXTERNAL GENITAL ORGANS.

THE URINARY ORGANS.

EVERY part of the urinary system is liable to cancer—kidney, ureter, bladder, prostate, and urethra. It is common in the

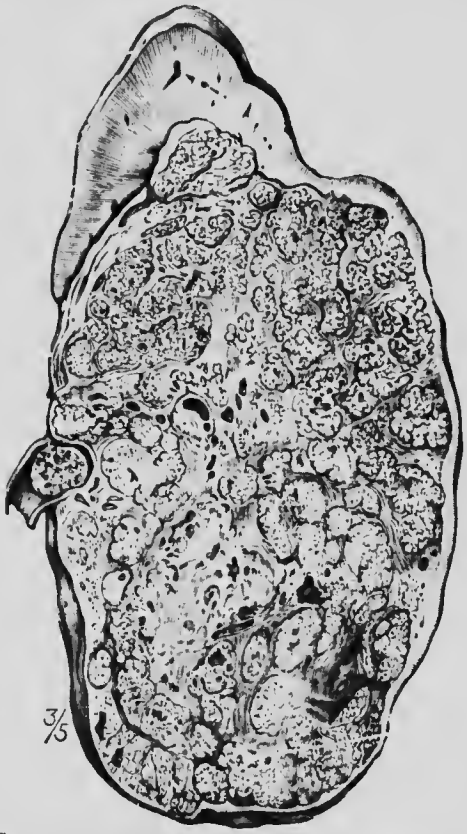

Fig. 178.—Cancerous kidney in section. From a man 54 years of age.

bladder; next in order of frequency come the complex glandular organs—the kidney and prostate. It is rarest in the conduits—the ureter and the urethra.

We shall find it convenient to consider each part in anatomical sequence, beginning with the kidney.

Cancer of the Kidney.—Carcinoma of this organ starts in the epithelium of the uriniferous tubules, and gradually transforms the renal tissue without violently distorting the shape of the gland (Fig. 178). The cancerous tissue creeps into the pelvis of the kidney and invades the ureter, extending sometimes the whole length of the duct, and the outrunner has been observed to enter the bladder. This relation

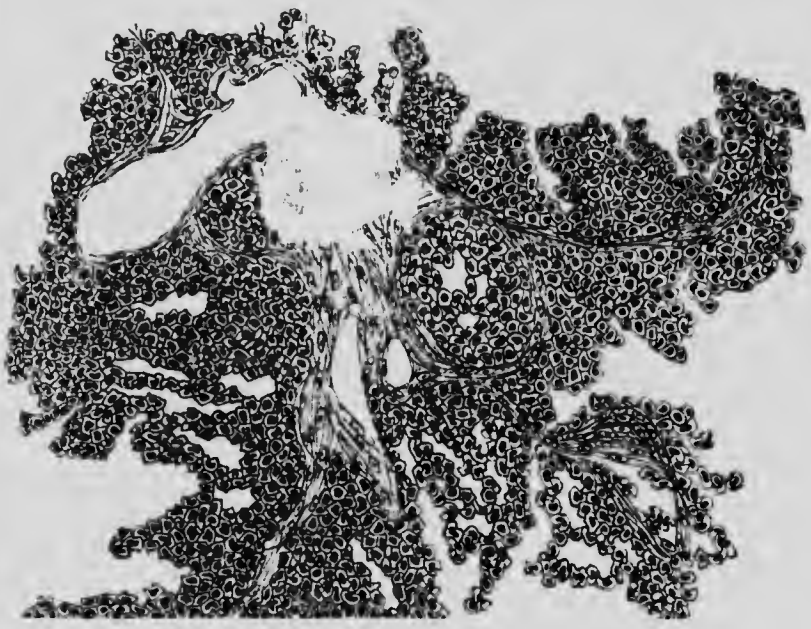

Fig. 179.—Microscopic characters of renal cancer.

of the carcinoma to the ureter explains the frequency of hæmaturia as a concomitant of this disease.

The minute characters of renal carcinoma are very striking, and consist of tubules lined with regularly arranged columnar epithelium (Fig. 179), and the general arrangement of these tubules in microscopic sections presents "a rough but striking resemblance to the tubular structure of the kidney" (Sharkey).

Our knowledge of the general characters of renal carcinoma is very limited, because it is only during the last ten years that any serious efforts have been made to separate the

epithelial malignant tumours (carcinoma) of the kidney from the connective tissue (sarcomatous) tumours, which are by far the most common form of malignant tumours that attack this gland.

Renal carcinoma is uncommon before middle life and increases in frequency after the fiftieth year, and is usually limited to one kidney. The unilateral character comes out strongly when the disease attacks a horseshoe kidney, for even under these conditions it remains restricted to one half of the compound gland (Fig. 180).

Cancer of the kidney is a very deadly disease, and a careful

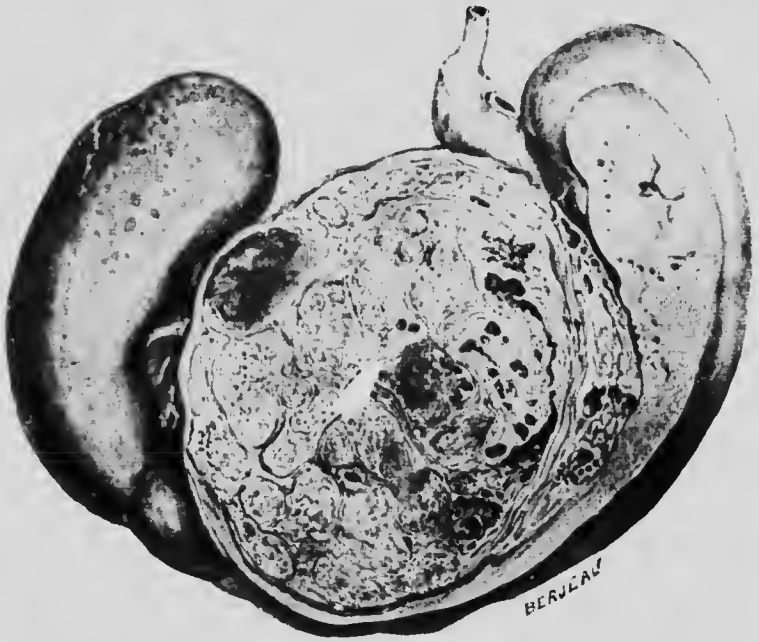

Fig. 180.—A horseshoe kidney; one half of the organ is the seat of carcinoma. (*Museum, Royal College of Surgeons.*) From a woman 60 years of age.

study of the records relating to cases in which the histology of the tumour was carefully determined shows that more than half the patients from whom the kidney was removed die from the direct effects of the operation. This is partly due to the exhausting effects of the cancer and hæmaturia upon individuals advanced in life. Of the patients who recover from the operation, I know of no record where life was prolonged more than a year.

Cancer of the Ureter.—The terminal orifices of ducts are not uncommon situations for primary cancer, *e.g.* the duodenal end of the bile duct, the urethral orifice in both sexes, and the vesical as well as the dilated or pelvic portion of the ureters. It is, however, rare for cancer to arise in any part of the ureter between the renal pelvis and the bladder. Voelcker has recorded a case in which a primary carcinoma arose in the right ureter at the spot where it crosses the brim of the pelvis. The patient, a man sixty-eight years of age, came under observation on account of haematuria. At the *post-mortem* examination a tumour as big as a cherry, which on microscopic examination furnished the characters of carcinoma, was found in the ureter. The lymph glands on the corresponding side of the aorta were infected. There was a large secondary mass of cancer in the liver, and there were nodules in the right lung, which agreed in their microscopic characters with the tumour in the ureter.

Cancer of the Bladder.—In this viscus cancer is of the squamous-celled variety, and arises in the mucous membrane. From what is known of the habits of this disease elsewhere, it would be anticipated that in a certain proportion of cases it would begin at the orifices of the ureters. This is actually the case; but it must not be assumed that when the ureteral orifices are found involved in the late stages that the disease originated at these orifices.

Cancer of the bladder seems to be more common in women than in men. The signs of its presence are haematuria, painful micturition, and cystitis. Such signs are, of course, equivocal, and it is usual to demonstrate its existence by means of the cystoscope, or a cystotomy in men, and dilatation of the urethra in women. It is very unusual before the age of forty. Death results from renal complications, exhaustion from repeated bleeding, bodily suffering, and frequent micturition.

Carcinoma has been observed on an extroverted bladder; the patient was a man aged sixty, who "had always earned his living by cracking stones" (Newland).

Treatment.—Operations on the bladder are of two kinds: (1) those which are performed to relieve the patient of the frequency of micturition and the attendant pain, and (2) those which are directed to the extirpation of the cancer.

Operation of the first kind consists of cystotomy, either through the perineum or above the pubes. I have found the best consequences follow a suprapubic opening. The urine flows away as soon as it enters the bladder, and the patient soon learns to manage the necessary tube and receptacle, and is not obliged to remain in bed.

The more radical treatment consists of either removal of the tumour with the implicated segment of the bladder, or complete extirpation of the viscus. In the case of women the ureters have been diverted into the vagina, and in the case of men into the rectum. It is a fact of some value that the rectum will accommodate a fairly large quantity of urine under such conditions. The results of complete removal of the bladder are not encouraging. Partial resection of the bladder is attended with better consequences, especially when the tumour is situated on or near its summit. Operative treatment of bladder tumours is necessarily restricted, because in the majority of cases the tumour arises in the vicinity of the ureteral orifices.

Cancer of the Urethra.—This is an extremely rare situation for cancer. Nevertheless, there are some carefully recorded cases. The disease is of the squamous-celled variety, and usually arises in that part of the urethra in relation with the bulb. The patients were between the ages of fifty and seventy-three. The trouble in each instance attracted attention as a hard mass in the perineum which interfered with micturition, and attempts to pass a catheter provoked great pain and induced free bleeding. The obstruction increased until the urethra became impermeable, and fistulæ formed in the perineum. In most of the cases perineal section was performed, and the cut surface of the tumour had a greyish-white appearance and was extremely brittle.

Cancer of the urethra occurs, though rarely, in women: it may be of the columnar-celled or squamous-celled type. The first variety may arise in the urethral recesses known as Skene's tubes.

The free removal of the urethra in women for carcinoma usually entails incontinence of urine. (See Boyd.)

Cancer of the Prostate.—The prostate is occasionally affected by cancer, especially in old men. As the disease

advances it extends beyond the prostate and infiltrates the tissues around the base of the bladder. The pelvic lymph glands become infected, and dissemination is common. It would appear that secondary deposits in bone are a very constant feature of prostatic cancer, and it has been particularly studied by von Recklinghausen.

The radical treatment of cancer of the prostate is beyond surgical art.

The enlargement of the prostate, which is so common after middle life, and is often termed prostatic adenoma, is the result of a slow, chronic inflammatory change. This subject has been very thoroughly handled by Ciechanowski (1903).

THE EXTERNAL GENITAL ORGANS.

The greater part of the external genital organs are directly continuous with and derived from the skin; it therefore comes about that they are liable to squamous-celled cancer. In some parts the skin glands are specialised and are the sources of glandular types of cancer, *e.g.* Tyson's glands of the penis and Bartholin's gland of the labium.

Cancer of the Scrotum (Sweep's Cancer).—This appears on the scrotum in the form of a wart or warts; they are often spoken of as soot-warts, for they not only occur on the scrotum of the chimney-sweep, but are met with in men who are brought much in contact with soot. In many cases the scrotal wart is harmless, but in a certain proportion of cases it grows slowly, or if multiple, one becomes more prominent than its fellows and ulcerates. The ulceration, at first limited to the wart, extends to the surrounding skin and forms a cancerous ulcer, which will extensively involve the scrotum, spread thence to the skin around the anus and pubes, and even to the thigh. In some cases the ulceration, instead of spreading widely, involves the tissues deeply, so that the tunica vaginalis is exposed and sometimes implicated in the disease; but this is rare.

The inguinal glands become infected and attain a large size: then slowly involve the skin, break down and ulcerate. This process often leads to the formation of deep excavations in the groin, and it not unfrequently happens that the femoral or the external iliac artery, or both, will be seen exposed and

pulsating on the floor of one of these deep pits. It is not uncommon in such cases for the ulceration to open up one of these large vessels, and violent fatal haemorrhage is the result.

It has been stated by several writers that in chimney-sweeps cancer may begin in the inguinal glands. There can be little doubt that such views arise in imperfect observation. In some of these cases the lesion on the scrotum assumes the form of a small hemispherical pimple no larger than a split pea, so small indeed that I have known them to escape very vigilant eyes; and yet such a small lesion will cause the inguinal lymph glands to grow into a mass as big as two fists. Two such cases have come under my own notice.

A very remarkable feature connected with cancer in English chimney-sweeps is, that they are not more prone to it in other parts of their bodies than those persons who follow other occupations; yet the scrotum, which in other individuals is the part least disposed to cancer, is in sweeps so very liable to become the seat of this disease. No answer to this problem is at present forthcoming; neither has anyone succeeded in assigning a reason why it is so very much more frequent in English chimney-sweeps than in sweeps of other nations.

There is good reason to believe that tar and paraffin are liable to produce an affection of the scrotum similar to sweep's cancer. Such cases are, however, very rare. The literature has been summarised by Butlin.

Treatment.—This consists in the free removal of the disease whenever it is practicable; the very best results follow the excision of a soot-wart in its earliest stages. When the disease is permitted to extend deeply into the tissues of the scrotum, so that it is necessary to excise one or both testicles with the scrotum, and perhaps a portion of the neighbouring skin, it is not probable that lasting benefit will follow the operation. In cases where soot-warts have been early and thoroughly removed there is good ground for the belief that a cure is sometimes brought about.

Cancer of the Testis.—This subject is discussed in Chapter LII.

Cancer of the Penis.—This disease may attack the

prepuce or the epithelial investment of the glans. Carcinoma arising in the epithelium of the urethra is considered on p. 370. The disease is excessively rare before the age of thirty years, and appears to be most common between the ages of fifty and seventy. There is reason to believe that phimosis, congenital or acquired, is a condition that favours the development of cancer of the penis. It is certainly true that phimosis, by leading to the retention of smegma, is indirectly a cause of penile warts not only in men but other mammals, especially horses and bulls. Mention has already been made of the fact that penile warts are particularly prone to be transformed into wart horns, and cases have been recorded in which men have had a wart horn on the penis for several years, and at length its base has become the starting-point of cancer. It must be remembered that cancer may begin as an ulcer on the penis, but the warty variety is by far the more frequent. When the disease begins as an ulcer, it is very liable to be mistaken for some manifestation of primary or tertiary syphilis. On the other hand, very great care must be taken not to mistake a breaking-down gumma of the glans penis for cancer.

Cancer, in whatever form it commences, gradually involves and as surely destroys the penis, implicates the scrotum, and infects the inguinal lymph glands on each side; in many cases the lumbar glands also become infected. Secondary deposits seem to be rare. The duration of life in this disease is very uncertain. As a rule, its course is short—six months to a year; but in many cases it is much longer. When the urethra is involved this passage is liable to become narrowed, and not unfrequently urinary fistulæ add to the patient's misery.

The penis is also liable to a rare species of cancer constructed on the type of the specialised sebaceous glands named after Tyson. I once had an opportunity of studying such a tumour in a man fifty years of age: it sprang from the penis and was confined to the corona glandis. The penis was amputated and the infected lymph glands enucleated from both groins, but the patient died nine months later with the signs of secondary deposits in the abdominal viscera, but no dissection was permitted. Sections were prepared from the

tumour in such a way as to include the glans penis, its corona, and the tumour; in this way the relation of the cancer to Tyson's glands was clearly demonstrated.

Carcinoma of Cowper's Glands.—These structures are liable to inflame and become cystic, and there is also reason to believe that the gland may become cancerous. The most recent contribution to the subject is by Witsenhausen.

Treatment.—Cancer of the penis is treated by partial or complete removal of this organ, according to the extent of the disease. Partial removal of the penis is a simple proceeding, and entails but little risk so long as the cut end of the urethra is stitched to the skin. When the disease is so extensive as to demand complete removal of the penis, the operation which gives best results consists in excising not only the corpus spongiosum and corpora cavernosa, but the penile crura as well, by detaching them from the pubic arch. The urethra is brought out and attached to the incision in the perineum. In all cases where it is justifiable to amputate or extirpate the penis for cancer the infected inguinal lymph glands should be thoroughly removed. The published results of this complete operation are very good, and my experience of it has been in every way satisfactory. The ultimate results of amputation of the penis are more favourable after partial than after complete removal of the organ, simply because the disease is not so advanced when partial amputation is sufficient.

Cancer of the Vulva and Vagina.—The variety of cancer which attacks the external genital organs of the female is, with the exception of Bartholin's glands, squamous-celled.

Collectively, cancer of these parts is not uncommon, but when each part is individually considered, then it is comparatively rare, but the disease is more frequent in the labia than in all other parts of the genital passage taken together.

The Labia Majora and Minora.—Carcinoma may begin on any part of the labia, but it generally attacks the opposed, or so-called mucous surfaces. In many cases this is preceded by leucoplakia, which resembles in many respects lingual leucoplakia, and I have satisfied myself that it is occasionally a sequel of syphilis. Another pre-cancerous condition of the labia is that known as *Kraurosis vulvæ*.

In order to give some idea of the relative infrequency of vulval cancer, I find that at the Chelsea Hospital for Women, where the yearly average of operations on the female genital organs is 500, labial cancer comes under observation about twice in a thousand cases. Cancer of the vulva and cancer of the lip in women equal each other in infrequency.

The disease runs a course very similar to squamous-celled cancer of the scrotum, and it is a singular fact that two cases of cancer of the labium have come under my notice in the wives of chimney sweeps. When recognised in the early stages, prompt and free excision and removal of the infected inguinal lymph glands is followed by much the same success which attends operations upon cancer of the lip. In operating for cancer of the vulva the method which has given me the best results, immediate and remote, consists in freely excising the primary disease with the scalpel and allowing the parts to heal: this usually takes place in fourteen days. The lymph glands, large and small, are then removed from both inguinal regions. Dividing the operation in this way avoids the risk of sepsis and diminishes shock and haemorrhage, for in many instances operations of the vulva are attended with free bleeding.

The Clitoris.—Cancer of this organ is a rare disease; the majority of the patients are over fifty years of age. One example has come under my notice, and in this the disease began at the free extremity of the clitoris, in a woman forty-five years of age.

The treatment consists of free removal of the clitoris and its crura, and removal of infected inguinal lymph glands. If the operation is carried out before the disease has extended to the nymphæ, labia, or mons, the outlook for the patient is favourable.

Björkquist has collected sixty-seven cases from the literature. He considers the prognosis grave: in twenty patients death occurred in sixteen months.

The Vagina.—Carcinoma may attack any part of the mucous membrane lining this canal, but it is much more prone to begin at the vulvo-vaginal junction. In the majority of cases which have come under my observation the cancer has been in the immediate vicinity of the urethral orifice. In

every instance the patients were past middle life, and one was seventy-three. The inguinal lymph glands are early infected. The cancer quickly implicates the vesico-vaginal septum and leads to fistula, and when it attacks the posterior wall it causes a recto-vaginal fistula. In one case the urethral orifice became blocked with cancerous granulation, and retention of urine was a very distressing symptom.

In the early stages cancer of the vagina produces such little inconvenience that the patients do not seek advice until the disease is far advanced. Surgery can do little in cancer of the vagina, for even in the very early stages free removal may anticipate some of the evils of the disease by establishing a vesical or a rectal fistula.

Carcinoma of Bartholin's Glands.—It is well known that these glands are very liable to become cystic; they are prone, too, to septic infection. They are also occasionally the source of cancer. Schweizer has reported a case and collected the literature.

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CHAPTER XXXVI.

EPITHELIAL TUMOURS OF THE UTERUS.

Epithelial tumours of the uterus arise in the glands of the endometrium, except squamous-celled cancer, which is limited to the vaginal portion of the cervix. It will be convenient, on anatomical as well as on clinical grounds, to consider them in two sections, namely, those which arise in the epithelium of the cervix, and those originating in the endometrium of the body of the uterus.

THE CERVICAL ENDOMETRIUM.

Adenomata.—The cervical canal is lined with columnar epithelium and furnished with numerous racemose glands. Adenomata, which are structurally repetitions of these glands, are very common at the neck of the uterus. There are two varieties: sessile and pedunculated adenomata.

A sessile adenoma appears as a soft velvety areola around the os; it is in colour like a ripe strawberry, and thickly dotted with minute spots of a brighter pink. This pink tissue is composed of glandular acini lined with large, regular, columnar epithelium. The glandular tissue often extends beyond the margins of the os and invades the vaginal portion of the cervix. Sometimes it is so abundant that the apex of the cervix, instead of being a cone, assumes rather the shape of the under surface of a mushroom. The glandular mass is not confined to the margins of the os, but extends for a variable distance up the canal. When adenoma affects a lacerated cervix the whole of the exposed portion of the canal is involved. The surface of a sessile adenoma is covered with tenacious mucus secreted by the abnormal glands.

Pedunculated adenomata are rarely large: they may grow from any part of the cervical canal, but are most frequently found springing from the lower 2 c . of the canal. As a rule they occur singly, but two or more may be present. They are soft and velvety to the touch, and dotted with minute

pores. Histologically, they consist of an axis of fibrous and sometimes muscle tissue, covered with mucous membrane continuous with that lining the cervical canal. When these pedunculated adenomata remain within the canal, the epithelium covering them and the glands they contain are of the same character as those of the cervical mucous membrane. When the tumours increase in size and project into the vagina, the epithelium covering the protruding portions becomes stratified, and the glands disappear.

Carcinoma of the Neck of the Uterus.—This part of

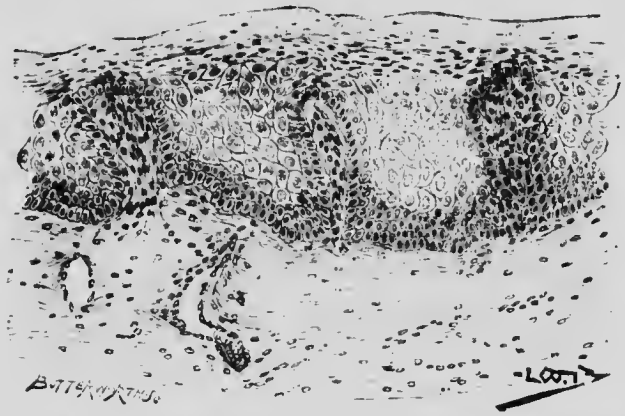

Fig. 181.—Microscopic characters of the epithelium covering the vaginal aspect of the neck of the uterus.

the uterus is liable to squamous-celled and columnar-celled cancer, according to the situation in which it arises. When the disease begins on the vaginal aspect of the neck of the uterus, it is of the squamous-celled species; if its origin is in the cervical endometrium, the cells will be columnar. (Figs. 181 and 182.)

A large amount of energy has been devoted to the microscopic examination of cancer of the neck of the uterus, with the hope of determining the relative frequency of squamous-celled and of the columnar-celled variety. So far as my own efforts are concerned, they were directed with the object of deciding, if possible, which variety gave the best results to operation; but after a long and laborious investigation I came to the conclusion that it was hazardous to attempt a prediction simply on the cell features of the cancer.

Although the ultimate results of cancer arising in the cervical endometrium, or on the vaginal aspect of the cervix, are the same, it will be advisable to discuss their pathologic features separately. In the majority of patients who come under observation, particularly in hospital practice, the disease has already destroyed, or eroded, the neck of the uterus to

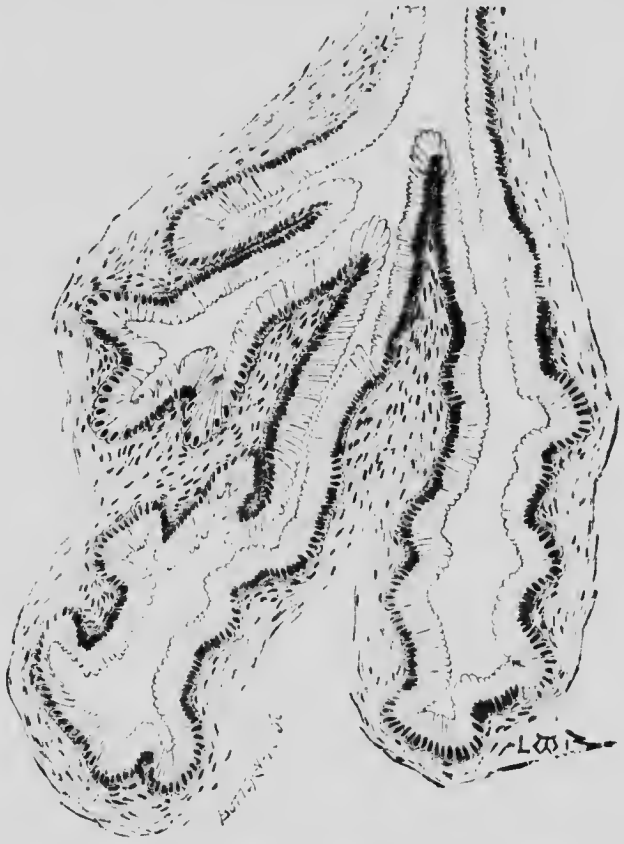

Fig. 182.—Microscopic characters of a gland from the cervical endometrium.

such an extent that it is impossible to determine whether it arose in the cervical canal or on the vaginal surface; nevertheless, patients do occasionally come under observation at a sufficiently early stage to enable an exact localisation of the primary focus of the disease to be made. In this way it has been determined that squamous-celled cancer of the cervix begins in much the same way as on the lips or tongue. It

may appear as a circular ulcer with raised and everted edges, or may erode the tissues deeply at the outset; exceptionally it forms luxuriant warty excrescences. The cancer infiltrates the cervix, extends to and implicates the vaginal wall, and involves the tissues of the mesometrium. Cancer also arises in the epithelium in any part of the cervical canal or its glands, but it appears to be more prone to arise in the lower than in the upper half of the canal. It begins either as a

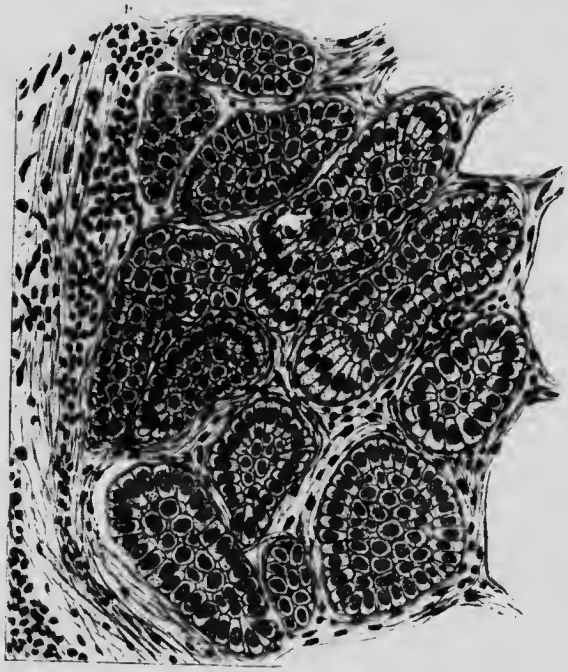

Fig. 183.—Microscopic characters of cancer of the cervix.

deeply eroding ulcer, or as a soft, fungating, vascular, cauliflower-like outgrowth. Commonly the cancer, after infiltrating the adjacent tissues of the cervix, spreads into the mesometrium and implicates the vaginal wall. It ulcerates early, and destroys the cervix and spreads into the body of the uterus, and in the late stages this organ may become hollowed out by ulceration until nothing but a thin layer of muscle tissue covered by peritoneum remains.

The microscopic features of cancer arising in the cervical epithelium consist of round spaces filled with columnar

epithelium. This depends on the fact that the invasion of the tissues is due to columns of epithelium, and in the microscopic sections these cell columns are represented cut at right angles (Fig. 183).

Cancer of the cervix leads to infection of the lumbar lymph glands. Dissemination is also frequent, and secondary deposits form in the lung, liver, and occasionally in the bones, but not with the same frequency as in cancer of the breast.

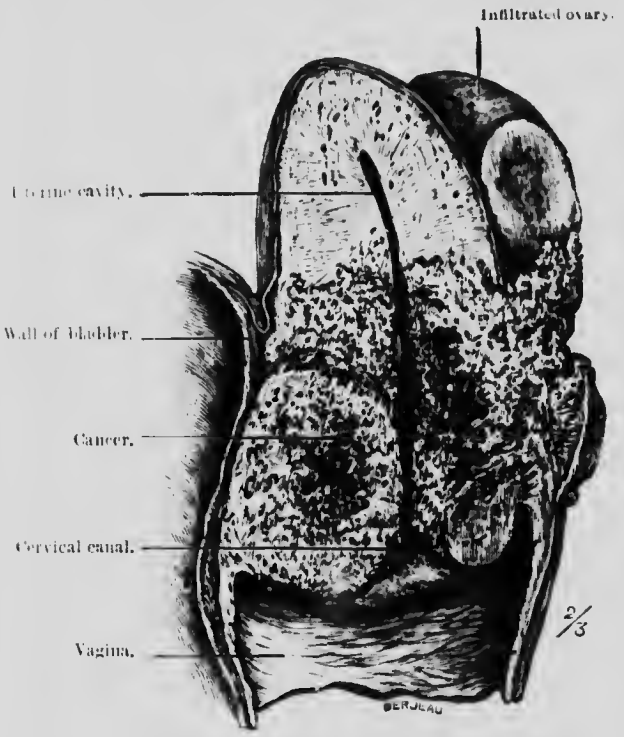

Fig. 181.—A cancerous uterus in sagittal section.

Cancer of the cervix leads to perforation of the anterior and posterior vaginal septa, so that urinary and faecal fistula are apt to complicate the late stages of the disease (Fig. 185).

When the broad ligaments are extensively infiltrated the ureters become involved; this leads to dilatation of the renal pelves. As cystitis is a common complication of carcinoma of the cervix, this, in conjunction with the interference with the ureters, serves to explain the almost constant presence of

suppurative pyelitis and nephritis found during *post-mortem* examinations of women with uterine cancer. A very large proportion of these patients exhibit marked uræmic symptoms in the later stages of their lives.

Among other complications of cancer of the cervix, especially when it extends to the body of the uterus, must be mentioned pyosalpinx and hydrosalpinx. In these cases the

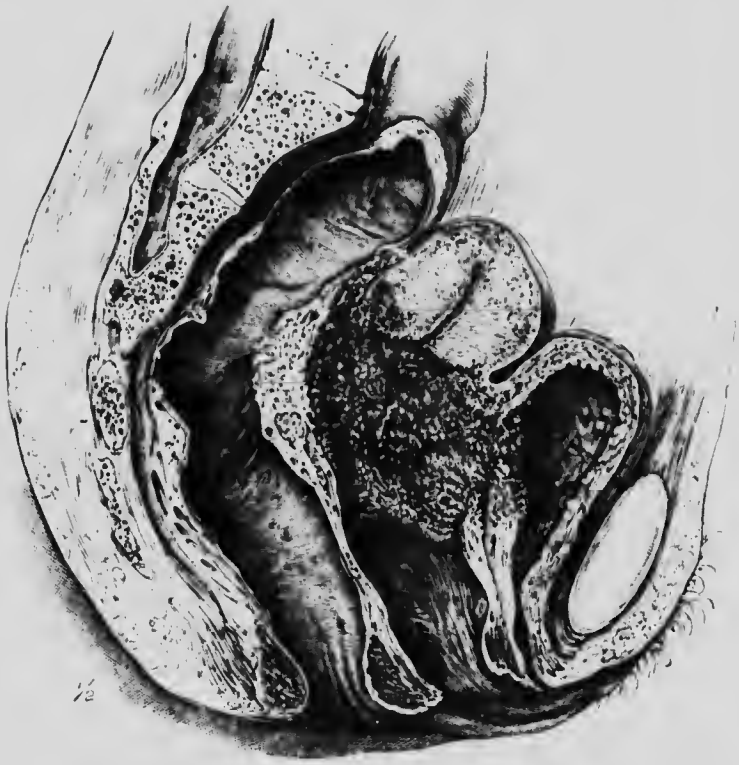

Fig. 185.—Pelvis and its viscera in section. From a case of cancer of the uterine cervix which invaded the bladder.

dilated tubes are rarely thicker than the thumb, but they are a source of danger, inasmuch as perforation occasionally occurs and sets up infective peritonitis. Exceptionally the cancer perforates the body of the uterus. When this happens peritonitis may ensue and quickly cause death; in some instances the carcinomatous material becomes distributed over the peritoneum, and small knots form upon the serous

surfaces of the intestine, liver, spleen, etc. This distribution of the cancer may lead to an effusion of blood-stained fluid into the belly, sometimes in considerable quantity; or to agglutination of coils of intestine, each cancerous nodule being the focus of a limited area of peritonitis. Occasionally actual perforation of the uterus is prevented by a piece of intestine becoming adherent to the uterus at the spot where

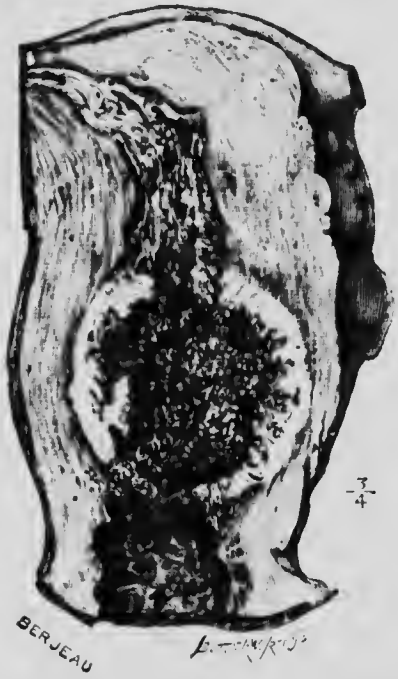

Fig. 186.—A cancerous uterus in coronal section. It was difficult to decide whether the cancer began in the upper part of the cervix or the lower part of the body the uterus. A process of the growth is creeping into the right Fallopian tube

the disease is approaching the surface: adhesion in this way may take place between the uterus and the small intestine.

It is important to bear this in mind, because when a faecal fistula complicates cancer of the uterus it is usually attributed to a communication with the rectum or sigmoid flexure, and these are the common situations: but in some cases the fistula is in the transverse colon, for when this section of the large bowel is omega-shaped the lower segment of the loop often comes in contact with the fundus of the uterus.

Cancer of the cervix uteri is very common between forty

and fifty; many cases occur between thirty and forty. Before thirty the disease is rare, but I have observed undoubted cases in women of twenty-three, twenty-five and twenty six years of age. It belongs especially to the latter part of the child-bearing period of life; *it is almost exclusively confined to women who have been pregnant.* Whether it be due to delivery or to the traumatism of the cervix associated with coitus I cannot determine; in the only exception to the rule mentioned above which has come under my observation the patient was married.

A remarkable record bearing on this matter has been published by Czerwenka. A woman thirty-five years of age had a double vagina and uterus bicornis bicollis. Coitus was practised in the left vagina. The left cervix was cancerous, the left uterus contained two fibroids, and the corresponding Fallopian tube contained pus and had its coelomic ostium occluded.

The signs of cancer of the cervix are bleeding, offensive discharges, and sometimes pain. The first two signs are those which usually lead women to seek advice.

In the early stages the margins of the os will be found everted, and a fungous mass protrudes from the canal, which bleeds on the slightest touch. In the late stages, when the neck of the uterus is destroyed and replaced by an ulcerating cancerous mass, there is no difficulty in recognising the nature of the lesion. Cancer of the uterus terminates in a variety of ways:—

1. The uterine artery may be opened by ulceration, and fatal haemorrhage ensue.

2. Repeated bleeding due to smaller arteries being eroded will often lead to exhaustion and death.

3. Implication of the bladder and one or both ureters causes cystitis, septic pyelitis, and uraemia (Fig. 187).

4. Septic changes in the uterus extend to the Fallopian tube, and cause pyosalpinx.

5. Peritonitis may be caused by rupture of a pus-containing Fallopian tube.

6. Intestinal obstruction may follow adhesion of a piece of small or large intestine to the uterus, or direct extension of the cancer into the rectum.

7. Hydroperitoneum and hydrothorax may arise from the presence of secondary nodules of cancer on the peritoneum or pleura.

8. The cervical canal sometimes becomes occluded, and the cavity of the uterus becomes distended with pus (pyometra). The chief danger in this complication is due to the Fallopian tubes becoming secondarily distended with pus which occasionally leaks into the peritoneum with lethal results.

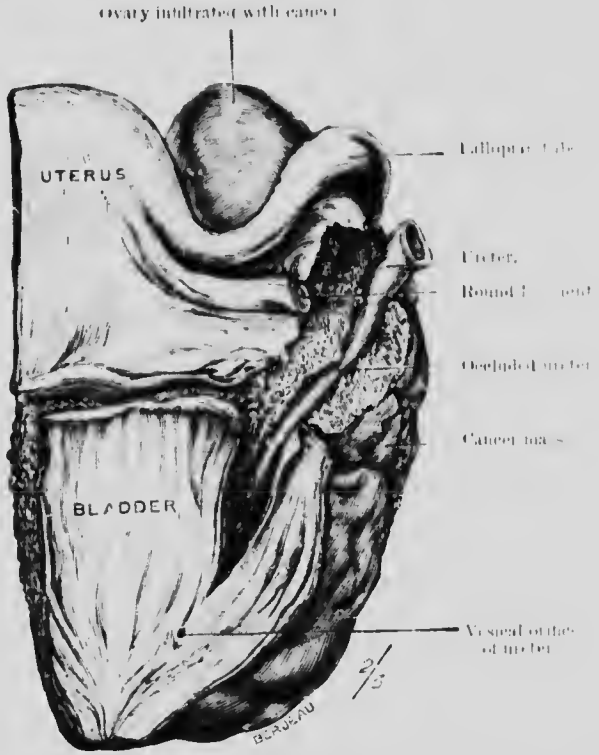

Fig. 187.—Cancer of the neck of the uterus implicating the bladder and the ureter.

Cancer of the cervix is sometimes complicated with other lesions of the genital organs: such as ovarian cysts and tumours, fibroids, etc.

Carcinoma of the Cervix and Pregnancy.—It may be stated without fear of contradiction that the most appalling complication of pregnancy is cancer of the cervix. It is somewhat difficult to understand how a woman with cancer of the

neck of the uterus can conceive, but it is quite certain that it happens, and that the complication is not uncommon. However, cases in which cancer in this situation obstructs delivery are unusual, and this is due to two circumstances.

1. The cancer predisposes to abortion.
2. When it has advanced to such a stage as to fill the vagina with an obstructive mass, it has such an effect upon the health of the mother that it endangers the life of the fœtus.

The second condition is of importance, because in considering the advisability of Cæsarean section in these circumstances it is well to be satisfied that the fœtus is alive. However, in very exceptional cases it has been found necessary to resort to this operation in order to deliver a dead and putrid fœtus.

The careful study of the literature relating to this complication shows clearly enough that when a pregnant woman with early cancer of the uterus comes under observation in the early months, her best hope lies in vaginal hysterectomy. In the later stages (fourth to the seventh month) very good consequences have followed amputation of the cervix, and this operation has been successfully performed without disturbing the pregnancy. In the latest stages the best consequences have followed the induction of labour and the immediate performance of vaginal hysterectomy—for, surprising as it may seem, the uterus enlarged by the pregnancy can be safely extirpated through the vagina.

These methods of treatment only apply to cases where the cancer is in such a condition as to afford reasonable hope of a prolongation of life. When the disease is in an inoperable stage and the fœtus is dead, then after a little patient waiting abortion usually occurs. When there is reliable evidence that the fœtus is alive, the pregnancy should be allowed to go to term; if the cancer affords an impassable barrier to the transit of the child, then Cæsarean section becomes a necessity.

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CHAPTER XXXVII.

EPITHELIAL TUMOURS OF THE UTERUS (*concluded*).

ADENOMA AND CARCINOMA OF THE CORPOREAL ENDOMETRIUM.

Adenomata.—These occur as pedunculated tumours, and have an appearance very similar to rectal adenomata; it is possible that on this account they are sometimes described

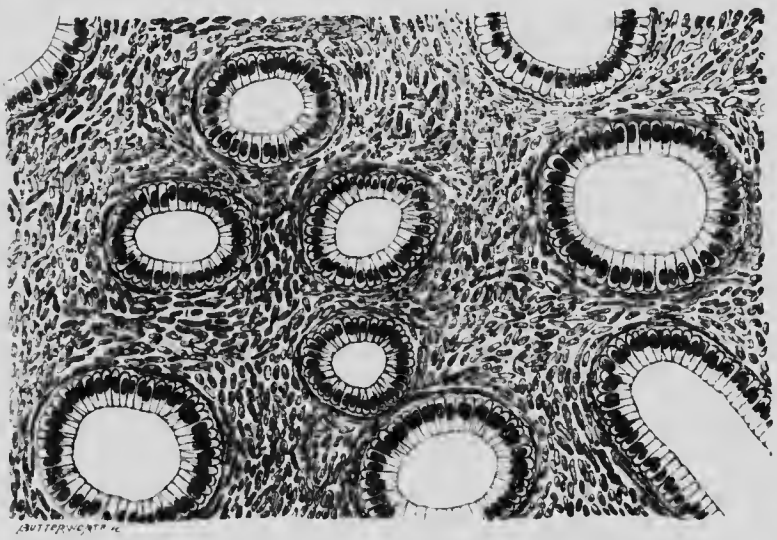

Fig. 188.—Tubular glands of the corporeal endometrium in transverse section.

as mucous polypi. Microscopically these tumours consist of cystic spaces lined with columnar epithelium, the cavities being filled with mucus. Adenomata of the corporeal endometrium differ from those of the cervix in that the cystic spaces are larger and more numerous, and the epithelium lining the spaces is tall and columnar, as in Fig. 188.

Adeno-myoma of the Uterus.—The term "adeno-myoma" is applied to a pathological formation in the uterus, the leading features of which are admirably summarised by Cullen in the following terms: "It is diffuse in character,

situated in the middle layer of the uterine wall, and is dependent on the uterine mucosa for its glandular elements. Although several observers, including von Recklinghausen, have recorded isolated examples of this disease, Cullen seems to have been the first to draw attention to its clinical importance (1897).

In well-marked cases adeno-myoma presents clinical features which cause it to resemble the common varieties of submucous fibroids. The ages of the patients vary from twenty to fifty years; the uterus is enlarged, there

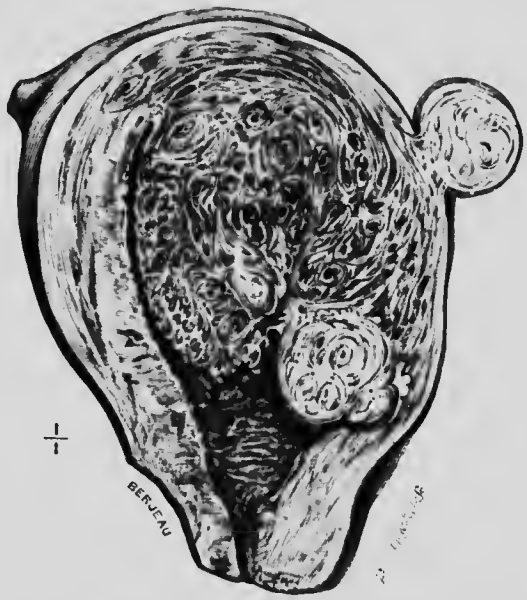

Fig. 189.—A uterus in sagittal section showing diffuse adeno-myoma, from a spinster 32 years of age. The gland spaces were cystic and filled with gelatinous material.

is profuse and in some instances uncontrollable menorrhagia and profound anæmia.

When the uterus is removed and divided longitudinally, the walls are seen to be greatly thickened, measuring in some specimens 5 cm.(2 inches) in thickness: this increase is due to the formation of new tissue between the outer wall of the uterus (the subserous stratum) and the superficial layer of the endometrium. There is no attempt at encapsulation, and the term "diffuse" is thoroughly justified (Fig. 189).

The new tissue consists mainly of bundles of plain muscle fibre, which instead of being arranged in vortices, as is so common in the ordinary hard fibroid, are disposed in an irregular manner, and the spaces between the bundles are filled with the peculiar stroma of the uterine mucosa containing gland tubules lined with columnar epithelium of the same type as the normal tubular glands of the endometrium. The glandular elements appear to be uniformly

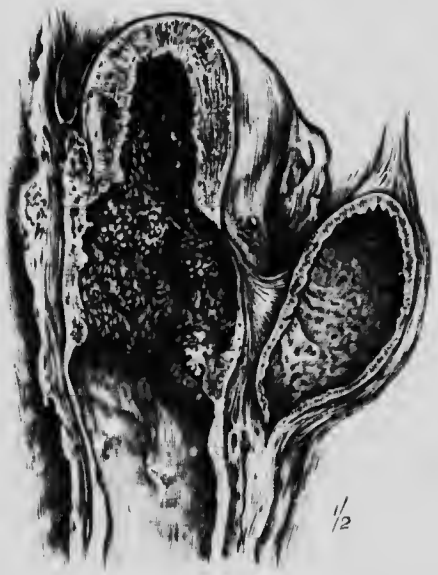

Fig. 190. Cancerous uterus in sagittal section. A bud-like process of the cancer protruded through the uterus and infected the peritoneum, which contained thousands of secondary nodules.

distributed throughout the adventitious tissue, and can be detected up to the limits of the thin muscular stratum underlying the peritoneal coat of the uterus.

Careful accounts of the histology of this disease have been published by Cullen, Cameron, Taylor and Leitch.

Treatment. — The only remedial measure available in this disease is extirpation of the uterus (hystereetomy).

Cancer of the Body of the Uterus.—This is much less frequent than cancer of the cervix, and it arises in the epithelium lining the cavity of the uterus and its tubular glands.

There is very little accurate knowledge regarding its early stages, and the writer has had only one opportunity of obtaining a cancerous uterus before the disease had extended to the muscular wall. The disease remains for a long time restricted to the body of the uterus, and may creep into the uterine sections of one or both Fallopian tubes; it rarely invades the cervix, and then only in the late stages of the disease. It is apt to perforate the wall of the uterus and infect the peritoneum (Fig. 190).

It is only in the last fifteen years that the importance of cancer of the body of the uterus has been clearly appreciated,

Fig. 191.—Microscopic characters of the common kind of cancer of the body of the uterus.

and this was due to the fact that there were no means available for the proper examination of the interior of the organ, and as a result the descriptions of diseases of the endometrium were disfigured or obscured by a crowd of terms such as senile endometritis, malignant endometritis, villous endometritis, and so on. When the plan of mechanically dilating the cervical canal was introduced, so that the endometrium could be examined and fragments obtained for the laboratory, then light began to shine, and we obtained some accurate data.

As in other organs, cancer of the body of the uterus consists of cell columns, the cells being identical with the epithelial cells of the endometrium. The disease assumes two distinct forms: thus it may appear as an eroding ulcer pene-

trating the muscular wall of the uterus, and sometimes even perforating the serous coat. In the common form it gives rise to luxuriant masses of soft, succulent, and vascular polypus-masses projecting into the cavity of the uterus; and this is the variety which used to be termed villous endometritis.

As the diagnosis of cancer of the body of the uterus is largely determined by the assistance of the microscope, it is essential for those who venture to give opinions on this point to be thoroughly familiar with the various abnormalities of

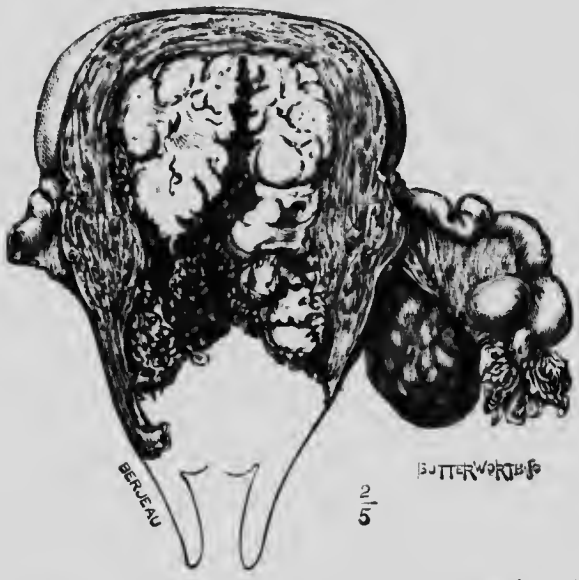

Fig. 192.—Uterus with "tubular" cancer, shown in coronal section; the patient was 41 years of age, and mother of one child.

the corporeal endometrium, especially those which are known as glandular polypi.

Although in writings and in clinical work we treat very definitely of cancer of the cervical endometrium and cancer of the corporeal endometrium, it is well to understand that cases come to hand in which, after the uterus has been removed, it is extremely difficult on examining the organ to state positively whether the disease arose in the body of the organ or in the upper segment of the cervical canal (Fig. 186).

The writer is also convinced that there are two species of cancer arising in the corporeal endometrium, and that these

species are distinct not only in their histologic features, but also in their gross characters and clinical aspects.

The commoner species resembles and, indeed, is very similar to that which attacks the cervical endometrium,

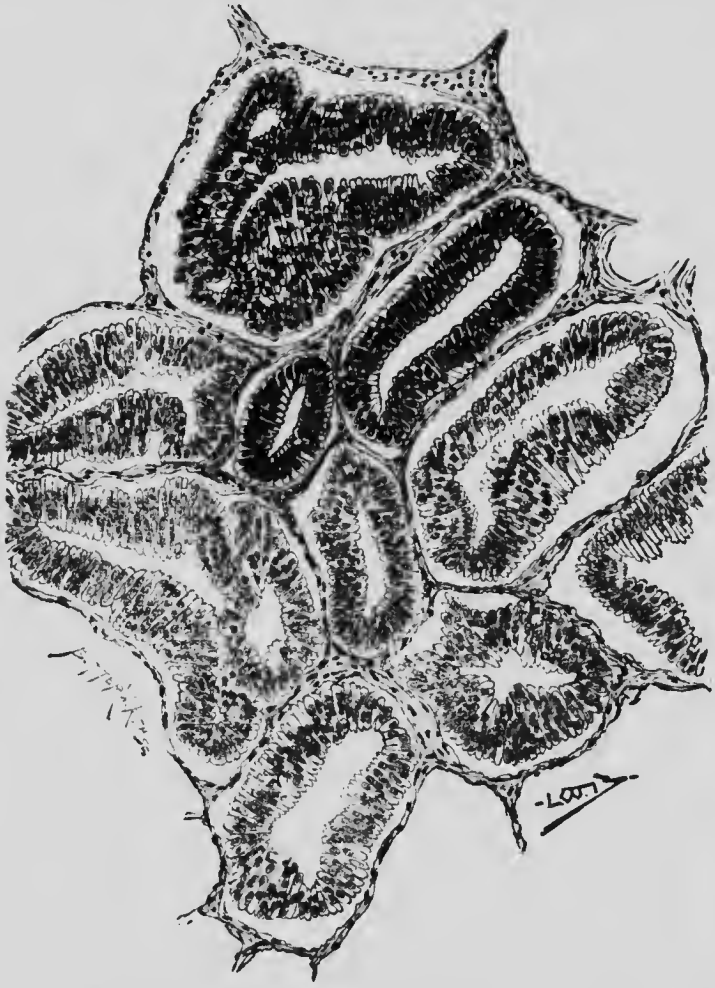

Fig. 193.—Microscopic characters of the cancer in the preceding figure: the uncommon kind, or "tubular" cancer.

except in the more perfect columnar type of the epithelium composing the cancer columns (Fig. 191). The rarer species is that which has been described as "malignant adenoma" by more than one writer, and this is due to the fact that the normal features of the uterine glands are less distorted than

in the common kind of cancer. It is remarkable in forming large yellowish-white masses in the endometrium and causing great enlargement of the uterus (Fig. 192). It appears probable that this rarer or tubular variety is a malignant form of the disease known as adeno-myoma of the uterus (p. 387).

Cancer of the corporeal endometrium is unusual before the forty-fifth year; it is most frequent at or subsequent to the menopause. The majority of the cases occur between the fiftieth and seventieth years. *A large proportion of the patients are nulliparæ.*

The patient's attention is usually attracted by fitful hæmorrhages after the menopause, followed by profuse and offensive discharges which are often blood-stained. The uterus on examination may feel scarcely enlarged: sometimes, however, it is much bigger than usual. In some instances cancer of the corporeal endometrium is associated with fibroids.

In order to give some reliable notion of the age distribution of cancer of the body of the uterus, I have arranged in a tabular form twelve consecutive cases which were under my care. The table not only shows the ages of the patients, but also their parity and the presence or otherwise of fibroids. The table is of interest, because it was formerly supposed that cancer of the corporeal endometrium arose mainly in aged spinsters or those who lived in sterile wedlock. It shows that this is not so exclusively a feature of the disease as we formerly believed: and this view is strengthened by the comparison of my table with the experience of other observers.

TABLE TO SHOW THE AGE DISTRIBUTION AND RELATION TO PREGNANCY OF CANCER OF THE BODY OF THE UTERUS.

No.	Age.	Pregnancy.	No.	Age.	Pregnancy.
1	56	0	7	54	1 Fib.
2	50	0 Fib.	8	53	6
3	42	0	9	41	1
4	36	0	10	54	0 Fib.
5	45	0	11	56	5
6	60	0 Fib.	12	46	3

Treatment.—The only satisfactory mode of treating cancer of the uterus is the rough method of complete removal. It is a melancholy fact that cancer of the cervix is extremely common, yet operative interference can only be carried out in a very small proportion of the cases with any prospect of success. So small is this proportion that in my practice it works out at only 10 per cent. The chief reason is this: As soon as the disease overruns the cervix, the proximity of the bladder, ureters, and rectum renders a wide removal of the implicated tissues impracticable. It was thought that the practice now prevalent of complete removal of the uterus for cancer of the cervix would improve the remote results: but in this we are sadly disappointed, and it is important to emphasise the fact that some of the most thorough and complete vaginal hysterectomies have been followed by the most rapid and extensive recurrences. This is due, in my opinion, to the same cause as the extensive recurrences which I mentioned as following very free surgical operations on the breast and submaxillary region—namely, cancer-infection of the tissues injured in the course of the operation. Look at vaginal hysterectomy for cancer from any point of view, and the results can only be regarded as depressing. The operation mortality is trifling, 5 per cent.: the rate of recurrence heavy, about 60 per cent. within the first six months; the average duration of life after operation eighteen months, my longest survival being four years.

In cancer of the body of the uterus I have had better results than in hysterectomy for cancer of the cervix; and the best consequences of all have followed abdominal hysterectomy for cancer of the body of the uterus.

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CHAPTER XXXVIII.

UTERINE FIBROIDS COMPLICATED WITH CANCER OF THE UTERUS.

Uterine fibroids are very common, so is cancer of the uterus, and as the maximum of frequency in relation to age is very nearly the same in the two diseases, it is not a matter for surprise that the two diseases should frequently co-exist. Whether the presence of fibroids predisposes the uterus to cancer is doubtful; but it may. The subject may be conveniently considered under two headings:—

1. Cancer of the neck of the uterus co-existing with fibroids.

2. Cancer of the body of the uterus complicating fibroids.

(Cancer of the Fallopian tubes may be associated with uterine fibroids. See Chapter XXXIX.)

The subject is an important one, not only as regards treatment, but also from the diagnostic point of view.

1. **Cancer of the Cervix and Fibroids.**—The especial danger of this combination depends on the fact that it is liable to be overlooked, because the most prominent clinical feature of fibroids as well as of cancer of the uterus is bleeding. When a patient with uncomplicated cancer of the neck of the uterus comes under observation the disease is almost certainly recognised, but when a woman known to have a fibroid in her uterus complains of more than usual bleeding, she is not so likely to be made the subject of routine examination, hence the disease remains for an indefinite time unsuspected and therefore undetected. There is also another danger: when cancer attacks the parts around the mouth of the womb its detection is a fairly simple act; but there is a fair proportion of cases in which the disease begins a short distance up the canal; such are easily overlooked, and the higher up the canal the disease is situated the more probable is the chance that it will escape detection, while if the uterus contains fibroids the chances are very great that the bleeding

will be attributed to them, and the existence of cancer will be entirely overlooked. Anyone who follows carefully the published accounts of operations for fibroids of the uterus, or has had a wide experience of the operation, will learn that a surgeon while performing subtotal hysterectomy notices after he has detached the body of the uterus from the cervix that the cut surface looks suspicious, and he realises that it is cancerous, and excises the neck of the uterus. In a few cases subtotal hysterectomy has been performed, and the patient, after recovering from the operation, has had recurrence of the bleeding, and consults the surgeon, who on examination finds that he had overlooked a cancerous cervix. On one occasion I performed a total hysterectomy, and some months later, as the patient complained of vaginal haemorrhages, I examined her, and found a recurrent cancerous mass occupying the vault of the vagina. The parts removed at the operation had been preserved: they were examined and a cancerous ulceration was found at the os uteri. Although total hysterectomy was performed as a primary operation in ignorance of the existence of cancer, it failed to exercise any influence for good on the progress of the disease.

This matter may be summarized thus:—It is by no means uncommon for a woman known to have fibroids in her uterus to lead a tolerably comfortable life, in spite of profuse or even long-drawn-out menstrual periods. Occasionally a patient of this kind suddenly experiences a marked increase in the flow, or has what she terms a "flooding," is alarmed, and seeks advice. Cases of this kind require careful consideration, for this alteration in the symptoms may indicate changes in the fibroid, or the supervention of cancer. If the patient is a spinster, or married but barren, there may be concurrent cancer of the body of the uterus. If married and fertile the co-existence of cancer of the cervix must be considered, and it is well to bear in mind that an early cancer a short distance up the cervical canal will give rise to bleeding and escape detection by the examining finger.

There is another aspect of cancer of the uterine neck which must receive consideration. It has been shown that when the body of the uterus has been removed for fibroids, an operation known to surgeons as subtotal hysterectomy,

carcinoma has occurred in the cervical stump at such an interval after the operation as to make it certain that it did not exist at the time the body of the uterus was removed. Such a case has come under my own observation; and it has been suggested, especially by Richelot, that it occurs with sufficient frequency to make it advisable in operations performed for the cure of fibroids to remove the neck completely with the body of the uterus (total hysterectomy) to avoid such a sequel. This recommendation appears too sweeping, especially in view of the fact that even complete excision of the neck of the uterus is not a safeguard against the occurrence of cancer, for Quénu has reported an observation in which carcinoma arose in the vaginal cicatrix four years and a half after total extirpation of the uterus for disease of the appendages.

An instructive record bearing on the subject of uterine fibroids and cancer has been published by Blacker. A woman, aged thirty-nine years, with a large uterine myoma, was submitted to bilateral oöphorectomy, and the uterus shrank into the pelvis. Eight years later carcinoma attacked the neck of the uterus and destroyed the patient.

I have had a similar experience. In January, 1902, I removed from the uterus of a woman, aged forty-seven, a submucous fibroid by the abdominal route; a right pyosalpinx was removed at the same time. She reported herself four years later with extensive cancer of the uterus.

2. **Cancer of the Body of the Uterus complicating Fibroids.**—This is not an uncommon combination. Cancer of the corporeal endometrium or, as it is more commonly called in clinical reports, cancer of the body of the uterus, is most frequent at or subsequently to the menopause. The majority of the patients are between the fiftieth and seventieth years: *and a large number of the patients are spinsters or barren wives.*

When a woman complains of irregular uterine bleeding after the menopause an examination is, as a rule, promptly made and efforts are particularly directed to determine the existence or non-existence of cancer. Many women with fibroids do not cease to menstruate, or at least suffer from a more or less regular loss of blood for many years after the

normal age for the menopause. When cancer of the body of the uterus arises in such a patient it is extremely liable to be overlooked.

When a woman known to have a fibroid in her uterus attains the menopause and remains free from a monthly loss for a few years, then suddenly begins to have "issues of blood," this may be due to cancer of the body of the uterus,

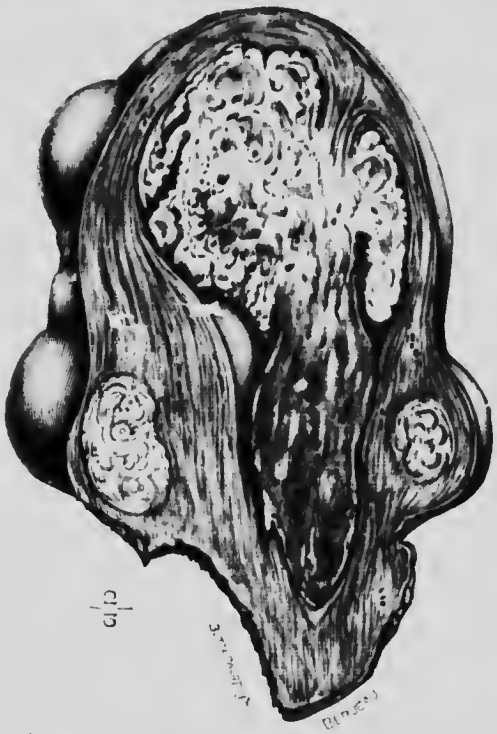

Fig. 191.—Uterus in section, showing primary cancer of the corporeal endometrium associated with fibroids. From a spinster aged 59 years.

and is always such a suspicious circumstance that it demands the most careful examination.

The matter may be put in an aphoristic form: *When a woman with uterine fibroids, having passed the menopause, begins to have irregular profuse uterine haemorrhages, it is extremely probable that she has cancer of the body of the uterus.*

It occasionally happens that a patient with fibroids may attain her menopause and remain free from losses of blood, in

a few years the fibroid may become infected and bleeding occur profusely as a sequel.

It has been suggested, especially by Piquand, that there are reasons for believing that submucous and interstitial fibroids may predispose to cancer of the corporeal endometrium, for the presence of fibroids sets up chronic metritis, which renders the endometrium susceptible to malignant transformation. Piquand also analysed a thousand cases of fibroids of the uterus and found cancer of the corporeal endometrium present in 15 cases: this is a high proportion. This induced me to examine a consecutive series of 500 cases in which I had removed the uterus for fibroids, and I found this unhappy combination in eight instances, the nature of the disease in each case being verified by a careful microscopic examination. All the patients were over 50 years of age.

It is premature to assert that interstitial and submucous fibroids exert such a malign influence as to predispose the corporeal endometrium to cancer; but it may be true, and it is therefore important to make observations of a clinical and pathological kind, as well as a statistical inquiry, so that a sound judgment may be formed. There is a point on which further inquiry may throw light: certainly, judging from the available statistics, fibroids appear to influence the *age incidence* of cancer of the body of the uterus. For example, my personal experience of operations for this topographical variety of uterine cancer is 23 cases. Five of these patients were under 50 and the youngest was 36 years of age. *All the women in whom the cancer was associated with fibroids had attained or passed the 50th year.* A scrutiny of the records of other writers supports this observation.

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CHAPTER XXXIX.

ADENOMA AND CARCINOMA OF THE FALLOPIAN TUBE.

Adenoma. — Epithelial tumours of an innocent type occur primarily in the Fallopian tube. One of the best known examples is that recorded by Doran, in which the tube was filled with dendritic masses covered with mucoid fluid. The colonic ostium of the tube was open, and fluid exuded from it into the pelvis. The excrescences grew from all parts of the mucous membrane in the dilated portion of the tube. Several

Fig. 195.—Adenoma of the Fallopian tube. (*After Doran.*)

pedunculated cysts with thin walls rise from amidst the excrescences and contain papillary outgrowths. The free surfaces of the outgrowths are covered with columnar epithelium. Some of the cells bear cilia. The stroma is made up of small fusiform connective tissue cells, and is poorly supplied with blood-vessels. The microscopic and naked-eye characters of the growth induced Doran to describe it as a papilloma (Fig. 195).

Some years ago I re-examined this specimen, and came to the conclusion that it is an adenoma developed on the type of the glandular recesses found in the Fallopian tube (Fig. 196).

Dr. W. Walter, of Manchester, was good enough to place in my hands for examination an even more convincing specimen of Fallopian adenoma than the one just considered. The specimen consisted of a large ovarian cyst with a distended Fallopian tube. On examining the tube, its eædomic ostium was found largely dilated, and a luxuriant mass of vesicles, like a bunch of grapes, protruded from it, producing an appearance not unlike a cornucopia (Fig. 197)

Fig. 196.—Microscopic characters of a Fallopian adenoma.

On laying open the Fallopian tube the vesicles were found to involve the outer third of the tube, and to spring from the mucous membrane. Sections prepared from the base and solid parts of the tube, when examined under the microscope, exhibited the structural characters of an adenoma (Fig. 198). The solid portion of the tumour was composed of delicate

connective tissue, in which were embedded glandular acini, lined with a single layer of regular columnar epithelium. In some parts of the tumour, especially near the surface, cystic spaces containing sprouting masses of intracystic growth were found. The specimen differed from Doran's case in that it contained a far larger proportion of stroma.

An interesting feature of the clinical history of these cases is the co-existence of hydroperitoneum. In the case described by Doran the fluid in the abdomen was removed by paracentesis on four occasions between March, 1878, and the removal of the tumour in April, 1879, on which occasion ten

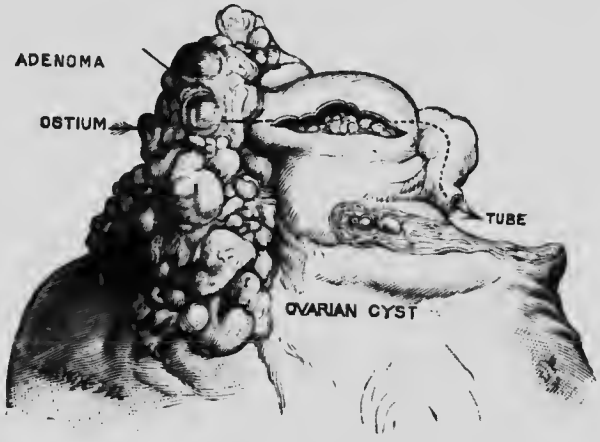

Fig. 197.—Adenoma of the Fallopian tube. (*Dr. Walter's case.*)

litres of fluid were evacuated. In addition, the patient suffered from fluid effusions in the right pleura, for which she was twice tapped. After the removal of the right tube with the tumour contained within it, the effusions ceased, and the patient was in good health in 1886.

The relation of hydroperitoneum to these adenomata associated with patency of the tubal ostium has been made by Doran the subject of careful and suggestive study, to which reference has already been made. As he states, "The ostium of the tube remained patent, and hydroperitoneum persisted until the diseased tube was removed. The evidence that the secretion escaped from the ostium was positive."

An additional case has been published by Doleris which

occurred in a woman twenty-eight years of age. Both ovaries and tubes were removed. The right tube formed a cyst the size of a small nutmeg. Masses of papillomatous growths sprang from the inner wall of the tube. The uterine end of the canal was very narrow. There was no fluid in the cœlom. A peculiar clinical feature of this case was the discharge of large quantities of sero-sanguineous fluid from the vagina. An attempt had been made to cure this by curetting the interior of the uterus. The effect of the operation was to produce right-sided parametritis. The discharges after the operation became continuous, and the fluid was pale yellow, and of a syrupy consistence which stiffened linen like starch.

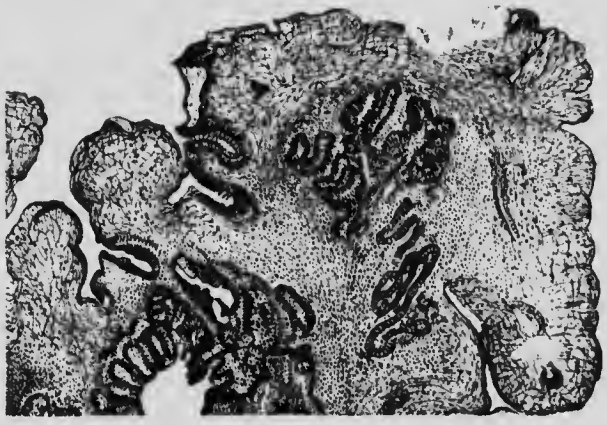

Fig. 198.—Microscopic characters of the tubal adenoma shown in Fig. 197.

Carcinoma.—Our knowledge of this disease of the tube dates from 1888, and a large amount of interest has been taken in it, and so many carefully observed examples have been described that primary cancer of the Fallopian tube has become a clinical entity, and may with care be diagnosed before operation.

The disease simulates in its leading features cancer of the body of the uterus, and, like it, is most common in women at or after the menopause: it gives rise to blood-stained discharges, and often irregular losses of venous blood from the vagina. It occurs in women who have had children, as well as in those who are sterile. With regard to patients in whom the uterus has been dilated for diagnostic purposes,

especially where the signs were those indicating cancer of the body of the uterus and no disease was found in this organ, and the haemorrhage continued, it is probable that in some there may have been cancer of the Fallopian tube.

My experience of this disease extends to three cases, and in two it was associated with fibroids of the uterus. In the specimen represented in Fig. 199, the patient, a woman fifty-

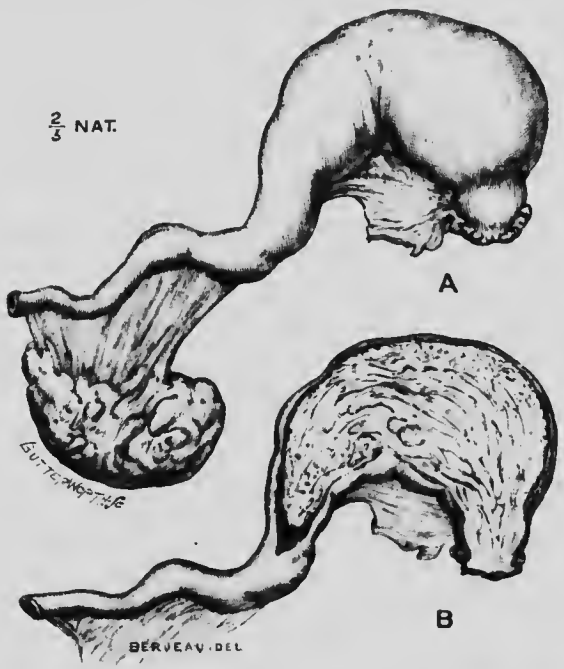

Fig. 199.—A, Ampulla of a Fallopian tube occupied by a primary cancer. B, the ampulla of the tube shown in section. From a sterile married woman 57 years of age. The growth had made its way through the coelomic ostium of the tube and infected the adjacent peritoneum.

seven years of age, had a large submucous fibroid, and the Fallopian tube ran across the crown of the tumour and had a total length of 22 cm., so that there was a long unimplicated section of attenuated and elongated tube between the cancer and the uterus. The specimen had another interest, for a portion of the cancer had made its way through the coelomic ostium and infected the adjacent peritoneum. Microscopically the structure of the tumour corresponded with primary cancer of the corporeal endometrium.

The uterus with its fibroid, and the ovaries and tubes were removed, and the patient enjoyed excellent health for eleven months, then signs of recurrence appeared in the pelvis, and she succumbed a few weeks later. This case illustrates very well the deadly nature of the disease, for a large number of reports testify that after removal of a cancerous tube the disease quickly returns with a fatal ending, and it has been suggested that it might be to the patient's advantage to remove the uterus as well as the tubes.

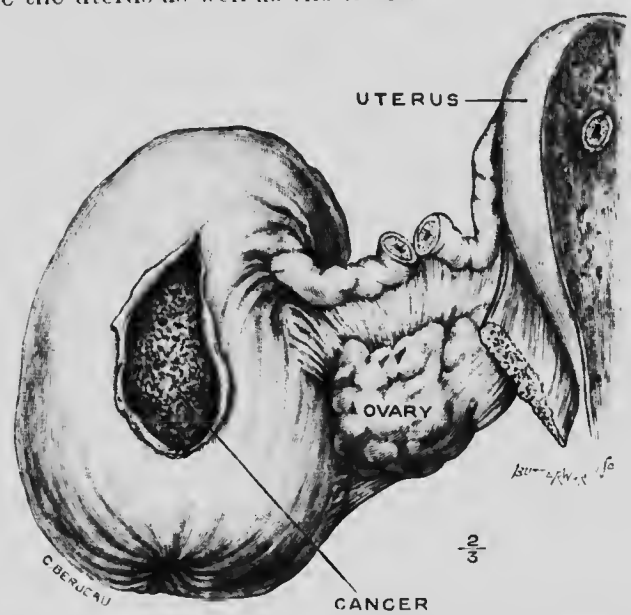

Fig. 200.—A Fallopian tube with the ovary, mesosalpinx, and adjacent portion of the wall of the uterus. The ostium of the tube is closed and the ampulla distended with a soft cancerous mass, which has extended along the lumen of the tube, and can be traced in the tubal tissues in its course through the uterine wall. The endometrium was not implicated. The uterus contained several large fibroids. The chief symptom was profuse bleeding, which led the patient to submit to operation.

In another woman under my care with large fibroids in the uterus I performed subtotal hysterectomy, and in the course of the operation found one of the tubes in shape and size like a large parsnip: its cœlomic ostium was occluded. On subsequent examination this tube was found to be stuffed with carcinoma.

The appearance of the tube when extracted from the

pelvis was like that of a parsnip with a long thin root, its crimped appearance in the drawing is due to the distortion produced by the preservative solution in which it was placed immediately after operation.

In this instance, the carcinoma arose in the ampulla of the tube, sealed the cœlomic ostium, and crept along the tubal lumen towards the uterus (Fig. 200). The growth could be traced through the uterus, but was confined to the tubal tissues, and we were able by careful microscopic examination to determine that the uterine tissue was not infected.

This specimen is of great interest in regard to the important feature connected with the occlusion of the cœlomic ostium, for it seems extremely probable that the closure or the patency of this mouth may exercise a very important influence in determining a slow or a rapid ending. The patient with an open cœlomic tubal ostium died within a year of operation: the patient with the occluded ostium was in excellent health and contemplating marriage six months after the hysterectomy.

Judging from the reported cases, it seems unusual for cancer of the Fallopian tubes to be complicated with fibroids of the uterus.

The disease is invariably unilateral, but Rollin has reported the details of a case which he regards as bilateral cancer of the Fallopian tubes in a woman forty-six years of age. The signs were those of tubal distension, the result of salpingitis. Both tubes equalled an orange in size, and contained chocolate-coloured fluid: the mucous membrane was beset with dendritic epithelial processes. A careful perusal of the description makes me regard the case as an example of tubal warts or papillomata.

Carcinoma of the Ovary.—This is discussed in Chapter L.

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Group IV.

TUMOURS ARISING FROM THE CHORIONIC VILLI.

CHAPTER XL.

CHORION-EPITHELIOMA (DECIDUOMA).

In 1889 Sänger and Pfeiffer independently described a variety of malignant disease arising in the uterus which presented microscopic characters so strongly resembling decidual tissue that the disease was named *Deciduoma malignum*. Subsequent investigations by other observers brought to light the important fact that this remarkable disease is very liable to arise in the endometrium within a few weeks or months of abortion, or delivery at term, and especially after the expulsion of the so-called "hydatid mole." Moreover, the microscopic investigation of the tumour showed that it conformed in histologic type to the multinuclear mantle or syncytium which covers the chorionic villus. This discovery led to a change of opinion as to the source of the disease, and as most writers regard it as arising from changes in the epithelial elements of the chorionic villi rather than in the decidua, the name chorion-epithelioma has come to be adopted in preference to deciduoma.

Before considering the essential features of this disease the change in the chorion known as the hydatid mole needs a brief description.

The normal villi of the chorion in the early stages of their development consist of an axis or core of delicate connective tissue covered with epithelium arranged in two layers: the inner is known as *Langhans' layer;* the outer, called the *syncytium*, is peculiar, and resembles a large elongated multinucleated cell enveloping the villus like a mantle. In the early stages, the connective tissue core of the villus is devoid of blood vessels: the tissue in these early stages consists of

branching cells separated from each other by mucoid intercellular substance; later, the cells become spindle-shaped and the tissue denser and vascularised.

In the disease known as "hydatid mole" the villi become changed into transparent grape-like bodies (Fig. 201), and look not unlike the vesicles so characteristic of the cystic stage of Taenia echinococcus (hydatids), and a hundred years ago the grape-like bodies or vesicular bodies were regarded as hydatids, especially as the embryo is rarely to be found in these specimens.

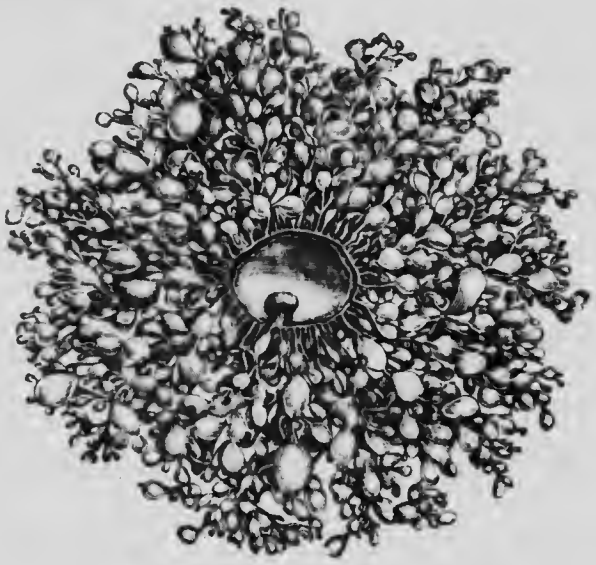

Fig. 201.—Hydatid Mole. (*After Bumm.*)

In 1827 Madame Boivin and Velpeau showed that the disease depended on a change in the chorionic villi. Virchow gave attention to the histology of these vesicle-like bodies, and considered them to be due to a myxomatous change in the villi (1853). This view prevailed until Marchand in 1895 demonstrated that the essential feature of the change depends more on the epithelium than the stroma of the villus, for it undergoes irregular proliferation and assumes invasive characters, penetrating the decidua and even the muscular wall of the uterus. The vessels of the villi disappear, the stroma degenerates, and the swollen condition of the so-called vesicles is the result of œdema rather than

mucoid change. The invasiveness or destructiveness of these altered villi has long been recognised, and specimens have been observed in which the villi have perforated the uterus and caused fatal bleeding into the abdominal cavity.

The hydatid mole (or *chorion-epithelioma benignum*) is not common; it has been estimated by one writer (Madame Boivin, 1827) to occur once in 20,000 pregnancies, and by another (Williamson, 1899) once in 2,400. It is quite certain that only a small proportion of women who have expelled hydatid moles suffer from chorion-epithelioma, but no reliable

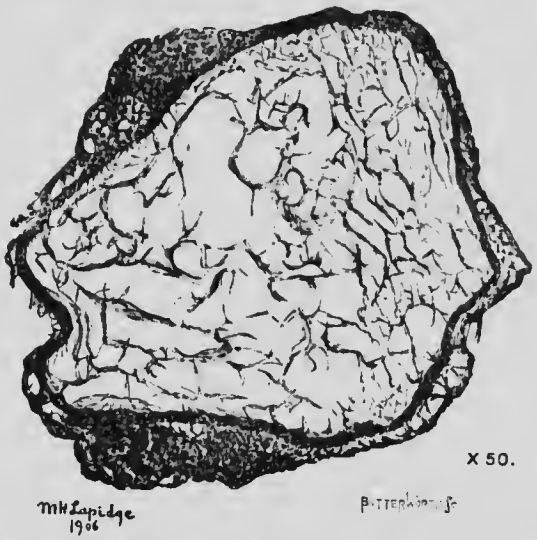

Fig. 202.—Microscopic appearance of a chorionic villus from a hydatid mole, in transverse section.

estimates are available. The liability of a woman who has had a miscarriage of this kind, to be the victim of such a deadly disease as chorion-epithelioma malignum renders it advisable that she should keep under medical supervision for some months after such an event.

Some writers are disposed to believe that there are two varieties of the hydatidiform-mole, one being purely innocent, and the other giving rise to the malignant chorion-epithelioma. As yet microscopical inquiries have not provided these theoretical distinctions with a histologic foundation.

Relation of the Hydatid Mole (Chorion-epithelioma benignum) to Lutein Cysts.—Some valuable observations

have been made on the frequent association of bilateral lutein cysts of the ovary and the so-called hydatid mole, indeed the presence of lutein cysts in this disease is constant enough to lead to the belief that the two conditions are correlated. The lutein cysts are large enough to be of clinical importance, and they have been known to obstruct delivery and in one instance to cause acute symptoms by undergoing axial rotation.

This has given a new interest to the yellow tissue which composes the greater part of a corpus luteum, and some observers state that it furnishes an internal secretion, and that the adhesion of the oösperm to the endometrium depends on a proper supply of lutein secretion.

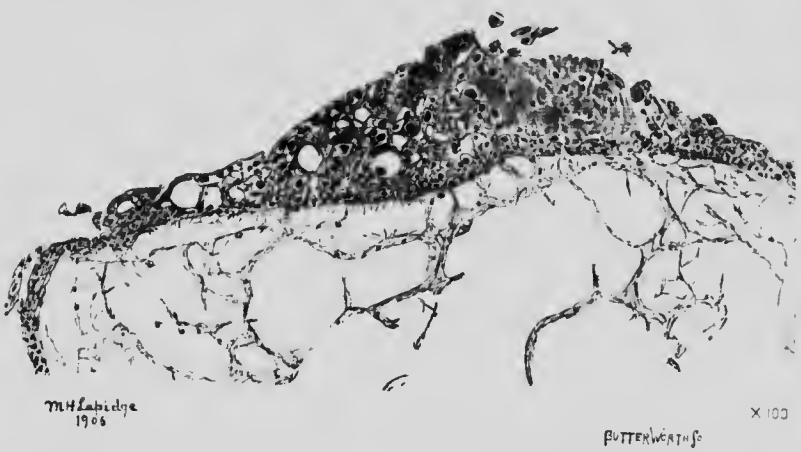

Fig. 203.—Portion of a chorionic villus from a hydatid mole more highly magnified and showing a piece of decidua.

Fraenkel has elaborated this theory, and his views receive the support of some competent German pathologists; an overproduction of this secretion, the result of a plus quantity of lutein tissue sets up, according to Pick, a "chorion-epitheliomatous reaction" in the embedded ovum and leads to the formation of a benign chorion-epithelioma (hydatid mole).

Lockyer has made a careful study of this question, and the result of his painstaking inquiry lends great support to the view that there is a close correlation between lutein cysts and chorion-epithelioma of both kinds.

Chorion-Epithelioma Malignum (Deciduoma).—The uterus when attacked by this disease usually enlarges and often becomes big enough to be appreciable as a tumour in the hypogastrium: its contour may be nodular. In some patients the disease is limited to the endometrium, and the primary focus of the disease may be so small as not to cause enlargement of the uterus. Some very exceptional cases have been described in which the disease did not involve the uterus, but began in the vagina.

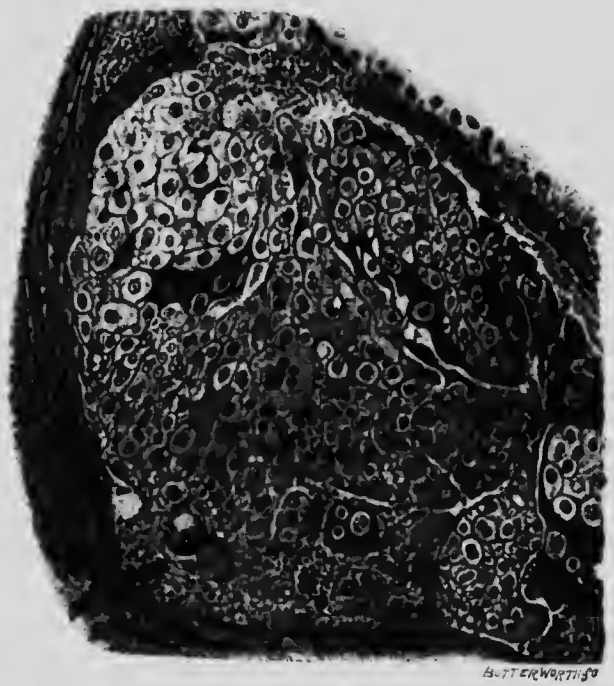

Fig. 264.—Microscopic characters of a cell mass from a chorion-epithelioma showing large decidua-like elements, and the forms intermediate between the Langhans' layer and the syncytium. (*After John H. Teacher.*)

The intimate dependence of chorion-epithelioma on changes associated with pregnancy is illustrated by the fact that this disease occurs primarily in the Fallopian tube as a sequel of tubal pregnancy. (See Risel.)

The result of the examination of a large number of examples of this disease by many investigators has established the fact that it arises in portions of the chorionic villi which remain embedded in the endometrium after the expulsion of

the main products of gestation, and especially if the villi have undergone hydatidiform change.

Some competent authorities still believe that there may be two varieties of this disease, one arising from the epithelial elements of the chorionic villi and the other in decidual tissue.

To the naked eye the tumour tissue appears on section as a soft reddish mass. "Histologically a chorion-epithelioma consists of well-defined cells of various shapes and sizes

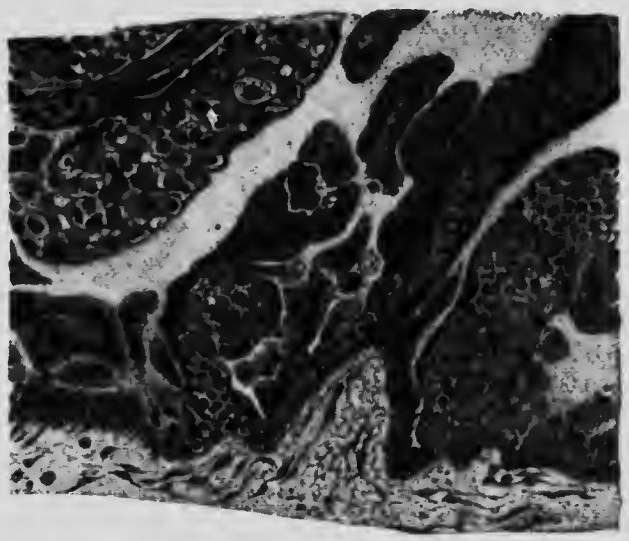

Fig. 205.—Portion of a chorionic villus from a chorion-epithelioma, showing the origin of the tumour from the epithelium; it shows the continuity of the various cell-formations with one other layer of the villus. (*After John H. Teacher.*)

closely packed together, and large multinuclear irregular masses of protoplasm in which no definite cell masses are recognisable. This tissue invades and destroys the uterine tissues after the manner of a malignant growth. It contains no proper connective tissue stroma, or blood vessels of its own." (Teacher.)

A remarkable feature connected with chorion-epithelioma is the discovery that certain intrathoracic teratomata and teratoid tumours of the testis contain tissue indistinguishable from that of chorion-epithelioma.

The eroding power of the cells of a chorion-epithelioma

enable them to penetrate the tissues and gain entrance to veins: fragments are deported by the blood stream to lodge in lungs, bones and other viscera and grow into secondary deposits. The common situations for these deposits are the lungs and vaginal veins.

The course of the disease is marked by oft-recurring profuse bleeding from the uterus; rigors; pyrexia; great emaciation and the signs of dissemination, such as secondary nodules in the lungs, bones, and the abdominal viscera. The disease is fatal, and runs usually a very rapid course, but it exhibits remarkable variations in virulence: the view is held by some observers that the virulence is greater after an abortion than when it supervenes on a pregnancy which has run to term or after the expulsion of a hydatid mole.

The chief clinical signs are frequent bleeding from the uterus, producing great anæmia, and accompanied usually by enlargement of the uterus following a recent labour or miscarriage. Many of these signs are caused also by the retention of a fragment of placenta, or a uterine mole. In such circumstances the cervical canal should be dilated and the cavity of the uterus explored; any retained fragments of conception that are removed should be submitted to careful microscopic examination in order to establish a reliable diagnosis.

Treatment.—The most satisfactory method of dealing with this disease is prompt removal of the uterus. Teacher considers it reasonable to conclude that operation offers a fair chance of recovery, and that it may be done with some prospect of success in the face of the gravest signs of disease and even if metastasis has occurred.

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Group V.

TERATOMATA AND DERMOIDS.

CHAPTER XLI.

TERATOMATA.

In this group we have to consider three remarkable genera of tumours which in their type forms are as easily distinguished as a butterfly and a buttercup, yet examples occur presenting such composite characters that it is difficult to assign them to a particular genus. This is true in a measure of all genera of tumour, and is due to our ignorance of their pathogenesis. The difficulty in regard to such compound tumours as teratomata and dermoids occurs especially in relation with the male and female genital glands. There are two forms of teratomata, external and internal. This chapter will be devoted to external teratomata, the internal are described in Chapter XLII.

A teratoma is an irregular conglomerate mass containing the tissues and fragments of viscera belonging to a suppressed fœtus attached to an otherwise normal individual.

EXTERNAL TERATOMATA.

In order to appreciate the nature of these singular malformations it will be necessary to consider the subject of conjoined twins, supernumerary limbs, and acardiac fœtuses. In the animal and vegetable kingdom it occasionally happens that a single ovum gives origin to two embryos, which may be quite separate from each other (twins) or they may be united, a condition known as **conjoined twins** (Fig. 206). When twins arise from a single ovum they are said to be uniovular, and as they are invariably of the same sex they are termed homologous. Conjoined twins are always homologous and uniovular.

When two embryos are conjoined, and one goes on to

complete development, whilst only certain parts of its companion continue to grow, the result is a **parasitic fœtus**. The mature individual supporting it is called the **autosite**.

In other examples the suppressed fœtus consists of an irregular-shaped tumour growing, perhaps, from the posterior surface of the sacrum, or within the abdomen or thorax,

Fig. 206.—The conjoined twin sisters Radica and Doodica at the age of 3½ years; born in 1889 at Noapara, a village in the province of Orissa, India. In 1899 they were re-exhibited in London in excellent health. Doodica died in 1902 (see p. 424).

which on dissection contains a few vertebræ, or processes of skin resembling digits, associated with a piece of intestine or an imperfect liver. This is a **teratoma**.

In order to demonstrate the relation between parasitic fœtuses and teratomata, it will be useful to refer to dichotomy.

In animals and vegetables there is a strong tendency for parts ending in free extremities to bifurcate or dichotomise. When this affects digits the result is supernumerary fingers and toes. Should it extend to the axis of the limb, supernumerary legs, wings, or fins are produced. Dichotomy is not confined to the limbs, but affects also the axis of the trunk. When the whole embryonic axis dichotomises, twins are produced. Should cleavage be partial, and affect the

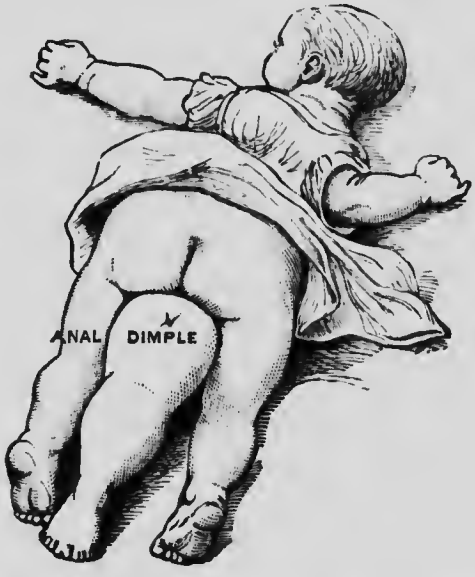

Fig. 207.—Posterior view of J. B. dos Santos at the age of six months (*After Acton.*)

caudal end of the trunk, it is spoken of as posterior dichotomy. When it involves the anterior end it is called anterior dichotomy. With complete dichotomy, in which both embryos go on to full development, either as separate or conjoined twins, we are not further concerned, and consideration of the conditions arising from the imperfect growth of one embryo whilst its companion continues to develop must be deferred until we have discussed the results of partial dichotomy.

Posterior Dichotomy.—When cleavage involves the caudal section of the trunk axis to any serious extent it necessarily follows that the pelvis as well as the vertebral column will be reduplicated: it is also obvious that the reduplication

of the pelvis involves a corresponding increase in the number of the pelvic organs, including the limbs. Thus it follows that supernumerary hind limbs may arise from dichotomy affecting the embryonic limb, or from cleavage of the caudal end of the trunk. The two modes also hold good for reduplication of the fore-limbs. The limbs may project from the ventral aspect of the pelvis, or be, as it were, dislocated on to the dorsal surface. Occasionally they occupy a position midway between these two extremes and lie more or less parallel with the normal hind limbs.

In some individuals one pair of supernumerary limbs fuse throughout their length (Fig. 207) and in others one limb is

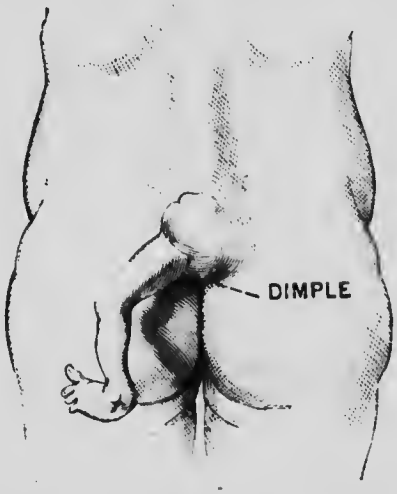

Fig. 208 – Sacral teratoma with a supernumerary leg.

suppressed (Fig. 208), but it is a noteworthy fact in its bearing on the cleavage theory that in all specimens of supernumerary limbs due to posterior cleavage there is an accessory but usually imperforate anus. In the case of Jean Battista dos Santos of Portugal, described in 1846 by W. Acton, and 19 years later by Ernest Hart in London, and by Handyside in Edinburgh, there was not only an additional (imperforate) anus, but the man had two functional penes. It is also an interesting fact that malformed individuals of this kind, whether male or female, are capable of producing healthy, well-formed offspring, the most striking example

being the Siamese twins, Chang and Eng Bunker. They married sisters, Chang had ten children, Eng twelve. One boy and one girl of Chang's were deaf and dumb, but there was no other blemish of any kind in the families of the twins.

Duplication of the pelvic limbs and of the anus occurs frequently in sheep, calves, and birds.

Fig. 209.—Anterior dichotomy.

(*From a photograph supplied by Dr. William Budd, of Bristol, July 20th, 1856, to Sir James Paget.*)

When the parasitic fœtus is so suppressed as to form only a shapeless or deformed lump, such as would be the case in Fig. 208 if the limb were absent, then the mass would be called a teratoma.

It is a fact that the autosite has no power of initiating independent movements in the limbs of the parasite, nevertheless he can localise the prick of a pin on the parasite, and feel uncomfortable when it is cold. Further, in the parasite represented in Fig. 211, micturition used to occur inde-

pendently and without the knowledge of the autosite until he felt urine trickling over him. Involuntary twitchings can sometimes be induced in teratomata by irritating them.

Anterior Dichotomy.—Cleavage may affect the facial portion only and produce reduplication of the jaws, or it may involve the head and produce a two-headed individual. Should it extend to the thoracic region of the spine, then an animal with two heads and reduplicated fore-limbs is the result. When partial dichotomy attacks the head the median parts of the reduplicated face are so conjoined and malformed that they are sometimes found hanging in the pharynx, being attached to its roof by a pedicle. Such tumours are called **basicranial teratomata**: the majority of tumours called pharyngeal dermoids are of this nature.

In order to appreciate the difficulty of interpreting the nature of tumours covered with skin and bearing teeth, reference should be made to the section on Heterotopic Teeth (Chapter LIII.). It is curious to find in a teratoma an organ like a vertebra, or a tooth, or a tongue well developed, although the rest of the fœtus is represented by a mere conglomeration of tissue.

Among remarkable instances of anterior dichotomy, Ritta-Christina and the blended Tocci brothers have been carefully described. This form of dichotomy has been studied in fish, tortoise, calves, birds, and snakes.

The details of the remarkable child represented in Fig. 209 were supplied to Sir James Paget by Dr. William Budd, of Bristol, in 1856. With the exception of the extraordinary excrescence, he writes, "the child presents no deviation from the normal type, but is as comely a little thing as you would wish to see. Every movement and every act of the natural face is simultaneously repeated in the second face in the most perfectly consensual manner. When the natural face sucks the second mouth sucks." Crying and yawning occurred at the same time in the two faces.

I have ventured to publish this case because, so far as my knowledge of teratology extends, no similar case in the human subject is known. The fact "that every movement and every act of the natural face is simultaneously repeated in the second face in the most perfectly consensual manner"

is quite in accord with what has been observed in calves the subject of "partial anterior dichotomy."

Thus far we have been concerned with duplicated parts that reach such a standard of development that their identification is a matter neither of difficulty nor of doubt. It will now be necessary to consider the meaning of those attached parts named parasitic fœtuses, and the irregular masses called teratomata.

It happens, and not unfrequently, that in cases of twins one of them is of natural shape and viable, but the other is very imperfectly developed, and as it lacks a heart (or if this organ be present it is rudimentary and functionless) it is said to be **acardiac**. The degree of development varies greatly: in

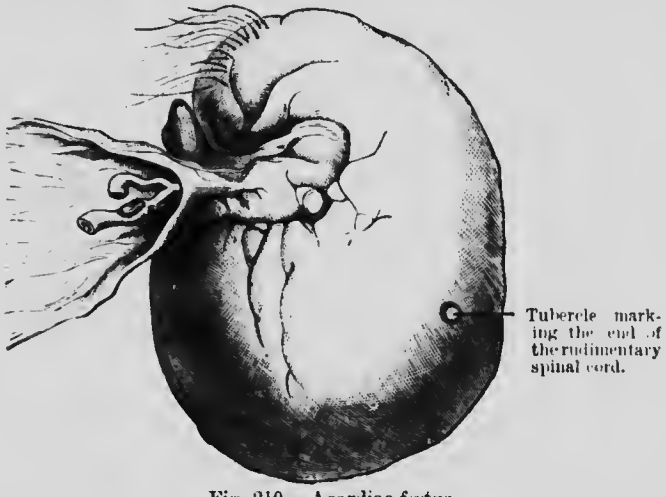

Fig. 210.—Acardiac fœtus.

some the fœtus may be complete save head and neck. In rarer cases the fœtus may be merely represented by an irregular-shaped mass consisting of œdematous integument surrounding a portion of the skeleton, usually an innominate bone with some of the bony elements of a lower limb.

In some specimens no particular skeletal element is recognisable, but a portion of intestine or rudiments of the genito-urinary organs can be detected. To such examples of acardiacus the adjective **amorphous** is applied, and to French teratologists they are known as "anidian monsters." An acardiac such as Fig. 210 has been described as a dermoid of

the umbilical cord (Budin). In very exceptional cases the acardiac may be so thoroughly amorphous that it is impossible to decide its nature until it has been submitted to a microscopic examination (Lea).

Acardiacs are not necessarily separate from the well-developed twin, but may be attached to it in a variety of ways.

Fig. 211.—Laloo, a Hindoo, with an acardiac parasite attached to his thorax.

In the common form the shapeless mass is connected with the dorsal aspect of the sacrum, and simulates a spina bifida sac, or the form of congenital sacro-coccygeal tumour which arises in the post-anal gut. These sacral teratomata often move when irritated, and this is a valuable diagnostic sign. In rarer cases teratomata have been observed in the thoracic and abdominal cavities connected with the vertebral column.

They are also met with in the head, particularly in relation with the jaws.

The explanation of acardiac fœtuses, whether free or parasitic, seems to be this: Two embryos arise from a single ovum: in some instances the cleavage is complete, but the heart of one embryo is defective. The circulation of the two embryos is continuous at the placenta, and the heart of the normal embryo is able to maintain in a measure the blood-current in its companion, and thus save it from complete

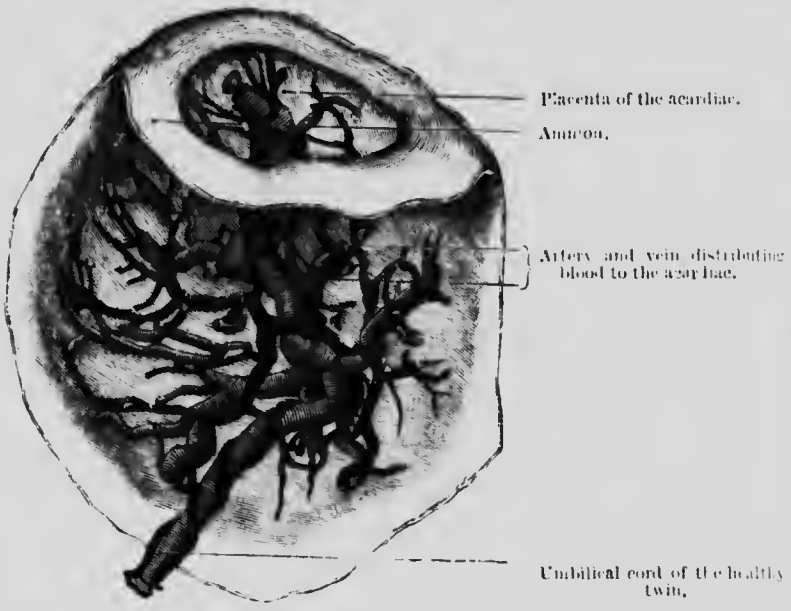

Fig. 212.—Placenta from a case of twins, one of which was an acardiac. (*After Astley Cooper.*)

suppression. Sir Astley Cooper demonstrated this compensatory mechanism in the case of an acardiacus placed in his hands by Dr. Hodgkin. An inspection of the drawing of the placenta from this case (Fig. 212) shows that the umbilical vessels in the two sections of the compound placenta were directly continuous.

In the case of a parasitic acardiac—*e.g.* Laloc—the circulation must be directly maintained by the heart of the autosite, as an independent heart has not, so far as I am aware, been detected in the parasite. The blood current is always extremely slow in the acardiac, and thermometric observations

demonstrate that its temperature is several degrees lower than that of the autosite.

Thus a study of the circumstances surrounding the development of twins and duplex monsters brings us to the conclusion that teratomata may arise either from partial dichotomy of the trunk axis of the embryo or from complete dichotomy. In the latter case while one twin has gone on to full development, the growth of the other has been arrested, and in some cases the suppression has been so great that the

Fig. 213.—Sacred cow with a parasitic calf (India).

companion fœtus is represented by a deformed or shapeless mass consisting of integument covering ill-formed pieces of the skeleton and portions of viscera. The best evidence that parasitic fœtuses and teratomata arise from cleavage is this: We always find like parts attached to like parts: head to head, pelvis to pelvis, thorax to thorax—to this I do not know an exception.

Treatment.—Parasitic acardiacs are in almost all cases so extremely valuable as sources of gain in fairs, shows, and large

cities that the parents, or the unscrupulous individuals who get possession of these children, will not permit operative interference. When the parasitic acardiac is of the amorphous variety and attached to the dorsal surface of the sacrum, attempts may be made to remove it. The child rarely survives the interference.

The xiphopagous twins, Radica and Doodica (Fig. 206) are remarkable in this respect, for Doodica became the victim of tuberculous peritonitis and Doyen divided the uniting band. Doodica died six hours after the operation, but Radica survived.

In the West the parasitic fœtus is a source of unholy gain: among Hindoos it is an object of veneration, especially when the autosite is a cow (Fig. 213).

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CHAPTER XLII.

TERATOMATA (*continued*).

INTERNAL TERATOMATA.

This variety occurs in the thorax, the abdomen, and the cranium: in the abdomen it occasionally attains a degree of development equal to that found in external parts. The internal teratoma differs from the external kind in being enclosed in a cyst, and it imperils the life of the autosite on mechanical causes, and in rare instances by displaying malignancy of a remarkable kind. It is unusual in these cavities of the body to find teratomata with limbs and organs so shaped as to enable the observer at once to recognise that he has before him a very badly developed embryo enclosed within its bearer, and it is customary to denominate such conglomerate lumps as teratoid tumours.

Intra-abdominal Teratomata.—A parasitic fœtus within the abdominal cavity is extremely rare; one of the best known examples was described by Young in 1808, under the title of "A Fœtus found in the Abdomen of a Boy." In this instance a large cyst was found in the belly of an infant a year old. The *post-mortem* examination was carefully conducted, and the cyst which lay behind the peritoneum contained, in addition to a large quantity of fluid, the pelvis, lower limbs, and genital organs of a fœtus (Fig. 214).

Five years later Phillips described, in a letter to Sir Benjamin Brodie, a case in which parts of a fœtus were found in a tumour lodged in the abdomen of a girl two and a half years of age. The brief description contains this statement:—"The cyst in the abdomen contained fluid and solid matter; the latter contained a large bone resembling a tibia covered with muscle and small bones like a tarsus. There were cystic spaces containing sanious fluid. The liver bore marks of inflammation and was studded with tubercles."

Lexer has described a teratoma as big as a fist removed during life from a girl seven weeks old; it was situated in the

foramen epiploicum and lay under the liver. This tumour had cystic and solid parts, the latter representing skeletal and visceral elements. The baby did not survive the operation.

Intrathoracic Teratomata. — Tumours described as dermoids within the thorax have been recorded by many writers. They are rare, but cause much distress to the patients who possess them. The majority occupy the mediastinum and grow downwards to one or other side, compressing the lung. A dermoid has been observed anterior to the pericardium (Hale White).

Fig. 211.—A foetus which was found enveloped in a cyst in the abdomen. (*After Young*, 1818.)

Many of the cases have been recorded as "dermoids of the lungs," but all the later reporters agree that the involvement of the lung is secondary. When the bronchi are implicated by such a tumour, "hair spitting" occurs, due to the cyst opening into the air passage as a consequence of suppuration. The inner wall of such cysts is often lined with nipple-like processes of skin.

Ritchie has described a teratoma which occupied the

mediastinum of a man of twenty-four years: attached to, and forming part of its wall, was a solid tumour containing tissue microscopically identical with chorion-epithelioma. The lungs and liver contained secondary deposits. It is somewhat remarkable to find among such highly organised tumours whose extreme specialization would almost pass as a guarantee of innocency, illustrations of what has already been mentioned in connection with other Groups that even genuine of the so-called benign tumours contains varieties which shade away indefinitely from the type species and display malignancy.

Intracranial Teratomata.—In the chapters dealing with sequestration dermoids it is pointed out that these tumours are found in connection with the scalp, and in association with the tentorium, and their presence in these situations may be attributed to small portions of surface epiblast sequestered in the course of the development of the skull (p. 453). Small dermoids exhibiting the same characters as the more commonly found near the angles of the orbits (p. 44[illegible]).

Complex tumours of the teratoid type are occasionally found at the base of the skull, usually occupying the pituitary fossa. Teratomata in this situation resemble those found at times in the pharynx and contain striped muscle fibre, hyaline cartilage, glandular tissue, and cysts lined with squamous epithelium. In one carefully described specimen ganglion cells and white nerve fibres were present: some of the nerve bundles had a cross section as big as the radial nerve. Pituitary teratomata have been described by Lawson, Bowlby, Hutchinson and Sainsbury. Dermoids have occasionally been found on the anterior lobe of the cerebrum. Buzzard described one which was situated on the orbital surface of the brain in front of the optic chiasma, between the dura mater and the leptomeninges: it had a cutaneous lining which presented hair follicles and sebaceous glands.

Teratomatous Tumours of the Pharynx and Palate.—It is worthy of note that the parts in relation with the cephalic as well as the caudal extremity of the notochord are common situations for tumours resembling teratomata in that they contain formed organs and normal tissues such as bone, skin, striped muscle, nerves, epithelium and the like. But

devoid of any shape and arrangement of the parts to suggest a fœtus, though arising in the same manner as a parasitic fœtus. To these conglomerate tumours the adjective teratoid is appropriately applied. In the palate and naso-pharynx teratoid tumours usually take the form of pedunculated tumours clad with skin which is often pilose (Fig. 215). The core of these tumours consists of connective tissue which may contain hyalin cartilage and a variable amount of striped muscle tissue. Tumours of this kind are congenital, rarely large, and in many cases it is difficult to decide whether the tumour grows from the palate or from the base of the skull and projects through a gap in the bony palate. Sometimes the attachment is so slender that the dermoid undergoes

Fig. 215.—Pedunculated skin clad pilose tumour from the pharyngeal aspect of the soft palate. (*Arnold.*)

spontaneous detachment; in the case reported by Lambl the child swallowed the tumour and voided it next day by the anus. Occasionally the tumour is sessile, and may even project into the floor of the pituitary fossa and compress the optic nerves and tracts.

Windle has collected the literature relating to teratoid tumours of the pharynx under the title of Epignathus, and has summarised the various views in regard to the nature of this condition.

In describing teratomata care was particularly taken to emphasise the fact that many cases of duplicity of parts depended on dichotomy. Cleavage may be so slight at the

cephalic end of the embryo as only to involve the face or even the jaws. Of this I have described several specimens, which make it clear that an identical state of things takes place in connection with the jaws as with the pelvic limbs. When this is the case, the supernumerary maxillæ fuse together and are impacted in the naso-pharynx and fixed to the base of the sphenoid. I have examined a large number of specimens (many of which are preserved in the splendid Teratological Collection of the museum of the Royal College of Surgeons), in which every gradation is traced, from well-formed maxillæ with unerupted teeth to a confused lump of teeth, bone, and cartilage impacted in the palate, but firmly united by a broad base to the sphenoid in the neighbourhood of the pituitary fossa.

Teratoid Tumours and Dermoids connected with the Rectum and Colon.—In order to appreciate the nature of teratoid tumours arising in the immediate neighbourhood of the rectum, it will be necessary to consider a few points connected with the embryology of this portion of the alimentary canal. In the early embryo, the central canal of the spinal cord and the alimentary canal are continuous around the caudal extremity of the notochord. This passage, which brings the developing cord and gut into such intimate union, is known as the neurenteric canal. When the proctodæum invaginates to form part of the cloacal chamber it meets the gut at a point some distance anterior to the spot where the neurenteric canal opens into it; hence there is for a time a segment of intestine extending behind the anus, and termed in consequence the "postanal gut." Afterwards this postanal section of the embryonic intestine disappears. There is good reason to regard the postanal gut as the source of that variety of congenital sacro-coccygeal tumour which was named by Brame and several writers who followed him "congenital cystic sarcoma." These will be referred to as tumours of the **postanal gut**. In addition, it will be necessary to consider dermoids situated between the rectum and the hollow of the sacrum—**postrectal dermoids**, and certain pedunculated tumours situated within the rectum—**rectal dermoids**.

Tumours which arise in the postanal gut exhibit a definite structure; they are composed of closed vesicles lined with

glandular epithelium, and contain glue-like fluid. Many of these tumours are composed of cysts and duct-like passages lined with cubical epithelium, held together by richly cellular connective tissue. In many situations the epithelium is columnar, set upon flatter cubicle cells. The cysts are filled with ropy mucus, and vary in size from a nut to the smallest space visible to the naked eye: many contain intracystic processes. These tumours present such very definite characters that they are sure to attract attention, and their large size makes them very conspicuous.

Middeldorpf was the first to associate clearly a congenital sacro-coccygeal tumour with the postanal gut. His specimen

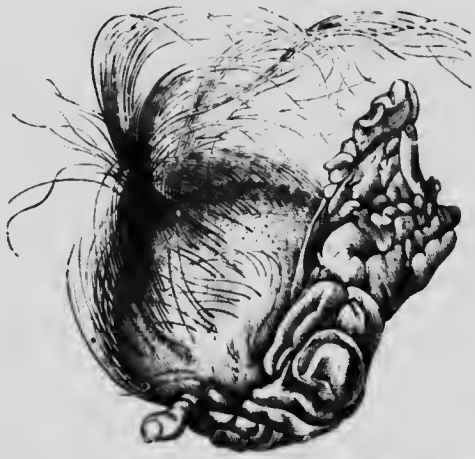

Fig. 216.—Rectal dermoid which contained brain substance enclosed in a bony capsule: from a woman aged 25. (*After Danzel.*)

was removed from the neighbourhood of the anus of a girl a year old. The tumour contained connective tissue, mucous membrane with characteristic follicles, submucous tissue, and longitudinal and circular layers of muscle fibres. I had come to the same conclusion in regard to the probable origin of these tumours before the publication of Middeldorpf's paper: his case is the most conclusive on record.

Postrectal dermoids are very rare, and do not form such large projecting masses as the preceding species. In many instances they are not noticed until after infant life, and their clinical tendencies are of a different character. It is also

somewhat remarkable that dermoids, although they are met with in many parts of the body, contain teeth only in certain situations: the postrectal region comes into this category.

Such dermoids also occur as surgical surprises, especially when they attain very large dimensions and extend upwards behind the pelvic peritoneum of men and women. Ord recorded a remarkable case which occurred in a man twenty-eight years old; the dermoid weighed fourteen pounds. Page successfully removed a dermoid, weighing three pounds, which occupied the hollow of the sacrum in a woman of forty-seven years; it lay behind the rectum. The pultaceous matter was evacuated through an incision in the perineum: the cyst wall was then successfully enucleated.

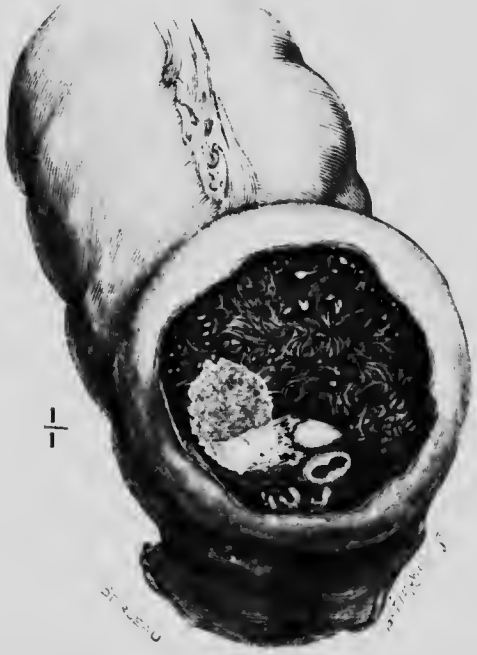

Fig. 217.—Postrectal dermoid containing hair and teeth: it was detected at a post-mortem examination.

Skutsch has recorded two examples of postrectal dermoids, and collected the chief German cases. One of the records states that the patient was pregnant, and he was able to empty and partially enucleate the dermoid through an incision in the perineum without disturbing the pregnancy.

Postrectal dermoids sometimes open spontaneously in the perineum; the fistula is usually situated in the middle line of the perineum near the tip of the coccyx. Keen removed a postrectal tumour from a girl three-and-a-half years of age; in the middle there was a fistula which led upwards to the third piece of the sacrum. The tumour contained fat, cartilage, etc. The tubular tract resembled a trachea, and possessed imperfect rings of cartilage, and was lined with ciliated epithelium.

Teratoid Tumours of the Rectum.—Several examples have been described growing from the mucous membrane of the rectum (Fig. 216); a curious feature in these cases is that

Fig. 218.—Cæcum and adjacent portion of the ileum of a man: a dermoid occupies the angle between the ileum and the cæcum. (The specimen is in the possession of Mr. A. Hall, Sheffield.)

the tumours are furnished with long locks of hair, which protrude from the anus and annoy the patients (Danzel, Port). Like postrectal teratoids, they sometimes contain teeth (Fig. 217).

Nearly all the recorded examples of rectal dermoids have occurred in women, and this formerly gave some support to the suggestion that they arose in the ovary, and eroded their way into the rectum. In one recorded case a teratoid tumour was found between the layers of the mesosigmoid; the patient died in consequence of an operation performed for its removal:

at the autopsy a dermoid was found in the connective tissue of the pelvis. The ovaries were normal (Moynihan). A teratoid tumour hanging from the mucous membrane of the sigmoid flexure led to intussusception in a girl aged sixteen (Clutton).

The study of dermoids and teratomata connected with the rectum is important and puzzling: some of them exhibit the characters of teratomata, and others should find a place with the simpler varieties of dermoids. The idea that some of them are included fœtuses is reasonable when they are situated around the terminal section of the gut, but this can scarcely be entertained when the tumour, as in the case described by Moynihan, is in relation with the sigmoid flexure of the colon. A remarkable dermoid is represented in Fig. 218, lodged in the angle formed by the junction of the ileum and the cæcum: the tumour lies between the layers of the peritoneal fold extending from the termination of the ileum to the mesentery of the vermiform appendix. It contained the usual pultaceous matter and hairs. The cavity was lined with stratified epithelium, but lacked a stratum granulosum. The specimen was obtained in the course of a post-mortem examination on the body of a man by Mr. Arthur Hall, who kindly gave me every facility for examining the specimen.

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CHAPTER XLIII.

SEQUESTRATION DERMOIDS.

Dermoids are tumours furnished with skin occurring in situations where this structure is not found under normal conditions. They only possess the structures normal to skin.

Dermoids may be arranged in two genera:—

1. Sequestration Dermoids.
2. Tubulo-dermoids.

To the first of these genera this and the next chapter are devoted.

Sequestration dermoids arise in detached or sequestered portions of skin, chiefly in situations where, during embryonic life, coalescence takes place between cutaneous surfaces. A sequestration dermoid occasionally takes the form of a skin-lined recess, but more commonly it assumes the form of a globular tumour with a central cavity lined with skin, furnished with dermal elements.

Dermoids of the Trunk.—These occur strictly in the regions where the lateral halves of the body coalesce. This line of union, commencing immediately below the occipital protuberance, extends along the middle of the back to the coccyx; it then passes through the perineum (scrotum and penis in the male) and upwards through the umbilicus, thorax, neck and chin, to terminate at the margin of the lower lip.

Dermoids are rare along the dorsal part of this line and are apt to be mistaken for spina bifida sacs, especially when situated in the lumbo-sacral region. The patient (Fig. 219) was a man twenty-two years of age. The tumour was congenital, and had been regarded as a spina bifida sac. It had never caused him inconvenience until a few days before his admission into the hospital, when it inflamed, burst, and discharged a quantity of foul-smelling sebaceous material mixed with hairs. The cavity was freely opened and cleared of decomposing material. The skin lining the interior of the

dermoid was beset with pores of large size, corresponding to the orifices of sweat glands; when the patient perspired, drops of sweat could be seen oozing from these pores. This skin also contained nerves, for the man could localise the prick of a pin on the interior of the dermoid as easily as one made upon the skin surrounding the tumour. When the tumour was removed, the spinous processes underlying it were found to be unusually short and surrounded by fat.

Fig. 219.—Dermoid in the lumbo-sacral region of a man 22 years of age.

Rarely dermoids are associated with spina bifida. Gilbert Barling observed such a combination in a child two years old affected with spina bifida occulta; the skin covering the defective spines presented the hair field usual in these cases. In the tissues immediately over the stunted spinous processes a dermoid was found containing sebaceous material and hair (Fig. 220).

It is very rare to find dermoids within the spinal canal. An interesting instance of this has been recorded by Hale White. It grew in the thoracic region of the spine, and

produced paraplegia. Laminectomy was performed on the patient, a man twenty-six years of age, but it was not successful.

Faulty coalescence of the cutaneous covering of the back often occurs over the lower sacral vertebræ, and gives rise to small congenital sinuses known as "postanal dimples" and "coccygeal sinuses." These recesses are lined with skin furnished with hairs, sebaceous and sweat glands. Sometimes they measure 10 mm. in depth. As a rule they are single, and often accompany lumbo-sacral spinal bifida. Though most commonly seen over the coccygeal, or the last two sacral vertebræ, I have seen them as high as the fourth lumbar vertebra, and always exactly in the middle line.

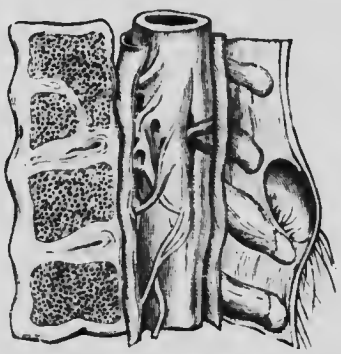

Fig. 220.—Section of three thoracic vertebræ with a small dermoid situated over two stunted spinous processes.

These dimples are interesting, for—as will be shown afterwards—in many situations where sequestration dermoids occur, similar cutaneous recesses are also seen. An examination of such a sinus serves to show that if its external orifice became occluded, without the deeper parts becoming obliterated, we should have the germ of a dermoid, for the numerous glands in the walls would be active, and their secretion, with the shed epithelial scales and hairs, would soon cause it to enlarge and assume such proportions as to render it recognisable as a tumour.

The coccygeal sinuses are sometimes troublesome, as hair and dirt accumulate in them and lead to suppuration. Clinically a suppurating coccygeal sinus simulates an anal fistula, but a little care prevents the surgeon from falling into error.

A good physiological type of such a sinus is furnished by the interdigital pouch of the sheep. This pouch (Fig. 221) lies between the digits, and all the dissection required to expose it is to separate the digits with a sharp knife, keeping close to the phalanges of one or the other side. In adult sheep it is always full of shed wool and grit. Sometimes its orifice is occluded and it becomes a retention cyst; suppuration follows, much to the sheep's discomfort. The walls of this pouch are full of very large glands. In order to get satisfactory sections, it is necessary to obtain the

Fig. 221.—Median aspect of a sheep's digit, showing the interdigital pouch.

digits from a still-born lamb, for as soon as lambs run about grit gets into the pouch and spoils the edge of the knife.

Dermoids of the Scrotum and Labium.—There are many good reasons for believing that the majority of dermoids reported as arising in the testicle were really scrotal in origin. This was clearly the case in a specimen described by Bilton Pollard as a dermoid of the testicle. The dermoid was situated on the left side of the scrotum, between the testicles, and adhered to the back of the left one outside the tunica vaginalis. It contained putty-like material in which

there were a few grey hairs. The cyst was lined with stratified epithelium; papillæ and sebaceous glands were detected.

Dermoids have been described in relation with the inguinal canal. The only record which can be relied on is that by H. J. Paterson; he removed a cyst of this kind from the inguinal canal of a man 35 years of age. The microscopic examination in this case was very thorough.

Dermoids of the **labium** are very rare: on one occasion I saw one removed as big as an orange from the right labium of

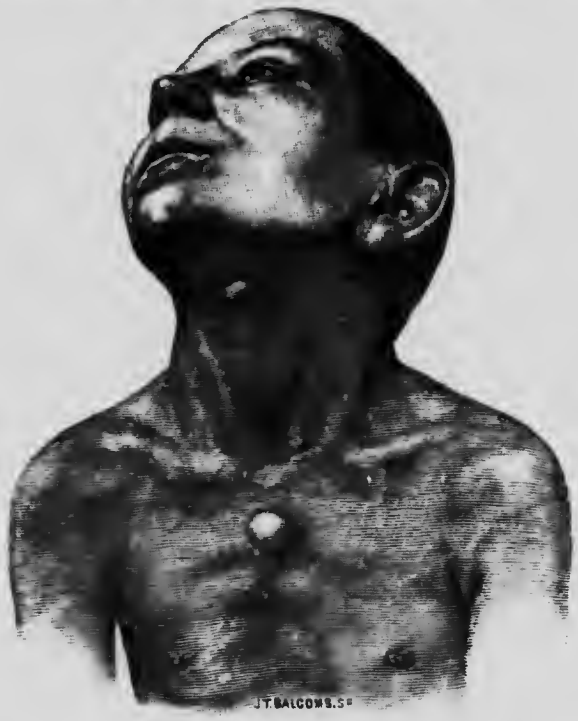

Fig. 222.—Dermoid situated over the junction of the manubrium and gladiolus of the sternum; there was also a dermoid near the left cornu of the hyoid bone. The youth was 19 years of age. (*After Bramann.*)

a woman 40 years of age. It contained the usual pultaceous material and shed hair. The dermoid had burrowed beneath the deep fascia of the thigh and come into relation with the tendon of the adductor longus muscle.

Dermoids of the Thorax.—Judging from the few available records, dermoids of the thorax are very uncommon. They

occur in two situations—viz. on the anterior aspect of the sternum and in the thoracic cavity. Dermoids on the front of the sternum are situated in the middle line near the junction of the manubrium with the gladiolus (Fig. 222); it is not uncommon to find a small cutaneous recess in this situation exactly in the middle line and resembling the coccygeal sinus. Sternal dermoids have been described by Braimann, Cahen, and Clutton.

An unusual situation for a dermoid is the episternal notch (Fig. 223), and it is easy to understand that one in this situation could burrow into the superior mediastinum.

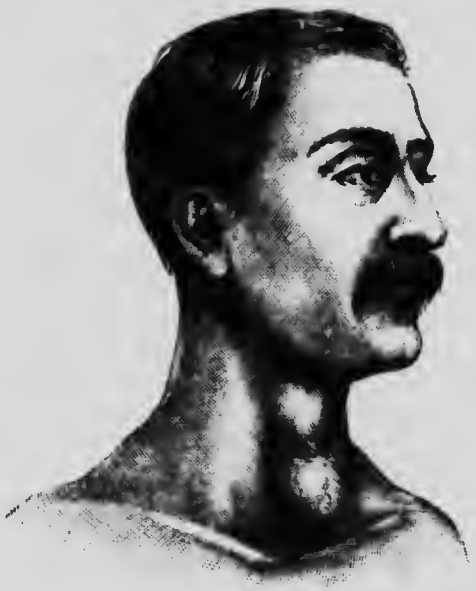

Fig. 223.—Dermoid in the episternal notch: it contained hair and pultaceous matter, and was superficial to the deep cervical fascia.

At first glance it would seem difficult to account for the presence of a large dermoid within the thorax, but a review of the mode of development of the sternum throws much clear light on the subject. The two lateral halves of the sternum are, in the early embryo, widely separated from each other; gradually they coalesce in the middle line. Every anatomist is aware that this median coalescence is extremely liable to be faulty, and conditions occur like those which, happening in

connection with the medullary folds, produce spina bifida. In this line of coalescence, so far as sternal dermoids are concerned, we may get skin-lined recesses resembling the coccygeal dimples. These sternal recesses, or dimples, occur near the junction of the manubrium with the gladiolus, and may be more than a centimetre deep. Should a piece of skin become sequestrated during coalescence of the thoracic walls, it may, during the development of the sternum, be dislocated forwards to the outer surface, or backwards towards the mediastinum, conditions in every way parallel to the variations in the position of cranial dermoids. So long as a

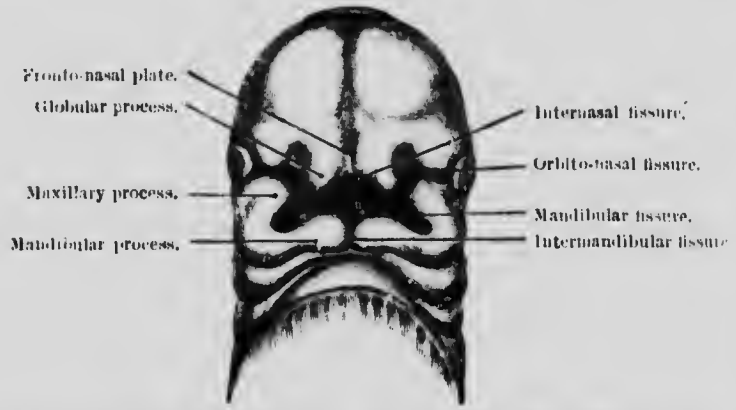

Fig. 221.—Head of an early embryo to show the fronto-nasal plate, globular processes, and associated fissures. (*Modified from His.*)

dermoid on a deep surface of the sternum remains small it will cause no trouble, but it is easy to understand that a large tumour would, if projecting into the thorax, encroach on the pleura: even then it would not produce much disturbance so long as air did not gain access to it; but if by pressure the wall of the cyst becomes so thin as to allow air to enter its cavity, or an actual communication forms between the cyst and a bronchus or the air-sacs of the lung, then suppuration with all its disastrous consequences will ensue. (Intrathoracic dermoids and teratoids are considered in Chapter xlii.)

Facial Dermoids.—Dermoids occur on the face in certain definite positions, such as the inner and outer angles of the orbit: the upper eyelid; in the naso-facial sulcus: on the

cheek slightly posterior to the angle of the mouth; in the middle line of the chin, and on the nose.

In order to appreciate the origin of dermoids in these situations it is necessary to bear in mind the relation of the facial fissures in the embryo, which in the adult are represented by the orbits, lacrimal ducts, mouth, and certain furrows in the lips and cheek.

In the early embryo the face is represented by an opening from which five fissures radiate (Fig. 224). The upper pair are the orbito-nasal; the two lower fissures are termed mandibular, and the fifth the intermandibular fissure. The

Fig. 225.—The face with black lines to indicate the situation of the embryonic fissures.

median fold projecting into the opening from above is the fronto-nasal process, which ultimately forms the nose. As it develops, a rounded prominence, known as the globular process, forms at each angle and gives rise to a portion of the ala of the nostril and the corresponding premaxilla. These globular processes fuse together in the middle line to form the central piece, or philtrum, of the upper lip. The elongation of the fronto-nasal process necessarily lengthens the orbito-nasal fissures. Eventually the sides of the fronto-nasal plate coalesce superficially with the maxillary processes in such a way as to leave a cleft on each side, which becomes the orbit; the line of union being permanently indicated in

the adult by the naso-facial sulcus or groove, and indicated still more deeply by the lacrimal duct, which is a persistent portion of the original orbito-nasal fissure. The union of the fronto-nasal plate with the maxillary processes completes the nose, cheeks, and upper lip

The above account indicates in a general way the relation of these fissures to each other; but it will be necessary in

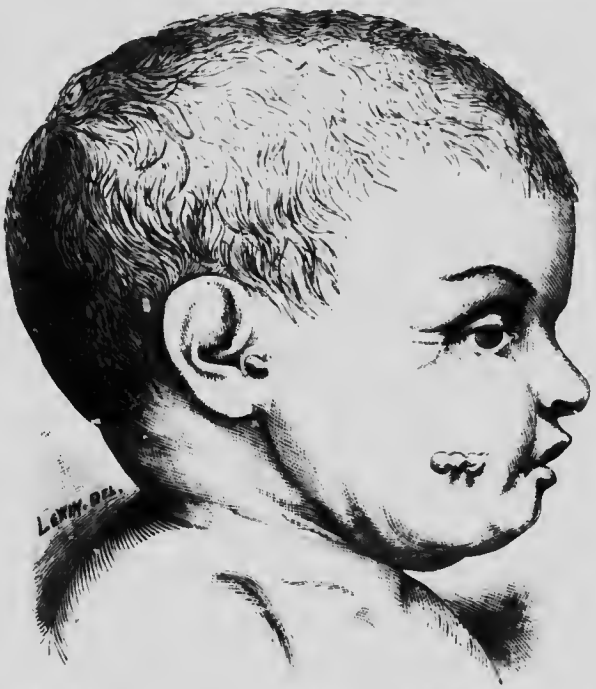

Fig. 226.—Right side of the head of a fœtus, showing a large mandibular tubercle and an accessory tragus.

considering dermoids arising in them to mention certain details connected with each. But here it may be stated that the defects associated with any of them are of four kinds: 1, the fissure may persist; 2, it may close imperfectly and leave a recess or puckering of the skin; 3, portions of the surface epithelium may be sequestered and give rise to dermoids; 4, there may be excessive coalescence.

These conditions may be illustrated by the mandibular fissure. In the embryo this fissure or cleft is relatively more extensive than the opening of the mouth which in the adult

ultimately represents it. In fishes the whole of the mandibular fissure persists as the gape; but in mammals the dorsal portions of the clefts are obliterated by the union of their margins, leaving the central portion as the mouth. Persistence of the whole length of the fissure is a rare defect, and is known as **macrostoma**, while excessive closure of the fissure produces **microstoma**. Imperfect union of those sections that normally coalesce gives rise to slighter imperfections, of which some examples will now be described.

Occasionally we find on one or both cheeks of children, at a spot varying from 2 to 4 cm. behind the angle of the mouth,

Fig. 227.—Head of a dog showing the mandibular tubercle

a small nodule rarely exceeding a rape-seed in size. Sometimes there is a depression or sinus in the cheek surmounted by the nodule. Occasionally the buccal mucous membrane presents a shallow recess, sometimes a sinus, and occasionally a white cicatrix at a spot corresponding to the nodule on the cutaneous surface of the cheek.

These **mandibular tubercles** and **recesses** are frequently associated with malformations of the corresponding auricles, as well as other facial defects, such as coloboma of the eyelid

and pilose cutaneous patches on the conjunctiva. The largest specimen which has yet come under my observation occurred in a still-born fœtus (Fig. 226). On the right cheek, 2 cm. behind the angle of the mouth, was a nodule the size of a rape-seed, and immediately behind this a pedunculated body. The tubercle on the cheek consisted of dense connective tissue traversed by blood-vessels and covered with skin beset with lanugo and richly supplied with sweat and sebaceous glands of large size.

It may here be pointed out that in many mammals, especially dogs, small cutaneous nodules furnished with vibrissæ may often be detected in a line with the angle of the mouth (Fig. 227). These nodules occupy positions identical with the mandibular tubercles of children.

There is very little relationship between pathology and poetry, but that very philosophical pathologist, Sir Samuel Wilks, in reference to my observation that the usual position of the mandibular tubercle and recess corresponds with that of the dimple in the baby's cheek, drew my attention to the following passage in his Harveian Oration, 1879: "From any point of view we take, and upon whatever subject we fix our gaze, we come to the conclusion that the greatest discovery ever made by man about himself, and of the earth of which he forms a part, is the doctrine of evolution.

> "'The softest dimple in a baby's smile
> Springs from the whole of past eternity,
> Tasked all the sum of things to bring it there.'"

Wilks observed to me how little the poet (Miss Bevington) divined that there is a material basis for these three pretty and significant lines. Jevons expressed the same truth in the following epigram: "The origin of everything that exists is wrapped up in the past history of the universe."

The Intermandibular Fissure.—When the mandibular processes fail to coalesce, the result will be a median cleft in the lower lip extending to or even beyond the chin. Median clefts of this kind are excessively rare. Occasionally such a defect is associated with a dermoid or a pair of small nodules in the skin. In terriers such nodules are almost constantly present between the symphysis and the body of the hyoid bone. In children with double hare-lip two sinuses are sometimes seen

in the mucous membrane of the lower lip. Their orifices are indicated by small but prominent papillæ. The sinuses are large enough to admit a probe, and they are in some cases 2 cm. deep. Mucus exudes from them, furnished by glands which beset the membrane lining their walls. These sinuses are probably due to faulty coalescence of the intermandibular fissure. This view is strengthened by an observation of Feurer, who detected a similar sinus in the upper lip of a lad on the right side of the philtrum; it corresponded exactly to the termination of the naso-facial fissure.

Fig. 228.—Mother and her two children with mandibular recesses. Each has double hare-lip. (*From a photograph.*)

For a remarkable observation in regard to mandibular recesses I am indebted to Mr. Nicoll. A mother and her two children had each a pair of recesses in the lower lip (Fig. 228). Each had double hare-lip, and the cicatrices of successful operation are clearly visible. The mother was one of a family of five, and each had double hare-lip and a pair of recesses in the lower lip.

For a long time I thought that these recesses probably had a morphological significance, and made a wide search through

the various families of the mammalia for a type, but without success. A careful description of the histology of these sinuses is furnished by Madelung. The earliest recorded example in British literature is by Arbuthnot Lane.

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CHAPTER XLIV.

SEQUESTRATION DERMOIDS (*Concluded*).

Dermoids of the Orbito-nasal Fissure.—Dermoids appear in this fissure in three situations: (*a*) At the outer angle of the orbit. (*b*) The inner angle of the orbit. (*c*) In the naso-facial sulcus. Of the three situations, by far the most frequent is the outer angle of the orbit, where they form rounded tumours rarely exceeding the dimensions of a cherry;

Fig. 229.—Dermoid at the outer angle of the orbit.

they lie in close relation with the pericranium covering the frontal bone, which is often deeply hollowed to accommodate them. Dermoids in this region vary somewhat in regard to their position; sometimes they are quite close to the external angular process of the frontal bone, or they may be 2 cm. or more posterior to it (Fig. 229): exceptionally they are on a level with, or even lie beneath, the eyebrow.

Dermoids at the inner angle are far less frequent (Fig. 230). In this situation the tumour may extend beyond the bone and

lie in intimate relation with the dura mater. It is very necessary to remember this in attempting the extirpation of the dermoid. In some cases the tumour may have a pedunele continuous with the dura mater. Under such conditions the dermoid may transmit the cerebral pulsation; it is then apt to be mistaken for a meningocele.

Fig. 230.—Dermoid at the inner angle of the orbit.

Dermoids occur not only at the orbital angles, but sometimes also in the tissue of the upper eyelid, unconnected with either bone or periosteum. These smaller dermoids probably arise in the fissure between the fronto-nasal plate and the cutaneous fold from which the eyelid is formed. The fissure between the two parts which form an eyelid sometimes persists. To this defect the term colobema of the eyelid is applied.

Dermoids arising in the orbital angles are the simplest of all dermoids, and though the skin lining them is usually rich

in the ordinary cutaneous elements, such as hair, sebaceous and sweat glands, complex structures such as teeth and bone, so far as my knowledge extends, have not been observed in them. I have satisfied myself that the skin in these dermoids is sensitive and that it possesses tactile sensibility.

Dermoids in the lower section of the *orbito-nasal* fissure

Fig. 231.—Dermoid in the naso-facial sulcus containing a tooth. (*After Paul.*)

Fig. 232. A translucent dermoid at the bridge of the nose. The man was 30 years of age.

are rare. They usually protrude in the naso-facial sulcus, and occasionally possess a tooth (Fig. 231).

Nasal Dermoids.—It is necessary to point out that in addition to the naso-facial sulcus, dermoids occur in two other situations on the nose. A not uncommon position is the bridge of the nose (Fig. 232). This part of the face is not traversed by a fissure, and the mode by which such a dermoid arises is in all respects identical with that which gives rise to cranial dermoids.

In the skull of an early embryo, the fronto-nasal plate which ultimately forms the nose consists of a lamina of hyalin cartilage covered externally with skin and internally with mucous membrane. After the third month sections made through the nasal capsule, immediately anterior to the

ethmoid, show that the skin is being dissociated from the underlying cartilage by bony tissue, which eventually becomes the nasal bones. Ultimately the cartilage disappears as a result of the pressure exercised by these bones. It is reasonable to believe that in the gradual separation of the skin from the cartilage of the fronto-nasal plate by the intrusion of the nasal bones, small portions of skin or epithelium become sequestrated and eventually develop into dermoids. This explanation is more fully set forth in the section on dermoids of the scalp and dura mater.

Fig. 233.—Dermoid recess in the nose of an adult.

Fig. 234.—Dermoid recess at the tip of the nose of a child. (The hair is represented too coarse.)

Dermoids near the tip of the nose are the consequence of faulty fusion of the internasal fissure, and usually take the form of narrow skin-lined recesses furnished with hair, which is often long enough to sprout beyond the recess (Figs. 233 and 234).

Hair-lined recesses in the mid-line of the nose at some point between the lower border of the nasal bone and the tip of the nose are very common, but they rarely call for treatment. They occur far more frequently in men than in women. In their mode of origin and characters they agree with the hair-lined sinuses known as postanal dimples.

A much rarer anomaly than a dermoid is excessive coalescence of the nasal segment of the orbito-nasal fissure (Fig. 235).

Dermoids of the Scalp and Dura Mater.—The common situations for dermoids of the scalp are over the anterior fontanelle (bregma) and occipital protuberance. In these situations they are occasionally confounded with sebaceous cysts or with meningoceles. Dermoids of the scalp often have a thin pedunculated attachment to the dura mater, the pedicle traversing a hole in the underlying bone, unless the cyst is over a fontanelle.

The term "wen" used to be applied indifferently to sebaceous cysts and dermoids of the scalp. Sir Astley Cooper, in his essay on "Encysted Tumours," even included orbital

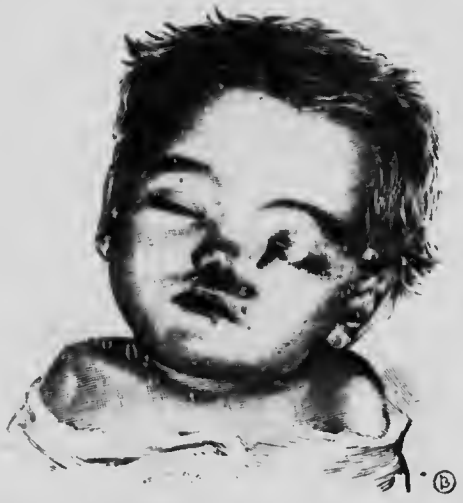


Fig. 235.—Child with a deformed nose due to excessive coalescence of the nasal section of the orbito-nasal fissure. The case was under the care of Mr. Nicoll.

dermoids among wens. In describing them he writes:—"The largest size I have known them acquire has been that of a common-sized cocoanut, and this grew upon the head of a man named Lake, who kept the house called the "Six Bells" at Dartford. It sprang from the vertex, and gave him a most grotesque appearance, for when his hat was put on, it was placed upon the tumour and scarcely reached his head. The cyst is in the collection at St. Thomas's Hospital, also a cast of his head taken just prior to the operation" (Fig. 236).

The cyst, which is probably the largest dermoid of the scalp on record, contains a number of round balls, some

having a diameter of 1 cm. These consist of epithelial cells mixed with fat. (See also Sibthorpe, and Marsh.)

Arnott published the details of an instructive case of a dermoid situated over the anterior fontanelle in an infant a few days old. The tumour exactly resembled a meningocele, "rising and falling with regular pulsation, and swelling when the child coughed": the resemblance was so strong that it was regarded as a meningocele. A few weeks later the child

Fig. 236.—Head of the man Lake with a large dermoid over the bregma.
(*From a cast in the Museum, St. Thomas's Hospital.*)

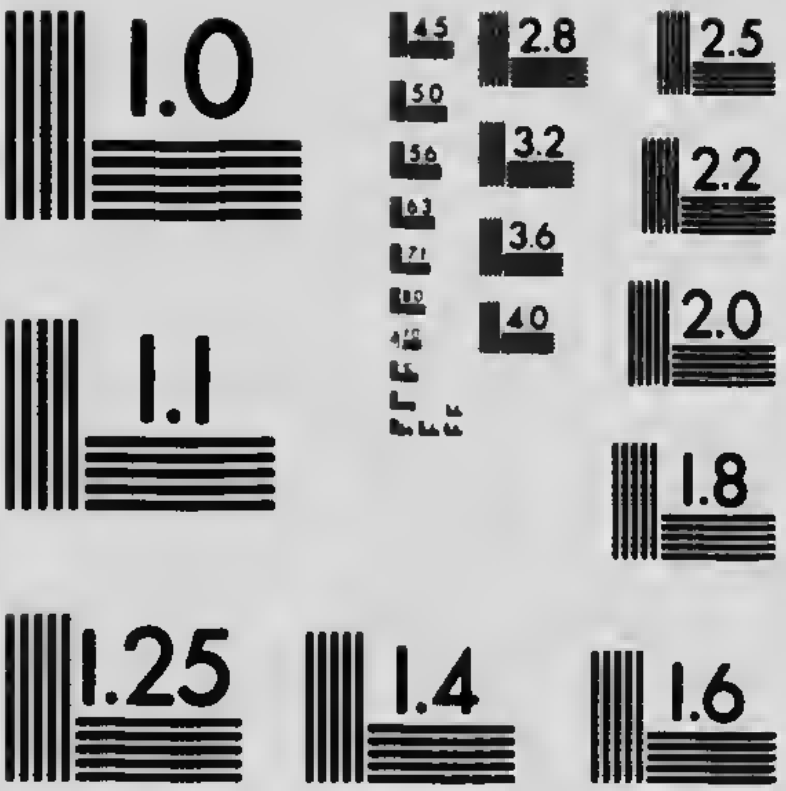
died from broncho-pneumonia, and the cyst was found to be a dermoid. The specimen is preserved at St. Thomas's Hospital. (See also Giraldés.)

Dermoids in the neighbourhood of the occipital protuberance (inion) may lie on the inner aspect of the occipital bone, and are nearly always in relation with the tentorium cerebelli. Examples have been described by Turner, Ogle, Pearson, Irvine, and Lannelongue. They occurred in children.

and in Ogle's case there was defective development of the squamous portion of the occipital bone. In Lamelongue's patient, a girl seven years old, the dermoid had attained the size of an orange; it produced marked symptoms, such as paralysis, amaurosis, and coma, ending in death.

Although at first sight a dermoid connected with the dura mater and projecting into the brain seems to violate all embryological rules, nevertheless, when we view this membrane from a morphological standpoint the strangeness vanishes and a satisfactory explanation is forthcoming.

Morphologically considered, the bony framework of the skull is an additional element to the primitive cranium, which is represented by the dura mater, and, as I have elsewhere endeavoured to show, the term extracranial should strictly apply to all tissues outside the dura mater. In surgical practice we find it convenient to regard the bones as the boundary of the skull, but morphologically this is inaccurate; the skull-bones are secondary cranial elements. Early in embryonic life the dura mater and skin are in contact; gradually the base and portions of the side-walls of the membranous cranium chondrify, thus separating the skin from the dura mater. In the vault of the skull, bone develops between the dura mater and its cutaneous cap, but the skin and dura mater remain in contact along the various sutures even for a year or more after birth. This relation of the dura mater and skin persists longest in the region of the anterior fontanelle (bregma) and the neighbourhood of the inion. Should the skin be imperfectly separated, or a portion remain persistently adherent to the dura mater, it would act precisely as a tumour germ and give rise to a dermoid. Such a tumour may retain its original attachment to the dura mater, and its pedicle become surrounded by bone; the dermoid would lie outside the bone, but be lodged in a depression on its surface, with an aperture transmitting its pedicle. On the other hand, the tumour may become separated from the skin by bone; it would then project on the inner surface, or between the layers of the dura mater. If this view of the origin of dermoids of the scalp be admitted, we must then modify our teaching, and say that the depressions in which dermoids of the cranium are lodged



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arise as imperfections in the developmental process, and are not due to absorption induced by pressure; further, the fibrous connection of such dermoids with the underlying dura mater is primary, not accidental.

A study of the development of the tentorium cerebelli will demonstrate that it is composed of two folds of dura mater, and it arises as an enfolding or crease in this membrane, caused by the rapid backward extension of the developing cerebrum. The opposed surfaces of the tentorial lamellæ, like the outer surface of the dura mater in relation with the cerebrum, were originally in contact with the skin, and as the posterior margins of the bay or recess formed by the crease in the dura mater come together, a portion of the skin may become nipped or even sequestrated between the layers of the tentorium; this, preserving its vitality, and in some cases its cutaneous connections, may ultimately give rise to an intracranial dermoid.

IMPLANTATION CYSTS.

These small cysts should not be included among tumours, but their consideration is imperative in connection with sequestration dermoids, for they furnish valuable evidence that dermoids of this genus arise from "rests," the result of faulty coalescence.

These cysts are caused by the accidental implantation of portions of skin, epithelium, or hair bulbs in the underlying connective tissues. The transplanted tissue acts in many instances as a graft, and forms a small cyst. Implantation cysts have received a variety of names, such as dermal cysts, traumatic dermoids, sebaceous cysts of the fingers, etc.

They are common on the fingers, the cornea, and the iris, but they may arise on any part of the skin. They have been observed by many surgeons, and careful accounts have been written, especially by Polaillon, Le Fort, and Garre.

Implantation cysts vary much in size; some are scarcely as big as a split pea, others may be as large as a ripe cherry. In many the microscopic characters "appear as if a piece of the skin covering the pulp of the finger had been inverted" (Shattock). In others the implanted epidermis seems to have been shed in layers, so that on section the interior of the cyst

is occupied by epithelial lamina. When these cysts occur on the scalp, the interior contains hair.

Implantation cysts are caused in a variety of ways, such as punctures by awls, forks, needles, thorns, glass, etc.; also accidental wounds by knives, incisions by scalpels, bites and lacerations.

These cases are of interest, for they serve to throw light on some cysts, containing hair and wool, preserved in the museum of the Royal College of Surgeons. Two of the cysts are from sheep, and contain wool embedded in fatty matter. Unfortunately, the catalogue affords no information as to the region of the body whence they were removed. The third and fourth specimens were removed from the shoulder of a cow that had six legs. The cysts contain light hair, fatty and calcareous matter. These four specimens are Hunterian. The fifth specimen was removed from beneath the integuments of the shoulder of an ox. It contained slender black hairs, resembling those on the skin of the animal, mixed with fat. I once obtained a good example of an implantation cyst from the axilla of an ox. The cyst was as large as a billiard ball, and in structure resembled a piece of inverted skin. Fortunately, these cysts can be explained on the same lines as similar cysts of the fingers in man. The sticks used by cattle-drovers are armed at the end with a sharp iron spike, 2.5 cm. (1") long, with which they "prod" the beasts, often very severely. It may be assumed that punctures produced with such an instrument may lead to the deposition of dermal grafts beneath the skin, which may give rise to cysts in the same way as punctured wounds in the skin of men and women. Punctured wounds in sheep and oxen may also be caused by projecting nails, iron spikes, tenter-hooks, and the like.

The opinion that cysts may arise in the subcutaneous tissues by implantation receives the strongest possible confirmation from what we know of similar cysts of the iris and cornea associated with mechanical injury.

Iritic Cysts.—Cysts of the iris are of comparative rarity, generally appearing as transparent vesicles situated on its anterior surface. As a rule they are sessile, but occasionally possess a pedicle. The contents may be opaque, but in

exceptional cases they have been filled with sebaceous material, such as fills the cavities of dermoids.

Hulke (1869) collected some valuable facts in relation to such cysts, and states that in fifteen out of nineteen cases, as well as in two reported by himself, there was distinct history of antecedent mechanical injury. He suggested that some of these cysts originated from portions of Descemet's membrane, which may have been torn from the cornea and implanted on the iris.

Numerous instances are known in which eyelashes, sometimes as many as six, have been implanted on the iris by foreign bodies penetrating the cornea, such as knives, needles, foils, and swords. Similar cysts have been produced in the eyes of rabbits by the artificial introduction of eyelashes and epithelium into the anterior chamber.

Corneal Cysts.—In addition to the evidence furnished by implantation cysts of the iris, we know that similar cysts occur in the cornea. Treacher Collins has investigated this matter, and has published some valuable researches in which he has succeeded in demonstrating that after gunshot injuries of the eyeball, blows from tip-cats, and incisions made for the extraction of cataracts, cysts, usually of small size, are liable to form in the cornea near the seat of injury. In some of the specimens the cysts may be very large and conspicuous; when examined microscopically, their inner walls are found lined with layers of cells identical with those covering the anterior surface of the conjunctiva. The structure of these cysts, taken in conjunction with the antecedent injuries, thoroughly supports the view that they arise from conjunctival epithelium transplanted into the deep tissues of the cornea.

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CHAPTER XLV.

TUBULO-DERMOIDS.

LINGUAL DERMOIDS; MEDIAN CERVICAL FISTULÆ; ACCESSORY THYROID GLANDS.

THERE exist in the human embryo certain canals and passages many of which normally disappear before birth. Among these **obsolete canals** there are three that require especial consideration in connection with dermoids—viz. the thyro-glossal duct, the postanal gut, and the branchial clefts. The remainder will be considered in the section devoted to cysts.

The Thyro-glossal Duct.—The thyroid gland of man consists of two lobes united by a narrower portion or isthmus. His maintains that the three parts of this gland arise separately. The lateral lobes originate independently of the isthmus; the latter is derived from a median tubular outgrowth from the ventral wall of the embryonic pharynx, known as the thyro-glossal duct. This duct bifurcates at its lower end and gives rise to the thyroid isthmus, which fuses with the lateral thyroid rudiments, and assists in forming the lobes of the gland. Originally the duct extends as far upwards (forwards in the embryo) as the dorsum of the tongue, but as the body of the hyoid bone develops, the duct becomes divided into an upper segment, the lingual duct, and a lower portion, the thyroid duct. In the ordinary course of development these ducts disappear, but in some cases they persist and attain a fair size. Thus the central part of the thyroid may be regarded as the remnant of a secreting gland provided with a duct which conveyed the products of the gland into the pharynx.

There are at least three abnormalities which appear to be associated with vagaries of the thyro-glossal duct, (1) lingual dermoids, (2) median cervical fistulæ, (3) accessory thyroids.

1. **Lingual Dermoids.**—Dermoids arising in the tongue have been many times observed and reported as sebaceous

cysts. Barker, however, published a clear account of their nature, and showed them to be true dermoids. Subsequent research has proved that those dermoids which occupy a central position in the tongue between the genio-hyo-glossi muscles arise in the lingual duct. When fully developed this duct extends from the foramen cæcum to the posterior surface of the basi-hyoid. Occasionally the duct is so large that a probe may be introduced into it from the foramen cæcum. The duct lies exactly between the genio-hyo-glossi muscles, and is not unfrequently replaced by a solid fibrous cord. It is easy to understand that if a persistent duct should have its upper end obstructed or obliterated, the continual shedding

Fig. 237.—Large lingual dermoid, protruding from the mouth. (*Gray.*)

of the epithelium which lines it and the accumulation of sebum from the glands would convert it into a cyst, which in due course would assume such a size as to come within the range of clinical observation.

The walls of lingual dermoids are composed of fibrous tissue, lined internally with squamous epithelium beset with hair and sometimes with glands. The contents of these cysts are epithelial cells, hair, sebum, and cholesterin. Should

the cyst burst, then it would suppurate and become very disagreeable.

Lingual dermoids are occasionally sufficiently large to attract attention in infants, but most of the examples come under notice in adolescents (Fig. 237).

In addition to the common variety of dermoid, the tongue is occasionally occupied by tumours which in structure resemble the thyroid gland. They occur in the neighbourhood of the foramen cæcum, between the genio-hyo-glossi muscles. Bernays has given a careful description of such a tumour which he removed from the tongue of a girl seventeen years of age, and associated the tumour with the lingual duct (also Wolff, Warren and McIlraith).

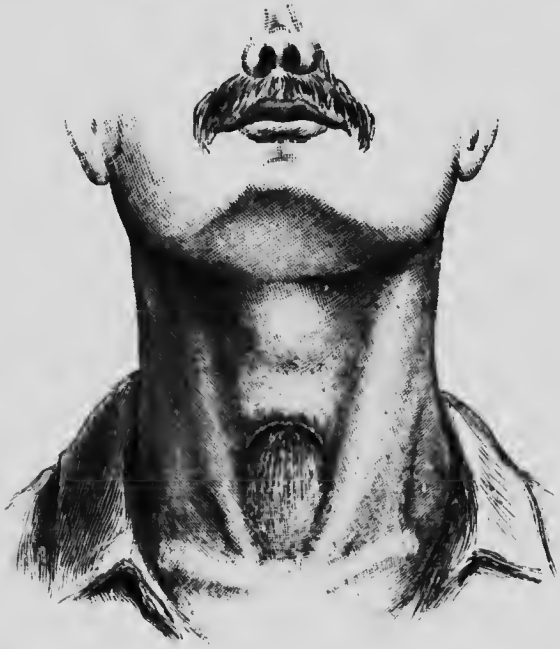

Fig. 238.—Median cervical fistula in a man aged 23 years. The fistula appeared when he was three years old.

2. **Median Cervical Fistulæ.**—These openings occur singly, and open at some point in the middle line of the neck between the hyoid bone and the top of the sternum. The common situation is a little below the level of the cricoid cartilage. Median cervical fistulæ differ from those arising in connection

with branchial clefts in the fact that they are never congenital: they may occur soon after birth or make their appearance as late as the fourteenth year

Cusset described a median cervical fistula in 1877, but Raymond Johnson clearly pointed out that median cervical fistulæ are preceded by a swelling in the middle line of the

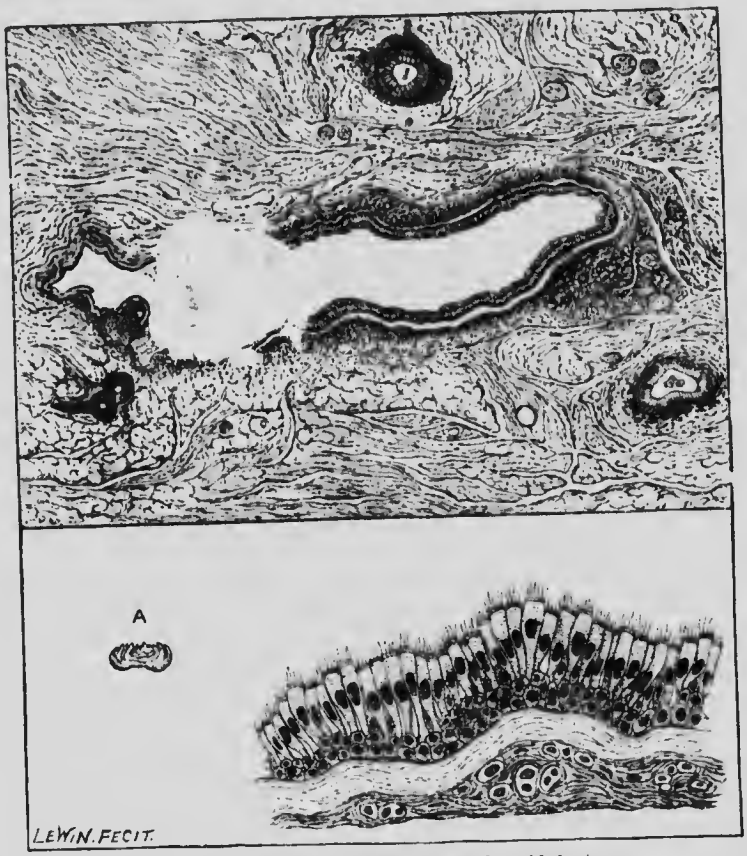

Fig. 239.—Section of a persistent thyroid duct.
A represents the duct of natural size. The lowest drawing shows the epithelium more highly magnified.

neck which either ruptures or is opened by the surgeon; this leaves a sinus which never closes.

The following is a common example of a median cervical fistula. The patient presented in the lower third of the neck a depression, the floor of which was puckered and scar-like (Fig. 238). At the upper part of this bay or recess there was

a rounded opening from which clear mucus exuded. An ordinary probe introduced into this hole easily passed upwards in the middle line directly beneath the skin, to stop at the middle of the lower border of the basi-hyal. The opening in the neck had existed as long as he could remember, but his parents told him that it appeared when he was about three years old. Ordinarily the fistula caused no inconvenience, but during the past two years it seemed

Fig. 240.—Median cervical fistula associated with a persistent thyroid duct.

subject to catarrh, and the excessive flow of mucus caused him much inconvenience, so it was dissected out.

The duct was lined with columnar ciliated epithelium. The tissue forming the walls of the duct resembled atrophied thyroid tissue; here and there (Fig. 239) isolated channels could be seen in section lined with columnar epithelium.

Occasionally a persistent thyroid duct is so large as to

form a conspicuous vertical ridge in the middle of the neck in association with a median cervical fistula (Fig. 240).

Thus a median cervical fistula is in striking contrast to branchial fistulæ, which are always lateral in position and in close relation with the anterior border of the sterno-mastoid muscle, and are always congenital.

Our knowledge of the nature of these fistulæ was not very satisfactory until the publication of an able paper by Marshall, detailing the anatomy of the parts in the neighbourhood of the hyoid bone of a child five years old, who had a median sinus in the neck. The patient was admitted into a hospital

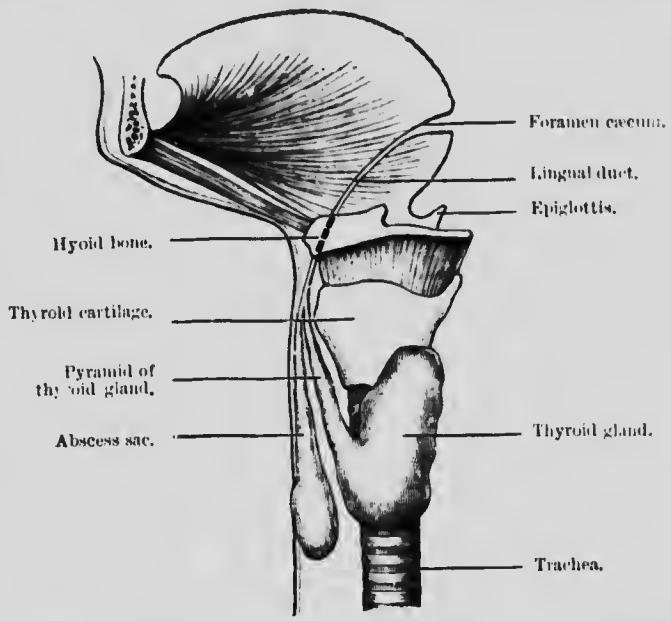

Fig. 241.—Diagram to show the relation of parts in a case of median cervical fistula. (*After C. F. Marshall.*)

for the purpose of having the duct excised; it contracted diphtheria and died before the operation could be performed.

In the median line of the neck, 2.5 cm. (1″) above the sternum, there was a sinus, which, during life, discharged a small quantity of mucous fluid. From this opening a hard cord could be felt extending up to the hyoid bone. On dissecting the front of the neck this cord was found to be tubular and patent up to within 1 cm. of its termination; the

upper end was firmly attached to the hyoid bone, the lower end dilated into a thin-walled sac opening on to the surface of the skin. The sac and tube lay between the skin and the anterior layer of the deep cervical fascia: at no place was there any connection with the thyroid gland.

On dividing the hyoid bone the tube could be traced as an ill-defined fibrous cord on to its dorsal surface, to which it was closely attached, and through the substance of the tongue to the foramen cæcum. About 2 cm. from the foramen it again became patent, and continued so up to the surface of the tongue. The canal was thus open at both ends, but impervious in the middle.

On further dissection a lobus pyramidalis was found connected with the left side of the thyroid isthmus, its upper end being united to the median fibrous cord at the same place as the above-mentioned canal. In other words, the fibrous cord behind the hyoid bone was continuous both with the pyramidal lobe of the thyroid and with the tube leading to the superficial sinus (Fig. 241).

The relations of the parts indicate the probable mode by which these median fistulæ arise; they are probably retention cysts formed in a persistent thyroid duct, and the pressure of the cyst ultimately causes the skin to yield and form a sinus.

3. **Accessory Thyroids.**—The consideration of accessory thyroids naturally follows on the description of median cervical fistulæ, for there is good reason to believe that the thyroid duct is the source of some of these bodies. They have long been known (Albers and Virchow), and in recent years have been carefully studied. They occur most frequently in the neighbourhood of the hyoid bone and in the hollow formed by the two lobes of the thyroid gland. As the thyro-glossal duct is directly associated with the formation of the thyroid body, and as median accessory thyroids are found directly in its track from the hyoid to the thyroid isthmus, it is not unreasonable to regard these little bodies as remnants of this remarkable tube.

Accessory thyroids occasionally arise in connection with the germs of the lateral lobes of the thyroid: these are most commonly found in the neighbourhood of the greater cornua of the hyoid.

Accessory thyroids are in the main innocent structures, but occasionally they give rise to troublesome tumours. It is well known that when the thyroid body becomes goitrous, and accessory thyroids co-exist, the latter will enlarge and become, in fact, goitrous. Apart from this, accessory thyroids will enlarge on their own account and produce tumours that closely simulate unilateral enlargement of the thyroid, and occasionally give rise to bronchoceles of moderate dimensions.

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CHAPTER XLVI.

CERVICAL FISTULÆ, DERMOIDS AND AURICLES.

CERVICAL FISTULÆ AND AURICLES.

Cervical Fistulæ.—It is not uncommon to find in the neck at some point along the anterior border of the sterno-mastoid muscle, a small orifice in the skin capable of admitting a bristle or a fine probe. These congenital openings are

Fig. 242.—Early human embryo, showing the gill clefts.

known as cervical or branchial fistulæ, and they are probably persistent representatives of the branchial fissures which were discovered in the embryos of pigs, horses, and man by Rathke in 1825 (Fig. 242.) Congenital fistulous openings in the side of the neck were observed many years before Rathke's embryologic discovery, and Heusinger (1854) was the first clearly to recognise the relationship of these fistulæ with the branchial clefts.

In the majority of cases these openings terminate as sinuses, but exceptionally they pass deeply among the structures of the neck and terminate on the wall of the pharynx or open into the pharyngeal cavity. One, two, or three orifices may be present in the same child, and they exhibit a great tendency to be bilateral, to affect several members of the same family, and to be transmitted to several generations. These sinuses or canals, which may vary in length from 2 to 5 cm., are lined by mucous membrane, sometimes with ciliated epithelium, or by skin containing sebaceous glands. The lining membrane of the canal usually secretes a thin mucous fluid, which may

become increased during catarrhal conditions of the respiratory passages. Occasionally the canal inflames and an abscess results, which may give rise to considerable pain and difficulty in deglutition. The external orifice of a branchial fistula may be indicated by a tag of skin, containing a piece of yellow elastic cartilage, and they are commonly known as cervical auricles.

The external orifices of these sinuses vary in position, but they are always situated along the anterior border of the sterno-mastoid muscle. The common situation is a spot in line with the angle of the jaw, but they may open anywhere along the line of the muscle from the mastoid process to the sterno-clavicular articulation. When the fistula extends to the pharynx, the duct bears a constant course and passes between the fork of the carotid artery, above the sling of the superior laryngeal nerve, and terminates in the sacculus pyriformis.

Heuter refers to a young man who had a cervical fistula and "wished to become a trumpeter"; he dissected out the fistulous tract "following it between the two carotids to the pharynx."

A lad of 15 years under my observation complained of a mucous discharge which soiled his collar occasionally; fluid when swallowed leaked through. I dissected out the duct and found it passed through the fork of the carotid artery.

Heusinger held the opinion that some pharyngeal diverticula arise as distensions of the persistent pharyngeal segments of branchial clefts. Morrison Watson recorded a case in which he made a careful dissection of such a diverticulum. The parts are shown in Fig. 243, and in the description it is stated that a tube terminating inferiorly in a cul-de-sac containing a large quantity of grumous material was found extending from the pharynx, immediately behind the tonsils, to the interclavicular notch. This tube possessed muscular walls, and in the deep part of its course passed between the fork of the carotids and over the loop of the superior laryngeal nerve; its lower part was parallel with the anterior border of the sterno-mastoid muscle; it rested on the sterno-hyoid and sterno-thyroid muscles. It communicated with the pharynx by means of a slit-like opening, not more than 3 mm. in length, the margins of which were so closely in contact that

the entry of solid particles into it from the mouth must have been prevented. The diverticulum itself increased in calibre from above downwards, so that whilst at the upper end a crow-quill could with difficulty be introduced, at the lower a pencil could readily be passed along the lumen of the tube.

It is further noteworthy that the pharyngeal orifice was situated between the lower jaw and the stylo-hyoid ligament. Its point of departure from the pharynx corresponds to the supratonsillar fossa. The muscle fibres were, for the most

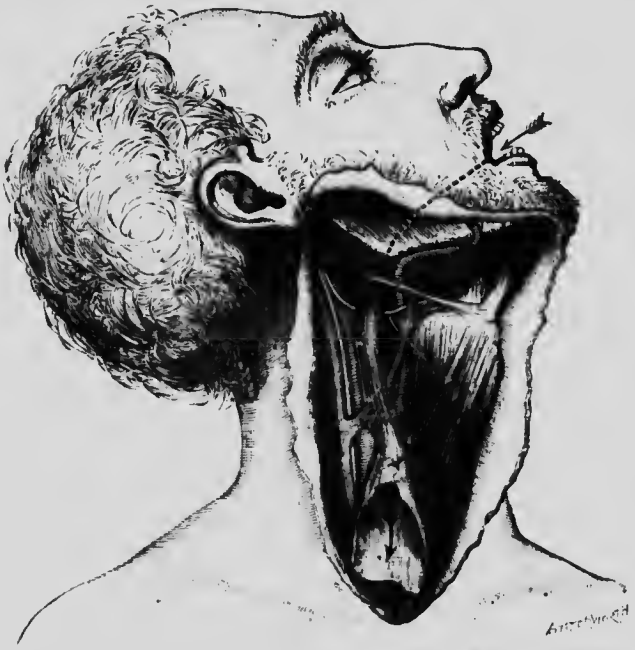

Fig. 213.—A pharyngeal diverticulum. (*After Morrison Watson.*)

part, red and striated, and the mucous lining resembled that of the œsophagus.

It has long been suspected that the so-called sebaceous cysts which arise in the neck below the deep fascia take origin in unobliterated segments of branchial clefts. Such a cyst need not necessarily contain grease or hair; it may be filled with mucus. The walls of cervical fistulæ are covered with epithelium of various kinds, which in some is ciliated and in others squamous, and so forth. Mucous cysts in the side of the neck arising in persistent branchial clefts must not

be confused with lymphatic cysts (see p. 174), or with dermoids associated with the thyro-glossal duct (see p. 458).

Rowley has described and figured a small tumour which he found in a frog, *Rana temporaria*, posteriorly to the angle of the jaw. This on microscopic examination was found to be made of concentric laminæ of epidermis and dermis. The structure and position of the tumour led Rowley to regard it as a dermoid due to the inclusion of epithelium during the occlusion of a gill-cleft in larval life.

Cervical Auricles. — In describing branchial fistulæ (p. 467) it was mentioned that the cutaneous orifices are

Fig. 244.—Cervical auricles in a child.

in some cases surmounted by tags of skin. These tags, or processes, sometimes occur unassociated with fistulæ, but always in situations where fistulæ, when present, open on the skin. Usually they are short, in some cases mere nodules, but in others form prominences 2 to 3 cm. in height These processes have been described under a variety of names, and classed among tumours, but at the present time they are commonly known as cervical auricles.

Like branchial fistulæ, they are always congenital, and sometimes affect several members of a family. The mother

may have a cervical auricle, and one of her children a branchial fistula, whilst another child may have an auricle associated with a fistula; they are often symmetrical (Fig. 244). A cervical auricle consists of an axis of yellow elastic cartilage, which sometimes extends deeply into the tissues of the neck; muscle fibres from the platysma are attached to the cartilage, and the whole is surmounted with skin containing hairs and sebaceous glands. A small arterial twig

Fig. 215.—Head of a goat with cervical auricles.

runs into the auricle and ramifies in the fibrous tissue and fat in which the cartilage is embedded.

Thus, structurally, cervical auricles are identical with the normal auricle or pinna, and they agree with the pinna morphologically, inasmuch as they are developed like it from that portion of a branchial bar which is directly in relation with the corresponding cleft.

In sharks the gill-slits open separately on the surface of the body; from the branchial bar, anterior to each slit, a fold of skin is formed which closes upon the slit like a lid

and is named from this resemblance the operculum. In mammalian embryos a slight prominence or tubercle is for a time visible anteriorly to each of these clefts. In most cases the tubercles disappear from the posterior bars, but those in relation with the anterior cleft enlarge and are joined by accessory tubercles to form the pinna. Thus embryology has taught me to regard the pinna as consisting mainly of an operculum which has become modified for acoustic purposes, for we may regard the tubercles formed in relation with the branchial clefts of man as representative of the opercula of certain Ichthyopsida. As the pinna is mainly derived from opercular tubercles, and cervical tubercles, in

Fig. 246.—Head of a horned sheep with cervical auricles.

all probability, represent persistent opercular tubercles, it is reasonable to term them cervical auricles.

The homology of at least a part of the pinna and cervical auricles with the operenla of fish has been made clearer by Schwalbe's discovery of auricular tubercles in the embryo of the turtle (Emys lutaria taurica); in the adult condition chelonians have no vestige of an auricle.

Cervical auricles occur in mammals other than man. Heusinger, in 1876, mentioned the frequency with which pendulous tags of skin occur in the necks of pigs, goats (Fig. 245) and sheep, (Fig. 246); yet very little has been done to extend his observations.

The anatomy of these auricles (which are especially common in Egyptian and Italian goats) is similar to that of cervical auricles in man: there is an axis of yellow elastic cartilage embedded in fibrous tissue and fat, the whole being covered with hairy skin.

In Great Britain cervical auricles are rare in pigs, but Professor Anderson Stuart has drawn attention to the existence in Australia of a breed of pigs known as the Bell-pig, on account of the presence of pendulous folds of skin in the neck

Fig. 247.—Head of a pig with cervical auricles (the Bell-pig of Australia).

(Fig. 247). It may here be mentioned that in Germany these auricles in sheep and pigs are known as *Glöckchen or Berlocken*.

Before concluding the subject of cervical auricles reference must be made to the presence of these appendages on the necks of satyrs. Mr. Shattock drew my attention to the fact that in the statues of many satyrs we find in the neck, in the situation where cervical auricles are usually found, prominences which in their variety of form resemble the cervical auricles of goats and men. In the ægipans (goat-footed satyrs) the auricles in the neck are pointed like their ears and are sessile, but in the fauns they are usually pendulous

(Fig. 248). In the statues of many satyrs, both fauns and ægipans, no auricles are represented, and they are less constant in modern than in ancient statues of fauns, and in some they are unilateral. The hircine element is particularly evident in the ægipans, even in their tails (Fig. 342.).

Fig. 248.—Faun and goat with cervical auricles. (*From the Capitol.*)

AURICULAR DERMOIDS AND FISTULÆ.

We may assume that the auricle or pinna consists mainly of an enormously developed operculum which has become utilised for acoustic purposes. It has already been pointed out that in the embryo each branchial cleft is surmounted by a swelling or tubercle corresponding to the operculum of the shark. In mammals, and, as Schwalbe has shown, in reptiles, the first cleft, which ultimately becomes modified into the tympano-Eustachian passage, is surrounded by additional

tubercles, some of which belong to the mandibular, and others to the hyoid bar (Fig. 249). It is by the subsequent growth and coalescence of these tubercles that the auricle is formed. These tubercles have received the following names from His:—I., tuberculum tragicum; II., tuberculum anterius; III., tuberculum intermedium; IV., tuberculum anthelicis; V., tuberculum antitragicum; and VI., lobulus.

The subsequent fate of these tubercles may be briefly given. The tuberculum tragicum unites across the cleft with the tuberculum antitragicum, the space formerly separating them being simply indicated by the incisura intertragica. The tuberculum intermedium is the source of the helix,

Fig. 249.—Two drawings representing the development of the auricle (see text above). (*Modified from His.*)

whilst the tuberculum anthelicis furnishes the anthelix; the nodule VI., cut off by the fusion of tragus and antitragus, becomes the lobule.

Imperfections in the development and union of these tubercles will serve to explain several congenital defects to which the auricle is liable. Of these, three are of especial interest:—(1) Auricular fistulæ; (2) Auricular dermoids; (3) accessory tragus.

1. Auricular Fistulæ.—Heusinger seems to have been the first to describe a congenital fistula in the helix. For the first complete account of these fistulæ in England we are indebted to Sir James Paget. The fistula usually appears as a small opening leading into a canal ending blindly in the substance of the helix. The auricle may be of good shape, but often it

is deformed (Fig. 250). Usually a small quantity of greasy material exudes from the orifice of the sinus, which varies from 2 to 6 mm. in depth. These fistulæ sometimes exist in individuals who also have branchial fistulæ; or one member of a family will have a congenital fistula in the auricle, and another a congenital fistula in the neck; they are hereditary.

It is far rarer to find congenital fistulæ in the lobule. Very few examples have been observed. A little girl known to me was born with a perforation in the lobule of the left

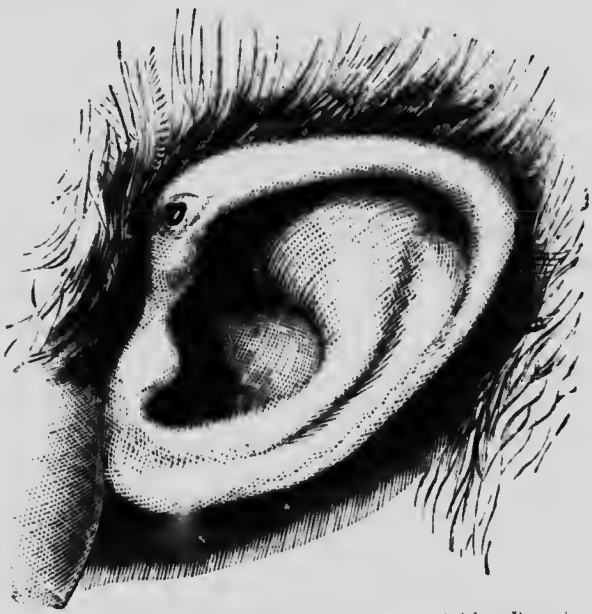

Fig. 250.—Congenital fistula in the helix. (*After Paget.*)

auricle exactly in the spot for wearing an earring, and to this day she wears a ring in this lobule and refuses to have the other pierced.

The facts now at our disposal enable us to understand how such fistulæ arise, for it seems reasonable to conclude that if the various lobules which conspire to form an auricle unite imperfectly, the intervening spaces would persist as sinuses or fistulæ.

2. **Auricular Dermoids.**—From what has just been stated regarding the probable mode of origin of auricular fistulæ, it

will be obvious that if unobliterated skin-lined spaces are left between the tubercles uniting to form the auricle, and the skin lining such spaces possesses glands (sequestered tracts of skin are unusually rich in sebaceous glands), we have in such a space a potential dermoid.

The auricle is not an uncommon situation for cysts often described as sebaceous; they are usually small, but sometimes attain the dimensions of a cherry, or even larger. When these supposed sebaceous cysts are examined microscopically they sometimes turn out to be dermoids. It is a curious fact that unless small dermoids in unusual situations are very carefully examined, they run a great chance of being put aside as sebaceous cysts.

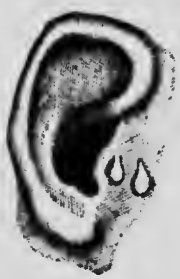

Fig. 251.—Auricle with a duplicated tragus.

Fig. 252.—Auricle of a fœtus with an unusually large Woolner's tip furnished with a tuft of lanugo.

Auricular dermoids of fair size sometimes occupy the groove between the pinna and the mastoid process; if allowed to grow they will form a deep hollow in the underlying bone.

3. **Accessory Tragus.**—One of the commonest malformations of the pinna is duplication of the tragus: the accessory tragus is extremely variable in shape; often it assumes the form of a low conical projection in front of or above the tragus (Fig. 251); sometimes it is pedunculated and hangs as a small cutaneous tag slightly in front of the tragus, beset with pale delicate hair. It is curious that an accessory tragus, a Woolner's tip (Fig. 252), or a mandibular tubercule (Fig. 226), is usually covered with long lanugo.

Occasionally an accessory tragus is associated with a circular cicatrix-like depression in the cheek immediately in front of the pinna. It is a fact of some interest that malfor-

mations of the tragus, and the presence of an accessory tragus, are often associated with defects in the mandibular fissure, such as macrostoma, mandibular fistula, and tubercle.

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CHAPTER XLVII.

TUMOURS OF THE FEMALE GENITAL GLAND (OVARY)

The ovary is a complex organ histologically and morphologically: it is with extraordinary frequency the source of tumours, some of them being so complex in character as to set at nought the ordinary rules of oncological classification. The frequency and clinical importance of ovarian tumours justifies their consideration as a subdivision in a general description of tumours.

The ovary consists morphologically of three parts:—

(*a*) **The Oöphoron.**—This forms the free surface of the ovary, and may be described as the egg-bearing segment, for it contains the ovarian follicles.

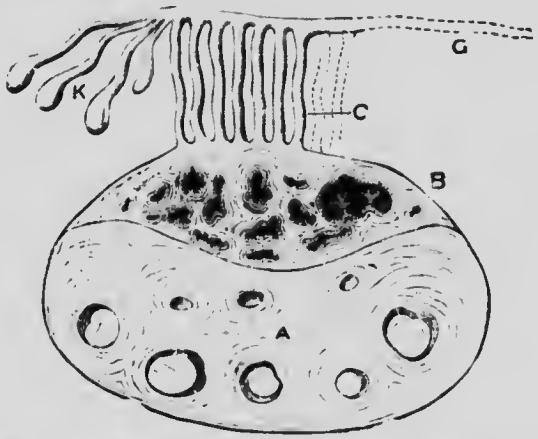

Fig. 253.—Diagram representing the morphologic regions of the ovary. A. Oöphoron. B. Paroöphoron. C. Parovarium (epoöphoron). K. Kobelt's tubes. G. Gartner's duct.

(*b*) **The Paroöphoron.**—This forms the hilum of the ovary: it consists of fibrous tissue and blood-vessels; it never contains ovarian follicles. In young ovaries glandular tissue may be detected, remnants of the mesonephros (Wolffian body) from which it is mainly derived.

(*c*) **The Parovarium** (Epoöphoron).- A structure consisting of a series of tubules situated between the layers of the mesosalpinx. These tubules at their ovarian extremities terminate in the paroöphoron; at the opposite end they open into the duct of Gartner: this duct may occasionally be traced downwards to the vagina. The parovarium with the duct of Gartner are the persistent excretory ducts of the mesonephros; in the female they are vestigial, but in the male they are functional as the excretory ducts of the testis.

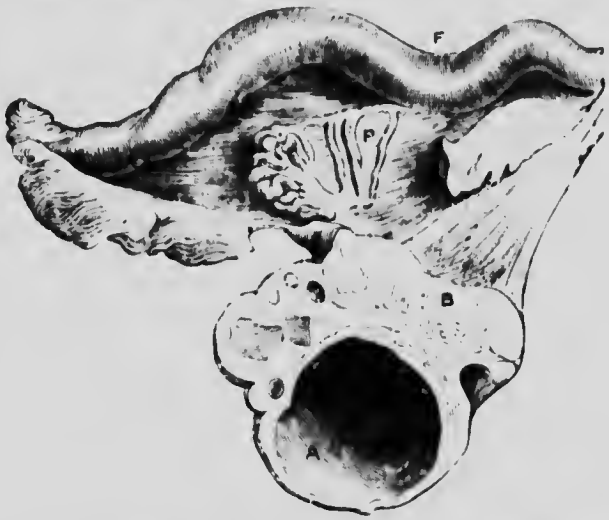

Fig. 254.—Cyst of the Oöphoron. Natural size.
A, Incipient cyst; B, paroöphoron; F, Fallopian tube; P, parovarium.

The tumours which arise in the ovary will be described in the following order, viz., Dermoids and Embryomata; Lutein Cysts; Papillomatous Cysts; Fibroids; Sarcomata; Carcinomata; Parovarian Cysts; and Gartnerian Cysts.

DERMOIDS AND EMBRYOMATA.

The oöphoron is the source of three varieties of tumours known as cysts, adenomata (multilocular cysts) and dermoids (or embryomata), which in their type forms are easily distinguished, but they approach each other by such gradations as to make it difficult to draw a dividing line; moreover, conglomerate tumours are occasionally found in the ovary consisting of dermoids, cysts and adenomata.

Simple Cysts.—These may be unilocular or multilocular. A small oöphoronic cyst is an enlarged ovarian follicle, and its walls are furnished with a well-developed membrana granulosa. In a very early stage it is easy to demonstrate the relation of such a cyst to the oöphoron. As the cyst enlarges it causes rapid absorption of the paroöphoron, and the region in which it arose is then not so easily demonstrable.

It is only by patiently waiting for opportunities of securing cysts in very early stages that it is possible to elucidate their mode of origin (Fig. 254). Much of the confusion which obscures the pathology of this question is due to the fact that most investigators have devoted their attention mainly to large cysts.

In cysts containing three or four litres of fluid the walls will be found to consist of fibrous tissue; and epithelium is rarely detected. It is impossible to state definitely the size of a cyst in which the epithelium disappears. The absence of epithelium is due to atrophic changes, the consequence of the continual pressure exerted by the accumulating fluid. Precisely similar changes may be studied in the mucous membrane of greatly distended gall-bladders. In large multilocular cysts, although the big loculi may be destitute of epithelium, the smaller cavities will retain their epithelium, which may be columnar, cubical, or stratified.

An extremely simple means of determining an oöphoronic tumour is to note the relation of the Fallopian tube; it lies curled up on the cyst, and when the parts are stretched the tube and tumour are separated by the mesosalpinx.

Adenomata (Multilocular Glandular Cysts).—This is an important variety of tumour. It has a dense fibrous capsule, and its surface is usually lobulated. These tumours attain colossal dimensions and consist of innumerable loculi and cysts which vary in size from a cavity no bigger than a pea to one holding a pint or more of fluid. Critical dissections of such cysts enable us to recognise three varieties of loculi. In typical specimens a honeycomb-like mass will be found projecting into some of the larger cavities and occupying usually one-third of its circumference, so that a section of the cavity resembles a signet-ring. Such are called primary, whilst the cavities occupying the honeycomb portion are

secondary cysts, and are, as a matter of fact, mucous retention cysts. The third set of loculi are of small size, and histologically are indistinguishable from distended ovarian follicles (Fig. 255).

The primary cysts in their early stages are lined with rich

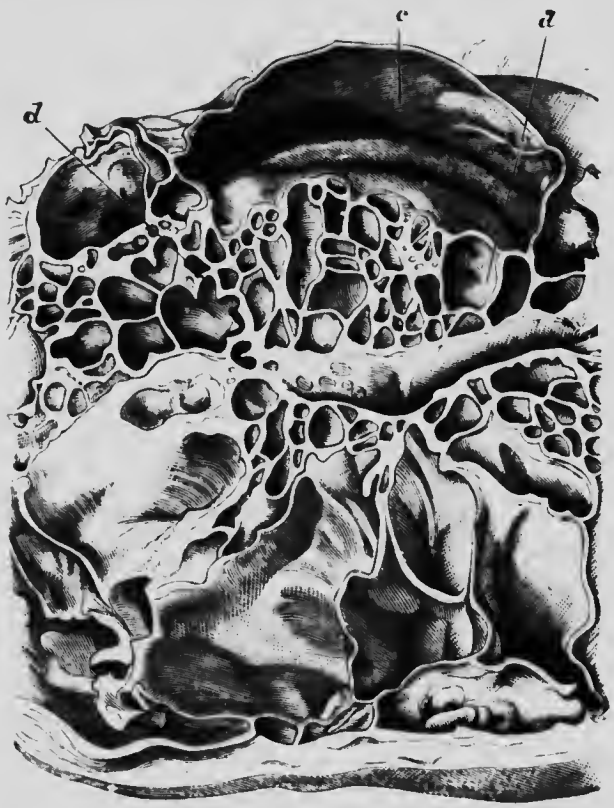

Fig. 255.—Portion of a large ovarian adenoma, showing the varieties of loculi. *c*, Primary loculi; *d*, secondary loculi.

columnar epithelium, and often contain mucous glands (Fig. 256). The fluid contained in the loculi of ovarian adenomata is identical in its physical and chemical characters with mucus. Occasionally it is as thick and tenacious as jelly. The lining of the cavities is in many specimens indistinguishable from mucous membrane.

In some specimens of ovarian adenomata the secondary loculi give rise to projections on the periphery of the tumour;

when numerous and close together, these projections cause the tumour to resemble a colossal bunch of grapes. It is no uncommon thing for a loculus of an ovarian adenoma to burst into the belly. When this happens the mucus which escapes is tolerated, but not absorbed, by the peritoneum. When the rent in the loculus is not repaired the glands in its walls continue to secrete, and the mucus accumulates in the belly,

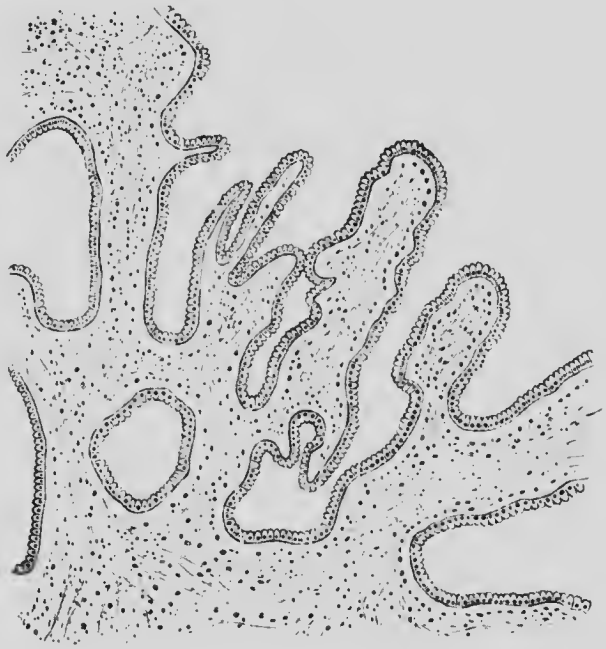

Fig. 256.—Section of the wall of a loculus from an ovarian adenoma, showing the glandular disposition of the epithelium.

simulating hydroperitoneum. On one occasion I removed from a woman's belly three gallons of inspissated mucus of this kind which had been secreted by an ovarian adenoma no bigger than a cocoanut. The belly was so tightly stuffed with this jelly-like material that it had produced a hernial protrusion at the umbilicus and the left femoral ring, the sac in each case being crammed with thick mucus.

Ovarian Cysts with Ciliated Epithelium.—As a rule the epithelium found in the type forms of ovarian adenomata is tall and columnar in character, and it may be ciliated. In

1905 I removed a fist-sized unilateral ovarian tumour from a woman forty-five years of age, and its semi-solid condition raised in my mind a suspicion of malignancy. On the instant of removal small pieces of the tumour were placed in preparation fluid and at once forwarded to Dr. Bashford. He reported that the tumour contained ciliated epithelium, and that it was innocent in character. I subsequently examined the tumour after it had been carefully hardened, and the

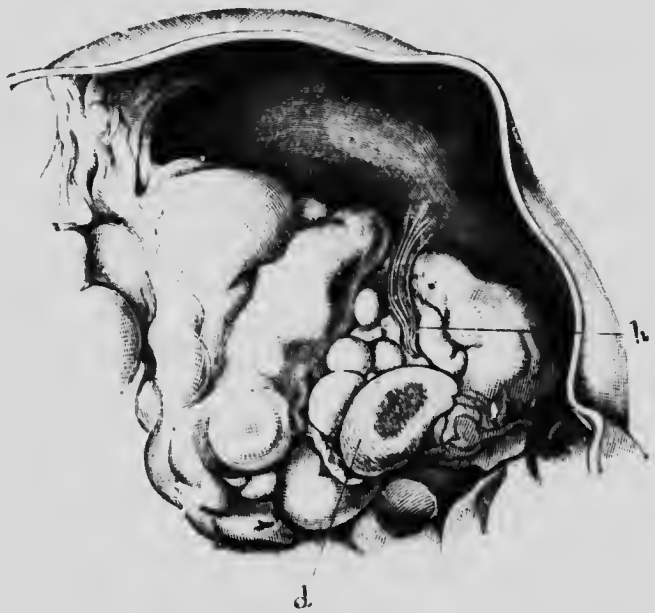

Fig. 257.—Ovarian adenoma, presenting a cutaneous clump (*d*) with a tuft of hair (*h*). (*Museum, St. Thomas's Hospital.*)

manner in which the solid parts are connected with the periphery of the tumour is exceptional (Fig. 258). The solid parts are made up of spaces lined with columnar cells; in many of the cystic spaces the epithelium presents cilia. The view that the tumour is of an innocent nature seems true, for a year later the patient was in excellent health.

The source of this ciliated epithelium is a matter for conjecture, but Walthard, who published the results of a painstaking investigation into the histology of the human ovary at various ages, mentions the occasional existence of small cysts

in this organ lined with cylindrical cells without any tendency to form warts, and in some the epithelium is columnar and ciliated. He also describes small epithelial bodies in the ovary which have no connection with ovarian follicles, and which, he believes, arise from the cell bundles which dip into the ovarian stroma, and out of which the true ovarian follicles evolve.

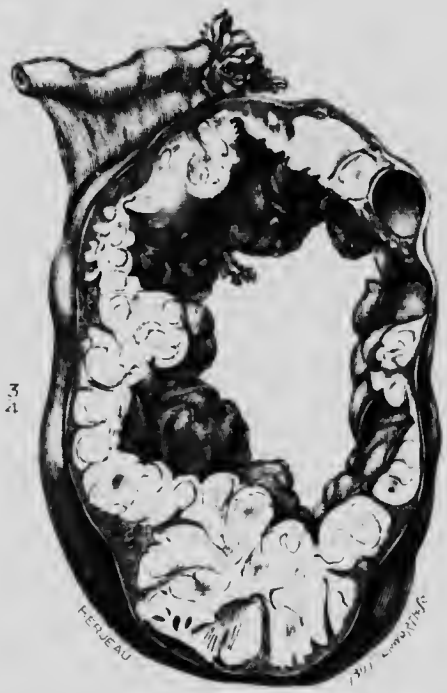

Fig. 258.—An ovarian adenoma in section. The gland spaces were lined with columnar epithelium, and some of them were ciliated.

Dermoids (Embryomata).—A very large proportion of oöphoronic cysts contain skin or mucous membrane, or both these structures, and some of the many organs peculiar to them, such as hair; sebaceous, mucous, and sweat glands; dermal bone, horn, nail, nipples and mammæ: teeth also occur in great numbers: such are called **dermoids.** They may be multilocular or unilocular, and attain a weight of 20 or even 40 kilogrammes. Sometimes a cyst will be lined throughout with typical mucous membrane covered with regular columnar epithelium, and will contain mucous glands.

It is impossible to determine in many cases, from a mere naked-eye examination, whether an oöphoronic tumour

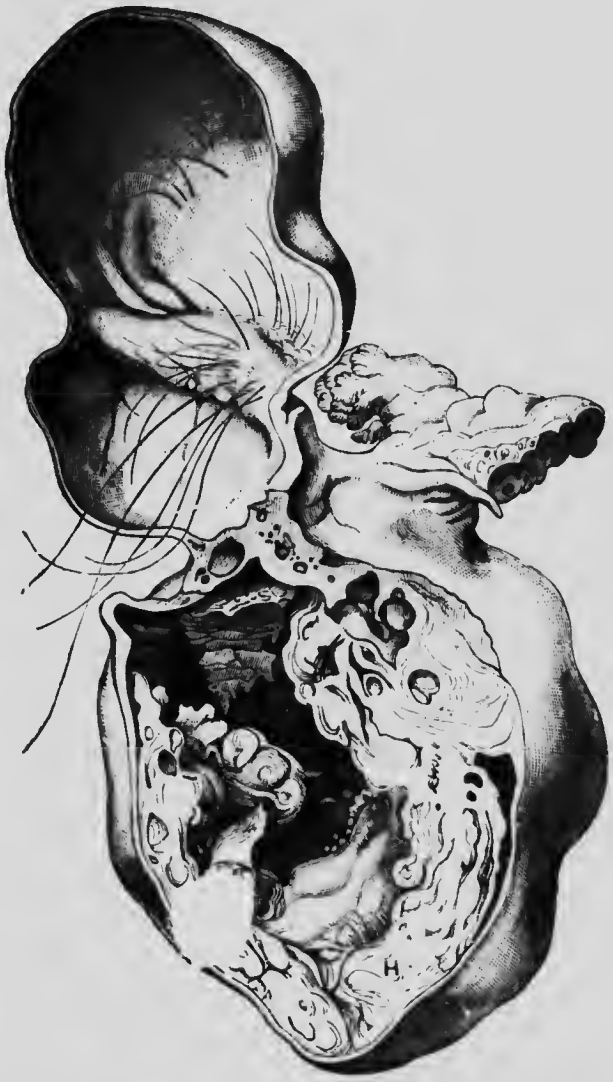

Fig. 259.—Ovarian dermoid. The lower part of the tumour contained teeth-germs in early stages of development. H. Tuft of hair.

should be regarded as an adenoma or a dermoid. In practice the presence of a tuft of hair or a tooth is a useful and ready way of settling the question. Failing this, a careful micro-

scopical examination is necessary. For instance, the tumour represented (nearly natural size) in Fig. 259 consists of two parts; one a thin-walled cyst (filled with sebaceous material when fresh) lined with piliferous skin. The lower and larger portion resembled, on superficial examination, an adenoma, and was nearly solid. A small tuft of lanugo-like hair induced me to make a careful histologic examination of the adjacent tissue. The sections revealed an extraordinary diversity of tissues and organs, such as sebaceous and sweat-glands, hair-germs, skin, teeth-germs with typical enamel-organs and dentine papillæ, epithelial pearls, and shapeless masses of epithelium.

Cysts occur in the oöphoron at all periods of life, even in very young children, and I have collected records of over one hundred cases in girls under fifteen years of age in which ovariotomy was a necessity from the size of the tumour. In one remarkable case an ovarian tumour from a girl of fifteen years weighed 44 kilos; the girl weighed 27 kilos (Keen).

Small cysts in the oöphoron are very common at birth, and are often bilateral: but, so far as I am aware, after a careful and prolonged investigation of the matter, no authentic example of an ovarian dermoid has been observed in a child before the end of the first year of life.

Adenomata and dermoids are very apt to affect both ovaries simultaneously; very rarely two independent dermoids may arise in one ovary; and it is a fact that both ovaries may be so distorted and destroyed by dermoids that the true ovarian tissue is unrecognisable to the naked eye, yet such organs are able not only to dominate menstruation but to discharge their egg-bearing functions successfully (see Cullingworth, Thornton, and F. Page).

Rate of Growth of Ovarian Adenomata and Dermoids.—Concerning the rate of growth of these tumours very little is known. Therefore the following observations may be of interest:—

1. *Ovarian Adenoma.*—In May, 1901, I removed from a woman forty-five years of age a typical left ovarian adenoma of the size of a football: it was full of the usual colloid stuff. The right ovary was very carefully examined and found to be normal. In February, 1903, I removed an ovarian adenoma

of the size of a football which had originated in the right ovary.

Thus a complex glandular tumour of the size of a football may grow from an ovary apparently normal in twenty-one months.

2. *Ovarian Dermoid.*—The following case is recorded by Flaischlen:—In May, 1887, Ruge ovariotomised a woman, removing a cyst as large as a child's head which had arisen in the left ovary. The right ovary was inspected and found to be natural.

Fig. 260.—Enormous ovarian cyst in a girl seventeen years of age; it contained 78 litres of fluid. (*After Dayot.*)

In June, 1888, a tumour the size of a fist was detected on the right side of the pelvis. In December, 1890, laparotomy was again performed, and a dermoid, containing hair and teeth, removed.

In this case the evidence is decisive that *a dermoid may arise in the ovary and attain dangerous proportions in an adult woman within the space of three years.*

That a tumour containing hair and erupted teeth should be produced in the course of three years is not inconsistent with the rate at which these organs are formed under normal conditions. For instance, the period between the fertilisation of an ovum and the eruption of the milk incisors in man is about fifteen months; in exceptional instances children are born with incisors above the gum. In such cases the process occupies less than nine months.

The cutaneous organs found in ovarian dermoids present such extraordinary variation as to demand separate consideration.

Skin.—This, in some specimens, is very thick, but it rarely possesses papillæ, and when present they are not furnished with touch corpuscles. Pigment is occasionally present. An epidermis may be demonstrated; sometimes it is very thick, and the superficial layers are shed into the cavity of the dermoid in broad flakes. The usual arrangement of the epithelium resembles that which is found on the buccal mucous membrane rather than on skin in general, and there is no stratum granulosum. The subcutaneous tissue of dermoids is often particularly rich in delicate fat.

In a few instances the epidermis has been found transformed into **nail**. An ill-formed nail has been detected at the extremity of a piece of bone resembling a phalanx by several observers.

Hair.—This varies in length, colour, and amount. A single tuft coiled into a ball and mixed with sebaceous matter is not infrequent, and may attain a length of 50 cm. Mundé has described and figured a specimen in which a tuft of hair in an ovarian dermoid was 1·5 metres long. Frequently only a few hairs are found scattered on the cyst wall, or the hair may be rolled into balls and lie free in the cyst. Occasionally the shed hair will "felt." The colour is equally capricious and, as a rule, differs from that on the exterior of the individual. The hair in such cysts changes in colour with age, and in elderly persons becomes quite white and is eventually shed, so that these cysts become actually bald. In an ovarian dermoid from a mare the hair resembled that on the animal's mane or tail (Pollock). In a similar tumour from a ewe wool existed.

Sebaceous Glands.—The extraordinary abundance and large size of these glands is a conspicuous feature of typical ovarian dermoids. They are occasionally transformed into cysts, and, exceptionally, **horns** sprout from them.

Sweat Glands.—These are not nearly so common as the sebaceous variety, and usually occur in irregular isolated clusters. I have as yet failed to detect the characteristic twist of the duct so constant in normal sweat glands.

Pultaceous Material.—The cavities of ovarian dermoids are often filled with a semi-fluid mixture of epithelium, sebum, fat, shed hairs, and often cholesterin. In small cysts the sebum is sometimes so pure as to be quite white in colour.

The fat may be liquid at the temperature of the body, but solidifies after its removal. In some dermoids it occurs

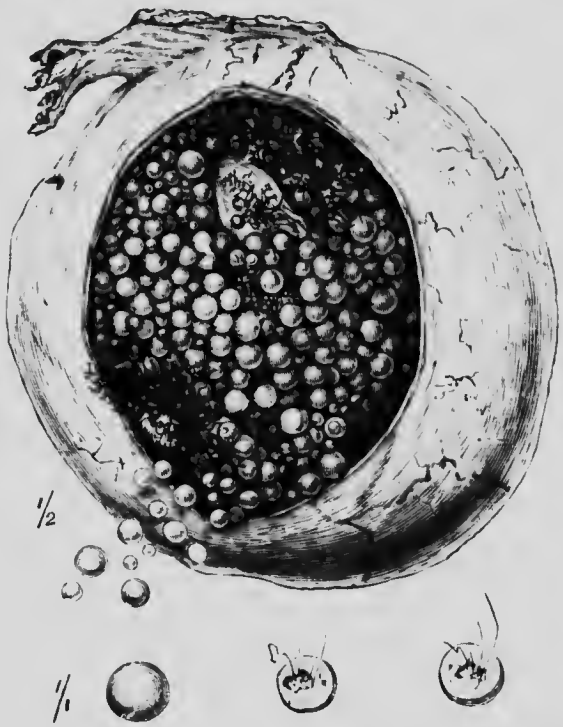

Fig. 261.—Ovarian dermoid containing 3,930 epithelial balls.

in lumps of the density and colour of cacao-butter. This variation probably depends on the proportion of stearin in the fat.

Epithelial Balls.—In some rare cases the shed epidermis forms rounded pill-like bodies which I ventured to call epithelial balls. As a rule, three, four, or even twenty, and perhaps fifty, may be present. In one remarkable specimen which I examined, the number amounted to 3,930. Each contained one or more hairs as a nucleus, around which the

epithelial masses cohered to form balls (Fig. 261). Bonney has reported a similar case, collected the literature, and attempted to demonstrate by experiment the probable mode by which these balls are formed. These pill-like bodies have been found in dermoids of the scalp and neck.

Ovarian Mammæ and Teats.—It is quite common to find in the interior of ovarian dermoids one or more tags of skin resembling a nipple or teat associated with hair and teeth (Fig. 262). These teats may be small and inconspicuous, but usually they are obvious to the most casual observer. Often they

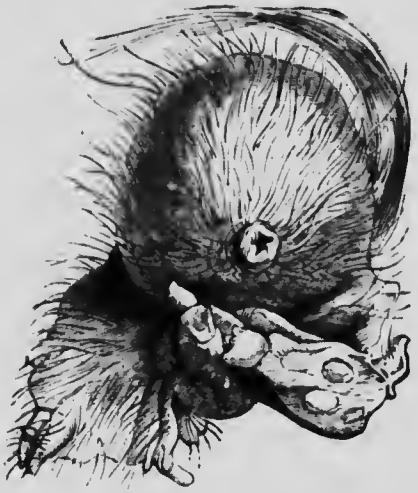

Fig. 262.—An ovarian mamma with hair and teeth.

are attached to round skin-covered prominences resembling mammæ. These teat-like processes are imperforate and beset with large sebaceous glands. In some specimens the mamma is plump and well-formed, but consists entirely of fat covered with skin. The nipple may be surrounded with an areola.

Complete forms are sometimes found with glandular acini ducts and a perforated nipple, and furnish a viscid fluid which exhibits the microscopic characters of milk and contains colostrum globules.

The most complete ovarian mamma from a histological point of view is one described by Velits: the nipple was surrounded by a rosy areola with clusters of Montgomery's

tubercles, and small tufts of blond hair. Its structure was characteristic of a mamma (Fig. 263).

Thyroid Gland.—In 1893 I removed a large ovarian tumour from a woman fifty years of age, and detected in it a firm, rounded, encapsuled body as big as a walnut. Its cut surface so resembled a thyroid gland that I examined it microscopically. The body was composed of closed vesicles filled with colloid material and lined with the sub-columnar epithelium so characteristic of the normal thyroid gland. Similar observations have been recorded by Kroemer and Bell.

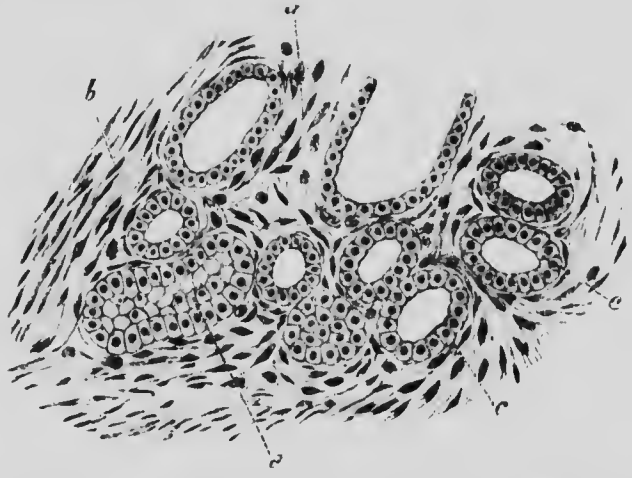

Fig. 263.—Histologic characters of the ovarian mamma described by Velits. *a*, Pigmented connective tissue; *b*, plain muscle fibre; *c*, *d* and *e*, gland-acini and ducts.

Bone.—This tissue is often present in ovarian dermoids in shapeless masses resembling the alveoli of jaws, or as irregular plates of extremely dense bone, "similar to the facial bones of an osseous fish" (Doran). In these ill-formed pieces of bone those writers who believed that dermoids were due to parthenogenesis saw jaws, skulls, pelves, limbs, etc., and other skeletal elements, as their fancies led them. Rarely the fibrous capsule of a dermoid becomes calcified in flakes until a hard shell is formed.

Nerve-tissue.—Our knowledge in relation to nerve-tissue in ovarian dermoids is not very satisfactory. Several

observers have detected the presence of tissue which in its histological characters was indistinguishable from "cerebral matter" (Gray). In several cases the brain substance was enclosed in a firm capsule in structure like dura mater lined with a delicate pia mater (Nemmann). A similar example has come under my own notice.

The whole question of nerve-tissue in dermoids requires careful study, aided by the improved methods of staining now employed in neurological histology.

In some of the malignant ovarian embryomata, embryonic brain substance, neuroglia and ganglion cells have been detected in the nodules disseminated on the peritoneum (Backhaus).

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CHAPTER XLVIII.

TUMOURS OF THE OVARY (*Continued*).

NATURE OF THE OVARIAN DERMOID (EMBRYOMA).

It has been held by several writers during the past fifteen years, myself among them, that dermoids of the ovary differ in so many respects from those found in connection with the embryonic fissures (sequestration dermoids) that they require separate consideration from the taxonomic, anatomic, and genetic points of view. The idea that they arise from included pieces of epiblast I have always endeavoured to combat. Apart from other considerations it must be remembered that sequestration dermoids are congenital, whereas there is no authentic observation of a dermoid existing in the ovary at birth: they occur in infancy and early girlhood, and often of large size. For some years I made a careful study of the ovaries of still-born fœtuses, and made unremitting inquiries amongst men who have specially interested themselves in this question, yet no specimen of this condition is available. This at once establishes a distinction between the sequestration dermoid, the teratoma, and the so-called dermoid of the ovary. The difference may be expressed in this way:—

1. A teratoma arises in embryonic life.
2. Sequestration dermoids are formed during fœtal life.
3. Ovarian dermoids or embryomata are of post-natal origin.

In its simplest form an ovarian embryoma is indistinguishable from the common dermoid of the facial fissures. It is a cyst lined with epithelium furnished with hair. In a more complex form, in addition to hair it possesses teeth, bone, and secreting glands. In its highest form there are organs such as a piece of intestine, soft bud-like processes composed of brain tissue, a well-formed vulva, a condition of things resembling an acardiac fœtus (see p. 420). This last form is excessively rare.

It has been pointed out by Wilms that an ovarian dermoid presents two parts, namely, a cyst and an embryonic rudiment. The cyst is composed of fibrous tissue arranged in wavy bundles: its inner aspect is lined with loose connective tissue, and at one part it presents a skin-covered surface of variable extent usually beset with hair. Associated with the skin-covered surface there is an "embryonic rudiment," usually in the form of a nipple-like process (pseudo-mamma)

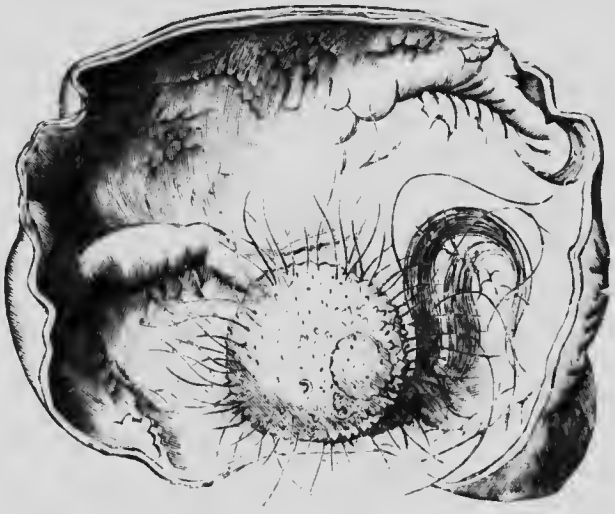

Fig. 261.—An ovarian dermoid or embryoma containing a pseudo-mamma. (*Museum, Royal College of Surgeons.*)

(Fig. 264). The size of this rudiment varies greatly: it may be so inconspicuous as to be easily overlooked, or so large as to strike the eye of the least observant; or the embryonal rudiment may approach the complexity of an acardiac fœtus.

Experience teaches that ovarian dermoids do not always conform to this simple plan of construction: specimens sometimes come to hand containing many cysts, and each cyst contains a "rudiment" (Fig. 265); moreover, it is not uncommon to find more than one nipple or pseudo-mamma in a cyst.

The tissue underlying the skin-clad surface contains

glandular tissue, which occasionally is so abundant as to obscure the small cutaneous element. Tumours of this kind are known as multilocular glandular cysts or, as I prefer to call them, ovarian adenomata. I pointed out in 1888 that these tumours should be classed with the

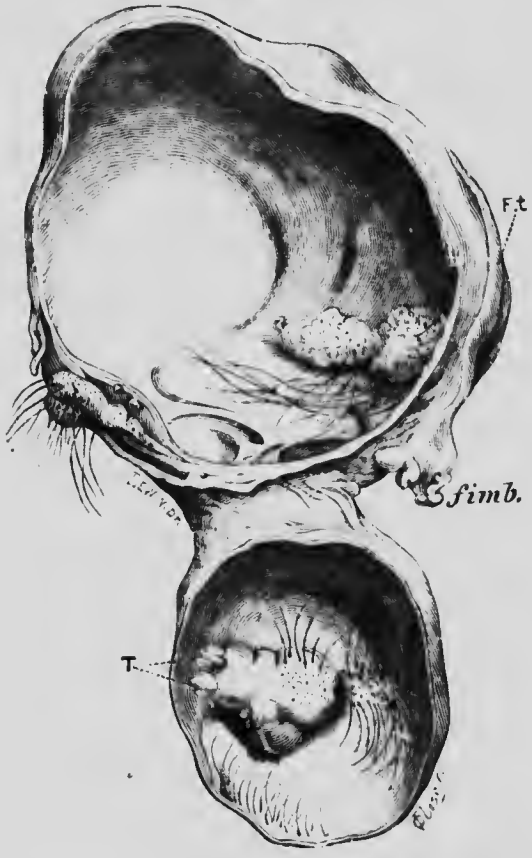

Fig. 265.—Ovarian dermoid (embryoma), composed of three cysts, each containing an "embryonal rudiment." F.t., Fallopian tube; fimb., Tubal fimbriæ; T, Teeth.

dermoids, and stated, after an examination of several very small specimens of ovarian dermoids, that these tumours arise in the egg-bearing portion of the ovary to which I gave the name **oöphoron,** and after a subsequent investigation expressed the view that the epithelial elements of the

follicles were the source of the diverse structures found in these remarkable tumours.

In order to account for these things there is a tendency to revert to the theory which was popular some years ago and attribute ovarian dermoids to the imperfect development of an ovum. This, however, is an unsatisfactory explanation when we remember that nipple-like processes are found in some of the intrathoracic embryomata, and teeth are not uncommon in those which are found in the testis, and in the **Fallopian tube** (Orthmann). In view of the opinion that the ovarian embryoma may be an attempt to form a fœtus without impregnation, it is worth notice that in 1799 Baillie, in describing an ovarian dermoid containing pilose skin, suet, and teeth, observes that this change has been generally considered as the very imperfect rudiments of a fœtus which has been formed in the ovarium. As, however, this change takes place in the ovarium before the uterus would appear capable of functions which would begin at the age of puberty, and where the hymen is entire, it is highly probable that it is independent of impregnation.

Interesting as all these questions are, the practical surgeon has now to face the important clinical fact that some of these ovarian embryomata display malignancy in its most dangerous form, namely, the power of dissemination. This will now be considered.

The Malignancy of Ovarian Embryomata.—If we restrict the term dermoid to those ovarian tumours which contain typical dermic elements such as skin, hair, teeth, skin glands, and the like, it may be truly said that they are the most benign tumours which attack women. There is, however, an interesting phenomenon connected with them requiring consideration, and which I have ventured to term **epithelial infection**. The details of several carefully described cases are available in which the peritoneum has been found dotted with minute knots furnished with small tufts of hair, growing among visceral adhesions, even as high as the liver. (Moore, 1866, Kolaczek, Fraenkel, and Grawitz.)

In each of these patients there was a dermoid in the ovary, and in the clinical reports of some of them there was a distinct history of an injury to the abdomen, which makes it

obvious that this condition could be explained by the epithelial contents of the dermoid escaping into the belly and becoming engrafted on the peritoneum. This view is supported by our knowledge of Implantation Cysts (p. 454).

If we widen the group of ovarian dermoids and include the ovarian adenoma, which I maintain is pathologically correct, then we must include a rare variety of peritoneal infection unmistakably malignant.

The most typical examples of ovarian adenomata may infect the peritoneum. I removed from a woman fifty-one years of age an adenoma the size of a football; two years later she again came under my [illegible] and I removed an ovarian adenoma of the opposite ova[illegible] had burst and filled the belly with the usually gelat[illegible]r colloid stuff. Six years after the second operation she came into my hands again with an enormously distended belly: at the operation the abdomen was found filled with colloid jelly, and the whole of the peritoneal surface covered with a multitude of small bodies which on microscopic examination exhibited the large columnar cells so characteristic of the ovarian adenoma. The patient was alive and well three years afterwards.

In contrast to this the following facts are gloomy. I have records of three cases in which a tumour to the naked eye and to the microscope seemed to be an ordinary benign adenoma, but it had burst before removal and filled the belly with the usual viscous matter. Before these patients recovered sufficient strength to leave their beds signs of recurrent growth made themselves obvious, and some twelve weeks later the patients died with secondary deposits on the peritoneum. Recently cases of this kind have been reported under the name of **malignant embryomata**; in some of them the peritoneal nodules contained cartilage, epithelial pearls, and ganglion cells. It has also been shown that in some of the cases the secondary nodules assume the form of grafts, and are in most instances confined to the peritoneum, but undoubted cases are known in which the malignancy assumed the form of visceral metastasis.

In 1871 Jessop of Leeds recorded briefly a case illustrating metastasis in connection with a dermoid. The patient was a girl aged thirteen years and the tumour consisted of one

large cyst with several smaller ones attached, and of a mass of white cheesy matter mixed with numerous thin colourless curly hairs. At the autopsy cancerous deposits were found in the liver, right suprarenal capsule and mesenteric glands.

Malignant embryomata of the ovary are rare, and occur in young adults and in early childhood. Dudgeon reports a fatal example in a girl aged three-and-a-half years.

(For a careful report of a case and a summary of the literature see Targett and Hicks.)

The bearing of the evidence at present available indicates that the more closely the elements of an ovarian tumour conforms to the adult type of tissue the more benign will be its clinical course. The more widely the glandular elements depart from the normal type the more prone will these elements be to infect the peritoneum if by accident, or in the course of an operation they be spread about the peritoneal cavity.

My pathological inquiries convinced me of the importance of this observation, and since 1890, I ceased to tap ovarian cysts in the course of removal, no matter their size, but remove them entire.

LUTEIN CYSTS.

Perhaps the most familiar naked-eye feature displayed on the cut surface of a mature ovary is the yellow body known as the corpus luteum. All who have been seriously interested in the pathology of ovarian cysts have noticed the frequency with which the corpora lutea are converted into cysts. Rokitansky drew attention to this, and held the opinion that they might enlarge and form tumours of sufficient size to become clinically important. Cysts arising in corpora lutea do attain a size sufficient to admit of detection in the course of a careful bimanual examination. When these cysts are small their nature is easily determined by the thick layer of yellow material which lines them, but as the cyst increases in size the lutein tissue is spread out and becomes less obvious until it fades away and leaves a transparent thin-walled cyst which would not be regarded as a lutein cyst unless examined with the assistance of a

microscope. It has been shown by Lockyer that an ovary may contain two or even a cluster of lutein cysts, and the condition may be bilateral; in this event the consequent enlargement of the ovaries is such that on physical examination a tumour of some size can be detected on each side of the uterus.

The importance of lutein cysts in the ovaries in association with the disease of the chorion, known as hydatidiform disease, and especially those cases which have been followed by chorion-epithelioma are considered in Chapter XL.

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CHAPTER XLIX.

TUMOURS OF THE OVARY (*Continued*).

PAPILLOMATOUS, PAROVARIAN, AND GARTNERIAN CYSTS.

That portion of the ovary which is termed the paroöphoron and receives the terminals of the parovarian tubules is usually represented in an adult ovary by a plug of connective tissue, which is occasionally referred to as the "tissue of the ovarian hilum," and has been the subject of much careful histologic investigation. This tissue is regarded by some writers as the source of the well-known papillomatous cysts of the ovary, and as epithelial elements occur as residues of the mesonephros in this "hilum tissue" the theory has a morphologic basis. In addition this tissue is probably the source of some of the ovarian fibroids and sarcomata.

Papillomatous Cysts of the Ovary.—These differ from the simple form of ovarian cyst in having their inner walls beset with soft dendritic warts. In the early stages these cysts do not affect the shape of the ovary until they attain an important size. The warts vary greatly in number, some cysts contain few, in others they are so luxuriant as to burst the cyst-wall and then protrude as a cauliflower-like mass. In some the warts will erode the wall at several points, and grow out as soft epithelial buds.

Coblenz was the first clearly to identify and distinguish these cysts from those arising in the parovarium and associate them with definite structures. His observations have been largely confirmed by Doran, who has devoted great attention to this question.

The distinguishing feature of these paroöphoronic cysts is that they contain *papillomata; but all papillomatous cysts of the ovary are not paroöphoronic in origin.* It will therefore be convenient in this chapter to consider the subject of warts in relation to the ovary. A paroöphoronic cyst may contain one large tuft surrounded by a few scattered nodules.

whereas in another example the cavity of the cyst may be so stuffed with them that it bursts. The museum of the Royal College of Surgeons, London, contains an admirable specimen illustrating this. It is thus described in the catalogue:—"An uterus with its appendages. A mass of finely lobulated and pedunculated growths springs from the site of each ovary, the substance of which, with follicles, was discovered on close search at the roots of the growths. These growths were probably enclosed at an early stage in a cyst wall" (Fig. 266).

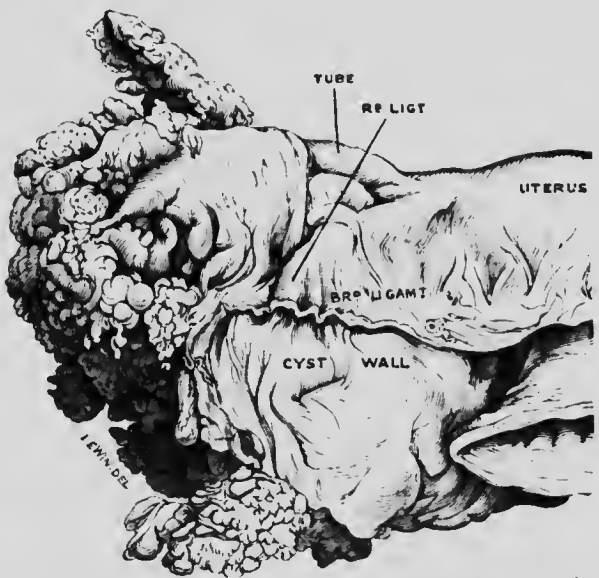

Fig. 266.—Ruptured papillomatous cyst (right half of the specimen). (*Museum, Royal College of Surgeons.*)

There can be little doubt that the opinion expressed in the catalogue that the growths were probably enclosed at an early stage in a cyst is correct, for remnants of the cyst wall are still present on the specimen.

A distinction must be drawn between rupture of the cyst and perforation of the cyst wall by the papillomata. In the latter condition cauliflower-like masses of warts project from the surface of the cyst into the abdominal cavity; sometimes at one spot, sometimes in three or four places.

An important pathological and clinical fact connected

with these cysts is that when they rupture, the fluid they contain is scattered broadcast over the peritoneum.

When there is general epithelial infection of the peritoneum, the warts are most numerous on the serous membrane lining the recto-vaginal pouch and on the omentum.

It has been clearly established that when the abdomen has been opened for the removal of a papillomatous cyst the peritoneum has been found studded with warts. A few years later the abdomen has been reopened and all the peritoneal warts have disappeared. Thus they behave like warts on the skin. This fact must be borne in mind, or the operator will hastily assume the disease to be malignant when he finds general peritoneal infection. The disappearance of peritoneal warts after removal of the primary tumour is an interesting fact, and may be probably explained in this way:—The life of multiple warts is often very transient, and this is probably the case with peritoneal papillomata; but as long as the seed supply continues new warts spring up, last for a time, and die, to be succeeded in their turn by a new crop. When the source of epithelium is removed by operation, the warts then existing die, and the crop of warts is not renewed. Exceptionally these papillomatous cysts rupture into the connective tissue of the mesometrium, and I have seen them clustering around the urachus as high as the umbilicus.

The dispersal of the cells from these emancipated warts is no doubt largely effected by movements of the intestines, in addition to the sudden inundation of the belly when the cyst bursts; but there is an additional complication which not only favours infection but is in itself inimical to life—namely **hydroperitoneum.** This condition differs from ascites in the circumstance that it is not the consequence of hepatic, cardiac, or renal disease, but is due to irritation of the peritoneum by secondary nodules of cancer, warts, tubal disease, and the like. Hydroperitoneum is a constant concomitant of the bursting of a papillomatous cyst. When the cyst is removed the exudation ceases.

One of the most remarkable examples of hydroperitoneum associated with papillomatous cysts on record is that described by Dr. Pye-Smith. In this case a woman was tapped for hydroperitoneum between August, 1884, and April,

1894, 299 times. On readmission for the 300th tapping she died. At the *post-mortem* examination a papillomatous cyst was found in connection with each ovary. These cysts could have been easily removed. The peritoneum was beset with warts.

It is important to draw a distinction between epithelial infection, which is such a marked feature of papillomatous cysts of the ovary and cancerous generalisation due to deportation of malignant cells by the blood and lymph vessels. It

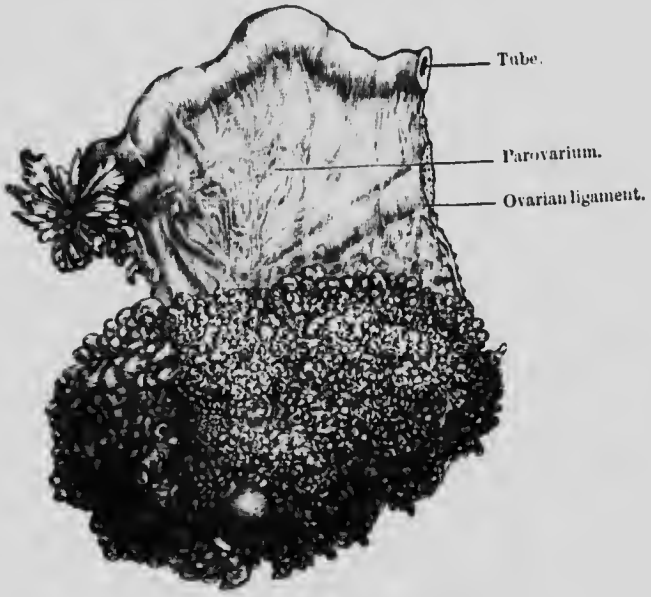

Fig. 267.—Ruptured papillomatous cyst.

is necessary to state that some papillomatous cysts display malignancy by recurring locally. Pozzi has especially emphasised the fact that a great number of patients from whom papillomatous cysts are removed make complete and durable recoveries, and I can affirm this from my own experience, but it is difficult to assert that the recovery is permanent in the face of the following record:

Pozzi removed in 1878 bilateral papillomatous cysts of the ovaries attended with very abundant hydroperitoneum from a woman twenty-five years of age; recovery was complete for twenty years. In 1898 hydroperitoneum reappeared,

and a second operation was performed, but the recurrent tumour could not be removed; the peritoneal cavity was drained, and the patient made a temporary recovery. She died a year later. Pozzi also writes favourably of the advantage of operating, whenever it is possible, on recurrent papillomatous masses even when they cannot be completely removed, for such a proceeding accompanied by temporary drainage is distinctly advantageous to the patient.

In 1899 I removed from a woman 40 years of age, bilateral papillomatous cysts and evacuated a large quantity of free peritoneal fluid. In 1905 this patient again came under my

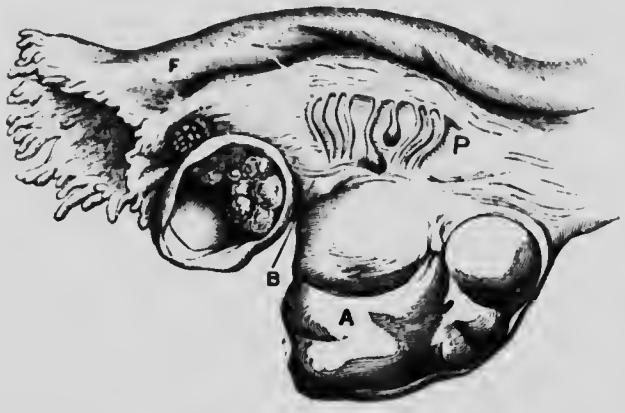

Fig. 268. A, Ovary; P, parovarium; F, Fallopian tube; B, mesosalpinx. (*Nat. size.*) Two small papillomatous cysts are seen in relation with the tubo-ovarian ligament.

observation with a large tense cyst in the hypogastrium as big as her head. I enucleated this cyst; it contained turbid fluid and the interior was beset with an abundant crop of soft, but not very vascular, papillomata. She was in good health a year later (1906).

Papillomatous cysts of the ovary are most frequent between the twenty-fifth and fiftieth years; they are the rarest species of cyst which arise in this organ. In most instances they admit of easy removal, but occasionally they burrow deeply between the layers of the mesometrium. In some of these cases it simplifies the operation to remove the uterus with the cysts. So far in all the cases which have come under my observation the cysts were bilateral. In several

patients the disease was much more advanced in one ovary than in its fellow.

Warty Ovaries.—There is a variety of papillomatous cyst arising in the mesosalpinx independently of the ovary or Gartner's duct. These cysts are usually found near the junction of the tubo-ovarian ligament with the ovary, and burrow between the layers of the mesosalpinx (Fig. 268).

When fresh they are transparent, and resemble incipient parovarian cysts, but they are unconnected with this structure. The most striking feature of these cysts is the almost invariable presence of a tuft of warts. It is difficult to be sure of the presence or absence of these warts without opening the cyst. The warts are composed of very dense fibrous tissue. In this respect they differ in a striking manner from the soft vascular processes found in typical papillomatous cysts. Wart-containing cysts also occur on the free surface of the ovary.

PAROVARIAN CYSTS.

The parovarium consists of a series of narrow tubules situated between the layers of the mesosalpinx and closely associated with the paroophoron. It is easily seen, when the mesosalpinx is stretched and held between the eye and the light, as a series of tubules radiating from the ovary to join a longitudinal tubule situate at a right angle to them. Although the tubules converge as they approach the ovary, nevertheless they remain distinct. Each tubule ends blindly, and is usually lined with epithelium. In form, size, and disposition they resemble the arrangement of the vasa efferentia of the testis. This resemblance was observed by Rosenmüller, who discovered this structure in 1807 whilst prosecuting anatomical researches at Erlangen. The parovarium is homologous with the vasa efferentia and epididymis of the testis, for these tubular structures in the male and female are the persistent excretory ducts of the Wolffian body (mesonephros). In the female they are vestigial, whereas in the male they are functional.

When present in its typical condition, the parovarium consists of three parts (Fig. 253): an outer series of tubules, free at one extremity, known as Kobelt's tubes; an inner set,

termed the vertical tubules; and a larger tube running at right angles to the vertical tubules which may occasionally be traced downwards to the vagina. This is Gartner's duct; it corresponds to the vas deferens in the male. The parovarium contains as a rule, twelve tubules; sometimes as many as seventeen may be counted, and in other specimens as few as five.

The cysts that arise in the parovarium are of two kinds; the more frequent are small pedunculated cysts connected with Kobelt's tubes. They rarely exceed a pea in size, and do not call for much comment, as they are of no clinical importance. They need to be mentioned, however, because they are often confounded with the hydatid of Morgagni. Occasionally some of the vertical tubules will break loose and form pedunculated cysts. Should the cyst rupture, it may be converted into a tuft of fimbriæ. The more important cysts are sessile, and remain between the layers of the mesosalpinx. In the early stages it is easy to demonstrate the relation of these cysts to the parovarium. When such a cyst enlarges, it burrows between the layers of the mesosalpinx and makes its way towards the Fallopian tube, which becomes stretched, because the abdominal end of the tube is fastened firmly to the ovary by the tubo-ovarian ligament, and the ovary in its turn is attached to the side of the uterus. In a very large cyst the Fallopian tube becomes greatly elongated, and attains a length of 40 cm. In spite of this extreme stretching, the lumen of the tube is rarely obstructed, and its abdominal ostium can usually be found, the fimbriæ being indicated by a few wattle-like processes.

Small cysts are, as a rule, transparent, but when they exceed the size of a cocoanut, this transparency is lost, and the walls become thick and tough. Small parovarian cysts are lined with columnar epithelium, which is sometimes ciliated: in cysts of moderate size the epithelium becomes stratified, and in large cysts it atrophies from pressure. Rarely they contain papillomata.

The fluid they contain is limpid and slightly opalescent: specific gravity 1002 to 1007, reaction slightly alkaline. A substance, precipitated by alcohol, is present in large quantity.

In big cysts the fluid is often turbid and may contain

cholesterin. When parovarian cysts rupture into the cœlom (peritoneal cavity) the fluid is quickly absorbed and excreted by the kidneys.

The points which enable a large parovarian cyst to be distinguished from an oophoronic cyst are these:—

1. The peritoneal coat is easily stripped off.
2. The ovary is usually found at the side of the cyst.
3. The cyst is usually unilocular.
4. The Fallopian tube is stretched over the cyst, but does not communicate with it (Fig. 269).
5. The specific gravity of the fluid does not exceed 1010, and may be much lower.

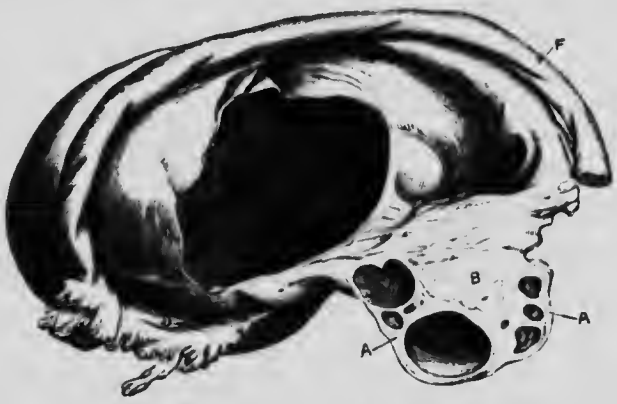

Fig. 269.—Cyst of the parovarium, showing its relation to ovary and tube. A, Oöphoron; B, paroöphoron; F, Fallopian tube. ($\frac{1}{3}$ *nat. size.*)

6. In some specimens the tissue of the mesosalpinx is greatly thickened.

It was formerly believed that cysts originating in the parovarium rarely exceeded the size of an orange, but Bantock demonstrated that parovarian cysts may attain very large proportions, and be capable of containing several litres of fluid. The largest parovarian cyst which has yet come under my care contained 20 litres of turbid fluid.

The age at which parovarian cysts occur is of some interest. It has already been mentioned that cysts of the oöphoron are encountered at any period, from fœtal life up to extreme old age. The occurrence of a parovarian cyst has not, as far as I am aware, been recorded in an individua

before the age of sixteen: many undoubted cases have been observed at seventeen, eighteen, and nineteen, the cysts being large enough to rise above the pubes. Before sixteen the

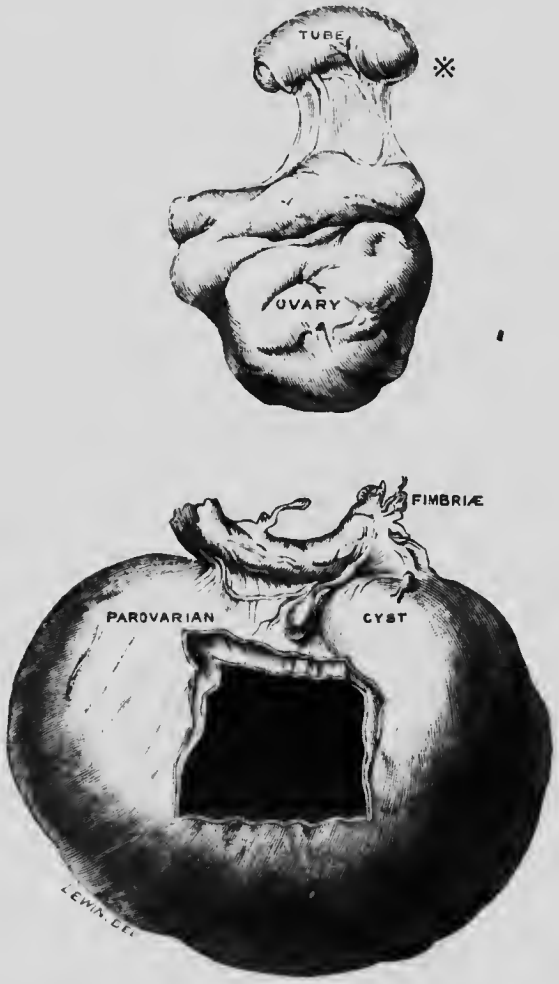

Fig. 270.—Ovary and stump of a Fallopian tube, left after axial rotation, ending in complete detachment of a parovarian cyst.

* The rounded stump of the tube at the point of detachment.

parovarium appears to be quiescent, but on the advent of puberty it seems to undergo great stimulation; a very large proportion of cysts, generically classed as ovarian, removed between the ages of seventeen and twenty-five, arise from it.

Parovarian cysts do not often contract adhesions, even when they suppurate. The layers of the mesometrium stretched over them occasionally contain an unusual proportion of unstriped muscle fibre: they rarely suppurate. Like other forms of cysts and tumours related to the ovary, they are liable to axial rotation and complete detachment (Fig. 270).

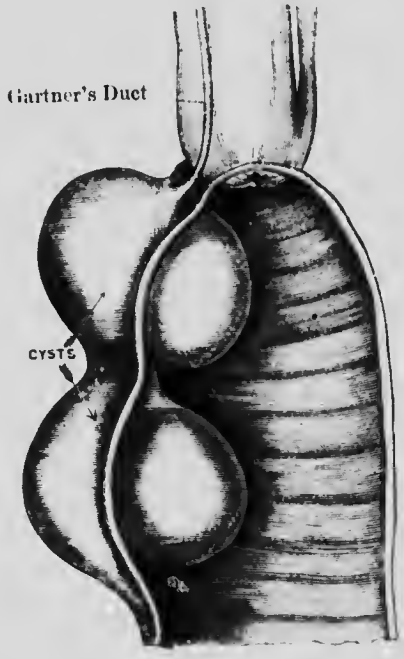

Fig. 271.—Uterine segment of a cow's vagina, showing two large cysts developed in the terminal segment of Gartner's duct.

GARTNERIAN CYSTS.

A larger experience of ovarian and parovarian cysts has served to convince me that many papillomatous cysts have an origin independent of the paroöphoron. A careful study of the relations of these cysts shows that many of them burrow deeply by the side of the uterus, and even extend along the wall of the vagina.

It is known that Gartner's duct occasionally persists in women, and after leaving the parovarium it traverses the layers of the mesometrium and runs down the side of the

uterus to reach the vagina. As it approaches the cervix, it is often embedded in its tissue.

Evidence is slowly accumulating in support of the opinion that some papillomatous cysts of the mesometrium, especially those which burrow deeply by the side of the uterus, arise in persistent portions of Gartner's duct, near its termination. Cysts arising in the lowest segment of this duct occasionally bulge into the vagina.

The cystic tendencies of Gartner's duct can easily be studied in cows (Fig. 271). In these animals the ducts are sometimes as large as crow-quills. Usually they become gradually lost on the sides of the uterus, but occasionally they may be traced to the vagina.

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CHAPTER L.

TUMOURS OF THE OVARY (*Continued*).

OVARIAN FIBROIDS; SARCOMATA AND CARCINOMATA.

Ovarian Fibroids. — Tumours are occasionally met with in the ovary which in their naked eye and microscopic characters are indistinguishable from the very hard variety of uterine fibroid. In their most typic form they are easily recognised, being ovoid in shape, regular in contour and smooth; intensely hard, encapsuled and, as a rule, free from adhesions. On section the fibrous tissue displays the whorled arrangement which is such a conspicuous feature of the hard variety of uterine fibroids. When the tumour is divided in such a way as to include the ovarian ligament, a small portion of the cortex may usually be detected associated with the ligament (Fig. 272).

Ovarian fibroids sometimes soften, and this leads to the formation of spurious cysts in their substance. Another feature of some importance, and one already mentioned, is their intense hardness; and in some cases this is so obvious that it has enabled me to suspect the nature of the tumour before operation. Calcification has been observed in them, but this is rare; they are occasionally complicated with hydroperitoneum, and, except in this circumstance, they rarely produce any very obvious impairment of the general health.

Ovarian fibroids are as a rule unilateral, but I have in one instance found both ovaries affected, and they may occasionally be associated with uterine fibroids; of this companionship I have seen one example. It is also usual for these tumours to be encapsuled in the ovary, no matter what size they attain; but there are examples which grow within the ovary and project from its surface like subserous fibroids of the uterus. It is probable that some tumours known as corpora fibrosa (Patenko), supposed to arise from corpora lutea, are of this nature.

However much ovarian fibroids may resemble uterine fibroids in possessing definite capsules, and in their gross as well as minute structure, and the extraordinary vortex-like arrangement of the constituent tissues, they differ in a very marked way in their age-distribution. Uterine fibroids only arise during menstrual life, which in its widest sense gives them an age limit of thirty years (15 to 45), but ovarian fibroids arise in advanced life. In ten cases under my

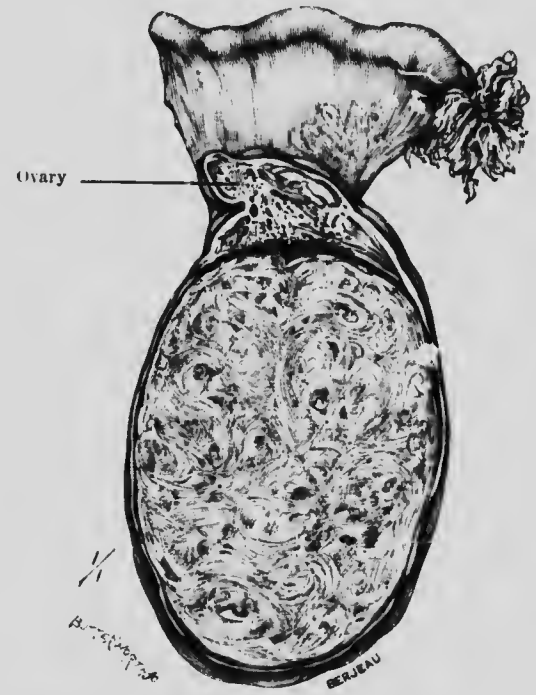

Fig. 272.—Ovarian fibroid in longitudinal section (*nat. size*). From a patient 30 years of age.

own observation the youngest patient was twenty-seven and the oldest sixty-seven. McCann successfully removed a tumour of this kind from a woman seventy-three years of age; she was well four and a half years later.

The earliest age at which these tumours have been observed is the twentieth year. This was a case reported by Doran, in which the patient married at fifteen, but had borne no children. Previous to the removal of the tumour by

Knowsley Thornton (1884) sexual desire appears to have been absent. After recovery this instinct rapidly developed: the patient left her husband, and bore a child to another man. Ultimately she returned to her home in good health.

Baillie (1799) gives a good figure of an ovarian fibroid, writes "that it resembles exactly in its texture" uterine fibroids, and draws attention to its rarity, and Virchow (1867) figured its relation to the ovary.

Tumours of the ovary described as myomata will require reinvestigation in the light of this additional knowledge; for the present they may be safely included in the same genus. It is not uncommon to find a fibroid sometimes as large as a duck's egg in the wall of a simple ovarian or a parovarian cyst.

One of the greatest difficulties in connection with our knowledge of the solid tumours of the ovary, especially the variety termed fibroma, has been the absence of information concerning the after-history of cases in which patients have been submitted to operation. This defect has been removed by the publications of Doran, Briggs and Fairbairn. I have followed up the after-history of ten patients under my care. Nine were alive at intervals varying from one to six years after operation. One died three months after the operation from a chronic affection of the lung and pleura.

The results of careful inquiries into the after-history of patients who have had ovarian fibroids removed, establish clearly that these tumours are as innocent as the hard variety of uterine fibroids. The immediate result of the removal of such tumours is excellent.

Sarcoma of the Ovary.—The ovary, like other paired organs, is very prone to become the seat of sarcoma in early life: to this succeeds a period of comparative immunity, followed by a second period of renewed but diminished liability.

Ovarian Sarcoma in Infants.—These tumours differ in several points from those found in adult ovaries, and their histologic peculiarities are such that I proposed the term oöphoromata for them; they attack both ovaries in about half the cases, grow very rapidly, often attain formidable proportions, and quickly destroy life.

Their removal is attended with an excessively high rate

of mortality, and in the patients which recover, quick recurrence is the rule.

In structure they consist of round or spindle cells, in which collections of cells are often conspicuous, resembling the alveolar disposition of cancer. This appearance is due to the entanglement of ovarian follicles in the sarcomatous tissue.

Ovarian Sarcomata in Adults.—Sarcomata are rare in the ovaries between the sixteenth and twentieth years: after this age they are encountered occasionally, and, as a rule, are unilateral. The two common periods for sarcoma to arise in the adult ovary are from the twentieth to the thirtieth years, and after the menopause. The hard encapsuled tumours of the ovary formerly classed among the sarcomata are now described as ovarian fibroids, and are free from the odium of malignancy.

Many ovarian sarcomata arise quickly, attain very large proportions often in a few months, and are accompanied by hydroperitoneum and marked leucocytosis. Such tumours are very soft and succulent, and occupied by spurious cysts due to degenerative changes. Microscopically they consist of round or oat-shaped cells, and as a rule, the more these cells predominate the more ominous is the outlook for the patient. Often the cellular elements burst the limiting tissues of the tumour, and, implicating adjacent organs—such as uterus, bowels, bladder, veins, and arteries—render removal during life impossible. Dissemination also occurs, and life is often destroyed within a few months of the onset of symptoms.

Some of these rapidly-growing sarcomata of the ovary are described by German writers as endotheliomata. In the light of recent observations on carcinomata of the ovaries it is extremely probable that many examples of supposed primary sarcomata of the ovary are really metastatic.

Ovarian sarcomata are more common in children than in adults, and have been observed even in a fœtus (Doran). I collected from current literature one hundred cases of ovariotomy in girls under fifteen years. Of this series forty-one were simple cysts or adenomata, and thirty-eight were typical dermoids; the remaining twenty-one being sarcomata. This, however, is far short of the real proportion of sarcomata, because there are many records in which

no operation was undertaken, the descriptions being based on *post-mortem* examinations.

Another important feature was the heavy mortality among the patients with sarcomata submitted to operation. Seven out of the twenty-one cases died, and of the fourteen which recovered I was able to ascertain that four died from recurrence within a year of the operation. (The tables are furnished in my work, "Surgical Diseases of the Ovaries," 2nd Edition, 1896.)

The youngest child on record who has been operated on for sarcoma of the ovary was thirty-three months. Unfortunately, death occurred a few hours after the operation. (Hoffman.)

Carcinoma of the Ovary.—Primary cancer of the ovary is a rare disease, and one concerning which we know little. We have come to learn that the ovaries are common situations for secondary cancer, especially when the disease arises primarily in the breast, gastro-intestinal tract, or the gall-bladder: in a fair proportion of patients both glands are infected, and in some instances the ovaries are so enlarged as to be obvious as tumours on physical examination.

Schlagenhaufer published a valuable inquiry showing the frequent association of malignant disease of the ovary with carcinoma of the stomach, intestine, and gall-bladder. In addition to some personal cases, he has collected a large number of recorded observations, making a total of seventy-nine cases, and among these, in sixty-one cases, the primary focus was in the stomach, ten in the bowels, and seven in the gall-bladder or its associated ducts. The relation between the primary cancer and the masses in the ovary is demonstrated by the fact that the structure of the ovarian tumours varies according to the situation in the gastro-intestinal tract of the primary disease. In studying Schlagenhaufer's tables it is astonishing to find in what a large proportion of patients ovariotomy, unilateral or bilateral, had been performed, and the primary cancerous focus in the stomach overlooked, in spite of the presence of typical signs of gastric disturbance, especially persistent vomiting and progressive emaciation.

The practical outcome of these observations is very important, and amounts to this: in cases of bilateral

solid tumours of the ovary, if accompanied by vomiting and ascites, a careful and accurate examination should be made of the abdominal viscera, especially the stomach.

It is also significant that whenever surgeons have made inquiries into the remote results of ovariotomy, they have been astonished to find that many of the patients have perished from recurrence in the abdomen, or from intestinal

Fig. 273.—A mass of cancer in the right ovary, secondary to cancer of the breast. (*Museum of the Royal College of Surgeons.*)

obstruction. The fact that many solid tumours of the ovaries are metastatic offers an explanation of some of these unhappy sequences.

I have often been puzzled on examining large deposits of cancer in the ovaries secondary to mammary or gastric carcinoma to satisfy myself how these things come to pass. The riddle is, I think, solved by Handley's discovery of the mode in which mammary cancer involves the abdomen. He has demonstrated in a most convincing manner that cancer spreads by permeating the deep fascia: by an insidious pro-

cess the cancer cells slowly creep along the lymphatics of the fascial plexus until they reach the epigastrium immediately below the ensiform cartilage: at this point the cancer-filled lymphatics of the fascial plexus in the middle line are separated from the subperitoneal fat only by a simple layer of fibrous tissue. Through this weak defence the cancer cells slowly find their way into the general peritoneal cavity and engraft themselves on the omentum and other suitable visceral plots, whereon they thrive and grow into metastatic nodules or lumps. Many of these infecting cells are conveyed into the pelvis and lodge on ovary, Fallopian tube, uterus, or pelvic peritoneum. The fluid normally present in the belly serves as an admirable vehicle for the transport of such cells, easily enabling them to reach the pelvic recesses, where they would remain undisturbed to grow into deadly masses. If we apply Handley's observations on the serpiginous spread of mammary cancer to a primary cancer in the stomach, gall-bladder, or colon, we may read its course in this way:—Arising in the mucous membrane, it slowly permeates it and implicates the submucous, muscular, and peritoneal coats; the cancer cells can then escape freely into the great serous cavity and be distributed by the fluid, aided by the movements of the bowels, and gradually reach the pelvis and other abdominal recesses. In the pelvis the most obvious organs on which they could fall would be the ovaries, as these so often rest on its floor. Under such conditions the ovaries may be fairly pictured in the mind as receiving a covering of falling cancer cells, as evergreen shrubs are clothed by snowflakes in winter.

The fact that other parts of the internal genitalia receive these cells is a matter of some importance, because one of the most striking features of operations for the removal of malignant ovaries is the rapidity with which the disease recurs. Lockyer made a valuable observation relating to this: he examined microscopically the tumours removed for bilateral carcinomatous disease, and although the attached tube and mesosalpinx belonging to each tumour appeared normal to eyes and fingers when examined microscopically, they were found extensively infected with cancer through the lymphatics. Under these conditions I have found one ovary

as large as an orange due to secondary cancer, and its companion smaller than normal, yet on microscopic examination it was permeated with cancer also.

Treatment.—The outcome of these pathological observations will determine those who have to deal with bilateral malignant tumours of the ovaries carefully to examine the patient for evidence of primary cancer in the gastro-intestinal tract. If the disease is in such a position that it can be

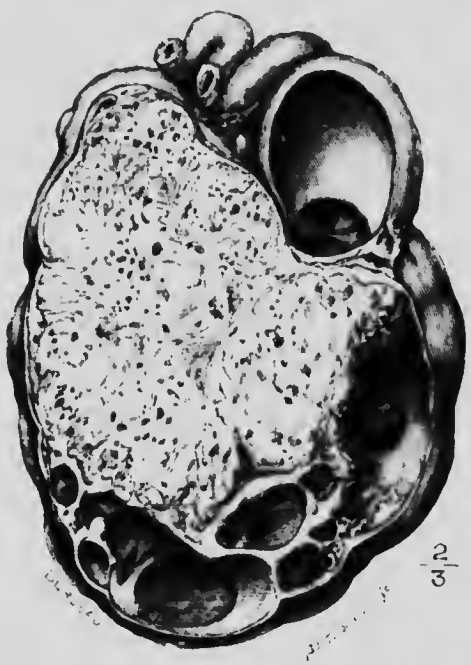

Fig. 274. — Cancerous ovary, secondary to cancer of the colon, in section. The Fallopian tube is infected by the cancer. From a woman aged 56 years.

excised with good prospect of success, this may be done. Then it will be necessary to remove not only the infected ovaries but the tubes, adjacent segments of the mesometria, and the uterus. Operations of this kind can only be carried out with hopeful prospects when there is no other evidence of gross infection than that afforded by the ovaries.

When the nature of solid malignant tumours of the ovaries comes to be more thoroughly appreciated by those who devote their attention to the surgery of the pelvic

organs it may enable them to contemplate the clinical aspect of the case with a wider knowledge of its surroundings, and perhaps save themselves and their patients much acute disappointment.

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CHAPTER LI.

TUMOURS OF THE OVARY (*Concluded*).

THE AXIAL ROTATION OF OVARIAN TUMOURS: EPITHELIAL INFECTION AND SUPPURATION OF OVARIAN CYSTS.

In 1865 Rokitansky drew attention to the fact that ovarian and uterine tumours sometimes rotate and twist their pedicles, or drag upon them in such a manner as to compress the vessels traversing the pedicles, and so interfere with the proper nutrition of the tumour. Occasionally the torsion, and, in some, the torsion and tension on the pedicle led to complete detachment of the tumour. He also drew attention to the fact that certain abdominal viscera are apt to undergo axial rotation. Of recent years much attention has been devoted to this subject, and accumulated observations have served to show that almost every variety of abdominal tumour and all the viscera, except the liver, have been found liable to this accident.

That a tumour hanging freely in the belly should, by mere alteration of the position of the body, or by motion imparted to it by a tumult of the bowels, spin round and twist its pedicle is as comprehensible as the fact that a good weathercock moves in varying directions under the influence of the wind. It is, however, puzzling to find the spleen, distended Fallopian tubes, undescended testes, the pregnant uterus, the kidneys, the cæcum, and the stomach liable to similar rotation.

Ovarian tumours of all kinds are very liable to axial rotation, even in the newly born (Otto von Franque). Concerning its cause very little is known. Various explanations have been advanced. It has been attributed to the alternate distention and evacuation of the bladder (Klob), or to the passage of fæces through the rectum (Lawson Tait): to sudden movements, such as a fall, slip, or unusual exertion (Tho

An important fact to remember is the frequency with which this accident occurs when ovarian cyst complicates pregnancy, and especially when an ovarian cyst coexists with myomatous uterus large enough to fill the pelvis.

When both ovaries are converted into cysts the risk of twisting is nearly the same as when pregnancy and an ovarian cyst are associated. When both ovaries are cystic and pregnancy ensues, the risk of axial rotation is more than doubled. The torsion may occur early in pregnancy or be delayed till delivery or miscarriage. In one instance at least, in a case of bilateral ovarian dermoids, both tumours had twisted their pedicles (Doran).

The occurrence of acute torsion immediately after delivery is due to the rapid diminution in the size of the uterus and to the movement which this organ, as it sinks into the pelvis, imparts to the tumour. In a case under my own observation acute axial rotation of an ovarian cyst as big as a fist was caused by the movement and dragging of a prolapsed uterus. The rotation caused the tumour to be impacted below the pelvis and the uterus remained outside the vagina and could not be reduced until the tumour had been removed.

Rotation of a cyst in the early stages of pregnancy is probably due to the gradual enlargement of the uterus displacing the tumour upwards; and as the pressure is exerted upon one side of the cyst, it would be in a favourable position to impart a rotatory motion to a non-adherent cyst. The *amount* of rotation varies greatly. In some cases the cyst has merely turned through half a circle: in others as many as five complete twists have been counted. The direction of the rotation may be from right to left, or *vice versâ*, but cysts exhibit a strong tendency to rotate towards the middle line rather than from it. Tumours of the right and left side are equally liable to rotate. Small tumours rotate more freely than large ones, and a long and slender pedicle favours its occurrence. The force with which some of the large cysts rotate is very great, for in some instances the uterus is involved in the twist. In one remarkable case the ovary was caught in the pedicle of a parovarian cyst during rotation and was divided (Fig. 275).

The *effect* of torsion on the circulation depends on the

tightness of the twist, and this varies with the thickness of the pedicle. The vessels in a long thin pedicle would suffer obstruction quicker than those in a short and thick one. When a pedicle is torsioned the thin-walled veins become compressed, whilst the more resilient arteries continue to convey blood to the cyst. The result is severe venous engorgement, and this leads to extravasation of blood into the cyst wall: in many cases the veins rupture, and hæmorrhage takes place into the cavity of the cyst. The hæmorrhage

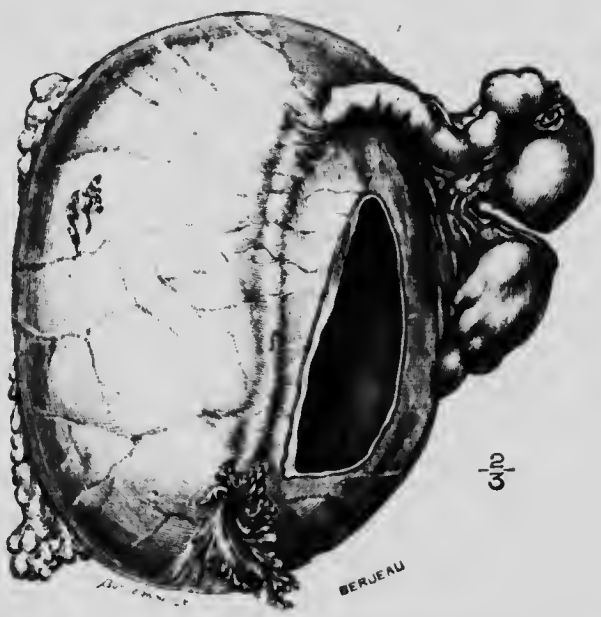

Fig. 275.—A parovarian cyst which rotated and twisted its pedicle. The ovary was caught in the pedicle and divided. (*Comyns Berkeley.*)

may be so profuse as to cause profound anæmia, and even death.

When the venous circulation is completely arrested in consequence of torsion, the appearance of the cyst is very striking and characteristic. On the abdomen being opened during life, instead of the cyst presenting the familiar white glistening appearance, it has a deep, dark, lustreless hue, which is most intense near its attachment to the pedicle. In milder degrees of torsion the change in colour only affects the base of the tumour. The pedicle on the distal side of the twist presents

the same dark hue, but on the uterine side it is, as a rule, of natural tint. The contrast of colour in the two parts of the pedicle is very striking. The walls of the cyst are thick and succulent; the blood contained in the cavity, or in the loculi if multilocular may be of a chocolate or of a dark-red colour.

When such a cyst is removed from the body and the blood allowed to drain away, or is washed away by a gentle stream of water, the tissues will resume their natural colour. This should be remembered, because some writers have attributed the dark colour to gangrene of the cyst. This is erroneous: gangrene of an ovarian cyst is a rare event, and can only take place when air is admitted from without, as during the operation of tapping, or when intestinal fluids obtain access to it.

The usual effects of acute torsion of the pedicle are passive congestion, thrombosis, extravasation of blood into the tissues of the tumour, and necrosis.

Necrosis is localised death, in contrast to the death of the organism as a whole, or "somatic death."

Moist gangrene is necrosis followed by decomposition and putrefaction of the dead tissues. When soft parts necrose in situations where they are accessible to putrefactive organisms, such as the exterior of the body, the lungs, or the intestinal tract, decomposition rapidly ensues, especially if the parts contain much blood. In the case of ovarian tumours with twisted pedicles, not in communication with the outer air directly or indirectly, micro-organisms can rarely gain access to them and cause decomposition.

It is therefore erroneous to describe as gangrene the changes observed in cysts with torsioned pedicles. This is further illustrated by the circumstance that small ovarian tumours may be completely twisted from their pedicles and subsequently shrink. Were the changes in the cyst gangrenous in character, general infection of the peritoneum and death would be the inevitable consequences.

Burdon Sanderson, in his article on the Pathology of Inflammation, refers to the peculiar plan of emasculating animals known as **bistournage**. In this method no instrument is used; the testicle is freed from its association with the dartos, then twisted on the spermatic cord as on an axis, four

or five times, the whole manipulation being performed with prodigious rapidity. If the animal is killed afterwards and

Fig. 276.—An ovarian dermoid containing hair and grease which had twisted its pedicle many times.
* The stump of the Fallopian tube.

the arteries injected, it is found that no blood enters the spermatic artery beyond the twisted part of the cord. Consequently, while the surrounding parts receive their natural

supply of blood from the pudic artery and preserve their vitality, the testicle itself is irretrievably condemned to death. We have in the above method practically a crucial experiment, which demonstrates that when a testicle is deprived of blood in consequence of axial rotation it necroses and finally atrophies.

A perusal of the records of cases described as gangrenous cysts indicates that the reporters have regarded the deep livid hue of such cysts as evidence of gangrene, and that others have confounded suppurating with gangrenous cysts.

Rotation of an ovarian cyst, when it gives rise to such severe changes as have just been considered, may be described as **acute torsion**. It frequently happens that during the performance of ovariotomy a thick pedicle is found twisted through half or even a complete circle, without producing an appreciable effect upon the tumour. In others, torsion takes place so gradually, yet so completely, that the pedicle is twisted like a rope, and not unfrequently the pedicle breaks and the tumour becomes detached from its uterine connections. To this variety the term **slow** or **chronic torsion** may be applied. Its effects are not less interesting than those which follow acute twisting. When rotation occurs slowly, the walls of the cyst inflame and adhesions are established between the cyst and the omentum, or the parietal peritoneum; such adhesions become vascular and maintain the vitality of the cyst wall after circulation is arrested through the pedicle. Cysts have been observed in all stages of transplantation.

Acute torsion is more frequent in tumours of medium size; it also occurs in small cysts; but it is the small tumours, especially dermoids, in which slow torsion takes place.

The dermoid which had undergone axial rotation, Fig. 276, had so lengthened its pedicle that the tumour sometimes rested in the loin and resembled a very movable kidney: it produced no pain, but annoyed the patient by its excursions about the belly.

The symptoms of acute torsion of an ovarian cyst are often so characteristic as to lead to a correct diagnosis. When a woman complains of sudden and violent pain in the abdomen, accompanied with vomiting, and she is known to have an ovarian tumour, or she presents herself for the first time to

the surgeon, and these signs are associated with an abdominal swelling the physical signs of which are indicative of an ovarian tumour, axial rotation should be suspected. Should the patient possess a gravid uterus as well as an ovarian cyst, it is even more probable that rotation has occurred; or if she has an ovarian tumour and has been recently delivered, this is an additional reason for suspecting that the symptoms arise from a twisted pedicle.

Clinical observations demonstrate that the predominant signs of acute axial rotation of abdominal tumours and viscera are those common to a strangulated hernia minus stercoraceous vomiting.

Even the presence of faecal vomiting does not always negative the existence of acute axial rotation of an ovarian tumour, for a loop of bowel is sometimes involved in the twist and produces intestinal obstruction.

Suppuration in Ovarian Dermoids.—When air or intestinal fluids gain access to these tumours, then septic infection with all its attendant evils is the result, and unless the pus finds an outlet the individual dies. The pus in a suppurating dermoid sometimes bursts into the bowel, bladder, vagina, or through the abdominal wall at or near the umbilicus. When the cyst communicates with the bladder it will sometimes entail very great misery, because fragments of bone, teeth, locks of hair, and sloughs become impacted in the urethra. Cystitis is an almost constant accompaniment. Ovarian teeth in the bladder have formed the nuclei of phosphatic calculi.

Hair from ovarian dermoids entering the bladder is voided with the urine, a condition of things described by French surgeons as *pilimiction*.

Rupture.—Ovarian cysts of all kinds are liable to burst into the belly, either without any obvious cause (spontaneous rupture), or from violence, such as falls, blows, coughing, vomiting, the manipulation of physicians, or an immoderate fit of laughter.

Modes of Death.—Tumours of the ovaries are now so promptly removed when discovered that there are happily few opportunities of studying the ways in which they destroy life. The chief modes are the following:—(1) Pressure on

the ureters, leading to hydronephrosis and uræmia; (2) cystitis and pyelitis; (3) intestinal obstruction; (4) suppuration of the cyst and septic infection from leakage (peritonitis); (5) hæmorrhage from rupture of the cyst; (6) axial rotation of the tumour; (7) impediment to delivery; (8) epithelial infection of the peritoneum, and occasionally dissemination (malignancy).

Treatment.—All ovarian cysts and tumours should be removed entire at the earliest possible moment.

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CHAPTER LII.

TUMOURS OF THE MALE GENITAL GLAND (TESTIS).

Even when divested of what may be called its adventitious tunics, acquired as a result of its emigration from the abdominal cavity to a position in the pouch of skin called the scrotum, the testis is a complex gland, for its ducts, the vasa efferentia, epididymis, and vas deferens, were originally the excretory ducts of the mesonephros (Wolffian body). A

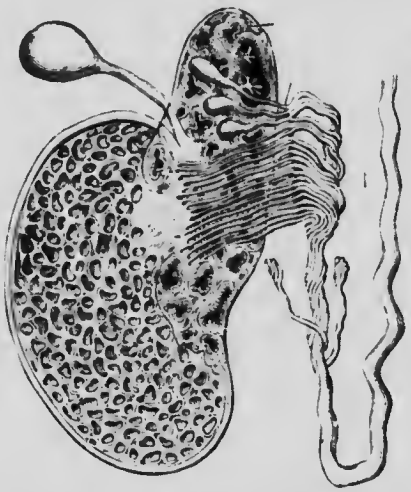

Fig. 277.—Diagram to show the relation of the mesonephros and its ducts to the adult testicle.

study of the evolution of the male secretory organ of vertebrates indicates clearly enough that the ducts have undergone a change of function, and that their relation to the testicle is secondary. An examination of the embryonic testis shows that remnants of the mesonephros persist among the ducts, and only a few of the Wolffian tubules are utilised by the testicle.

The relation of the various embryonic structures to each other is shown diagrammatically in Fig. 277. In the adult

testis it will be readily seen that a few of the Wolffian tubules become the vasa efferentia, the remainder usually atrophy; but in many individuals one, two, or more persist, usually as pedunculated cysts of small size at the top of the testicle.

The shrunken remains of the mesonephros (Wolffian body) sometimes persist as a collection of cæcal tubes furnished with epithelium, lying among the vasa efferentia, between the epididymis and the testis, and often extending a little distance into the tissues of the cord. These remnants are known as the paradidymis. Thus in the male the **mesonephros** is represented by the paradidymis, its **tubules** by the vasa efferentia and Kobelt's tubes, and its **duct** by the epididymis and vas deferens.

It is important to appreciate the anatomy and morphology of the testicle as a prelude to the study of its tumours, because the majority of them arise in the paradidymis, and independently of the true tissue of the testis. Although tumours of the testis are by no means common, they are remarkable for their variety, as well as the peculiarity of the tissues composing them, and many display malignancy in a very high degree.

The terminology of tumours of the testis is obscured by a fog of names; some are described as cystic sarcomata, cystic fibromata, myxomata, and the like. In this work they will be considered under the head of General Cystic Disease of the Testis, which includes Carcinomata, Myomata, Dermoids, and Sarcomata.

General Cystic Disease of the Testis.—The tumours which come under this heading form an important clinical group, and were made the subject of careful study by Curling under the above designation in 1853.

These tumours in their typical condition are made up of large numbers of cystic spaces, which vary greatly in size; some are no larger than rape-seed, others may attain the size of a hazel-nut. Many are distinctly tubular, and the cysts may communicate with each other. The loculi are lined with regular columnar, cubical, or stratified epithelium, and intracystic papillomata are not uncommon. The connective tissue framework of the tumour consists mainly of simple fibrous tissue, but it may be so abundant as to form the bulk of the

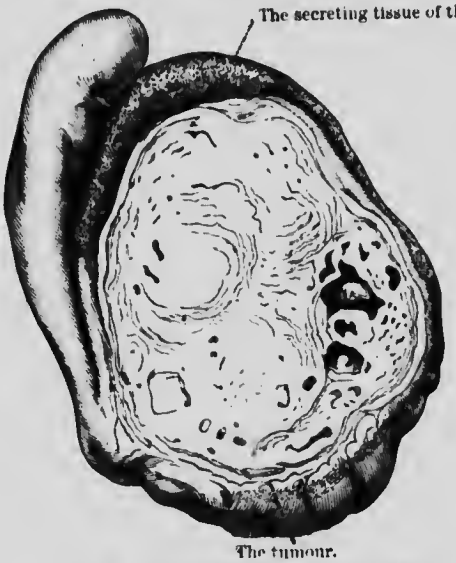

Fig. 278.—Cystic disease of the testis.
(*Museum, St. Mary's Hospital.*)

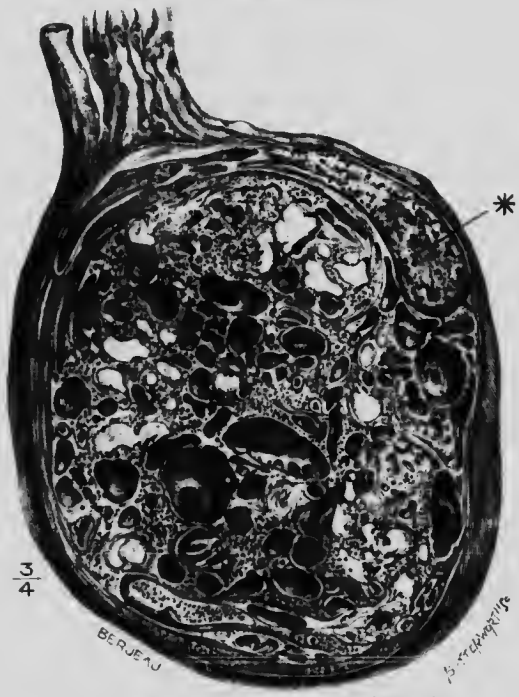

Fig. 279.—Cystic tumour of the testis, shown in section. * The testis.
(*Museum, Royal College of Surgeons.*)

tumour, the cystic spaces being few. In some specimens especially those occurring in infants, striated muscle fibre has been detected.

Curling drew attention to two important features connected with this disease, namely, the frequency with which the tumours contain hyalin cartilage, and the fact that they arise in the rete testis, and as the tumour grows it flattens the body of the testicle until this is reduced to a narrow stratum intervening between the tunica vaginalis and the tumour (Figs. 278, 279). In the large specimens it is often difficult to detect any remnant of the testicle, without the aid of a microscope.

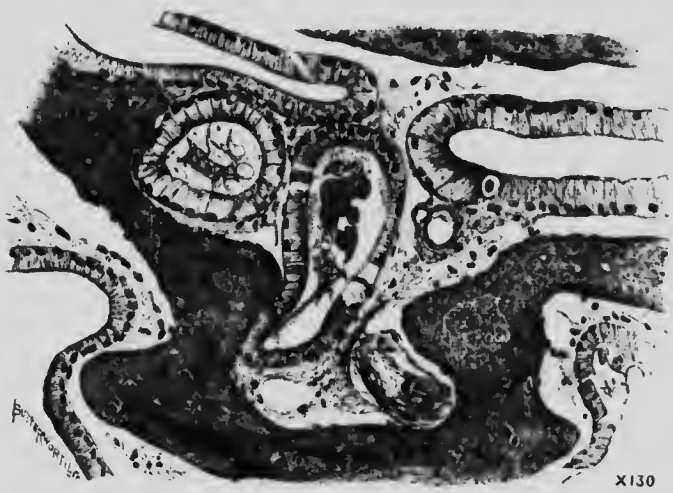

Fig. 280.—Hyalin cartilage in the stroma of a recurrent carcinoma of the rectum. (*After Foulerton.*)

The frequent presence of hyalin cartilage in tumours of the testis has attracted the attention of many writers, and especially as in some cases it forms the chief portion of the tumour and its metastases; several investigators have endeavoured to determine the nature of the chondrification. In consequence of the frequency with which cartilage is found in these tumours it has been customary to class them as sarcomata.

Foulerton has shown that many malignant tumours of the testis are in structure and pathologic tendency carcinomata; and he points out that Paget's classic specimen when

re-examined by Kanthack and Pigg was found to be a carcinoma. He is also of opinion that writers on surgical pathology are in the habit of considering the presence of hyalin cartilage as evidence that the tumour is a sarcoma, and that chondrification of tissue in typical cancers has not been sufficiently considered. He has, however, proved in an unequivocal way that hyalin cartilage occurs in association with cancer of the rectum (Fig. 280), and has proved its presence in a lymph gland infected with carcinoma. Foulerton is also of opinion that many, if not the majority of malign tumours of the testis are more properly classed with the carcinomata than with the sarcomata; at the same time he is in agreement with preceding observers that malignant tumours of the testis arise in the hilum of this organ.

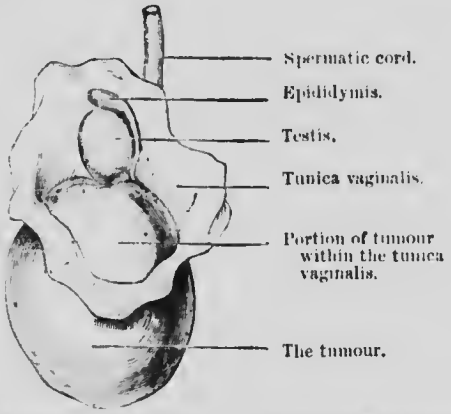

Fig. 281. Tumour of the testis from a child; it contained muscle spindles, some of which were transversely striated. (*After Naumann.*)

No doubt much of the difficulty associated with these tumours is due to their relative rarity, for even in a large general hospital in London two cases a year is a fair average. It is also necessary to draw attention to the statement so repeatedly found in the clinical reports relating to malignant tumour of the testis that the patient attributes the onset of the disease to an accident, such as a crush or a blow.

Myomata.—Tracts of striated muscle fibre are occasionally found in the complex tumours arising in the paradidymis, and tumours are occasionally found in relation with the testis (Fig. 281) consisting almost entirely of muscle cells, some of which are transversely striated.

Dermoids of the Testis.—Tumours of the testis containing skin, hair and teeth are rare, especially when care is taken to distinguish between sequestration dermoids of the scrotum and those situated inside the tunica vaginalis testis. The rarity of testicular dermoids may be gathered from the fact that, as far as I can ascertain, during the last twenty-five years three examples have been recorded in England, and of these one came from India, and another from Central China was sent to me by Dr. Booth (Fig. 282), and is now in the museum of the Royal College of Surgeons. Its walls are thick and gristly, and

Fig. 282.—Dermoid (embryoma) of the testis in section. From a Chinese boy, in whom it was congenital.

the whole mass was invested by a delicate tunica vaginalis. The cavity of the tumour contained the usual sebaceous matter, loose hair and an embryonic rudiment consisting of bone, hyalin cartilage, and a multicuspidate tooth. The "rudiment" has a covering of stratified epithelium, lanugo-like hairs, and sebaceous cysts. Shattock carefully examined the walls of the tumour and succeeded in demonstrating a thin layer of well-developed testicular tubuli lying beyond the dense fibrous tissue comprising the chief thickness of the cyst wall. On the opposite side of the specimen he found the epididymis.

In its gross anatomy and structural details this tumour reveals the usual features of dermoids growing in relation with the testis. Some, it is true, are more complex and contain nerve cells, as in one very carefully reported case examined by Cornil—in a "bud" growing from the cyst wall a collection of nerve-tissue containing ganglion cells was detected.

In its clinical details the tumour from the Chinese boy did not differ from its forerunners. In nearly all the recorded cases enlargement of the testis was observed at or shortly after birth. In a fair proportion the patients were deprived of the affected organ in early childhood. In those who were not operated upon during infancy, the tumour seems to have caused little inconvenience; indeed, it appears to lie dormant till puberty, then bruises and knocks, or abscesses and sinuses, cause trouble and lead to surgical interference.

Most of our knowledge of testicular dermoids dates from an elaborate article published by Verneuil in 1855, founded on the reports of nine cases he collected from the literature of the preceding one hundred and fifty years, and one example which came under his own observation. The conclusions expressed in this admirable paper have become classical, and form the foundation of our knowledge of the subject: and even at this date, nearly half a century since its publication, Verneuil's views are reproduced (frequently without any reference to, and often, perhaps, in ignorance of their source) in monographs devoted to diseases of the male genital organs and in text-books of surgery. It is true, notwithstanding the fact that these tumours can now be studied with all the advantages of modern histologic methods and differential staining, that we know no more concerning their pathogenesis than Verneuil, and testicular dermoids remain with us, as with him, pathological curiosities.

It is also noteworthy that dermoids of the testis, according to all the available records, are unilateral, whereas ovarian dermoids are very frequently bilateral.

Verneuil shows in the title of his paper ("Mémoire sur l'Inclusion scrotale et testiculaire")—which title, he relates, was selected as conveying precisely the view he held in regard to the nature of the disease that he believed that testicular

dermoids belonged to the class of double monsters known as parasitic fœtuses. A study of the records published during the last ten years supports Verneuil's contention that dermoids within the tunica vaginalis, though attached to and often intimately associated with the testis, are not really "of the testis" in its strictest sense: they do not arise from transformation of testicular tissue, but whether they should

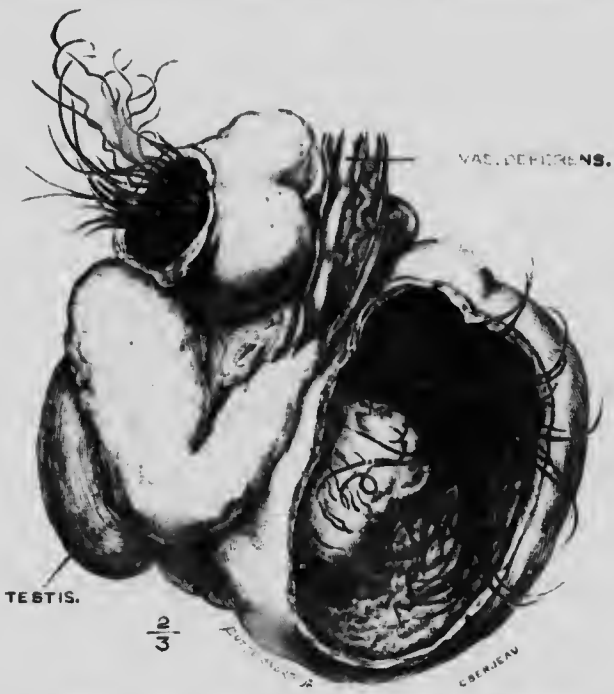

Fig. 283.—Undescended testis removed from a colt. It is associated with a large dermoid containing grease and coarse hair like that of the mane and tail.

be regarded as parasitic fœtuses (teratomata) is another question, and one which requires further consideration and elucidation. In some of the cases the dermoid was attached to the gland by such slender connections that the surgeon succeeded in detaching the tumour and preserved the testis. Admirable conservative operations of this character are recorded by Cornil and Berger, Chevassu and Reclus.

Horses are especially liable to dermoids, a fact known to Verneuil; and dermoids are often associated with undescended

testes. Like typical ovarian dermoids, they contained an ill-developed embryonic rudiment contained in a cyst, covered with pilose skin and stuffed with loose hair, grease, and occasionally teeth resembling equine incisors. The hair resembles that of the mane or tail (Fig. 283). In all the specimens I have seen the dermoid, though attached to the testis and epididymis, lies outside the tunica albuginea, a fact mentioned by all writers on this matter.

The occurrence of dermoids in the undescended testes of horses has a clinical interest, for, as I have already mentioned, in the records of the human cases, although the unusual size of the testis was invariably noticed at birth, yet it did not interfere with the descent of the organ. There is a case recorded by Delbet in which a testis, retained at birth in the inguinal ring, gradually descended to the scrotum; subsequently it was found to be occupied by a dermoid. In this respect horses and boys differ very markedly, but they agree in the following points: although a dermoid may be attached to, or incorporated with, either a right or a left testis in fairly equal proportions, an example of bilateral testicular dermoid has yet to be recorded. In this respect the testes are in marked contrast with the ovaries, for ovarian dermoids are very frequently bilateral.

The study of testicular tumours shows, as in other organs, that some of the species with highly organised elements are mainly sources of inconvenience to their owners, and then we pass in this instance by rapid gradations to tumours exhibiting the banal features of sarcomata.

Sarcomata.—It is necessary to point out that in addition to the tumours displaying malignancy which arise in the paradidymis, sarcomata arise in the connective tissue of the testis proper, that is, the tissue lying between the seminiferous tubules, and remaining, in their early stages, encapsuled by the tunica albuginea. Such tumours may have oat-shaped cells, or round cells, and occasionally they have the well-known microscopic features of lympho-sarcomata. The difficulty of distinguishing them is further increased by the fact that small cystic spaces sometimes form in the soft tissue of the tumour, and produce an appearance deceptively like the general cystic disease already described. Even the micro-

scope fails us in some of these deadly tumours. On one occasion a testis with a tumour-like body in its centre, equal in size to a walnut, was submitted to me after castration. I expressed my fear to the operator that he had unnecessarily removed the organ for what appeared to be a gumma. A similar opinion was given independently by an admirable pathologist. We were wrong, for within eighteen months of the operation the man died with extensive abdominal metastasis. In rare instances sarcomata may attack both testicles. Hutchinson has recorded an example in a man of seventy years.

These things help to show the difficult taxonomic problems which face systematic writers who attempt to classify tumours of the testis.

Among the most important observations which show the complex characters of testicular tumours are those made by Schlagenhaufer. A man aged forty-three years had a tumour of his testis enclosed in a firm white connective tissue capsule: the tumour consisted of a brown-red crumbly tissue, which on microscopic examination resembled that of a typical chorion-epithelioma. The man died with secondary deposits in the left lung, thyroid gland, and right kidney. These deposits also exhibited the structure of chorion-epithelioma.

Some similar observations have been made by other pathologists, and they all agree that the naked eye and microscopic characters of the tissue are identical with chorion-epithelioma. This tissue has also been found by Ritchie in secondary tumours associated with an intrathoracic teratoma (see p. 426).

Whatever view pathologists may take of the structural characters of testicular tumours, the surgeon never forgets the grim reality that the majority of these complex growths quickly destroy life, as the following case illustrates:—

A man twenty-eight years of age complained of a swollen scrotum, which he had noticed eight months. It was recognised as a sarcoma of the testis, and the spermatic cord, which appeared to be healthy, was cut across well within the inguinal canal (Fig. 284). He quickly recovered from the operation, but died ten months later with enormous metastasis within the abdomen.

One of the most prominent clinical features of malignant tumours of the testis is the rapidity and extent of the lymph-gland infection. The great size which the lumbar lymph glands attain in some patients is truly astonishing. The connective tissue in the hilum of the testis is described as consisting "of fine fasciculi and laminæ of areolar tissue, these being covered by and partly composed of flattened epithelioid cells. Between the laminæ and fasciculi are

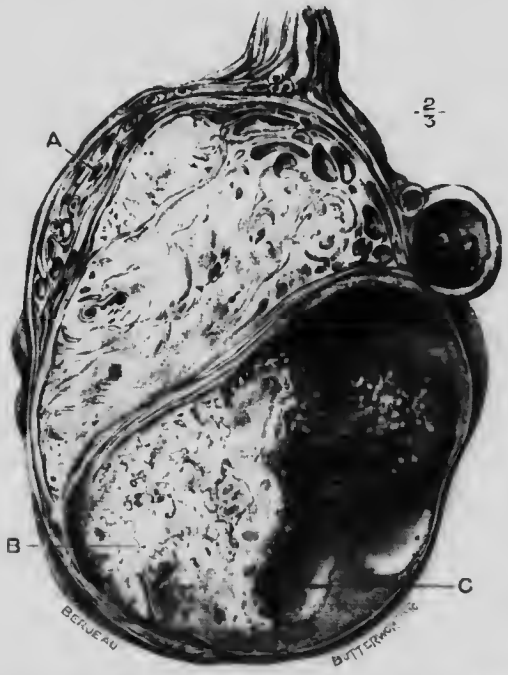

Fig. 281. Tumour of the testis in section. A, Epididymis. B, Sarcomatous tissue. C, Remnant of the body of the testis.

large cleft-like spaces, containing lymph and almost everywhere enclosing the basement of the tubules. If these spaces are injected by the puncture method, the injecting fluid flows away by the lymphatics of the spermatic cord" (Quain). This free lymphatic communication of the hilum-territory explains the extreme facility with which the abdominal lymph system can be infected. Dissemination of testicular sarcoma is sometimes brought about by the veins for it occasionally happens that secondary nodules are found in the skin, lungs, and

other viscera. Nevertheless, the prevailing mode of infection is by the lymphatics, and this may involve the lymph glands which extend from the fifth lumbar vertebra to the root of the neck. A very careful study of the lymphatics of the testis has been published by Most.

Clinical Features.—The clinical recognition of malignant tumours of the testis is not by any means a simple matter; it is often impossible to distinguish between a hæmatocele and a solid tumour. The points on which it is best to rely are the weight of the tumour and absence of inflammation, syphilis, and translucency. Some sarcomata are intensely hard, others are soft and almost fluctuate; most of them are painless, but a few are the seat of continual pain.

Treatment.—A study of the effects of operation for the cure of tumours of the testis is very instructive, as it exhibits malignant disease in some of its worst aspects. Castration, save in very exceptional cases, is one of the safest operations in surgery. In the early stages of sarcoma the diseased testis can be completely removed. Recurrence in the wound or stump is an unusual event; but dissemination, due to infection of the lumbar lymph glands, destroys more than half the patients within a year of the operation. These glands are in close relation with the inferior vena cava and the abdominal aorta, and this intimate association with these blood vessels is the chief obstacle to their removal. In spite of this, cancerous lumbar glands have been extirpated with success.

Encysted Hydrocele of the Testis (Spermatocele).—The cysts to which the term "encysted hydrocele of the testicle" should be applied arise sometimes in the vasa efferentia of the testis and sometimes in Kobelt's tubes, and it is a curious fact that these cysts occur in those structures which in the female give rise to parovarian cysts. As encysted hydroceles in the male and parovarian cysts in the female arise in homologous organs, these cysts are morphologically homologous.

Encysted hydroceles are always closely associated with the testis, and lie outside its tunica vaginalis, but they may project into the cavity of this sac. Occasionally a hydrocele of the tunica vaginalis is associated with an encysted hydrocele.

When an encysted hydrocele is very large it may so overlap the testis that it is difficult to differentiate between it and

a hydrocele of the tunica vaginalis, until actual dissection in the course of an operation shows that the cyst is independent of the tunica vaginalis.

The lining epithelium of these cysts may be of the stratified, cubical, columnar, or even of the ciliated variety; the cysts contain fluid, which may be clear, or white like milk, due to the presence of fat; sometimes spermatozoa are present, or the fluid may be blood-stained. Cysts containing semen are sometimes called **spermatoceles**. In size these cysts vary greatly. As a rule they do not exceed the dimensions of an egg, and often are much smaller.

An encysted hydrocele must not be confounded with a cyst arising in an unobliterated funicular process.

In addition to the sessile form of encysted hydrocele of the testis there is a pedunculated variety which is usually described as a supernumerary hydatid of Morgagni. These cysts rarely exceed a cherry in size, and arise in Kobelt's tubules. As a rule only one cyst is present, but two or three are not uncommon. Sometimes they will, like the hydatid of Morgagni, project into the cavity of the tunica vaginalis.

Literature.—It is an interesting feature of the writings concerning dermoids of the testis that the majority of the observations, and certainly the best among them, have been the work of French surgical writers. It would seem that the classical monograph of Verneuil gave the subject a French domicile. The subjoined list makes no pretence to completeness, but furnishes references to the best-known and most easily accessible records, in which the details are related with sufficient care and completeness to make them useful either to the surgeon or to the pathologist:—

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CHAPTER LIII.

HETEROTOPIC TEETH.

Among mammals the normal situation for teeth is the mouth (buccal cavity), but under pathologic and teratologic conditions they arise in such unexpected situations as the ovary, testis, rectum, neck and pharynx, in man, and in connection with the tympanum of horses (mastoid teeth). Among heterotopic teeth those found in ovarian dermoids (embryomas) are the best known, and have been the subject of several careful investigations.

Ovarian Teeth.—A large proportion of ovarian dermoids contain teeth. In number they vary greatly. Sometimes only two or three are found; in others twenty or more may be counted; a larger number is very unusual. The teeth may be embedded in loose, ill-formed bone, or project from a flat osseous plate like nails driven through a piece of thin wood (Fig. 285). Often the roots of ovarian teeth are embedded in soft tissue, or the entire teeth remain hidden in crypts or cysts. When the crown projects boldly the neck of the tooth may be surrounded with pink tissue resembling the gums.

Teeth occur more frequently in ovarian dermoids than would be gathered from the current descriptions. Unless the teeth are actually erupted the surgeon may fail to notice them until he makes, or orders to be made, a careful dissection of the dermoid. On several occasions I have astonished my assistants by directing a dermoid in which no dental structures were obvious to be destroyed by prolonged boiling; when the residue was examined many (sometimes twenty or thirty) teeth were found.

The teeth are not scattered irregularly through the dermoid unless present in very great number, but are collected in one or more groups; they vary in shape and resemble incisors, canines and supernumerary teeth. The root is usually single; teeth with more than one root, or with a

bifurcated root, are very rare. When the crown is simple the root is long; multicuspidate teeth have short roots.

Ovarian teeth are composed of enamel and dentine; cementum is by no means constant. The enamel is lodged on the crown in lumps or hummocks, with deep ravines

Fig. 285.—Cluster of ovarian teeth embedded in bone.

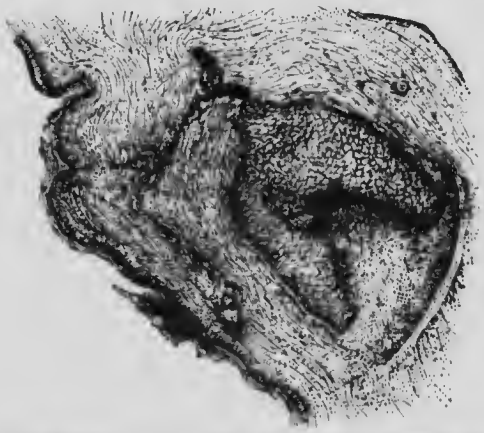


Fig. 286.—A developing ovarian tooth, showing the enamel organ. From an adult woman.

extending to the dentine. The enamel prisms run in all directions. The pulp is very irregular: some of the teeth, especially those resembling incisors and canines, may lack a central chamber. In multicuspidate teeth the pulp chamber is of fair size. In some the pulp is converted into osteo-dentine (Fig. 287): in others it is full of fat globules. The presence of nerves in the pulps of ovarian teeth was asserted

by Salter, and tissue resembling nerve-fibrils may be detected in pulp suitably prepared. Ovarian teeth develop on the same principle as normal teeth (Figs. 286 and 288).

For several years I made a series of observations in order

Fig. 287.—Microscopic characters of a multicuspidate and bicuspidate ovarian tooth.

In A the pulp chamber contains osteo-dentine; in B the pulp chamber is exceedingly small, and occupied with osteo-dentine; cementum is absent from the roots.

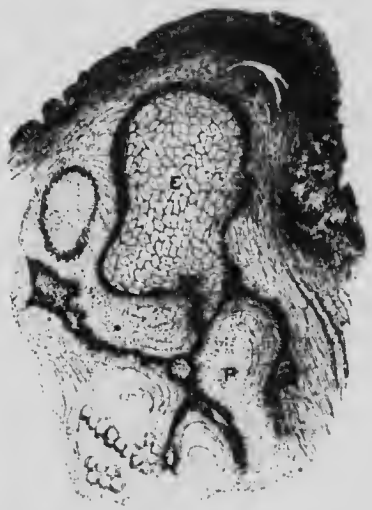


Fig. 288.—Germ of an ovarian tooth. E, Enamel organ; P, Papilla.

to determine if the development and eruption of ovarian teeth is in any way influenced by age, and to ascertain if, like the hair of dermoids, they are shed in old age. The evidence proved that the development of ovarian teeth is uninfluenced by age: for example, a dermoid the size of a tennis ball, from

a girl six years of age, contained many teeth, six of which were fully erupted, whereas an ovarian dermoid from a woman in middle life contained germs of teeth in great abundance, but none had reached the stage of calcification.

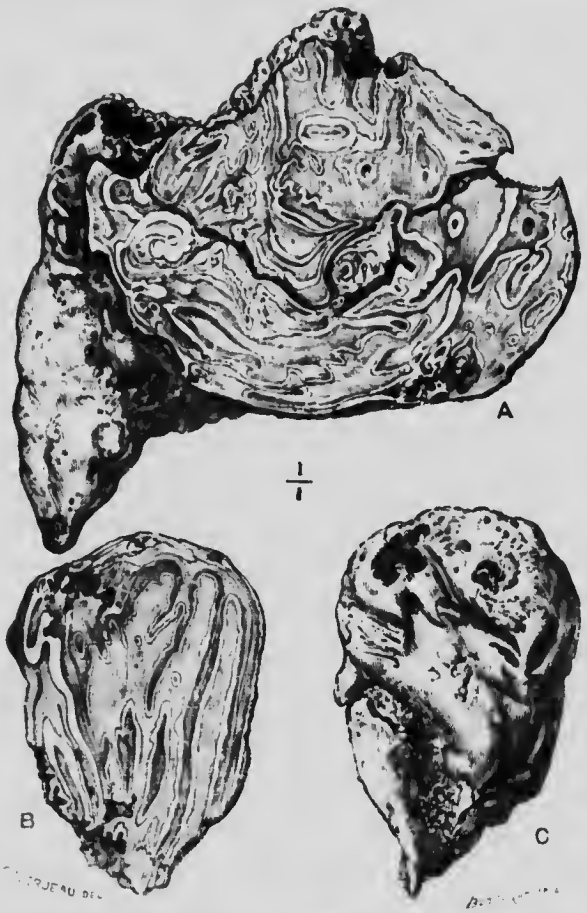


Fig. 285.—Two dental masses successively removed from the temporal fossa of the mare represented in Fig. 291. The larger tumour A is shown in section to display the enamel strata; it weighed 175 grammes. The smaller body C weighed 44 grammes; it is also shown in section B.

Mastoid (Tympanic) Teeth in Horses.—The occurrence of teeth in the mastoid portion of the temporal bone in horses has been known for upwards of a century, and specimens of these curious teeth exist in many veterinary museums. The number of teeth varies: as a rule one tooth is present, stuck

like a peg in the bone. It is not uncommon to find two, and in rare instances four teeth. Mastoid teeth are very misshapen, and usually of the molar type; often they are such ill-formed lumps as to come under the denomination odontomes: indeed, Broca included these bodies among his

Fig. 290. The tympanic region of a horse's skull with a cluster of teeth.

odontomes heterotopiques (Fig. 289). Mastoid teeth possess the three familiar dental tissues—enamel, dentine, and cementum. A careful examination of the very few available specimens in which the skull has been preserved with the mastoid teeth in position, shows that they are in relation with the tympanum, and especially with that part of it known as the attic. This is true of a specimen in the museum of the

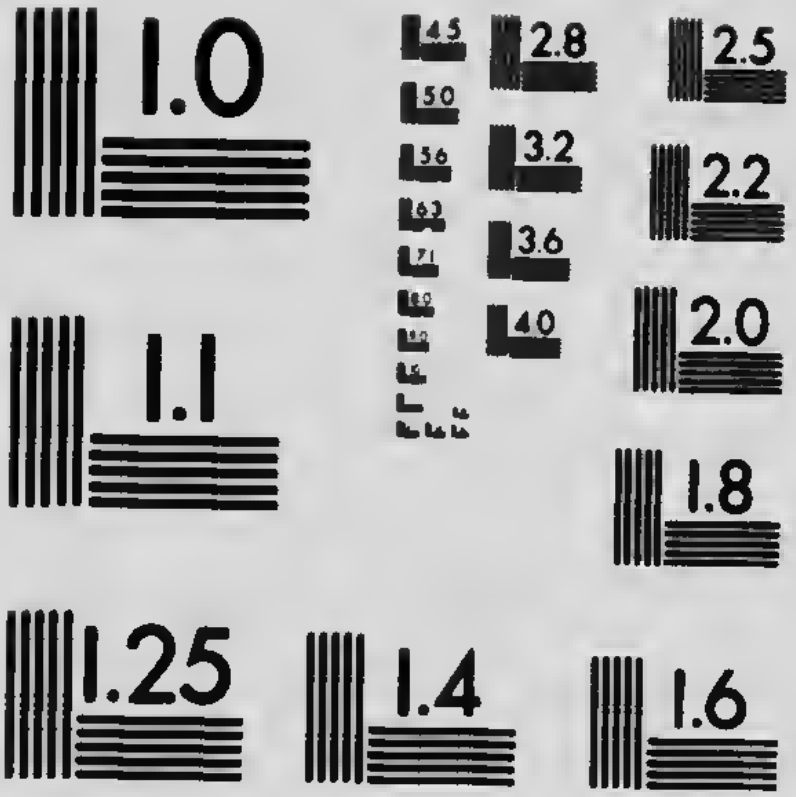
Royal Veterinary College, London, in which a solitary tooth stands out from the remains of its bony capsule, the roots of the tooth being lodged in the tympanic attic.

Owing to the kindness of Professor Dewar I was able carefully to study a skull with the teeth in position (Fig. 290). In this specimen the teeth are not lodged in sockets, but encysted by an incomplete bony capsule, in the mastoid portion of the temporal bone, especially in that part immediately overlapped by the squamosal. The cluster of teeth has markedly compressed the external auditory meatus. The tumour has deformed the interior of the cranium, and an uncovered portion of tooth projects into the cerebellar fossa. During life it was probably excluded by the dura mater. It is impossible accurately to determine the number of separate dental bodies in this specimen without destroying it, but I feel sure there are at least four separate pieces.

There is no satisfactory explanation available as to the origin of these teeth. There is, one would certainly imagine, some morphological reason for their localisation in the temporal bone, and, as the drawings show, they have peculiarities in shape and size which should serve for their ready recognition, and enable us at once to distinguish them from testicular or ovarian teeth.

Before it is possible to make any decisive statement in regard to the nature of the mastoid teeth of horses, it is very desirable to obtain facts concerning their anatomical relationship with the soft parts, and especially the connection of the fistula with the pharynx.

Mastoid teeth are troublesome to horses, and give rise to some interesting clinical conditions. The horse is usually brought to the veterinary surgeon on account of a swelling, but more frequently a sinus near the base of the auricle. When a probe is passed along the sinus it comes in contact with a tooth. The recorded cases of this disease fail to make it clear whether the sinus is congenital or is a consequence of suppuration as the tooth develops. Hensinger, in an admirable paper on cervical fistulæ, regards them as persistent branchial fistulæ, and states that they are more frequent in carriage-horses (*Luxuspferde*) than in draught-horses as the secretion from the sinus soils the surrounding



skin and attracts the attention of the grooms. This sinus is very constantly associated with mastoid teeth in foals as well as in adult and aged horses. The veterinarian usually treats these cases in a summary manner, for he enlarges the sinus and, ascertaining the exact position of the tooth, extracts it by forceps or by a chisel and mallet; he then stuffs the cavity with antiseptic gauze, and encourages it to become obliterated by granulation. A study of the character and position of these teeth shows that their removal is some-

Fig. 291. Head of a van mare with a sinus leading to a mastoid tooth. The drooping lip shows that there was paralysis of the facial nerve.

times attended with difficulty, certainly with grave danger to the horse, and occasionally their extraction is impracticable. Cases are known in which horses have died from septic meningitis, the result of suppuration around the teeth.

Cervical Teeth in Sheep.—Sheep are liable to a peculiar anomaly in the immediate neighbourhood of the ear, which consists of a fistula opening near its base; but its skin edge is invariably surmounted by an incisor tooth. The first impression is that the opening represents a persistent branchial fistula, but in man teeth are not associated with

these fistulæ. Congenital cervical fistulæ in sheep have received careful attention, and these investigations show that the abnormal orifice is an accessory mouth. In an example which came under my notice (Fig. 292) the tooth, which had the characters of a temporary incisor, is lodged in a bony pedicle surrounded by mucous membrane of the same features as the gums, and the cutaneous recess in which

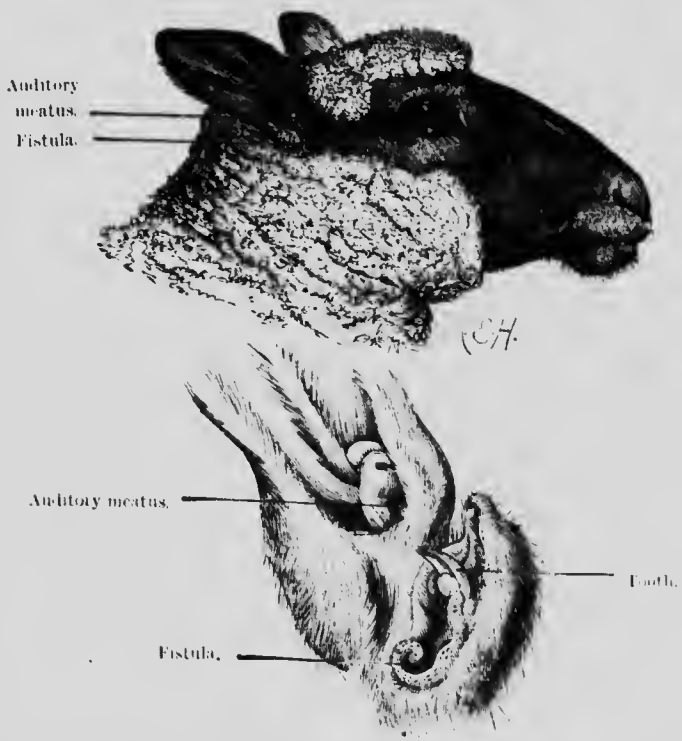


Fig. 292.—Head of a sheep with a cervical teratoma. In the lower figure the teratoma is shown of natural size.

it is accommodated presents in the aspect which is in contact with the tooth a number of processes resembling the papillæ on the sheep's lips, and the arrangement of the wool on the outer surface of this accessory lip is identical with that covering its normal lip. This specimen by itself is somewhat puzzling, but a wider survey of the question adds a special interest to it.

Gurlt had the opportunity of studying several examples

which enabled him to prove conclusively the nature of this condition, and in one of his specimens two temporary incisors were lodged in a miniature but unmistakable mandible, and associated with a tongue of corresponding size. The fistulous track communicated with the pharynx. A similar condition in a cow is represented in Fig. 293. When the animal drank, some of the fluid escaped through the fistula.

Without entering too fully into the details of this matter, the revelation afforded by a careful anatomical study of the specimens amounts to this:—

The cervical teeth and the associated structures are the

Fig. 293.—Head of a cross-bred Devon cow with a teratoma attached to its throat. A cane passed through the fistula A entered the pharynx of the cow.

remnants of an attached or parasitic fœtus, and the cutaneous opening represents its mouth.

It is rare for an animal with one of these accessory mouths to come under the notice of a trained observer, so I gladly avail myself of the notes taken by Mr. Wilson, a veterinary surgeon, concerning a lamb. Some few days after the lamb was born, the shepherd noticed that the wool on the right shoulder was saturated with milk. He carefully watched the lamb suckling, and on close examination discovered a slit behind the right inferior maxilla through which the milk issued. He drew his master's attention to this, who found to his astonishment a rudimentary tongue and jaw

covered with a lip: naturally he kept the animal alive out of curiosity. When the lamb was weaned and turned out on pasture land there was always a food-stained condition of the wool around the opening, but the animal appeared to maintain a decent condition. When turned out in the winter it lost the use of its front legs, and was taken to the farm buildings, kept warm, and hand-fed. At this stage Mr. Wilson saw it, and found a pharyngeal fissure three inches in length, tongue freely movable, working in harmony with the normal tongue.

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Gurlt, "Thierische Missgeburten."—Berlin, 1877. Taf. xv.

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Group VI.

CYSTS.

CHAPTER LIV.

Cysts, or cystomata, result from the abnormal dilatation of pre-existing tubules or cavities. In the simplest form they consist of a wall usually composed of fibrous tissue, but it not unfrequently contains muscle fibre. The cyst-contents may be mucus, bile, saliva, urine, etc., according to the nature of the organ with which the cyst is associated.

Cysts may be arranged in three groups:—i. Retention cysts; ii. Tubulo-cysts; iii. Hydroceles.

There are some conditions often classed as cysts which in this work will be arranged as a sub-group under the title Pseudo-cysts, and will embrace—i. Diverticula; ii. Bursæ; iii. Neural Cysts.

RETENTION CYSTS.

When the duct of a gland becomes obstructed, the fluid, hindered from escaping, accumulates in the ducts and acini and dilates them. If the hindrance to the free flow of the secretion is maintained, or oft repeated, the glandular tissue becomes impaired, then atrophies, and finally the gland and its duct become converted into a fluid-containing sac or cyst.

It is generally believed that when the duct of a gland is completely obstructed the conversion of the parts into a cyst is a passive process; but occasion will be taken in the course of this section to show that this is not the case. When an excretory duct is so completely obstructed that no secretion escapes, then the gland rapidly atrophies. Retention cysts are due to obstruction to the free flow of secretion, or temporary arrests of the flow frequently recurring. The best example of cysts arising in this way are those due to dilatation of the pelvis and infundibula of the kidney—a condition known by the term **hydronephrosis**.

The purest forms of retention cysts arise in connection with hollow organs, the inner walls of which are provided with glands. The vermiform appendix is a case in point. This tubular structure is richly provided with glands. Occasionally the communication of the appendix with the cæcum is obstructed, and the glands continuing to secrete, the accumulating fluid distends the appendix into a sausage-shaped cyst.

The uterus is another example. After a difficult labour the walls of the cervical canal are not unfrequently damaged, and in the process of repair the canal may become obstructed. This leads to retention of the products secreted by the uterine glands, and the uterus will attain such proportions as to cause the enlargement to be attributed to pregnancy; the condition is known as **hydrometra**. It is occasionally seen in old women, but is more common in mammals normally furnished with bicornate uteri, such as ewes, cows, mares, and sows. It may be unilateral or bilateral.

When occurring in mammals in which the uterus has long cornua—*e.g.* cat, bitch, hare, etc.—the distended cornua are apt to be confounded with Fallopian tubes. It may affect one or both cornua of a bicornate uterus in a woman.

The danger of retention of this kind is due not so much to the size of the cyst as to the great risk that ensues when large collections of retained secretions are invaded by putrefactive organisms. The cysts in such an event become converted into abscesses, and the life of the individual is greatly imperilled. These changes in retention cysts are indicated by special names—as **pyometra, pyonephrosis,** etc.

Cysts of the Liver.—All cysts, in the pathologic limitation of the term, arise in pre-existing epithelium-lined spaces and ducts: even ducts and canals of microscopic proportions are often the source of cysts of such dimensions that they cause so much inconvenience and distress as to necessitate surgical treatment. This is illustrated by the liver, an organ thoroughly permeated by minute passages—the bile canals.

Two forms of cysts are found in the liver, arising from its canals and ducts, namely multiple cysts and solitary cysts.

1. *Multiple Cysts of the Liver.*—This variety has long been recognised by pathologists under the term general cystic

disease of the liver. In typical examples the liver is converted into a huge honeycomb-like mass (Fig. 294). The cavities vary greatly in size—some are as small as grape-seed, others

Fig. 294.—A liver shown in section. The spaces on the cut surface are dilated bile canals. From a woman 46 years of age. (*Museum of the Royal College of Surgeons, London.*)

may exceed a ripe cherry in size. The cysts may project on the surface of the liver, but though this organ may be enormously enlarged, and weigh thirty-five pounds, yet its shape is preserved. The smaller cysts are lined with epithelium. This is best seen in specimens with the cystic change in an early

stage, when the dilated canals look like sharp definite punctures in the liver substance. As the cysts increase in size and number the hepatic tissue is encroached upon, and appears as narrow bridges between large tracts of honeycomb, but by degrees these become broken up by absorption, and then the remnants of the normal hepatic tissue appear as islands on the cut surface of the liver.

The microscopic characters of the cysts when examined in the early stages prove that they arise in the bile canals, but no investigator has succeeded in ascertaining the cause of this disease, or in associating it with obstruction to the escape of bile. The most remarkable circumstance connected with this disease of the liver is its occasional association with general cystic disease of the kidneys (see Chapter LV).

This cystic disease of the liver causes great enlargement of the organ, but is painless, causes no jaundice, presents no diagnostic features, and comes invariably as a *post-mortem* surprise.

This curious disease has attracted the attention of several pathologists, including Virchow, Rokitansky, Bristowe, Still, Shattock, and Rolleston. Blackburn, in a careful and critical paper, has reviewed the various theories relating to this disease and collected the literature.

2. *Solitary* (non-parasitic) *Cyst of the Liver.*—This is a rare condition, and the general character of such a cyst may be inferred from the specimen represented in Fig. 295. In nearly all the recorded cases the cysts grow from the free margin of the liver and possess thin walls which are translucent and have no communication with the gall bladder. The peritoneal investment and the capsule of the liver are directly continuous with the cyst wall. On microscopic examination of a large solitary cyst, which I enucleated from the liver of a woman 75 years of age, the cyst wall at the point where it joins the liver exhibited small loculi lined with epithelium; ducts could also be detected lined with cubic cells. The cyst wall consisted of fibrous tissue, and its inner surface presented spaces covered with flattened epithelium. In some parts of the cyst wall, liver substance was detected. In such cysts the fluid may be straw-coloured bile, or blood.

The solitary cyst of the liver probably arises from the

dilatation and fusion of bile ducts, and although it is difficult to explain its origin, attention may be drawn to the following points. The recorded examples occurred in women. It is noteworthy that the liver of many women presents along its free border a variable strip of thin atrophied tissue, which appears almost white in contrast with the dark hue of the normal liver. This atrophy of the free border of the liver is

Fig. 295.—A cyst (non-parasitic) growing from the free border of the liver. Obtained *post mortem* from a woman 38 years of age. (*Museum of the Royal College of Surgeons.*)

attributed, and I think correctly, to the pressure of stays; whether this be true or not, it is in this pale thin strip of liver that the solitary non-parasitic cyst arose in my patient, and it was due to the dilatation of the bile ducts in this tissue; the dilated ducts subsequently fused to form larger spaces, much in the same way that cystic spaces arise in a cavernous nævus from the fusion of adjacent blood vessels composing the primary nævus.

Few special treatises mention the solitary cyst of the liver, but a sufficient number of examples have been recorded to prove that it is a clinical entity and may require surgical treatment. In a patient under my care the cyst contained two pints of straw-coloured fluid and simulated a mesenteric cyst. One physician who saw the patient regarded the swelling as an ovarian cyst.

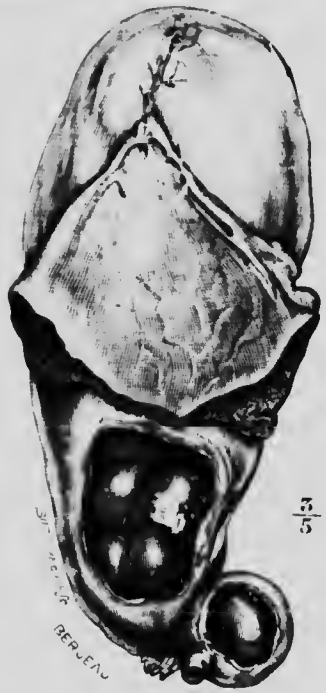

Fig. 296.—Gall bladder distended with mucus secondary to obstruction of the cystic duct with gall-stones. The triangular piece of liver attached to it was removed with the gall bladder.

In regard to treatment, two methods have been adopted. The common plan consists in opening the cyst, evacuating its contents, and then draining it. This is tedious: in my case I succeeded in enucleating the cyst wall with the best consequences.

It is worth notice that multiple cysts of the liver admit of no treatment, and as far as I know, do not admit of diagnosis; the solitary (non-parasitic) cyst is a clinical puzzle, but is amenable to surgery.

The Gall Bladder.—This structure illustrates very well the mode of formation of retention cysts. The gall bladder consists of three coats, of which the middle one contains unstriped muscle fibre; the inner one is mucous membrane beset with mucous glands, its epithelium being directly continuous with that lining the hepatic ducts on the one hand and with the epithelium covering the duodenum on the other. The outer coat is derived from the peritoneum and subserous tissue. Bile from the hepatic ducts is conveyed into the gall bladder by way of the cystic duct, and when it escapes from the gall bladder it again traverses the cystic duct and passes along the common bile duct to the duodenum. The common duct just as it enters the wall of the intestine receives the duct of the pancreas. The point of junction is indicated by a slight recess known as the ampulla or diverticulum of Vater. The peculiar arrangement of the ducts leading to and from the gall bladder renders it peculiarly liable to have its communications interfered with. Obstruction may occur in the cystic duct (Fig. 296), in the common duct, in the ampulla, or in the wall of the duodenum. The obstruction may be due to impacted gall-stones, a pancreatic concretion in the diverticulum, tumours of the pancreas, duodenum, primary cancer of the common bile duct, etc.

When the common duct is obstructed by gall-stones, the gall bladder usually atrophies in consequence of cholecystitis. In obstruction due to cancer of the head of the pancreas the gall bladder becomes, as a rule, greatly distended with bile. When the cystic duct is obstructed, and no bile finds its way into the gall bladder, the latter may become so distended with mucoid fluid and attain such large proportions as to be mistaken for an ovarian cyst. A gall bladder distended in this way is really a *mucocele*, and the consistence of the mucus varies greatly.

Ranula.—This term is probably one of the oldest in surgery, and its etymology is not very obvious. Until recently it was applied to all cysts in the floor of the mouth, and as cysts in this situation are of various kinds and arise from different structures, it naturally followed that the term gradually came to possess a merely topographical significance. There is at the present time a strong tendency to restrict the

name ranula to cysts arising in connection with the ducts of the three sets of salivary glands opening into the mouth, and to designate them as submaxillary, sublingual, or parotid ranulæ, according to the gland affected. If surgeons would use the term in this definite sense much unnecessary discussion would be saved. Ranulæ are common in connection with the submaxillary and sublingual glands. The cysts are, as a rule, thin-walled, and lie in the furrow between the gum and the tongue, and bulge upwards into the floor of the mouth. When large they cause a prominence in the submaxillary triangle. The cyst may be filled with saliva. Sometimes it contains mucus and a yellow substance resembling the yolk of an egg.

Occasionally the obstruction is caused by a calculus impacted in the orifice of the duct, but cases come under observation in which the duct is not completely obstructed, yet the fluid is retained. Observation teaches that when the main excretory duct of the submaxillary gland is blocked by a calculus, inflammatory (infective) changes follow in the gland which subsequently produce hardening (sclerosis) of its tissue. Cystic changes are exceptional, and there is, in all probability, a pathological cause apart from mere obstruction concerned in their production.

Parotid ranulæ are rare in the human subject, but they have been observed in calves, oxen, and horses.

Much needless discussion has taken place in regard to the sources of ranulæ, because the various writers seem to forget that in addition to salivary glands there are mucous glands, and one of variable size near the tip of the tongue known as Nuhn's gland. Any of these may dilate into a cyst. Still further to complicate the diagnosis, dermoid cysts not unfrequently arise in the floor of the mouth near the frænum of the tongue or deeply in its substance. It has also been urged, as an objection to the view that ranulæ arise in the ducts of the salivary glands, that the fluid they contain is not always saliva. This is very weak argument. Many hydronephrotic cysts contain fluid which it would be difficult to regard as urine, and an obstructed gall bladder is sometimes filled with fluid that does not possess a single attribute of bile. So a cyst arising in connection with a salivary gland will sometimes

contain fluid that fails to furnish the characteristic reactions of saliva.

Pancreatic Cysts.—It has long been known that the duct of the pancreas is liable to become dilated, and as the condition is analogous to the distension of the ducts of the buccal salivary glands, dilatation of the pancreatic duct (canal of Wirsung) is sometimes referred to as a "pancreatic ranula."

Virchow recognised two varieties of pancreatic ranula. In one variety the canal is dilated irregularly throughout its whole extent, so that it assumes the appearance of a chaplet of cysts; in the other the duct is dilated immediately behind its terminal orifice. Such cysts, he writes, may attain the size of a fist, and are consecutive to cicatricial contractions and compression by tumours. The cysts are not filled simply with pancreatic secretion, for when they attain a certain size they will be found to contain mucoid material, products of haemorrhages, and, not rarely, calculi. Judging from what is known of retention cysts in general, it would, as a matter of simple inference, be thought that pancreatic ranulæ arise from partial obstruction to the pancreatic duct, either from impaction of a pancreatic calculus in the terminal segment of the duct, a gall-stone lodged at the duodenal orifice, or a tumour arising in connection with the ducts or tissues in the immediate neighbourhood. This, however, does not appear to be the case, for pancreatic cysts have been observed and no obstruction has been detected. Besides this, the duct of the pancreas has been found completely obstructed by a calculus, and the gland, instead of being converted into a cyst, has atrophied, its secreting elements being largely replaced by fibrous tissue.

Experimental evidence also supports this conclusion, for it has been demonstrated that when the pancreatic duct is occluded during life by a ligature, the gland does not become cystic, but atrophies. Thus experimental and clinical evidence indicates that pancreatic cysts are the result of pathological changes which may, or may not, be associated with obstruction of the duct.

A great deal of attention has, during the past ten years, been devoted to pancreatic cysts in their clinical as well as

their pathological aspect, and certainly the evidence indicates that other causes than obstruction, partial or complete, are responsible for their production.

Cysts described as pancreatic sometimes attain very large proportions, and examples have been reported with a capacity of two gallons or more. These very big cysts form smooth globular swellings in the upper part of the belly. They lie behind the peritoneum, and, of course, have the stomach and transverse colon in front; when very large these cysts will extend some distance below the transverse colon.

The fluid contained in large pancreatic cysts is usually turbid. Sometimes it is white or even opalescent, occasionally it is clear, and in some cysts it will have a brown or even a green tint. The specific gravity varies between 1010 and 1020, and there is a small trace of albumen. Mucin is often present, also tyrosin and blood pigment, and traces of urea have been detected. The fluid is sometimes capable of emulsifying fats.

The modes by which very large pancreatic cysts arise are not by any means clear, but it is important to bear in mind that there is, in a very significant proportion of cases, a definite history of antecedent injury. This fact gives colour to the suggestion that some of the cysts are due primarily to laceration of the pancreas and subsequent extravasation of its secretion behind the peritoneum. Another very important feature of these cysts is the liability to haemorrhage, and this may take place so abundantly into the cyst as to jeopardise the life of the patient; indeed, in some cases it has been fatal.

Pancreatic cysts occur at almost all periods of life. Examples have been reported as early as the eighth year of life and as late as the seventy-third. They appear to be most frequent in men than in women.

Pancreatic cysts attributed to injury have followed a variety of accidents, such as falls from a great height, causing abdominal pain: a crush of the abdomen between the buffers of railway waggons; fall from a horse, or from a vehicle; kicks from men, and in several cases from horses.

Jordan Lloyd has attempted to show that the large pancreatic cysts that follow injury to the abdomen are really collections of fluid in the cavity of the lesser omentum, and

when the fluid has the property of rapidly converting starch into sugar it may be assumed that the pancreas has been injured. He also points out that the characteristic feature of so-called pancreatic cysts—viz. a swelling occupying the epigastric, umbilical, and left hypochondriac regions—is precisely that which would result from distension of the lesser bag of the peritoneum. It is probable that some cases of supposed pancreatic cysts were really effusions into the lesser bag of the peritoneum, for undoubted examples of distension of this cavity with fluid have been observed, dissected, and described. The whole subject of so-called pancreatic cysts has been ably handled and the literature collected by Leith.

Dacryops.—This term is applied to cysts occurring in the upper eyelid; they are due to distension of the ducts of the lacrimal gland. They appear, as a rule, in the upper and outer part of the eyelid, the cyst extending beneath the border of the orbit towards the lacrimal gland. The cyst enlarges when the patient weeps. Dacryops may arise in two ways—either as a consequence of a wound or abscess of the lid, or as a congenital defect. As a rule, they are of traumatic origin. The condition is one of extreme rarity.

Hulke, in an interesting paper on this subject, states his belief that these cysts were first accurately described by Dr. J. A. Schmidt in 1803, and that Beer (1817) mentions that he had six cases of this kind, which he describes under the name "dacryops" which Schmidt had applied to them.

When these cysts are opened through the skin a fistula is sure to be the result. The same thing often happens when the cysts have a traumatic origin. The condition is then termed *dacryops fistulosus*.

Cysts of the Hyaloid Canal.—This tiny relic, which sometimes persists in the vitreous after the disappearance of the central hyaloid artery, may occasionally dilate and form a cyst large enough to be visible on ophthalmoscopic examination.

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CHAPTER LV.

RETENTION CYSTS (*continued*).

HYDRONEPHROSIS.

THE secretion (urine) of the kidneys is conducted into the bladder by means of two ducts (the ureters); from the bladder the urine is discharged at intervals through the urethra. When from various causes the urine is hindered from escaping freely, either from the bladder, or from the ureters into the bladder, it accumulates in the ureters and dilates them; the pressure of the fluid then acts upon the pelves of the kidneys, and if maintained causes the renal pelves to be dilated into large sacs, converts the infundibula into large tubes, and finally induces atrophy of the renal tissue until the kidneys are converted into multilocular sacs. To a kidney altered in this way the term hydronephrosis (Rayer, 1836) is applied. Hydronephrosis arises from a variety of causes, and the condition of the ureter associated with it depends on the cause and situation of the obstruction. It is also important to bear in mind that the largest examples of hydronephrosis are produced by partial obstruction to the flow of urine or to frequently recurring attacks of complete obstruction. It is also a curious fact that in many of the largest examples of hydronephrosis it is difficult to demonstrate the cause.

Hydronephrosis may be bilateral or unilateral. When the obstruction is at the neck of the bladder or in the urethra it will be bilateral.

The chief causes of **Bilateral hydronephrosis** are:—

Calculus in the urethra or in the bladder (Fig. 297).

Stricture of the urethra.

Tumours of the prostate gland, especially an enlarged middle lobe.

Tumours and cysts of the pelvic organs: especially impacted uterine and cervix fibroids.

In bilateral hydronephrosis secondary to obstruction at the neck of the bladder, an interesting change may sometimes be observed at the vesical orifices of the ureters. Normally these openings scarcely admit a fine probe, but under the conditions

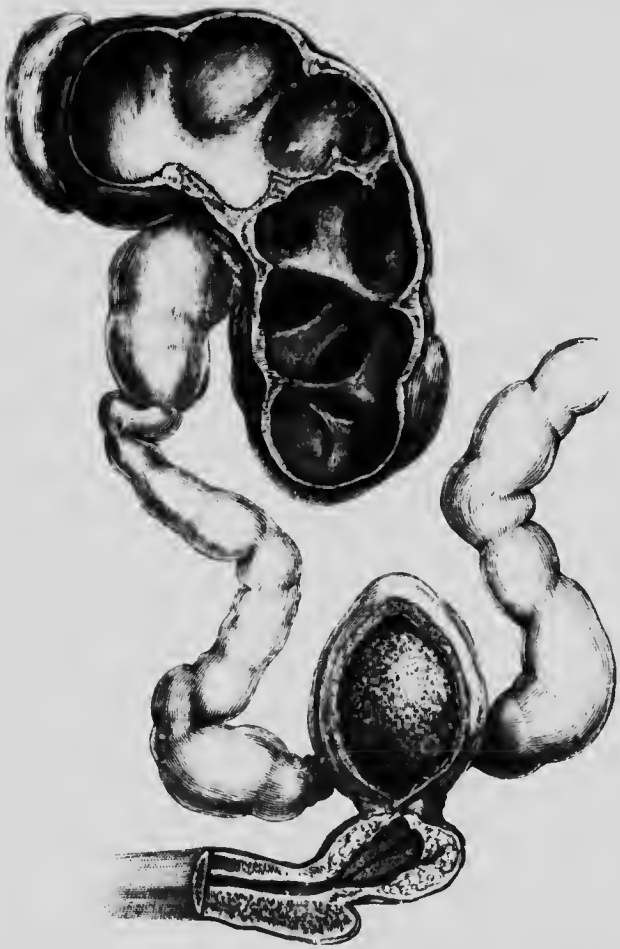

Fig. 297.—Hydronephrosis secondary to a large calculus in the bladder; two fragments of calculus occupy the prostatic portion of the urethra. The left kidney was in a similar condition. The patient, a man 26 years of age, died with complete suppression of urine. (*Museum, Middlesex Hospital.*) (¼ *nat. size.*)

just mentioned will assume a circular form, and be large enough to admit the tip of the little finger, so that fluid injected into the bladder through the urethra will enter the ureters and gain the dilated pelves of the kidneys. This

condition is particularly apt to supervene upon oft-repeated attacks of retention of urine secondary to pressure on the urethra exercised by a uterus occupied by fibro-myomata, especially those which grow in the cervix and become

Fig. 298.—The urinary organs with the right adrenal of a new-born child.

impacted immediately before the incidence of a menstrual period.

Ante-Natal Hydronephrosis.—A very large number of examples of hydronephrosis have been carefully examined and recorded in children at birth, and in some of the instances the

distension of the pelves of the kidneys has been so great as to obstruct delivery and entail embryotomy in order to allow of the extraction of the fœtus.

In many of the records the reporters state that they were unable to find anything to explain the condition; in many of the more recent cases, however, the cause of the obstruction has been determined. The chief of these are:—

Imperforate urethra (Figs. 308, 310).

Imperforate hymen (Fig. 311).

Torsion of the penis (Fig. 299).

Ante-natal hydronephrosis is a subject of great interest, because it serves to show that the kidneys are functional in the late stages of fœtal life, and supports the view that the bath of amniotic fluid (or hydrosphere) in which the fœtus floats represents, at any rate in part, fœtal urine. It also throws some light on cases of advanced hydronephrosis sometimes met with in infants and young children, and for which no adequate cause had previously been forthcoming.

The urinary organs represented in Fig. 298 were obtained from an infant which survived its birth a few days. The right kidney only was present; it occupied its normal position in the loin. Its infundibula, pelvis, and ureter were widely dilated, and at the point where the ureter opened into the bladder there was a small circular diaphragm-like valve, but this structure offered no obstruction to the flow of fluid from the ureter into the bladder when tested after death.

The bladder presented only one ureteral orifice, and its walls were thinner than usual. The penis, urethra, and testicles were normal, and the left adrenal occupied its usual position. No traces of the left renal artery, vein, or ureter were found. The anus was normal.

In this case dissection failed to bring to light anything to account for the distension of the excretory ducts of the kidney, but it clearly indicated that mechanical obstruction of some kind interfered with the flow of urine through the vesical orifice of the ureter.

Torsion of the Penis.—It is an undoubted fact that torsion of the penis and bilateral hydronephrosis are sometimes associated, and it is possible that in some cases of congenital double hydronephrosis in which there was great

dilatation of the ureters and in which careful dissection of the parts failed to detect any organic cause, twisting of the penis may have been overlooked.

An example of torsion of the penis is represented in Fig. 299. The patient, a baby three months old, had his penis directed laterally; when the organ was brought into a natural position, on being released it at once resumed its abnormal deflection to the left. This penis, as is the case with twisted penes in general, was unusually large. There was also a groove on the under surface of the glans indicating a minimum degree of hypospadias; the frænum was absent. At

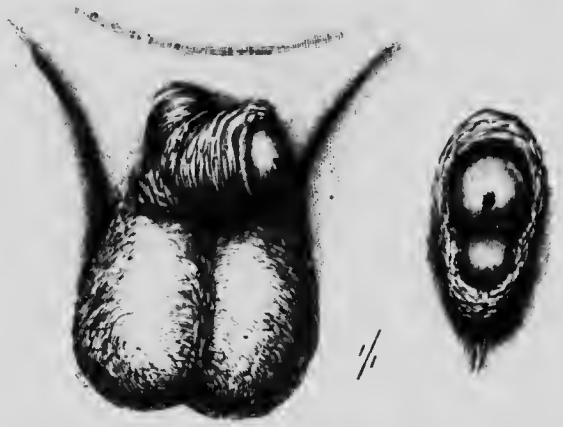

Fig. 299.—A twisted penis. The small figure shows the groove on the glans and the absence of the frænum. (*Nat. size.*)

the angle of torsion there is a sac-like pouch of skin. The penis is probably distorted in this way by the pressure of the thighs whilst in the uterus, and it is possible that the penis may be nipped between the thighs and obstruct the urethra and lead to hydronephrosis without actually twisting the penis.

Unilateral Hydronephrosis has many causes:—

Retention of a calculus in the ureter.

Tumour of the bladder implicating the vesical orifice of the ureter.

Calculus lodged in the pelvis of the kidney and blocking the orifice of the ureter (Fig. 305).

Partial rotation of the kidney kinking the ureter.

Tumours and cysts of the pelvic organs pressing on the ureter.

Cicatrix of the ureter due to injury.

Inadequacy of the ureter (Fig. 302).

It has been suggested that the ureter is occasionally obstructed by branches of the renal artery taking an abnormal course. I have made a careful study of cases supposed to demonstrate this, and have been convinced that the unusual relation of the vessels is often due to the dilatation of the renal pelvis: and that the constricting effects supposed to be exercised by the artery are the direct outcome of the increase in the size of the pelvis.

Among uncommon varieties of unilateral hydronephrosis may be mentioned sacculation of one half of a horseshoe kidney, and the rarer anomaly in which a kidney is furnished with two ureters, one of which becomes obstructed and leads to dilatation of that portion of the renal pelvis connected with it, and corresponding atrophy of that part of the renal cortex which drains into it.

Intermitting Hydronephrosis.—When a hydronephrotic kidney is of large size it can be perceived clinically as a definite tumour. It occasionally happens that patients come under observation with a swelling in the loin which can be readily perceived at one examination but not at another, or it obviously diminishes in bulk without completely vanishing. In some of these cases the patients are able to state definitely that, coincidently with the diminution in the volume of the tumour, there has been a sudden increase in the quantity of the urine voided. The urine in some instances has been found to contain traces of blood and mucus. To hydronephrosis of this kind the term **intermitting** is applied.

It must be borne in mind that there may be difficulty in some cases in deciding clinically between a very large hydronephrotic cyst and an ovarian or parovarian cyst, and it is well established that cysts of the ovary and parovarium sometimes rupture, and the fluid, escaping into the peritoneum, is absorbed and rapidly excreted by the kidneys. Thus, *profuse diuresis following upon the sudden disappearance of an abdominal tumour is as characteristic of rupture of an ovarian cyst as of an intermitting renal cyst.*

There can be little doubt that nearly all hydronephroses intermit, but the term intermitting hydronephrosis is reserved for those examples in which there is great diminution, and in some instances temporary disappearance, of the swelling.

Exceptionally, both kidneys when hydronephrotic may intermit alternately. Of this rare form I have had one case under my care; as the diagnosis was somewhat obscure,

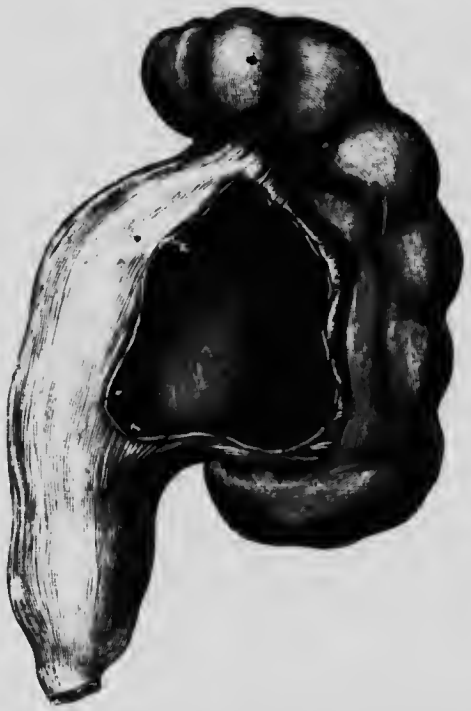

Fig. 300.—Unilateral (intermitting) hydronephrosis (without obvious cause). The ureter, at the point where it left the renal sinus, had a diameter of 8 cm.

cœliotomy was performed. In the course of the operation the phenomenon of intermission was actually observed. The hydronephrosis diminished in size, and the bladder slowly filled. Intermitting hydronephrosis is also associated with the remarkable anomaly known as inadequate ureter.

It is a startling fact that many of the largest specimens of hydronephrosis are those in which no obstruction could be demonstrated, and the histories of the patients fail to throw any light on the cause (Fig. 300). The most remarkable

Fig 301.—Hydro-ureter without obvious cause. From an old man.

example of this is the case of Mary Nix, who died at Hampton-Poyle, near Oxford, at the age of twenty-three. She had a hydronephrosis containing fluid to the amount of thirty gallons, wine measure. The dissection of the body was conducted by Samuel Glass with "some learned gentlemen of the university." Nothing was found to account for the condition.

Fig. 302.—Dilated renal pelvis associated with an inadequate ureter.

Now that we know many cases of dilated ureter and saeculated kidney have an ante-natal cause, it is very probable that many very large hydronephroses of inexplicable origin in the adult began while the individual tenanted the uterus.

Inadequate Ureter.—It is well recognised that the junction of the renal pelvis with the ureter proper is indicated by a marked narrowing of the lumen of the duct, which may be conveniently called the "ureteral strait." It occasionally

happens that the ureter from this point downwards is very markedly narrow, and is sometimes even less than one-fourth its proper dimensions (Figs. 302, 303).

Abnormally narrow ureters of the kind may be conveniently termed "inadequate." Five examples of this condition have come under my observation, and in each instance it was associated with intermitting hydronephrosis. It is an extraordinary fact in some of these cases that the urine will

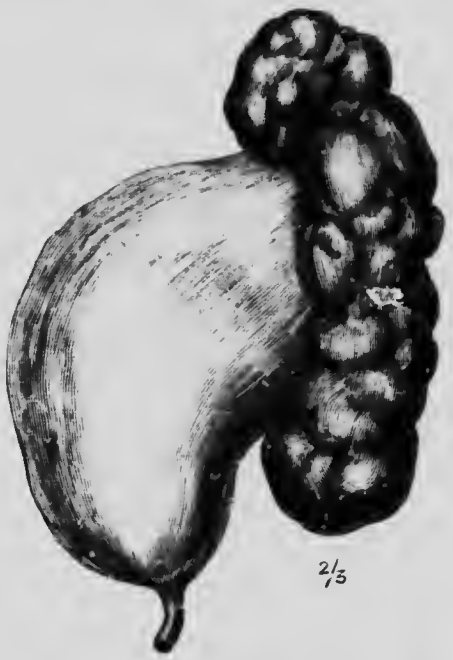

Fig. 303.—Kidney with dilated pelvis and inadequate ureter. From a woman 41 years of age.

collect and form a sac holding two, three, or even four litres, and produce very great pain; suddenly, and without any warning, the blockade will be raised, and the urine will pass into the bladder and be voided, and the large cystic swelling subside in a night. This excessive narrowness of the ureter is most probably a congenital defect.

The insidious way in which the gradual dilatation of the renal pelvis, infundibula, and calyces destroys a kidney is very extraordinary. When hydronephrosis is unilateral it

rarely betrays itself until the tumour is very large; often the only trouble it causes is increased frequency of micturition.

When the hydronephrosis is bilateral the signs are often in abeyance until the amount of renal capital is reduced to the minimum amount capable of meeting the ordinary de-

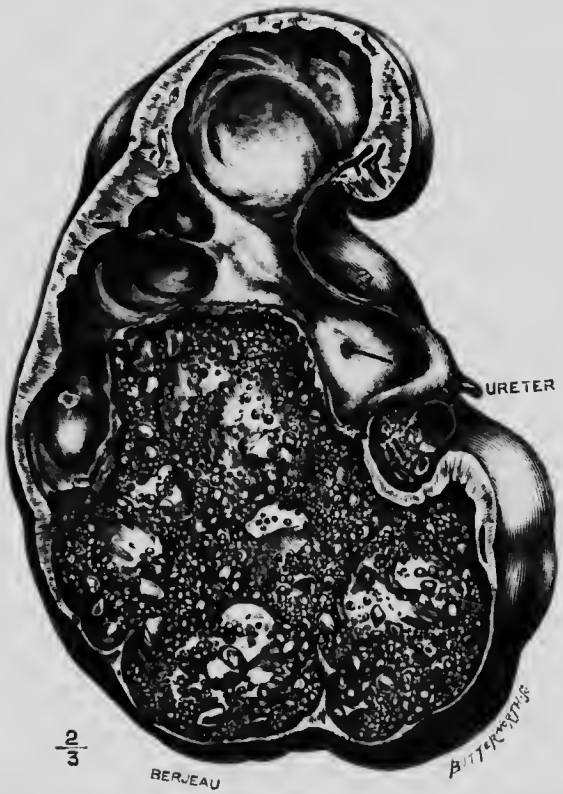

Fig. 304.—A sacculated kidney with an inadequate ureter; the largest sacculus contained more than 40,000 calculi. Removed from a man 38 years of age.

mands of the individual; directly there is an extra call, then the small balance of available renal tissue becomes alarmingly manifest, and the patient dies.

A rare combination of inadequate ureter and sacculated kidney is to find a sacculus stuffed with a multitude of small calculi. The kidney in Fig. 304 is of this character. I removed it from a man in the Middlesex Hospital in 1904.

The calculi were remarkable for their iridescence, which caused them to resemble grains of burnished gold, and when the thinned wall of the kidney burst, in the course of extracting it through the wound, many of these rounded bodies escaped, and ran about like quicksilver.

There is an analogous case in the museum of the Royal

Fig. 305.—A pyonephrosis in section; the pelvis at its junction with the ureter is partially blocked by a calculus. (*Museum of the Royal College of Surgeons.*)

College of Surgeons, not only as regards the large number of calculi and their shape, but also in the fact that the kidney which contained them was "hydronephrotic and the ureter narrowed." The specimen was obtained after death from a man aged nineteen years.

Pyonephrosis.—Although a hydronephrosis continues its course in secret, it is almost certain to be made manifest when it suppurates, and my observations among the quick

and the dead have taught me that this is one of the greatest dangers to which an individual with unilateral hydronephrosis is liable (Fig. 305).

It is necessary to draw a distinction between pyonephrosis and suppurating hydronephrosis. In the case of a pyonephrosis the lesion is inflammatory from the outset, whether it starts primarily in the kidney or spreads to this gland from the bladder, ureter, or elsewhere.

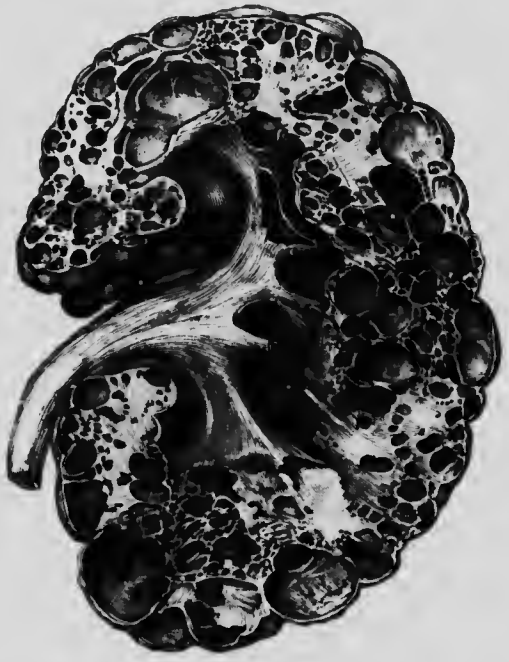

Fig. 306.—A congenital cystic kidney in section. (*Nat. size.*)
(*Museum, Royal College of Surgeons.*)

In some cases of suppurating hydronephrosis under my own care, I have been satisfied that the colon was the source of infection, and the pus contained *bacillus coli communis*. The intimate relations existing between the kidney and colon, more especially when the former is hydronephrotic, make one wonder that fistulous communication between these viscera is not a frequent complication.

Congenital Cystic Kidney.—This term is applied to a very characteristic disease of the kidneys. In typical examples

these organs are converted into cystic masses, so that they exhibit a sponge-like appearance on section. The cysts vary greatly in size; some are as small as rape-seed, others as large as cherries; they rarely exceed these dimensions. Some of the cysts project from the surface of the kidney, but though interfering with the smoothness of the gland, they do not distort it. The cortical and medullary portions of such kidneys are indistinguishably blended, but here and there

Fig. 307. – A congenital cystic kidney; early stage. (*Shattock.*)

tracts of cortical tissue may be detected among the cysts (Fig. 306). In the early stages the cyst walls have a membrana propria and are lined with tesselated epithelium. In advanced stages of the disease and in the large cysts the epithelium disappears. A striking feature of these kidneys is the narrowness of the ureters, and yet in all the cases which have come under my observation these ducts have been pervious throughout. The arteries supplying kidneys changed in this way are smaller than normal.

A congenitally cystic kidney sometimes attains an

enormous size, so large indeed as seriously to impede labour, and in many cases embryotomy has been necessary in order to enable delivery to be effected. In a large proportion of instances in which the fœtus comes away without difficulty it is still-born and often malformed; such conditions as anencephalia, club-foot, and spina bifida are often associated with congenital cystic disease of the kidneys. Minor degrees of the affection are not incompatible with life, and several instances are known in which such kidneys have been found in adult individuals.

Although this condition of kidney is very common and specimens illustrating it exist in many pathological museums, we know very little concerning the early stages. I have examined a well-marked example in a fœtus of the sixth month, and Shattock observed one at the fourth month. The earliest stage has been observed by Shattock (Fig. 307), and a careful examination of the minute structure of the cyst, as well as a comparison of the history of the cyst with that of the mesonephros (Wolffian body), induced him to think it probable that these kidneys consisted of a combination of mesonephros and metanephros. Virchow regarded the cysts as dilatations of the uriniferous tubules in consequence of the absence of a renal pelvis. It is, however, a curious fact that "congenital cystic kidney" occasionally occurs in association with imperforate urethra. A very remarkable case came under my notice in which a child born at full term, but with great difficulty on account of the large size of its belly, was found to have an imperforate urethra, a large dilated left ureter, and a hydronephrotic left kidney. The opposite kidney was a typical example of the congenital cystic kidney (Fig. 308). This combination of the two forms of hydronephrotic and congenital cystic kidney in the same individual, associated with imperforate urethra, supports Virchow's view that these cysts are due to ectasia of uriniferous tubules.

The large number of specimens of congenital cystic kidney preserved in museums indicates that the condition, if advanced at the time of birth, is incompatible with life. It is, however, quite certain that a precisely similar change is met with in adults, and, what is also remarkable, it is very frequently associated with a similar change in the liver (see

Chapter LIV.). The available facts indicate that a moderate amount of cystic change in the kidneys is not incompatible with life, but as the disease advances the secreting tissue of the organs is slowly but surely destroyed, and in due course uræmia supervenes and the patient dies.

There is reason to believe that this cystic change may be limited to part of a kidney. Edmunds described a specimen (Fig. 309) which he removed from a girl of eighteen years, in

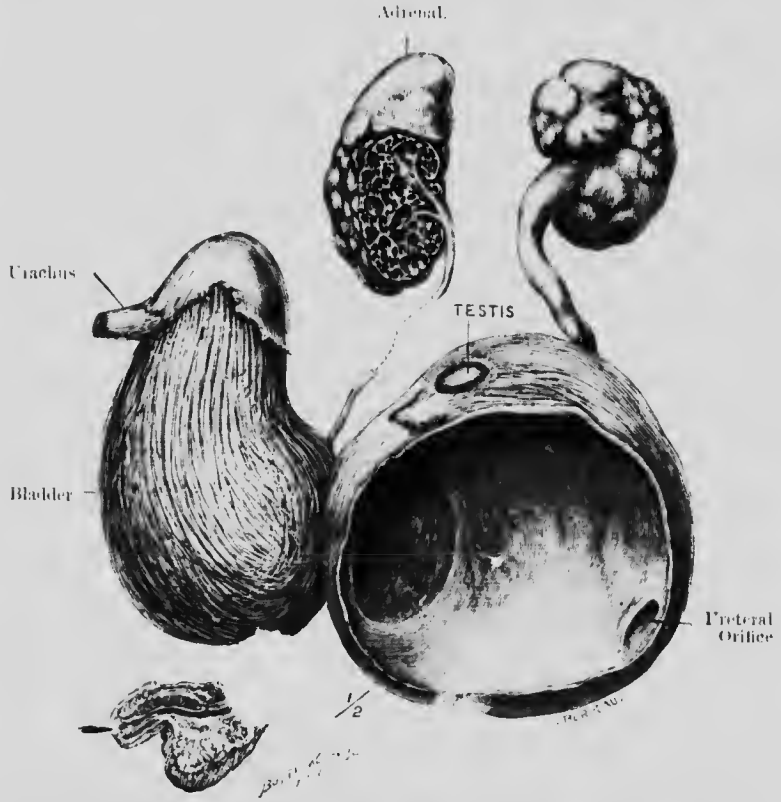

Fig. 308.—Urinary organs of a fœtus. The urethra is imperforate, the bladder hypertrophied, the left ureter dilated, and the kidney hydronephrotic. The right kidney is a congeries of cysts (congenital cystic kidney).

which "an encapsuled tumour" projected into one of the calyces of the kidney. It had a diameter of 6 cm., and was composed of a "congeries of cysts" lined with cubical epithelium.

The specimen shown in Fig. 308 is interesting from the

light it throws on the conditions described as bifid bladder. Connected with the side of the bladder is a large sacculus with a capacity of 300 c.c. The left ureter opens into this sacculus by a valvular orifice: the ureter itself is dilated throughout as well as the renal pelvis, and the sacculus communicates with the vesical cavity by an orifice three centimetres in diameter. A careful study of the relations of the

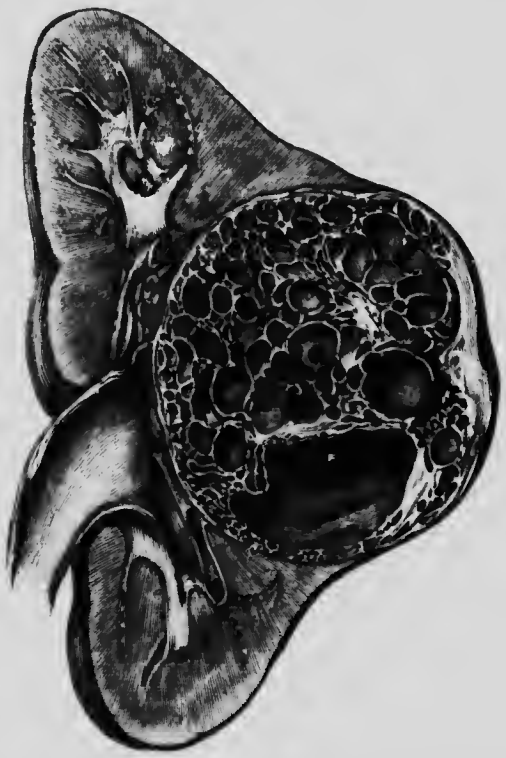

Fig. 309.—Localised cystic disease of the kidney. (*After Edmunds.*)

sacculus proves that it is an enormous local dilatation of the ureter, and as it enlarged it carried on its crest the testis; the spermatic vessels were seen in the fresh condition of the specimen stretched across its wall.

I am of opinion that many specimens which have been loosely described as bifid bladders were probably of the same character as this. Some specimens described as bifid bladders are due to dilatation of the urachus (allantoic cysts), and

others reported as examples of lateral bifidity of the bladder, or congenital diverticulum of the bladder, were in all probability enlargement of the vesical end of the ureter.

Assuming that the congenital cystic kidney is due to pressure leading to dilatation of the uriniferous tubules, we are met by a difficulty in dealing with the specimen, Fig. 308:

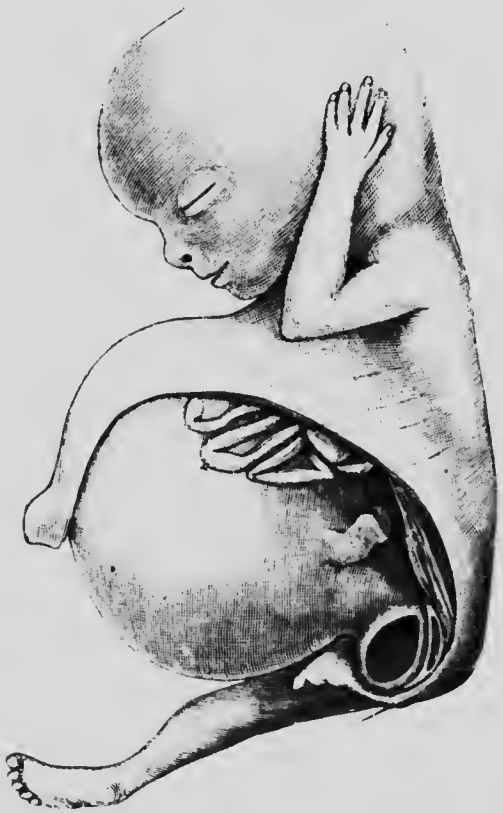

Fig. 310.—Fœtus of the fourth month, with imperforate urethra and a large distended bladder. The kidneys were cystic, as in Fig. 307. (*Shattock.*)

the same cause has produced hydronephrosis in one kidney and general cystic disease in its fellow. I think the difference may be, in part perhaps, explained by the period of intra-uterine life at which the obstruction manifests itself.

Shattock described a fœtus of the fourth month with an imperforate urethra; this fœtus had a very large dilated

bladder (Fig. 310), and both kidneys were typical examples of general cystic disease.

The museum of St. Bartholomew's Hospital contains the reproductive organs of a child born at full time: the hymen was imperforate and the bladder greatly distended; the vagina was converted into a large cyst containing mucus (Fig. 311). The pressure of the distended vagina had compressed the urethra, distended the bladder, and dilated the

Fig. 311.—Kidney, uterus, vagina, and bladder of a new-born child, shown in section. The distension of the vagina and uterus is due to an imperforate hymen. The ureter is widely dilated and the kidney sacculated. (*Museum, St. Bartholomew's Hospital.*)

renal pelvis, producing the condition known as sacculated kidney. A comparison of these specimens seems to indicate that the dilatation of the uriniferous tubules which results in general cystic disease of the kidneys is due to some cause acting very early in embryonic life. When obstruction to the outlet of urinary secretion occurs in the later stages of

intra-uterine life, dilatation of the renal pelvis and its recesses (hydronephrosis) is the more frequent consequence.

It is, however, a point of some importance to realise that there are cases in which the kidneys, though the seat of general cystic disease, are capable of performing their function, and the individual attains adult life. In such cases the cysts of the kidneys increase in size, and the organs attain the proportions of full-grown pumpkins. Eventually the secreting substance of the kidneys is destroyed and the patient slowly dies from uræmia. It is important to realise this condition of kidney, because in several instances surgeons have removed organs enlarged in this way: such interference has not been to the advantage of the patients. The museum of the Royal College of Surgeons, London, contains an excellent series of specimens illustrating general cystic disease of the kidney in man and other mammals.

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CHAPTER LVI.

TUBULO-CYSTS.

The human body contains certain tubes which, so far as is known, serve no useful purpose in the adult, and may be called in consequence **functionless ducts**. Some of these—*e.g.* the vitello-intestinal duct and the urachus—were probably useful to the embryo; others, like the parovarium and Gartner's duct, are serviceable in the male, as they act as conduits to the testis. Functionless ducts must not be confounded with **obsolete canals**: these serve no useful purpose in man, but were, in all probability, functional in the ancestors of existing vertebrata (Chapter XLV.). Both sets of canals are of interest to the pathologist, as they are the source of cysts which are not only inconvenient to the individual but actually dangerous to life.

The genus **Tubulo-Cysts** includes the seven following species:—1, Cysts of the vitello-intestinal duct; 2, Cysts of the urachus; 3, Paroöphoronic cysts; 4, Parovarian cysts; 5, Cystic disease (adenoma) of the testis; 6, Cysts of Gartner's duct (Chapter XLIX.); 7, Cysts of Müller's duct. In the present chapter species 1, 2, and 7 will be dealt with.

Cysts of the Vitello-Intestinal Duct.—It is not uncommon to find connected with the umbilicus of babes and young children small tumours varying in size from a pea to a cherry. These tumours are bright red, soft and velvety to the touch, and are, as a rule, connected to the navel by slender pedicles, and in appearance resemble red currants; occasionally they are sessile.

These tumours are composed of unstriped muscle fibre, mucous membrane, Lieberkühn's follicles, and columnar epithelium, collected into a mass. Typical cases have been carefully described by many observers.

In rarer cases the umbilicus is occupied by a cyst, which may project externally or internally. Such a cyst is lined

with mucous membrane furnished with villi, columnar epithelium and follicles. A cyst of this character is easily confounded with the sac of an umbilical hernia.

The histology and position of pedunculated tumours and sessile cysts at the navel indicate the structure from which they arise—viz. a remnant of the vitello-intestinal duct which, in the embryo, traverses this part of the abdominal wall (Fig. 312). In transverse sections of the umbilical cord, close to the belly wall of the embryo at the fifth month, the vitello-in-

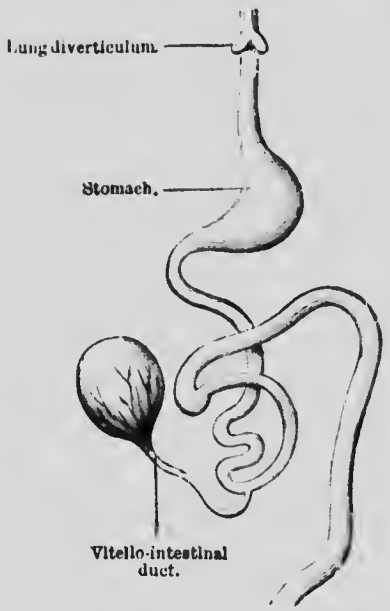

Fig. 312.—Diagram of the alimentary canal of the embryo, showing the position of the yolk sac.

testinal duct can often be detected, with its lumen lined with subcolumnar epithelium. It is also well known that the duct, instead of shrivelling, sometimes grows *pari passu* with the gut to which it is connected, and acquires a lumen almost equal to that of the ileum. Instead of persisting from the gut to the navel the duct may atrophy, leaving a small portion attached to the intestine or to the abdominal wall. Such remnants may develop into cysts the walls of which are identical in structure with those of a small intestine.

A much rarer variety of cyst arising in a remnant of the

vitello-intestinal duct is due to the distension of that portion of the duct which is connected with the ileum. In recently hatched chicks the intestinal attachment of the duct is often indicated by a nipple-like process on the free border of the gut. This is hollow, but does not communicate with the lumen of the ileum. As a rule it atrophies completely. It may, however, grow and form a large cyst. The museum of the Royal College of Surgeons contains a piece of intestine from an emu chick with a large cyst suspended from it by means of a narrow and acutely torsioned pedicle. This cyst in all probability originated in a persistent portion of the vitello-intestinal duct.

Cysts of like proportions and of identical origin have been recorded in the human subject. One of the best-known cases was reported by Roth.

Occasionally a persistent vitello-intestinal duct will remain open at the umbilicus and discharge fæces. Such cases have been successfully dealt with by surgeons.

There are few structures in our bodies more capable of exciting philosophical speculation than the yolk sac and its duct. This organ may in man and all the higher mammals be regarded as vestigial, for its duties have been in part abrogated by the allantois, but more completely by the placenta. In the human embryo it is the function of the allantois to convey the blood-vessels which it receives from the developing aorta and distribute them to those chorionic villi destined to form the fœtal portion of the placenta.

In some sharks the yolk sac is covered with vascular villous tufts which fit into depressions of the oviduct. Even in some mammals—*e.g.* guinea-pigs—the yolk sac enters into vascular connection with the uterine mucous membrane. There are abundant and good reasons for Balfour's conclusions that placental mammals are descendants of forms the embryos of which had large yolk sacs; but the yolk became reduced in quantity owing to the nutriment the embryo received from the maternal tissues by means of the vascular connection of the yolk sac with the uterine wall. Subsequently the function of the yolk sac became limited by the allantois and the gradual evolution of the placenta, and

finally, so far as man is concerned, abolished. Thus in man it is vestigial, and, like such structures in general, is liable to many vagaries.

There is good reason to believe that the vitello-intestinal duct, besides being a source of cysts, is also responsible for the curious defect in the ileum to which I have applied the name **imperforate ileum**. It occasionally happens that the lumen of the ileum is interrupted by a perforated diaphragm

Fig. 313.—Septate ileum. (*Museum, Middlesex Hospital.*)

(Fig. 313). To such a condition the term **septate ileum** is applicable. When such a diaphragm is present its situation is sometimes indicated by a marked constriction of the gut. In other specimens a more or less perfect valve of this kind is associated with a persistent duct. In such cases the duct opens into the ileum on the distal side of the valve. In other instances the ileum becomes greatly dilated near its middle, and the walls are much hypertrophied; to this succeeds a narrow isthmus which opens into a normal segment of ileum. Lastly, in the complete form the ileum is interrupted (Fig. 314).

These curious defects are attributable to the influence of the vitello-intestinal duct, because they always occur in that

portion of the ileum to which the duct, when persistent, is attached—that is, they do not occur within 30 cm. of the ileo-cæcal valve, and are rarely found at a greater distance than 1 metre from the cæcum.

The most reliable evidence for associating these defects with the duct of the yolk sac is that furnished by specimens in which a persistent duct and a valve coexist. In my early observations I had regarded imperforate ileum as depending upon the influence of the vitello-intestinal duct, and sub-

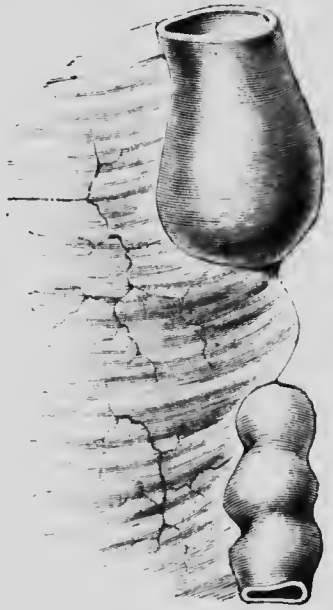

Fig. 311.—Imperforate ileum. (*Museum, Middlesex Hospital.*)

sequent observations put the speculation on a sound basis. The specimens which demonstrate these views are preserved in the museum of the Middlesex Hospital.

Cysts of the Urachus.—The urinary bladder of man, in common with that of other mammals, presents at its apex an impervious cord that passes to the umbilicus. This cord known as the *urachus*, is traversed at birth by a narrow canal lined with epithelium directly continuous with that of the bladder.

The urinary bladder with the urachus is the persistent portion of the allantois, the organ which in the early embryo

conveys blood-vessels from the aorta to the developing placenta. In the adult the urachus lies in the subperitoneal tissue exactly in the middle line of the anterior abdominal wall, between the summit of the bladder and the umbilicus. When the urachus becomes dilated it forms a cyst lying outside the peritoneum and in close relation with the bladder.

Instead of a portion of the allantois narrowing to form a urachus, the whole of its intra-abdominal portion may dilate and form a large urinary bladder.

Several cases are known in which the umbilical end of the urachus has remained patent, so that urine was voided at this spot. A urinary calculus has been extracted from such a persistent urachus.

Cysts of the dimensions of a cherry are not uncommon in the urachus, especially near the summit of the bladder; sometimes a number of small dilatations occur, causing the urachus to assume a moniliform appearance.

In rare cases the urachus may dilate into a cyst as large as a distended bladder. The walls of such cysts are composed of unstriped muscle tissue. Care must be taken not to confound a sacculus at the apex of the bladder, or extending into the suspensory ligament, with a cyst arising in the urachus.

Lawson Tait drew attention to the probable origin of some forms of extra-peritoneal cysts in the urachus, and the whole matter has been subjected to a very critical and painstaking analysis by Doran.

Allantoic (urachus) cysts not only occur in man, but I have observed them also in the pig, horse, ox, and mole.

Cysts of Müller's Ducts.—In many vertebrata the eggs, after their escape from the ovary, are conveyed to the exterior by means of a muscular conduit known as the oviduct. The general disposition of these ducts, for there are usually two, may be gathered from an examination of a female frog or toad. The ducts extend from the cloaca posteriorly to the roots of the lungs anteriorly; they are supported on the dorsal wall of the abdomen by means of a delicate fold of peritoneum, and each duct communicates with the peritoneal cavity by a dilated orifice known as the infundibulum. In the breeding season the ducts become greatly enlarged and convoluted, resembling coils of small intestine.

Normally, oviducts are present in the female only. It is, however, remarkable that the embryos of those forms in which the sexes are distinct in the adult condition have the rudiments of the sexual organs

peculiar to the male and female; they are hermaphrodite. As development continues one set of organs usually attains a functional condition; the other atrophies more or less completely.

The distinguishing features of the internal sexual organs of a female frog are two ovaries and two oviducts. In the male the oviducts are usually absent. It is, however, an interesting fact that in many male frogs the oviducts may be detected as thin, delicate threads ascending in the peritoneum from the structures called vesiculæ seminales to the roots of the lungs. Sometimes the ducts are of large size, almost equal to the oviducts in the female. Persistent Müllerian ducts are more common in male toads than in frogs. Often they are associated with the malformation of the genital gland known as an ova-testis; but they are fairly frequent even when the genital gland is a typical testis. No one can doubt that an oviduct in a male frog or toad is functionless, and it is not uncommon to meet with small dilatations or cysts lying in the track of, and arising from, the functionless oviducts. Persistent Müller's ducts are by no means confined to batrachians, but they have been observed in fish, lizards, stallions, birds and men.

Good examples of cysts arising in functionless ducts are sometimes met with in birds. In birds, as in frogs and toads, the eggs are conveyed to the exterior by means of an oviduct, but in the case of birds the duct is functional on the left side only. Each chick has two oviducts, but the right ovary and duct, from some unexplained cause, atrophies, leaving, as a rule, a small, narrow tubule surmounted by a lobule of fat. This remnant of the right duct is very apt to dilate and form a cyst. When the stump of the duct is longer than usual it will sometimes become unequally dilated and form a chaplet of cysts.

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CHAPTER LVII.

HYDROCELE.

THE name **hydrocele** is applied to several different kinds of cystic tumours, and as the name is so deeply rooted in surgical literature it would be very inconvenient to attempt to discard it. In this work the term will be restricted to *cysts due to an excessive accumulation of fluid in a diverticulum or pouch of the peritoneum*, such as—1, hydrocele of the tunica vaginalis; 2, hydrocele of the canal of Nuck; 3, ovarian hydrocele; 4, omental hydrocele.

1. **Hydrocele of the Tunica Vaginalis.**—Each testicle is preceded in its descent by a diverticulum of the parietal peritoneum, which enters the scrotum by way of the inguinal canal. As the testicle descends behind this diverticulum, or **funicular pouch,** as it is termed, it invaginates the membrane in such a way as to invest the anterior two-thirds of its surface with a double layer of peritoneum. When the testicle first gains the scrotum the funicular pouch is in free communication with the general peritoneal cavity. It is a remarkable fact that in almost every mammal, male and female, save man, this relation of the funicular pouch to the peritoneal cavity persists throughout life. The only exceptions which have come under my notice occurred in a chimpanzee and a gorilla (males).

In exceptional instances this communication persists even in man, but in him it is distinctly abnormal. Normally the peritoneum becomes adherent immediately above the testis, this adhesion dividing the pouch into two parts; that in relation to the testis persists throughout life as the **tunica vaginalis,** whilst that above the testis usually undergoes obliteration in the course of the early months of infant life. Occasionally occlusion of this pouch is delayed for some years, and in rarer cases it may persist throughout life.

Normally the only portion of the funicular pouch that

persists throughout life is that which is in immediate relation with the testis—the tunica vaginalis—and when this becomes distended with fluid it is termed *hydrocele* of the *tunica vaginalis*. When containing blood it is called *hæmatocele* of the *tunica vaginalis*. Should the whole of the funicular pouch persist and become occupied by fluid, it is called a *congenital hydrocele*. Frequently the tunica vaginalis is formed as usual, but the portion intervening between it and the internal abdominal ring persists and may become distended with fluid. This is known as *funicular hydrocele*; it is often called *encysted hydrocele of the cord*.

Hydrocele of the tunica vaginalis appears in two forms **acute** and **chronic**. Acute hydrocele is due to inflammatory effusion into the sac, either the result of injury or secondary to acute orchitis. This is the rarer form, and, as a rule, the fluid is absorbed and the parts return to their normal condition as the inflammatory trouble that caused it subsides. Exceptionally a hydrocele appearing in this way persists.

The common form of hydrocele is a passive effusion into the tunica vaginalis, usually appearing about the middle period of life, and in many cases without any exciting cause, either local or constitutional. It is very common in men who have lived in the tropics. Hydrocele is met with in extreme old age, and is occasionally bilateral.

The amount of fluid in hydrocele varies greatly; in some it amounts to one or two ounces, whilst in others it measures a pint or more. The fluid is limpid, of a straw colour, with a sp. gr. of about 1015. It contains a large amount of albumen and the substance known as fibrinogen. When allowed to stand after withdrawal it spontaneously coagulates.

When the fluid is removed by tapping it usually quickly reaccumulates, so that the amount of fluid furnished by a large hydrocele in the course of a few years is often considerable. Even the withdrawal of large quantities of fluid from a hydrocele at frequent intervals seems to exercise no evil influence upon the health of the patient.

The presence of a large quantity of fluid in the tunica vaginalis leads to changes, not only in the membrane itself but also in the testicle, for this gland, pressed upon by the fluid, will in course of time atrophy. In most specimens the

testis is situated in the lower and back part of the sac, as in Fig. 315. In those cases in which the testis is inverted the hydrocele projects posteriorly, and the testis lies in front and at the upper part of the sac.

In addition to atrophy of the testis, the diminution in the size of its secreting tissue may be masked by great thickening of its tunica albuginea, a condition termed periorchitis, which is by no means infrequent in old hydroceles, especially those

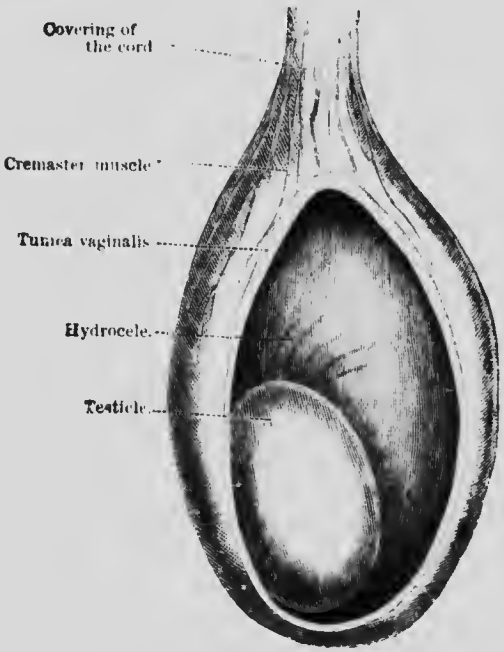

Fig. 315.—Hydrocele of the tunica vaginalis testis.

which have been repeatedly tapped. This thickening, or sclerosis, manifested by the immediate covering of the testis, is often seen in the tunica vaginalis throughout its whole extent, and in some cases this membrane may be as thick and almost as hard as pasteboard. The hardness of these thick sacs is sometimes increased by calcareous matter. When such sacs are dissected out they are not unlike a cocoanut in shape, size, and even in consistence. Secondary changes of this kind may be due to repeated attacks of inflammation set up by tapping: in some cases bands of adhesions or

broad septa form, and produce a loculated cyst. In other cases suppuration ensues, which may lead to serious consequences. Occasionally loose bodies are found in the sac of the tunica vaginalis, often associated with, but sometimes independent of, hydroceles. Some are no larger than the head of a pin, others attain the dimensions of a cherry. The larger examples consist of dense, structureless laminæ.

Rupture of a Hydrocele—This is a rare accident, and is the result of slight injury or a muscular strain; in some cases it appears to have happened spontaneously. Hastings has collected forty cases, and the records shew that the accident occurs mainly in chronic cases and is associated with degenerate changes in the tunic.

In a case under my care the patient complained of pain, followed by œdema, and some hours later ecchymosis of the scrotum due to extravasation of the fluid into its loose tissues.

The variety known as **congenital hydrocele** is due to the persistence of the funicular pouch throughout its whole extent. In this form we meet with two conditions: the sac may retain its connection with the general peritoneal cavity, or it may be occluded at the internal abdominal ring. When the orifice of the sac is not occluded the fluid that accumulates in the sac gravitates into it from the peritoneal cavity during the day; but during the night, when the body has been in a recumbent position for a prolonged period, the fluid returns wholly or in part to the abdomen, so that in the morning the scrotal swelling will be found greatly diminished, if not entirely gone. As the day goes on the fluid will slowly re-accumulate in the tunica vaginalis. Such alteration in size of the swelling is characteristic of this variety of hydrocele: but it is sometimes simulated by, and mistaken for, inguinal hernia.

When the funicular pouch is shut off at the inguinal canal and becomes distended with fluid it is sometimes difficult to distinguish it, except by dissection, from a hydrocele of the tunica vaginalis.

Congenital hydrocele is most commonly met with in children, and is very rare after the fifteenth year. An accumulation of fluid is not uncommon in the funicular pouch of infants, and it often disappears spontaneously.

Funicular hydrocele is another variety, frequently referred to as encysted hydrocele of the cord. It is due to effusion of fluid into that portion of the funicular pouch which intervenes between the tunica vaginalis and the internal abdominal ring, and which, under normal conditions, suffers obliteration. This form of hydrocele is very frequent in infants, and presents itself as an ovoid tumour lying between the testis and the inguinal canal. Although it possesses very characteristic features, this variety of hydrocele is frequently confounded with hernia of the intestines into the funicular pouch. Funicular hydroceles occasionally occur in young adults.

It should be borne in mind that an inguinal hernia may be associated with a hydrocele, and it happens occasionally that the neck of a hernial sac may become so narrowed that gut and omentum no longer pass through it. A pouch of this kind would, if distended with fluid, simulate a hydrocele of the tunica vaginalis. In exceptional cases **hydrocele of a hernical sac** accompanies ascites. In several instances collections of ascitic fluid have been evacuated through a trocar inserted into the sac of an old hernia. "Hydrocele of a hernial sac" is common in the femoral variety of hernia. According to Horrocks, the large scrotal cyst which troubled Gibbon, the historian, was an irreducible hernia with a large quantity of fluid in the sac.

2. **Hydrocele of the Canal of Nuck.**—In female fœtuses a diverticulum of the parietal peritoneum descends into the inguinal canal, and is in all respects identical with the funicular pouch in the male; it is known as the canal of Nuck. Usually this pouch becomes obliterated, but it is by no means rare to find it patent in young women. Occasionally the canal becomes distended with fluid and forms a cyst occupying the inguinal canal, and is then termed a hydrocele of the canal of Nuck.

Treatment of Hydrocele.—The routine practice of treating *hydrocele of the tunica vaginalis* is to draw off the fluid by means of a narrow trocar and cannula. The cyst almost invariably refills, necessitating repeated tapping. The simplest method is to open the sac, and, after inverting the tunica vaginalis, return it with the testis into the scrotum. This is also the most appropriate method of treatment for rupture of

the tunica vaginalis testis. *Hydrocele of the canal of Nuck* should be dissected out and the neck of the sac ligatured. The same method anwers well for *hydrocele of a hernial sac*, whether inguinal or femoral.

3. **Ovarian Hydrocele.**—The ovaries in rats and mice are contained within a serous sac derived from the peritoneum. The abdominal ostium of the Fallopian tube communicates with the ovarian sac; hence, when the ova escape from the ovary they enter the Fallopian tube and gain the uterus without entering the general peritoneal cavity, as is the case with the human ovum. This serous sac investment of the

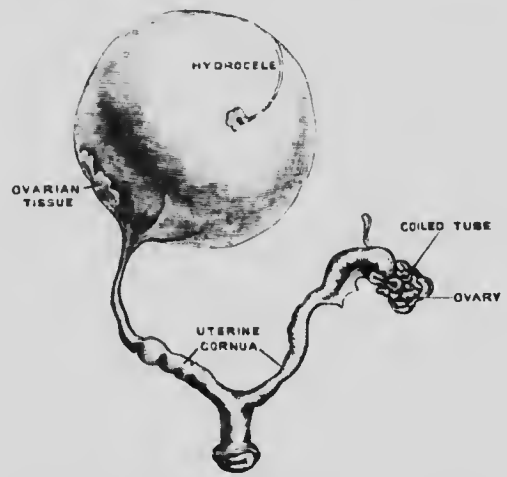

Fig. 316.—Ovarian hydrocele in a rat. (*Nat. size.*)

ovary recalls the tunica vaginalis of the testicle, and, like it, the ovarian sac is liable to become distended with serous fluid, a condition to which I have applied the name **ovarian hydrocele**. Cysts of this kind in rats may attain a large size, and their general features are well illustrated in Fig. 316. The Fallopian tube in the rat is coiled up between the cornu of the uterus and the ovarian sac, but when the sac becomes distended it uncoils the tube and stretches it around the circumference of the cyst: the tubal ostium opens on the inner wall of the hydrocele, and the adjacent section of the tube is, as a rule, dilated. The ovary, when the cyst is small, projects into the cysts, but in very large hydroceles it

atrophies from pressure. As the ovarian sac is in communication with the uterine cornu it sometimes becomes implicated in septic conditions of the uterus, and the sac may be found distended with pus.

No other mammal normally possesses such a complete ovarian sac as do rats and mice, but many have a pouch that communicates with the general peritoneal cavity by a small aperture; in others the pouch has a narrow slit; whilst in women the ovary, in its virgin condition, lies in a shallow recess. Notwithstanding the fact that the mouth of the ovarian pouch is in women very wide, there is good reason to believe that its edges may unite when the pouch is abnormally deep and convert it into a closed sac, which subsequently becomes a hydrocele. Ovarian hydroceles occur in the human female, and sometimes attain a large size. They present the following anatomical features:—

The sac projects from, and is intimately connected with the posterior layer of the broad ligament. In small hydroceles the ovary projects into the cavity of the cyst, but in large examples it is atrophied. The Fallopian tube lies on the crown of the cyst, its outer half is dilated and tortuous; the ostium opens into the hydrocele by a large circular or elliptical aperture. Ridges of mucous membrane issue from the interior of the tube and pass on to the walls of the hydrocele in a radiating fashion. When the specimens are examined in a fresh state it is not rare to find the aperture fringed with tubal fimbriæ. The general appearance of a typical ovarian hydrocele suggests "a retort with a convoluted delivery-tube" (Griffith).

Besides finding ovarian hydroceles in rats and women, I have detected one in a guinea-pig, and Schneidemühl has observed one in a mare.

The cysts liable to be confounded with ovarian hydroceles are parovarian cysts, small paroöphoronic cysts, and large hydrosalpinges. A parovarian or paroöphoronic cyst is distinguished from a hydrocele of the ovary by the fact that the Fallopian tube is stretched across the cyst but does not communicate with its cavity.

In the case of a large hydrosalpinx the ampulla is often so flexed on the tube as to produce a retort-shaped cyst: but

there are no fringes or ridges of the mucous membrane at the orifice of communication, and the ovary lies free of the cyst wall and is often lodged in the flexure of the tube.

Ovarian hydroceles must not be confounded with tubo-ovarian cysts and abscesses the result of salpingitis.

4. **Omental Hydrocele.**—Under normal conditions the lesser cavity of the peritoneum extends into the great omentum; occasionally this space becomes distended with fluid, and its communication with the upper area of the lesser cavity becoming shut off, the omental space is isolated and converted into a cyst. Similar cysts arise in the transverse mesocolon, and I have encountered them in the mesocæcum and mesosigmoid. Omental hydroceles are sometimes so big as to simulate ovarian tumours.

Chyle Cysts.—This is perhaps the best place to mention a rare but interesting lesion known as chyle cyst of the mesentery. The sac of the cyst appears to be formed of the separated layers of the mesentery, the interspace being occupied by fluid identical in its physical and chemical characters with chyle. In their anatomical features these cysts are similar to omental hydroceles, and, like them, are occasionally big enough clinically to simulate ovarian cysts (Rasch, Bramann, Mendes de Leon, and Fetherston).

There is a variety of cyst containing chyle which is met with in infants and children. Such cysts are closely connected with the mesenteric border of the intestine and push their way between the layers of the mesentery. There is reason to believe that they arise as abstrictions of the intestines during fœtal life. This variety has been particularly studied by Eve, Fawcett, and Dowd. These cysts are important, for they have caused fatal intestinal obstruction.

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CHAPTER LVIII.

PSEUDO-CYSTS—DIVERTICULA.

The term **diverticulum** is used to denote hernia or protrusion of the lining membrane of a cavity through a defective spot in its walls. Such protrusions occur in connection with the œsophagus and intestines, the bladder and the trachea; also in relation with joints and tendon-sheaths forming synovial cysts and ganglia; and in blood-vessels forming sacculated aneurisms and varices.

Intestinal Diverticula.—These are hernial protrusions of the mucous membrane of the bowel through interspaces in the muscular coat. Structurally they consist of mucous membrane with a covering of peritoneum. Sometimes a few strands of muscle fibre can be detected stretched across the pouch.

Frequently diverticula occur in multiples; as many as two hundred have been found in one case. These pouches occur in all parts of the intestine, but are most frequent in the colon, and especially about the sigmoid flexure. In the small intestine they usually occur along the line of the attachment of the mesentery. In the colon they are found about the attachment of the appendices epiploicæ, and may even project into them.

In dimensions diverticula vary greatly—some are as small as peas, others as large as oranges. When the pouches are numerous, as a rule they are small; when few in number, or solitary, they may be large. Intestinal diverticula are common in old persons, but they rarely lead to serious consequences.

Some writers describe diverticula of the intestines as consisting of two varieties, *true* and *false*. According to this arrangement a persistent vitello-intestinal duct would be called a true diverticulum.

Vesical Diverticula.—Hernial protrusions of the mucous membrane of the bladder between the fasciculi of the muscular coat are of frequent occurrence. The cause of the protrusion

is impediment to the free flow of urine: the obstruction may be seated in the urethra or at the neck of the bladder. Under such conditions there may be several diverticula: the bladder is then said to be sacculated. Sometimes there is only one sacculc, and this may attain a large size. Vesical diverticula usually communicate with the cavity of the bladder by large orifices. A sacculus extending into the suspensory ligament of the bladder must not be confounded with a urachus cyst.

Sacculated bladders, apart from the cause that produces the sacculus, do not often give rise to trouble. Calculi are sometimes found within them, and in cases where the outflow of urine is seriously obstructed the walls of a sacculus will sometimes yield and allow the urine to extravasate into the surrounding loose connective tissue.

As impediments to the free escape of urine from the bladder occur more frequently in men than in women, it naturally follows that sacculated bladders are more common in men. Nevertheless, vesical diverticula of large size are occasionally found in women, and in exceptional cases have caused death.

Pharyngeal Diverticula (*Pharyngoceles*).—Localised dilatations of the pharynx are of three kinds:—

Abnormal persistence and distension of certain pouches which, as a rule, exist in the embryo only—*e.g.* the pouch of Rathké and the branchial clefts.

Pouching of the pharyngeal wall at its junction with the œsophagus.

Protrusions (herniæ) of the mucous membrane lining Rosenmüller's fossa.

When the pouch of Rathke persists it may dilate and form a cyst in the pharynx near the junction of its posterior wall with the roof. Such cysts have been known to attain the dimensions of a ripe cherry.

Pharyngoceles.—In order to appreciate the nature of at least one form of pharyngeal pouch it will be necessary to take into consideration an interesting congenital defect to which the pharynx is liable.

It occasionally happens that children are born with what is known as an **imperforate pharynx,** that is, instead of the pharynx and œsophagus forming a continuous tube, the

pharynx terminates as a cul-de-sac near the level of the cricoid cartilage.

In such cases the upper end of the œsophagus terminates by opening into the trachea through its posterior wall. The situation of the œsophago-tracheal fistula varies in different specimens; sometimes it is as high as the third tracheal semi-ring, or it may be as low as the bifurcation of the trachea, and in at least one case it opened into the left bronchus. In most examples of imperforate larynx the œsophagus is connected

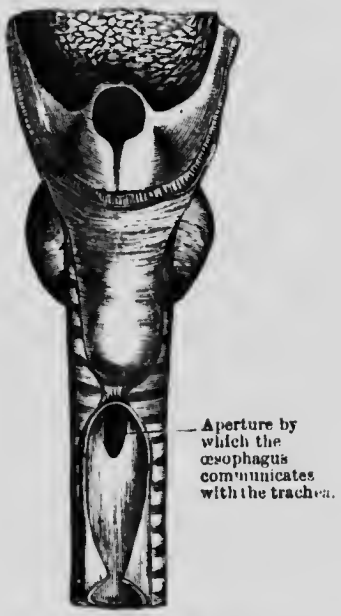

Fig. 317.—Imperforate pharynx.

with the lower end of the pharynx by a fibrous band, which indicates that the two structures were originally continuous, but that their continuity has been disturbed by secondary changes (Fig. 317).

The constant association of an œsophago-tracheal fistula and imperforate pharynx indicates some relation between the two conditions. The explanation which at once suggests itself is, that it may be due to some influence exercised by the pulmonary diverticulum which leaves that portion of the embryonic fore-gut ultimately represented by the œsophagus.

This subject has been handled with remarkable acumen by Shattock.

It is necessary to describe congenital imperfections at the junction of the pharynx and œsophagus, because it is at this point that pouches are apt to form. A typical example of a pharyngeal pouch, or **pharyngocele**, is shown in Fig. 318. The case is very carefully described by Worthington. The parts were obtained from a man sixty-nine years of age.

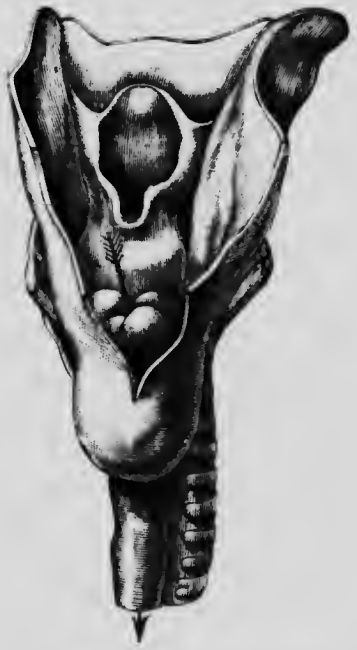

Fig. 318.—Pharyngeal diverticulum. (*After Worthington.*)

There was a stricture of the œsophagus at the level of the crieoid cartilage that would admit merely a urethral bougie. This obstruction ultimately led to the death of the patient. He could swallow food and retain it for a time; it would then regurgitate. At the *post-mortem* dissection the pouch was detected; it was in shape like the finger of a glove, and had a depth of 9 cm. and a circumference of 6 cm. The mucous membrane at the seat of the stricture was quite healthy. About two-thirds of the pouch was covered with muscle derived from the inferior constrictor.

An examination of pharyngeal pouches such as exist in museums would lead the observer to believe that the orifice of communication between the pharynx and the pouch was circular; but there is good reason to believe that it assumes a slit-like form even when the pouch is full of food.

So far as our knowledge at present extends in regard to this variety of pharyngocele, it would appear that such pouches arise in all probability as congenital defects; but it is important to remember that they rarely cause inconvenience until late in life. Thus Ludlow's patient was sixty; Worthington's sixty-nine; Chavasse's forty-nine; and Butlin's, forty-seven. It is necessary to point out that a pharyngocele of the character represented in Fig. 318 arises in a different manner from that depicted in Fig. 243; the latter is probably due to a persistent bronchial cleft.

Treatment.—Pharyngoceles are likely to be much more carefully studied in the future than they have been in the past, for the condition has on more than one occasion been correctly diagnosed, and the pouch removed through an incision in the neck and its slit-like orifice of communication with the pharynx occluded by sutures, a manœuvre that has been followed with complete success in the hands of Bergmann, Butlin, and others.

Œsophageal Diverticula.—Hernial protrusions of the mucous membrane of the œsophagus through the muscular coat are not common. They vary greatly in size. Some are no larger than cherries, others may attain the size of a closed fist. Diverticula arise in many parts of the œsophagus; nothing is known as to their cause.

Tracheal Diverticula. These are small hernial protrusions of the mucous membrane of the trachea; they are uncommon, and invariably occur near the junction of the trachealis muscle with the cornua of the semi-rings of the trachea. Rokitansky regarded them as dependent on chronic catarrh of the trachea. Gruber, on the other hand, was of opinion that they are retention cysts of the glands in the tracheal mucous membrane; they are of little clinical interest.

The Tracheal Diverticulum of the Emu.—The emu (*Dromæus novæ-hollandiæ*) is normally provided with a tracheal diverticulum of great interest. In this bird there is a natural defect in the front of the trachea,

at a spot varying between the fiftieth and sixty-fifth ring. The deficiency may involve six or more rings. In the emu chick the defect is scarcely noticeable, and the extremities of the rings are almost in contact. As the bird grows the tracheal mucous membrane becomes slowly herniated through the opening until it forms a huge sac between the skin of the neck and the trachea. The cyst wall is composed of connective tissue with scattered bundles of striated muscle fibre; its mucous lining is

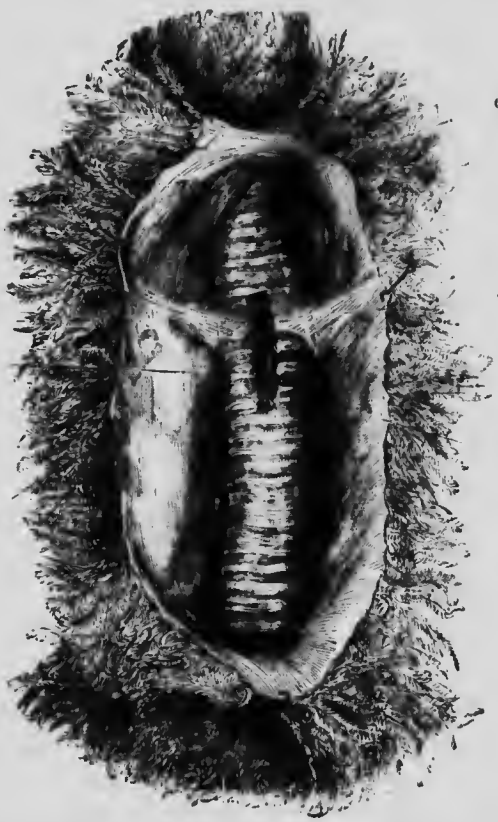

Fig. 319.—Tracheal opening and pouch of an emu. The pouch is cut so as to expose its interior. The surrounding feathers are cut short. (*After Murie.*)

directly continuous with that of the windpipe, and is dotted with the orifices of glands (Fig. 319).

The adult emu inflates this sac when it produces the peculiar booming sound which resembles the noise made by blowing across the mouth of a large bottle.

This large tracheal sac may inflame and become distended with mucus. In a specimen which I secured and forwarded for preservation to the museum of the Royal College of Surgeons, London, the sac

contained two pints of mucus. The bird was unfortunately drowned in this fluid, for while I was making an attempt to evacuate the contents of the sac the fluid entered the opening in the trachea and suffocated it.

Murie has written an excellent account of the anatomy of the trachea of the emu. I can confirm his observations, having enjoyed the opportunities of dissecting the adult emu and the emu chick. Concerning the function of this pouch nothing is known.

The Guttural Pouches of the Horse.—In man the pharyngeal orifice of each Eustachian tube opens in relation with a bay or recess termed the fossa of Rossenmüller. In the horse the tubes terminate

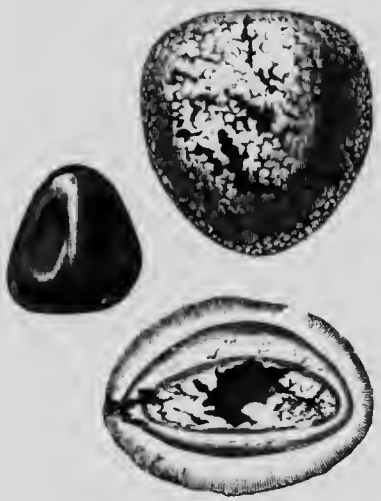

Fig. 320.—Concretions from the guttural pouches of horses. (*Nat. size.*)

in a very different manner. When the head is removed at the occipito-atlantal articulation, and the pharynx, with the associated structures, carefully dissected from the muscles on the ventral aspect of the cervical region of the spine, it will be found, as a rule, difficult to avoid cutting into two large sacs separated from the atlas and axis by loose connective tissue. These sacs reach to the base of the skull, extend downwards to the larynx, and send processes to occupy the intervals between the long styloid processes and the mandible. These sacs are the *guttural pouches*: they abut upon, but have no communication with, each other, and occupy the whole of the naso-pharynx. Each pouch is lined with delicate mucous membrane containing glands and furnished with ciliated epithelium.

The mucous membrane of the guttural pouches is directly continuous with that lining the Eustachian tubes. The pouches themselves appear as large saccular dilatations of the terminal ends of the tubes, and for this reason they are termed by some writers the Eustachian pouches. Each pouch opens into the pharynx immediately

above the soft palate by a valvular orifice; one side of the valve is formed by the leaf-like termination of the Eustachian tube. Of the functions of these pouches nothing is known. They are often a source of inconvenience to horses, for the mucous membrane is very prone to become inflamed, and the scanty outlet for the secretion leads to its retention and the consequent dilatation of the sacs. When enlarged in this way they may have a capacity of six or more ounces each. The retained secretion may decompose, and the sac become distended with pus, which is discharged at intervals through the nose; or the pharyngeal orifice may be occluded, and the pouches enlarge to such an extent as to require an incision through the skin of the neck or through the mouth.

Not unfrequently the contents of the pouches become inspissated and formed into concretions. These are of different shapes and sizes, and vary in number from one, two, or three to fifty or even more. Generally they are of an oval shape; not seldom they resemble beans. In consistence these concretions are like cheese, and on section have a laminated appearance. They are composed of mucus and inflammatory products mixed up with organic particles (Fig. 320).

The grit in these concretions enables an explanation to be offered concerning the liability of the pouches to attacks of inflammation. As the orifices of the pouches are in direct communication with the nasal passages, dust can easily gain entrance into them when snuffed up with fragments of hay, straw, dried seeds, and other organic and inorganic particles from dusty nose-bags and mangers.

Laryngoceles.—In certain adult monkeys, particularly the chimpanzee (*Simia troglodytes*), the deep cervical fascia is undermined by diverticula from the laryngeal mucous membrane. This large sub-fascial air chamber communicates with the larynx through the thyro-hyoid membrane; it extends downwards to within 2 cm. of the presternum. Exceptionally it dips into the anterior mediastinum, and laterally into the armpits, the axillary fasciæ forming the lowest limits of the sac.

In one fine chimpanzee I injected this huge reservoir, and found it would hold three pints of injection mass. In the howling monkey, *Myectes*, the air-sac is very large, and the basi-hyal is hollowed to form a resonance chamber. Cervical air-sacs exist in many mammals, and can be inflated at will. They arise as diverticula from the larynx, either from the ventricle or from the pouch of Morgagni in the middle line of the larynx below the epiglottis. In the early stages the lateral pouch resembles the human sacculus laryngis inflated. Gradually the sacs undermine the deep cervical fascia and

subsequently coalesce. The air-sac of the adult chimpanzee is formed by fusion of two lateral pouches and a median pouch.

There is great variety in the degree of development of the cervical sacs in different genera and species of mammals.

In 1888 I stated the following reasons for regarding some kinds of congenital cervical cysts in children as examples of laryngeal saccules:—

The congenital nature of the cysts. Repetitions of animal structures of this kind are always congenital.

Their relation to the hyoid bone and larynx. The hollow of the basi-hyal in man represents the large cavity in the basi-hyal of many mammals.

The situations of the cysts beneath the deep cervical fascia and their occasional extension into the axillæ.

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CHAPTER LIX.

PSEUDO-CYSTS *(Concluded)*.

SYNOVIAL CYST, GANGLION, AND BURSA.

Synovial Cysts.—Cysts containing synovia arise in three ways:—

(1) Hernial protrusions of the synovial membranes of joints.

(2) Bursæ in the immediate neighbourhood of joints.

(3) Hernial protrusions of the synovial sheaths of tendons.

Synovial cysts arise in connection with the hip, knee, ankle, shoulder, elbow, and wrist joints. They have been most carefully studied in connection with the knee joint. The cysts form swellings, in some cases as large as an orange, situated near the knee-joint, usually in close relation with the tendons of the semi-membranosus, biceps, or gastrocnemius muscles. Occasionally the cyst will be situated in the calf on the inner side, sometimes as much as 8 cm. below the knee. When the swelling is situated near the joint, pressure will cause it to disappear, the synovia it contains passing into the general cavity of the joint. When the cyst is situated at a distance from the joint, pressure upon it may have no effect in diminishing its size, because in many cases the communication between the cyst and the joint cavity is by a very narrow, almost capillary channel.

The cysts arise usually in connection with joints which are chronically diseased, and seem to be common in tubercular joints. It is believed by those who have devoted special attention to these cysts that when the joints become distended with synovia, the internal pressure causes the synovial membrane to protrude through weak spots in the capsule, the diverticula making their way along the intermuscular planes. This mode of origin is similar to that which obtains in the case of sacculated bladders.

It is also certain, for it has been demonstrated by dis-

section, that some synovial cysts are due to bursæ normally existing under the adjacent tendons becoming abnormally large and communicating with the joint cavity in consequence

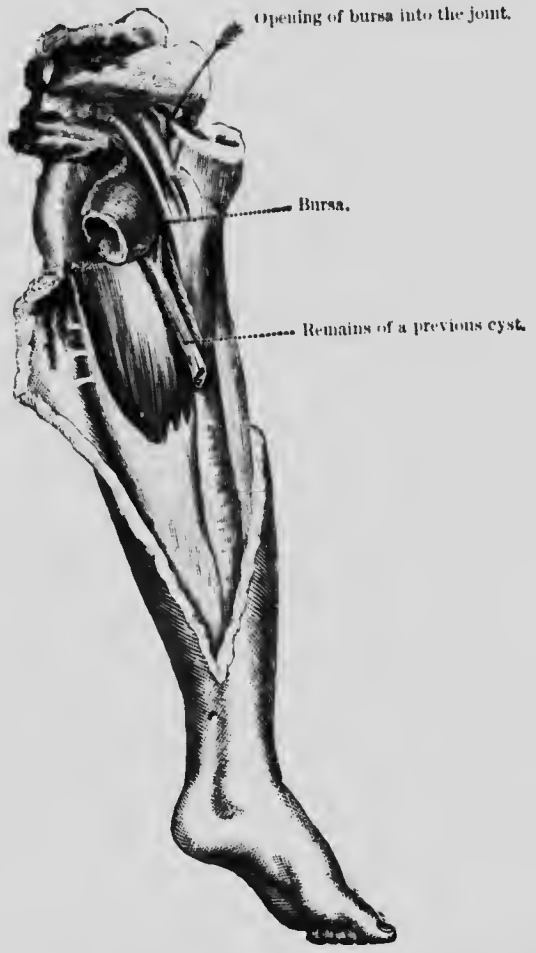

Fig. 321.—Bursa under the semi-membranosus tendon communicating with the knee-joint. A cyst had been incised and drained sixteen months previously. Its partially obliterated channel persists. (*D'Arcy Power.*)

of absorption of the contiguous parts of the wall by pressure (Fig. 321) This seems to happen most frequently in the case of the bursa under the semi-membranosus. It does not necessarily follow because an individual has a synovial cyst near the knee that the joint is diseased; attendance in an

out-patient room will show that many synovial cysts slowly disappear without treatment. This is important to bear in mind, for interference with these cysts is, as a rule, needless and often productive of much harm. Aspiration, injection of iodine, and the insertions of setons may lead to suppuration, and destruction of the joint with which the cyst is connected. Mr. Morrant Baker, who first drew special attention to these synovial diverticula, states that when they arise in connection with the **knee** the cyst will project in the popliteal space, the upper part of the calf, or on the inner side of the calf as much as 10 cm. below the head of the tibia.

In the case of the **shoulder** the cyst projects in front of the joint a little below the clavicle, or in the upper third of the arm in the course of the long tendon of the biceps.

In the case of the **elbow,** the cyst projects on the inner side of the arm above the condyle. I have seen a cyst of this kind as high as the insertion of the coraco-brachialis, connected with the elbow joint by a tubular process of the diameter of the anterior interosseous artery. When they arise from the **carpal joints,** the cysts project on the back or front of the wrist. (See under Ganglion.) When connected with the **hip joint** the cyst forms a swelling in Scarpa's space, and in the case of the **ankle** the bulging is most marked in front and to the outer side of the joint.

The fluid contained in synovial cysts is in most cases identical with synovia, and occasionally contains "melon-seed" bodies. When the joint is the seat of tubercular disease the fluid in the cyst will be purulent; when the skin over these swellings is red and glossy they have been mistaken for simple abscesses and incised.

Ganglion.—A ganglion is a cyst formed by the hernial protrusion of the synovial lining of a tendon sheath. There are two species—simple and compound.

A **simple ganglion** is seen in most typical condition on the back of the carpus, where it forms a rounded sessile elastic swelling which becomes tense when the wrist is flexed, and partially, or wholly, disappears when the wrist is extended. Many of these swellings, which are entered in clinical records as ganglions (or ganglia), are not connected with tendon sheaths. I have satisfied myself by careful

dissections that many of them are diverticula from the carpal joints, and in some instances they arise from the inferior radio-ulnar joint. As in the case of the larger joints, synovial cysts arising from the carpus are occasionally associated with tubercular arthritis.

Ganglia are sometimes met with on the fingers in connection with the sheaths of the long flexors and on the dorsum of the foot; as well as on the outer side of the ankle in relation with the tendons of the peroneus longus and brevis. The fluid in a simple ganglion is clear, transparent, and viscid, and resembles apple jelly.

The **compound ganglion** is a much more serious condition. It occurs mainly at the wrist in connection with the flexor and extensor tendons; it also occurs occasionally on the tendons of the peroneal muscles, where they lie in relation with the calcaneum.

A compound ganglion at the wrist assumes an irregular shape and extends for a variable distance up the forearm; it also sends a prolongation under the annular ligament to appear in the palm, when it arises in connection with the flexor tendons; a similar extension under the posterior annular ligaments is usually noticed when a ganglion is connected with the extensor tendons. A compound ganglion is usually soft and elastic, and imparts a crepitant sensation to the examining fingers when the tendons are set in action. This crepitant sensation is due to the presence in the ganglion of small bodies familiarly known as **melon-seed bodies,** from their shape and consistence; these are sometimes present in enormous numbers. There is much difference of opinion as to the source of these bodies; often, in the course of an operation, they may be seen hanging from the inner wall of the ganglion. An examination of many of the loose bodies will show that they have slender stalks: these appear more clearly when they are placed in water. Bodies identical in structure are met with in synovial diverticula and even in bursal sacs, particularly the prepatellar bursa.

Treatment.—A simple ganglion, such as is so common on the back of the wrist, is in a general way successfully treated by bursting it subcutaneously by the direct pressure of the thumb, and then applying a graduated compress for a few

days. When the wall is so thick that it will not rupture, the swelling may be punctured with a very narrow scalpel; this allows the mucoid contents to escape, and the application of a firm compress for a few days will obliterate the sac.

A compound ganglion should be dissected out as if it were a tumour, and it would appear that the patient runs less risk from this mode of treatment than by the common practice of incision and drainage.

It is well to bear in mind that some of these ganglia are associated with the early stages of tubercular disease of the wrist joint, and a few are undoubtedly due to tubercular infection of the tendon sheaths.

Bursæ.—On many parts of our bodies where muscles and tendons glide over osseous surfaces, or in situations where skin lies in close contact with bony prominences, membranous sacs occur filled with glairy fluid; such sacs are known as **bursæ.** Structurally a bursa consists of a thin-walled sac filled with glairy fluid. The inner wall of the cyst is quite smooth and, as a rule, devoid of epithelium.

In certain situations, such as the anterior surface of the patella and the posterior surface of the olecranon, a bursa is normally present. Bursal sacs may form in any part of the subcutaneous tissues when the overlying skin is submitted to friction and intermittent pressure, as in talipes when the patient walks on the dorsum or side of the foot; beneath corns; and at the metatarso-phalangeal joint in the condition termed bunion. Such are called **adventitious bursæ.** When bursæ arise in connection with tendons, they are spoken of as **subtendinous bursæ,** and they often communicate with the sheath of the tendon, and even with an adjacent joint. The large bursa so constantly present at the insertion of the semimembranosus often has a direct communication with the joint.

The origin of bursal sacs has been explained in the following manner:—

When the skin moves over joints, or passes over hard prominences, the intermediate connective tissue becomes torn or ruptured, thereby leading to the formation of spaces in which fluid collects. The boundary walls are at first irregular, and formed by adjacent connective tissue. Finally this becomes smooth and forms the sac wall.

Bursæ may arise during intrauterine life when the fœtus is submitted to abnormal pressure. Many remarkable instances of this have been recorded, especially in association with talipes.

Most subcutaneous and many subtendinous bursæ arise after birth. When a subcutaneous bursa attains an abnormal size it is invariably due to unusual pressure associated with particular occupations. For instance, too much kneeling on hard material, whether in housemaids, devout persons, or carpet-layers, produces the familar **prepatellar bursa**; repeated blows on the elbow produce **miner's elbow**; from carrying weights on the shoulder **porters** are liable to get a bursa over the acromial end of the clavicle: **tailors** from their cross-legged habit of sitting are sometimes troubled with one over the external malleolus; whilst **weavers** and **lightermen** from prolonged sitting on hard seats suffer from bursæ over their ischial tuberosities: **soldiers** when sleeping too frequently on the hard floor of the guard-room get them over their greater trochanters: the pressure of ill-fitting boots develops a bursa over the enlarged head of the metatarsal bone of the hallux; when associated with partial dislocation of the first phalanx it is known as a **bunion,** and bursæ are quite common on the ends of **amputation stumps**. Clement Lucas has described as the **needlewoman's bursa** a cyst that formed on the palmar surface of the terminal phalanx of the middle finger in an old seamstress. A bursa is often present between the body of the hyoid bone and the thyro-hyoid membrane, and **jockeys** acquire one in front of the ankle from the pressure of the stirrup.

Bursæ are liable to inflame, a process that may lead to suppuration, or stop short of that condition and become chronic or recurrent and lead to secondary changes in the walls of the sac so that its cavity becomes almost obliterated. Chronically inflamed bursæ sometimes attain the size of fists, especially the prepatellar and ischial varieties. Prepatellar bursæ sometimes rapidly solidify in syphilities.

Jephson, in his interesting account of "Fighting Paul" and the Rebellion at the Equator, relates that the writer saw many men of the Bari tribe whom he saw working in the fields had enlarged prepatellar bursæ due to kneeling whilst

at work, and to the fact that the entrances to the huts were so low that it was necessary to enter on the hands and knees.

Treatment.—An inflamed bursa demands rest and the local treatment usually employed for inflamed parts. When the bursa is distended with fluid it is the custom to apply a

322.—A gravid Fallopian tube with a pseudo-cyst or capsule formed around the blood effused through the coelomic ostium. B shows the capsule entire, and in A it is in section so as to display its relation to the ostium and fimbriæ.*

plaster of mercury and ammoniacum over the swelling and fix it firmly with a bandage. It is probable that the firm compression is the chief agent in promoting the absorption of the fluid. In some cases the swelling subsides spontaneously, and this probably explains the supposed efficacy of the application of tincture of iodine.

When bursæ are repeatedly irritated, the walls become so thick that the tumour has to be excised. This mode of treatment is necessary when a bursa contains loose bodies. When the bursa is situated over the patella, malleolus, ischial tuberosity, or trochanter its removal is a very simple proceeding.

When a bunion inflames and suppurates it may involve the underlying metatarso-phalangeal joint. Many of these cases, especially in elderly individuals, demand amputation of the toe. When it is necessary to carry out this measure, it is much more satisfactory to remove the metatarsal bone as well as the toe.

When the bursa between the body of the hyoid bone and the thyro-hyoid membrane is very large it should be incised and drained. Care is necessary to avoid confounding an enlarged thyro-hyoid bursa with a cyst of an accessory thyroid gland, and *vice versâ*.

Pseudo-Cysts in connection with the Fallopian Tube.—When from any cause a clean foreign body finds its way into the peritoneal cavity, or a sterile coagulable fluid is exuded therein, a process is established whereby the foreign substance is encysted. Shattock once found a rounded body with a diameter of 6·25 cm. in the pelvis of a man between the rectum and bladder. On section a piece of iron was detected in its centre, surrounded by regular laminæ of structureless material. He regarded this as an instance in which a piece of metal taken into the alimentary canal had entered the peritoneal cavity by traversing the wall of the intestine; it had then become encysted by exudation (lymph) from the peritoneum.

It happens very frequently that in cases of tubal pregnancy which terminate by what is known as tubal abortion, and especially the form known as incomplete tubal abortion, in which blood slowly trickles, or even drips, from the cœlomic ostium, that the effused blood becomes surrounded by a lowly organised capsule, and this is occasionally so complete as to appear like an ovoid bulb or amphora containing blood, and its neck embracing the cœlomic ostium of the tube (Fig. 322).

This condition, and the mode of formation of the cap-

sules, have been particularly studied by Saenger, Taylor, and Handley. The last observer has proved that capsules of this kind are also formed occasionally in connection with tubal pregnancy terminating by rupture.

Capsules of this nature occasionally form around sterile inflammatory effusions (Fig. 323).

It would appear that the conditions necessary for the production of these capsules are that the intruded product —whether a solid body, an infusion of blood, or coagulable inflammatory fluid—should be free from pathogenic organisms, and, in the case of fluid, that it be slowly effused.

Fig. 323. Fallopian tube and ovary; the colomic ostium and fimbriæ are enclosed in a capsule of new formation. From a case of acute salpingitis.

In this way imperfect capsules are formed on the walls of ovarian cysts, especially dermoids, and there can be little doubt that many of the reported cases in which these cysts are stated to have burrowed between the layers of the broad ligaments rest on erroneous observation, and that the supposed investment of the mesometrium was in reality a capsule of new formation.

The most perfect capsules formed in this way are met with around echinococcus cysts in the belly, especially those which project from the under-surface of the liver, or grow in the meshes of the omentum, and on occasions they may be very thick. This explains how echinococcus colonies in the belly

are provided with thick spurious capsules, whereas those growing in the cerebrum have none.

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CHAPTER LX.

NEURAL CYSTS.

UNDER this heading it is proposed to consider a number of conditions, some of which, like hydrocephalus and one variety of spina bifida should be described with tubulo-cysts. Other varieties of spina bifida should be discussed with diverticula. On the whole it is more convenient to consider them collectively as **neural cysts**.

Hydrocephalus.—This term is applied to the head when abnormally enlarged in consequence of excessive accumulation of fluid in the ventricles of the brain. A very large majority of cases are congenital, or commence in the early months of infancy. Occasionally the condition will arise at a later period of life, when the fontanelles are obliterated; expansion of the skull is then impossible. Hydrocephalus very frequently accompanies spina bifida. Very many hydrocephalic fœtuses die during delivery, the large size of the head hindering the successful transit through the maternal passages. In some cases the head ruptures in consequence of the pressure to which it is subjected, or is intentionally perforated. In most cases of hydrocephalus which survive delivery, distension is only slight at birth.

The frequency with which hydrocephalus and hydramnion co-exist would indicate that the association is something more than mere coincidence. Statistics respecting the frequency of hydrocephalus drawn from living children are untrustworthy, as pre-natal hydrocephalus is very fatal.

In typical cases of hydrocephalus attention is arrested by the large size of the cranium and the smallness of the face. This is due to the slow accumulation of fluid within the cerebral ventricles, distending them and causing wide separation of the cranial bones, whilst the bones of the face retain their natural proportions. The two halves of the frontal bone are separated from each other: the spaces between the

parietal bones, and between these and the occipital, are far wider than usual (Fig. 324). Indeed, the bones of the cranial vault are so separated from each other, whilst those of the base retain their usual juxtaposition, that the bones of a hydrocephalic skull were compared by Tronsseau to the petals of an opening flower.

The head may become so large as to attain a circumference of a metre, or even a metre and a half when measured horizontally—that is, from the superciliary ridges to the inion.

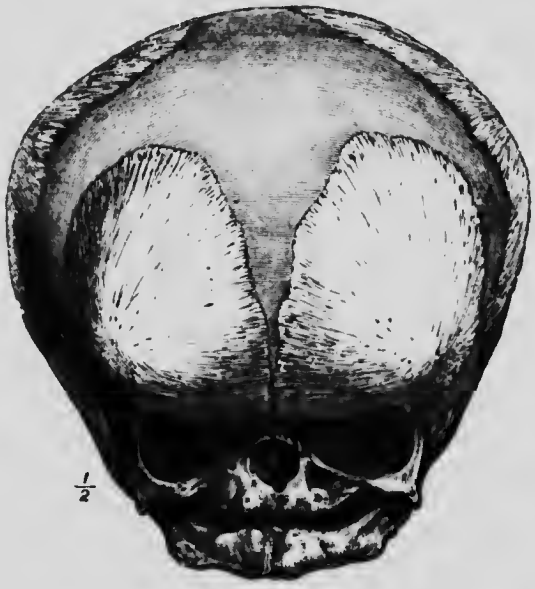

Fig. 324.—Hydrocephalic skull, from an infant. (*Museum, Middlesex Hospital.*)

The bones are excessively thin, and consist of a single table. The vault presents large membranous spaces irregularly dotted with ossific deposits. The sutures in relation with the parietal bones are occupied with Wormian bones; as many as two hundred have been counted in one skull (Fig. 325). In hydrocephalics who attain adult life the skull may become completely covered in with bone.

The brain presents great changes. The lateral ventricles are widely distended, and the crura cerebri, corpora striata, optic thalami, and other structures in the base of the brain

are flattened. The cerebral hemispheres form thin boundaries to the ventricles, often less than 10 mm. in thickness: the convolutions become obliterated. In nearly all the specimens the distension is limited to the lateral and third ventricles; occasionally the fourth ventricle also is distended (Fig. 326). In some specimens each lateral ventricle has been

Fig. 325.—Hydrocephalic skull, showing Wormian bones. (*Museum, Middlesex Hospital.*)

known to attain a length of 20 cm. and to communicate with its fellow through an opening the size of an orange.

When the ventricles are very distended and the skull is proportionally thin, a wave of fluctuation may be transmitted from side to side. In exceptional cases the head is translucent.

In an account of hydrocephalus it is difficult to avoid reference to the classical case of James Cardinal, especially as a cast of his head is to be found in many pathological museums (Fig. 327).

James Cardinal died at the age of twenty-nine years in

Guy's Hospital, under the care of Sir Astley Cooper, in 1824. He was born at Coggeshall, Essex, in 1795. At birth his head was very little larger than natural. A fortnight later it began to increase, and gradually grew until he was five years old; it then appeared to remain stationary. He was unable to walk until six years of age, but went to school and learned

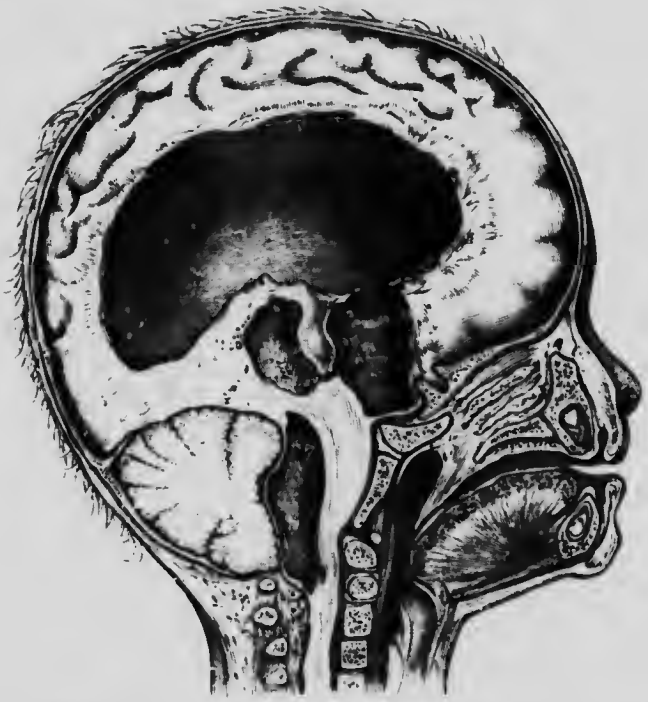

Fig. 326.—Sagittal section of a hydrocephalic skull from a child, with the brain *in situ*. The head of the arrow is in the fourth and its feathers in the third ventricle. The infundibulum is widely dilated. (*Museum, Middlesex Hospital.*)

to read and write. His head was at this period translucent when placed between the eye of the observer and a bright light. Cardinal continued in tolerable health until twenty-three years of age, when he began to have fits, for which he applied to the hospital. His manners were childish, otherwise his mental faculties were well developed. Death eventually supervened from lung disease.

When the head was examined the brain was found lying

at the base of the skull. Between the membranes there were seven pints of fluid. The ventricles contained one pint. It appeared as if the fluid had been originally contained within the ventricles, but had burst through an opening in the corpus callosum and compressed the brain downwards. The cranium measured 82·5 cm. (33″) in circumference, and had a capacity of ten pints. The skeleton is contained in Guy's Hospital Museum.

Fig. 327.—Drawing from a cast of the head of James Cardinal. The cast from which this drawing was taken appears to have been moulded April 11th, 1822.

The fluid in hydrocephalus is identical with cerebro-spinal fluid. Occasionally it has been found to contain albumen. This may be attributed to inflammation, and has been observed in those cases where paracentesis has been performed. The amount of fluid may be very large. Six and eight and even ten pints have been recorded. Little is known as to the cause of hydrocephalus. In many cases obstruction to the interventricular communications has been detected. Hydrocephalus is often associated with spina bifida, and all the passages in the brain and the central canal of the cord have

been found dilated. In several cases in which hydrocephalus supervened on spina bifida I found the central canal of the cord normal. Interference with the interventricular passages will produce hydrocephalus (Fig. 328).

The great difficulty encountered in investigating the pathology of this condition arises from the soft and diffluent nature of the brain of hydrocephalic fœtuses, especially when stillborn. It should also be remembered that many grave malformations of the limbs and viscera are often associated with hydrocephalus, and it is well to bear in mind the frequency with which it is accompanied by hydramnion.

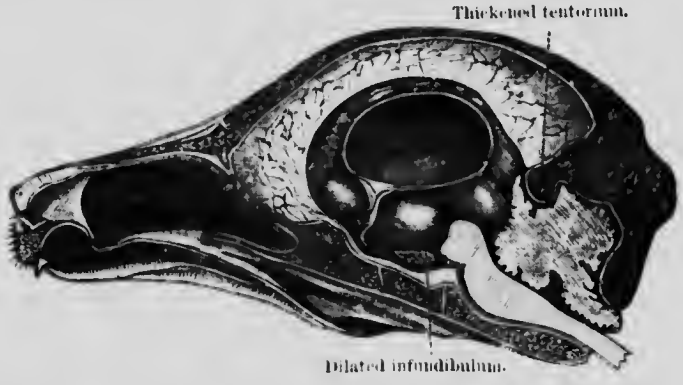

Fig. 328.—Head of a lion's whelp in section, showing great dilatation of the cerebral ventricles due to obstruction of the interventricular passages by a thickened (rickety) tentorium.

Hydrocele of the Fourth Ventricle.—Leading from each lateral angle of the fourth cerebral ventricle there is a tubular process encircled by a duplicature of the ligula termed the cornucopia. These passages or **lateral recesses** are traversed by the choroid plexuses of the fourth ventricle, and the recesses themselves open into the subarachnoid space at the base of the flocculus, close beside the root filaments of the facial, auditory, glosso-pharyngeal and vagus nerves. These passages establish free communication between the fourth ventricle and the general subarachnoid space. When one of these processes becomes occluded, the recess will dilate and form what Virchow terms hydrocele of the fourth ventricle. This pathologist has figured a specimen that had attained the size of a cherry-stone and pressed upon the flocculus and the

facial nerve: remnants of the choroid plexus of the fourth ventricle projected into the cyst. Though the walls of this cyst were thin, its pressure had caused paralysis of the facial nerve.

Cranial Meningocele.—This term is applied to a hernial protrusion of the meninges of the brain through an unossified portion of the skull. When the protrusion consists of brain matter as well as membranes it is described as a **meningo-encephalocele.**

Meningoceles, using the term in its general sense, occur in definite regions. The commonest of all situations is the occiput; in about two-thirds of the cases the tumour projects

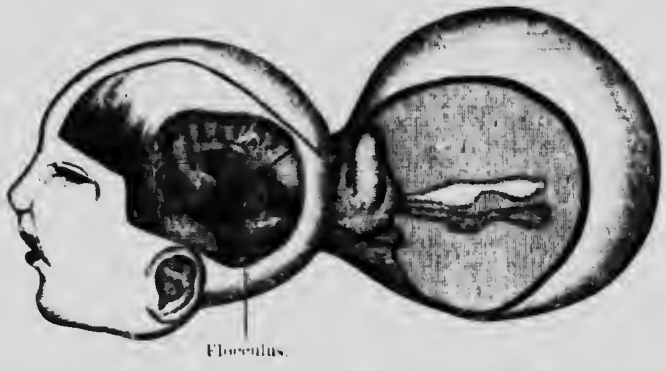

Fig. 329.—Occipital meningo-encephalocele. The cyst probably represents an expanded fourth ventricle: there was no cerebellum, but a large and conspicuous flocculus.

in this part of the skull. Next in frequency to their appearance at the occiput, meningoceles appear at the root of the nose. In other regions of the skull they are excessively rare. It is usually stated that they may appear at the anterior fontanelle, but critical examination of the descriptions of suspected cases makes it probable that many of the supposed meningoceles were dermoids (p. 452).

Occipital meningoceles appear, during life, to protrude through the foramen magnum; when the parts are dissected the pedicle will be found to make its way through a gap in the supra-occipital between the posterior margin of the foramen magnum and the occipital protuberance. This space during early embryonic life is occupied by a fontanelle.

When the meningocele is examined it will be found to be covered externally by skin, and usually lined internally by tissue directly continuous with the ependyma of the ventricles.

The relation of the flocculus in cases of occipital meningocele is of importance. In the descriptions of reported cases of this malformation the cerebellum, if referred to, is described as rudimentary or absent. As a matter of fact, in these cases the cerebellum is absent, and that which is supposed to represent this part of the brain is an enlarged flocculus (Fig. 329). Cleland has pointed out that the flocculus is developed from a lateral outgrowth of the floor of the third encephalic vesicle, whilst the cerebellum is developed from the foremost part of the roof of that vesicle. An appreciation of this fact throws valuable light on the nature of occipital meningocele, for the absence of the cerebellum indicates that the hernial protrusion is the third encephalic vesicle; instead of its walls thickening to form a cerebellum, they become passively dilated into a cyst. Indeed, this form of meningocele bears much the same relation to the fourth ventricle and the cerebellum that hydrocephalus bears to the lateral ventricles and the cerebrum. An occipital meningocele might not inaptly be described as *hydrocephalus limited to the fourth ventricle.*

Occipital meningo-encephaloceles often hang so low as to render it difficult to decide whether the cyst belongs to the cranium or to the cervical region of the spine. There is reason to believe that the pedicle of a cranial meningocele may become obliterated so as to cut off the communication between the cyst and the subdural space. I have never had an opportunity of dissecting a specimen in which this has happened. Such an event certainly occurs with spinal meningoceles.

A cranial meningocele is sometimes associated with spina bifida; such a combination is, as a rule, accompanied by gross malformations, especially in connection with the lower limbs. It has already been mentioned that dermoids are apt to be mistaken for meningoceles, and it is certain that meningoceles are sometimes mistaken for dermoids. With careful aseptic precautions, meningoceles may be, and often are, safely

excised. In some successful cases hydrocephalus has followed the excision of a cranial meningocele.

Individuals with meningoceles, particularly when the cyst is large, rarely survive their birth many weeks. Death is usually due to sloughing of the sac and consequent septic meningitis.

Cranial meningoceles are simulated by tumours, especially dermoids, and occasionally by a cephalhæmatoma. A remark-

Fig. 330.—Monkey (*Cebus monachus*) with a large pulsating tumour containing blood on its head.

able case of this came under my notice in a Capuchin monkey (*Cebus monachus*). When deposited in the Zoological gardens this monkey had on its head a large rounded tumour (Fig. 330), which was soft and fluctuating at the top, where a feeble pulsation was perceptible. That portion of the tumour near the skull was extremely hard and felt like bone. The monkey was in excellent health and seemed in no way encumbered by its burden. It continued in this

way many weeks; the tumour did not increase in size, but the hardening of its walls became more extensive. Some months later the monkey fell ill, and as it seemed in great suffering I killed it by means of chloroform. The tumour when dissected was found to be an old cephalhæmatoma with extensive ossification of its walls (Fig. 331); the crater-like arrangement of bone on the top of the skull was covered

Fig. 331.—Skull of *Cebus monachus*, showing the bony walls of the cephalhæmatoma and a group of Wormian bones. (*Museum, Royal College of Surgeons.*)

in by pericranium and contained dark fluid blood. The frontal bone where it formed the floor of the cavity was so thin that in places it yielded to the pressure of the fingers like parchment. Some of the ossicles which formed the walls of the cyst were bevelled at the edges and serrated, so as to articulate one with the other like Wormian bones. Fragments of these bones were examined microscopically and found to exhibit the structure of true bone. The serrations at the edges of these bones were probably due to the movements of the cyst during their formation, for it was noted that there was slight pulsation.

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CHAPTER LXI.

NEURAL CYSTS (*Concluded*).

Spina Bifida.—The term spina bifida is applied to congenital defect in the union of the laminæ of one or more vertebræ,

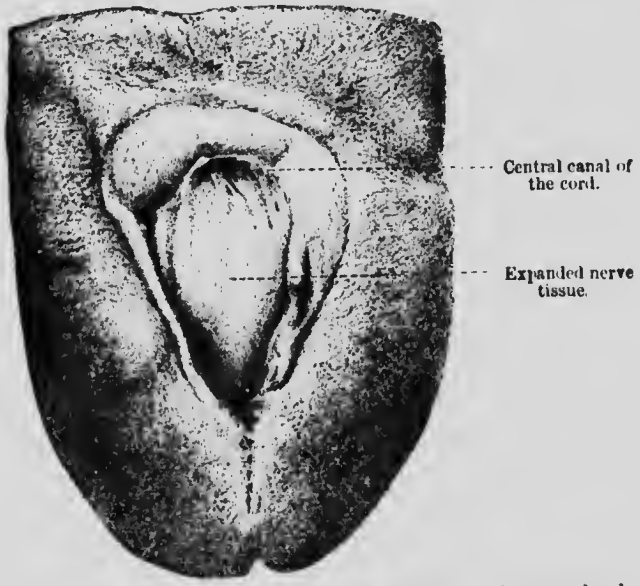


Fig. 332.—Lumbar region of a fœtus with spina bifida, variety myelocele. (After Shattock.) (*Museum, Middlesex Hospital.*)

associated with malformation of the spinal cord or its membranes.

The spinal cord and a large part of the brain are formed by the dorsal coalescence of the medullary folds. The fusion of these folds commences in the thoracic and extends into the cephalic and caudal regions. For a short time after coalescence the embryonic cord and superficial epiblast remain in contact. Gradually they become separated by the intrusion of connective tissue, some of which chondrifies and

afterwards ossifies to form vertebræ and intervertebral discs. In the early stages the cord has a longitudinal extent equal to that of the notochord, and this equality is maintained for some time after the closure of the medullary groove. Subsequently the vertebral column grows at a greater rate than the nerve-tube; the result is that at birth the medullary cone at the end of the cord is opposite the upper border of the second lumbar vertebra.

The varieties of spina bifida are determined according to the stage of development at which the defect occurs, as determined by the anatomy of the parts. They are:—

1, Myelocele; 2, syringo-myelocele; 3, meningo-myelocele; 4, meningocele; 5, masked spina bifida (*spina bifida occulta*).

Fig. 333.—Diagram to represent the microscopic characters of a transverse section of a myelocele.

1. *The medullary folds may unite imperfectly and give rise to a* MYELOCELE (Fig. 332).

In this case the cord is normally formed in the cervical and thoracic regions, but in the lumbar portion the central canal suddenly opens on to a shallow depression, the sides of which are slightly intumescent and then become gradually continuous with the skin. The tissue surrounding the furrow represents the medullary folds and consists mainly of very vascular nerve tissue. When fresh this area is bright red and resembles a nævus.

When this red tissue is carefully dissected from the underlying vertebræ and prepared for the microscope, it will exhibit on each side of the furrow nerve-cells embedded in

neuroglia intermixed with plexuses of arterioles, venules, and capillaries (Fig. 333). It is hard to determine the existence of epithelium on the surface of myeloceles, because there is usually some inflammation, and occasionally sloughing.

Myeloceles are, according to my observations, more common in the stillborn than in children who survive their birth a few days.

Children with myeloceles rarely live more than a few days: the central canal of the cord, being open, allows a continual draining away of the cerebro-spinal fluid, which soon leads to death.

2. *The medullary folds unite throughout, but fail to separate from the surface epiblast. The central canal becomes subsequently dilated*:—SYRINGO-MYELOCELE.

Fig. 334.—Syringo-myelocele in transverse section.

Syringo-myelocele is an excessively rare variety of spina bifida, and cannot be determined from simpler forms during life. When the parts are dissected the distinguishing feature is that the nerves gain the intervertebral foramina by running round the convexity of the cyst (Fig. 334).

Although syringo-myelocele is very rare in a typical form, it may occur in combination with a meningocele. Clutton has carefully described an example (Fig. 335).

3. *The cord is normally closed, but, before it separates from the surface epiblast, becomes compressed, by a collection of fluid within the meningeal spaces*:—MENINGO-MYELOCELE.

Probably two-thirds of all cases of spina bifida that survive their birth are meningo-myeloceles. The condition is easily recognised: there is a deficiency in the arches of the

vertebræ, usually in the lumbar region, occupied by a cyst of variable size. Unless inflamed, or flaccid in consequence of leakage, the cyst is translucent and often presents a pink tinge. Its most posterior part is somewhat flattened, and occasionally a shallow median groove is seen. In some specimens, quite in the centre of the cyst there is a small umbilicus marking the central canal of the cord. At the edge of the cyst, where its walls become continuous with the skin, the margin is slightly raised, and immediately beyond

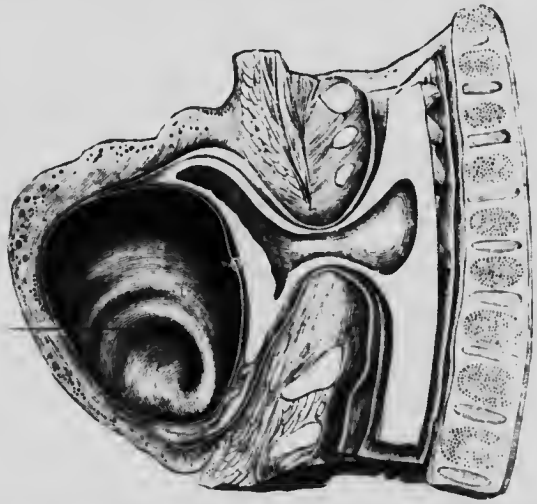


Fig. 335.—Syringo-myelocele and meningocele in longitudinal section; from the cervical region. (*After Clutton.*)

this the skin, even in the new-born, may present a circle of long hairs.

Meningo-myeloceles are often associated with hydrocephalus and, in a large proportion of cases, with double talipes equinovarus, and other severe deformities of the lower limbs.

On transverse section of a meningo-myelocele the cord is found flattened on the posterior wall of the cyst like a strap, whilst the nerves reach their respective foramina by directly traversing the cavity of the cyst (Fig. 336).

That the strap-like band of nerve tissue on the posterior wall of the sac is the flattened spinal cord was demonstrated by Shattock. He cut sections of this part of the cyst and detected the central canal (Fig. 337).

4. *The cord is normal, but there is a local hernia of the membranes*:—MENINGOCELE.

Protrusion of the membranes unaccompanied by the cord is by no means common in spina bifida. Although it has

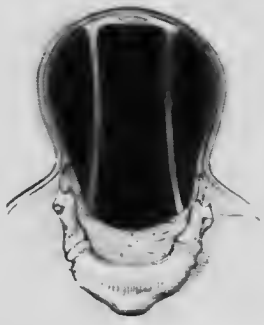


Fig. 336.—Diagram showing meningo-myelocele in transverse section. The cord is flattened on the posterior wall of the cyst, and the nerves traverse its cavity.

been met with in the cervical region of the spine, it most frequently affects the lumbo-sacral region, or may be entirely confined to the sacral portion of the spine. Some writers on this malformation believe that the hernial protrusion may

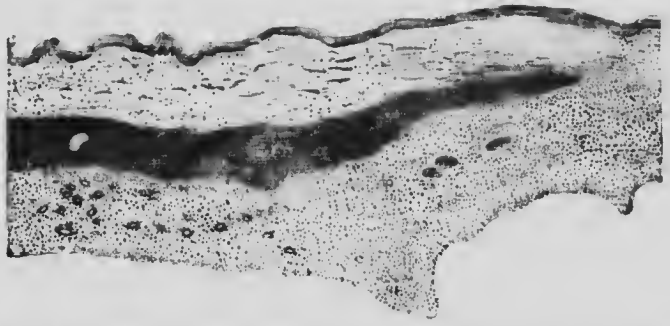


Fig. 337.—Microscopical appearances of the nerve tissue from the wall of a meningo-myelocele showing the central canal. (*After Shattock.*)

make its way between the arches of two vertebræ instead of between the laminæ of a single vertebra. It is a fact that the sac of a meningocele sometimes emerges through a very narrow orifice, and in a few instances this causes the cyst to become more or less pedunculated, and may lead to occlusion

of the aperture by which the dural space and the cyst communicate and thus isolate the cyst.

Virchow investigated a remarkable specimen illustrating this process. The patient was a negro child born with a large tumour pendulous from its buttock (Fig. 338). The tumour was removed in Central Africa and sent to Virchow, under the impression that it was a fatty tumour. Dissection

Fig. 338.—African child with a pedunculated tumour (an occluded spina bifida sac) attached to its buttock. *After Virchow.*

revealed a central space in the tumour lined with dura mater, which was covered with fat intermixed with muscle tissue. The structure and arrangement of the parts were such as to lead Virchow to the opinion that the tumour was the sac of a meningocele (Fig. 339).

A tumour in many respects similar to this, save that it occurred in the cervical region of the spine, was removed by Solly in 1856 from a woman twenty-seven years of age. The

description of the case is accompanied by an exceedingly interesting clinical history. Protrusions of dura mater unaccompanied by cord or nerves (meningoceles) are more common in the sacral region than elsewhere. In some instances the membranes emerge through the deficiency (hiatus sacralis) normally present below the third sacral vertebra.

This will perhaps be the most convenient place in which to refer to an abnormal disposition of the cord which I have met with in association with spina bifida. It is well known

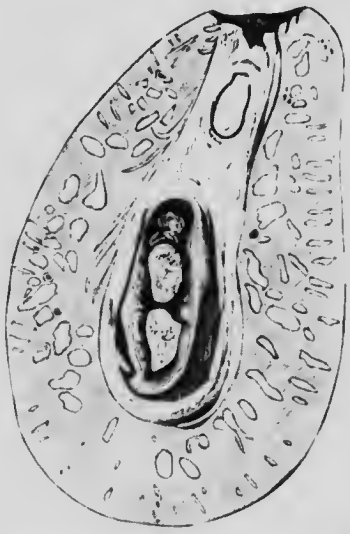


Fig. 339.—Tumour from the African child (see previous figure), shown in section.

that in the early embryo the cord extends the whole length of the vertebral column, but at birth the apex of the medullary cone is on a level with the upper border of the second lumbar vertebra. I have placed in the museum of the Middlesex Hospital a spine with a large meningocele in the sacral region; the cord runs the whole length of the neural canal and terminates near the tip of the sacrum (Fig. 340).

5. *The cord and its membranes are normally formed, but the arches of one or more vertebræ are defective. There is, however, no protrusion of the membranes or cord*:—MASKED SPINA BIFIDA (spina bifida occulta).

This defect, as it is unaccompanied by a cyst, is very apt to be overlooked. An interesting feature usually associated with this condition is an abnormal growth of hair in the loins. Hair-fields of this description may be localised to the loin, as

Fig. 340.—Spinal column in section with a sacral meningocele. The spinal cord is retained in the sacral section of the neural canal, its embryonic position. From a child aged three months.

in the original case described by Virchow, and the hair may form a long tuft (Fig. 341). In exceptional cases an abnormal growth of hair may extend from the loins over the buttocks and for a considerable distance down the thighs.

The two varieties observed in the distribution of hair in these cases are well illustrated by the arrangement adopted

by artists and sculptors in their representations of fauns and the goat-footed satyrs (Fig. 342).

Many cases of spina bifida in addition to the "masked" species are accompanied by an excessive development of hair in the loin. Attention has also been drawn to the fact that a circlet of hairs is often observed on the skin immediately bordering the sac of a meningo-myelocele, even in new-born babes.

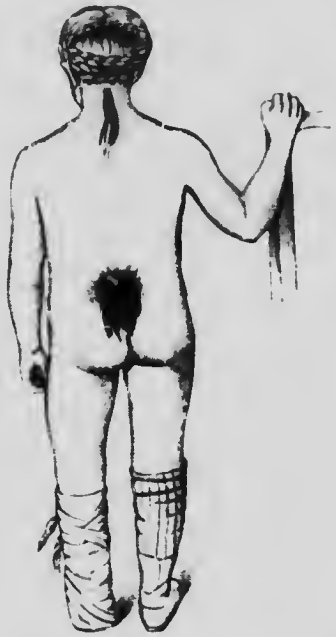


Fig. 311.—Hair-field overlying a spina bifida occulta: there is also a long tuft in the cervical region. (*Fischer.*)

This excessive development of hair associated with defective closure of the neural arches is interesting when studied in connection with the luxuriant growth of feathers on the heads of Polish fowls, for in many of these birds there is defective ossification of the bones of the cranial vault. An important condition often associated with spina bifida occulta is perforating ulcer of the foot. Indeed, this association is now so well recognised that in every case of perforating ulcer of the foot, occurring in young patients, it is the duty of the surgeon, as a matter of routine, to examine the loins.

In addition to non-union of the arches in the vicinity of spina bifida, the vertebræ are liable to be defective in other ways, and of these defects the most striking is the absence of half a vertebra—that is, half the centrum, with its pedicle, lamina, transverse, articular and spinous processes, is wholly wanting. The persistent half of such a vertebra has the characters shown in Fig. 343, and is often ankylosed to the vertebra above and below. Sometimes the half-vertebra is in excess of the ordinary number. Exceptionally, a consider-

Fig. 342.—Ægipan sporting with a faun. (Bacchus and Silenus.)

able extent of the column will be replaced by an alternating series of half-vertebræ; this is especially seen when the cervical portion of the column is the seat of spina bifida.

Half-vertebræ occur occasionally independently of spina bifida; they have also been detected in the spines of snakes, calves, fish (sole), and rabbits. The amount of disturbance sometimes caused in a vertebral column by spina bifida is very remarkable. Occasionally horizontal processes of bone project from the vertebral centra into the neural canal, and sometimes transfix the cord. Several examples have been

carefully described in which the cord has bifurcated and coalesced again in order to enclose a beam of bone crossing the canal in a sagittal direction.

Complications of Spina Bifida.—Unfortunately all species of spina bifida are apt to be associated with other serious conditions, such as talipes equino-varus, single and double, and other gross deformities of the legs, hydrocephalus, meningocele, and malformations of the alimentary canal, such as imperforate anus and on rare occasions imperforate pharynx.

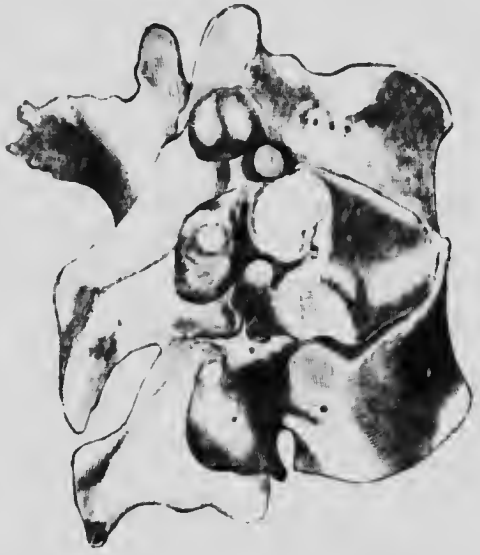


Fig. 343. Half-vertebra. (*After Shattock.*)

Very exceptionally these two imperforate conditions of the alimentary canal have co-existed.

The most serious complication of spina bifida is **hydrocephalus**; the ventricular cavities of the brain may be abnormally dilated at birth: in many cases the hydrocephalus slowly develops during the first few weeks of infant life, and the head gradually assumes enormous dimensions. In a small proportion of cases the sac of the spina bifida spontaneously shrinks: coincidently with this the fontanelles gradually widen and hydrocephalus develops. I have in several children seen hydrocephalus supervene when the sac in the loin has been made to shrink by artificial means.

We have now to consider the various modes by which spina bifida destroys life. Of all the varieties of this malformation, **myelocele** is the most fatal. A very large proportion of fœtuses in which this condition is present are stillborn; the few that survive their birth rarely live longer than three days, the continual leakage of cerebro-spinal fluid being sufficient to explain the invariable brevity of their lives.

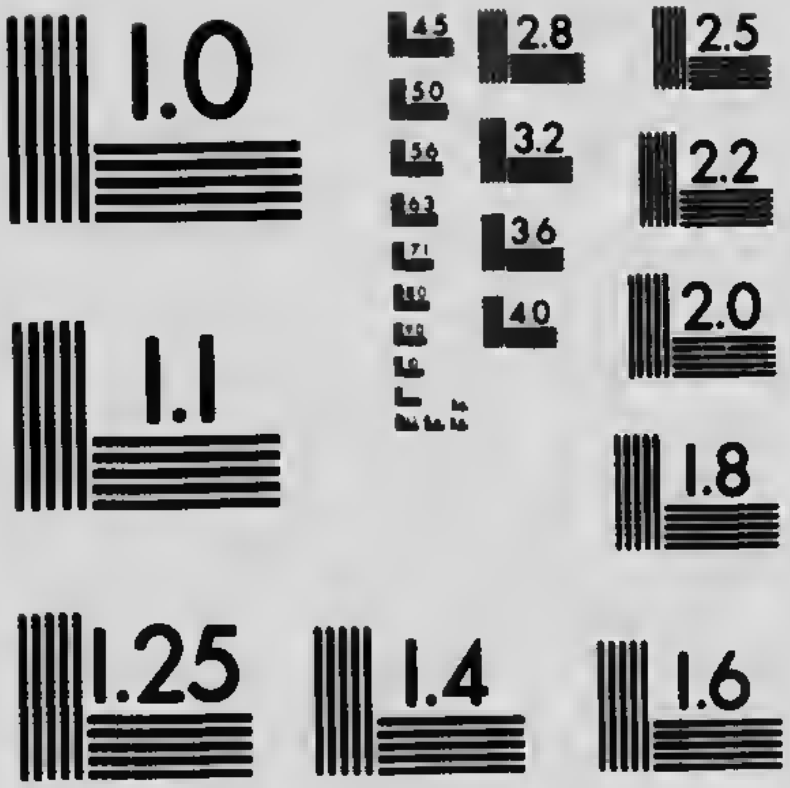
When a distinct sac is present life may be prolonged many weeks, even when the sac wall is thin; when it is thick, life may be prolonged several years; and when it is completely skin-covered some of these children survive and grow up to be healthy men and women. The prospects of each particular case are largely influenced by the thickness of the sac wall and the absence of complications, especially hydrocephalus.

In many cases, especially when the walls of the cyst are thin, the tissue is apt to slough—an event that allows the sudden escape of the cerebro-spinal fluid and may terminate the life of the child in a few hours. Children often survive this accident to succumb seven or ten days later to septic meningitis. Exceptionally, I have observed children recover from rupture of the sac, and, escaping meningitis, slowly die from hydrocephalus. Occasionally the sac in the loin and the hydrocephalus will increase simultaneously. In such a case pressure on the anterior fontanelle will increase the tension in the spina bifida sac, and *vice versâ*.

The duration of a child's life with spina bifida, excepting the "masked" species, is very uncertain; it is often prolonged when the nurse and mother are careful, and vigilantly preserve the sac from injury.

That spina bifida is a serious affection may be gathered from the figures in the Registrar-General's Reports; about 800 individuals in England die from it every year. This information is not precise, as the actual number of cases is much greater, because the birth of the stillborn is not registered. No facts are accessible that will enable an estimate to be formed of the real frequency of the malformation.

Treatment.—This has undergone a great change in recent years. Instead of the slow and uncertain method of



injection with iodo-glycerine solution, it has been shown that spina sacs may be safely excised.

The Evolution of the Central Nervous System.—The extraordinary frequency with which the membranous and bony coverings of the central nervous system are malformed induced me some years ago to investigate the abnormalities collectively classed under the term spina bifida, with the hope of obtaining some light as to the mode of evolution of the brain and spinal cord, for, as I pointed out in 1886, the pathological behaviour of the central canal of the cord indicated that it was an obsolete passage. In 1887 I came to the conclusion from embryological and pathological data that the brain and cord were in all probability *evolved from a segment of the primitive intestine*. This view has been confirmed since by the independent researches of Gaskell.

Andriezen has demonstrated the existence in amphioxus and ammocœtes of an epithelium-lined duct extending from the buccal cavity into the ventricle (thalamocele), and succeeded in transmitting carmine particles suspended in water into the central canal of the cord. His view is that the central canal of the cord is a remnant of the water-vascular system.

Tails.—This account of spina bifida would be imperfect without a brief notice of tails, real and supposed, in the human subject. We may with Virchow arrange tails in two classes, *true* and *false*. True tails may be *complete* or *incomplete*: the most perfect or complete tails contain bony segments (vertebræ), as in the case of cats and dogs; the less perfect or incomplete tails are like those of pigs, soft and flexible. No one has yet reported an example of a tail in the human subject containing bony elements. Several cases have been investigated in which an appendage 5 cm. long, and soft like a pig's tail, has been found directly continuous with the coccygeal vertebræ.

Most of the cases reported as tails were nothing more than examples of congenital sacro-coccygeal tumours, or a tuft of hair covering a masked spina bifida. Tumours supposed to be tails were in some cases dermoids; in others fatty tumours, or the sac of a spina bifida, and in many cases teratomata.

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CHAPTER LXII.

ECHINOCOCCUS-DISEASE (HYDATID CYSTS).

The term **hydatid** formerly covered a large number of pathological productions, but the term is now restricted in human pathology to the cystic stage of *Tænia echinococcus*. This cestode, which in its mature form inhabits the intestines of dogs, is about 4 mm. in length and consists of four segments, of which the fourth is larger than the rest of the body and is the only segment that becomes mature (Fig. 344).

Fig. 344.—Tænia echinococcus. (*Leuckart.*)

In referring to *T. echinococcus* in the mucous membrane of the dog's intestine, Leuckart writes that it "occurs in considerable numbers, sometimes in many thousands, between the villi, so that only the milk-white proglottides project." It has been calculated that a ripe proglottis of this cestode contains about 5,000 ova. This is a good example of the prodigality of nature in all that concerns eggs, both animal and vegetable.

The eggs of this worm are passively conveyed with either food or water into the alimentary canal of man, where they are hatched; the embryos migrate from the intestine into some vascular organ or tissue, or, by gaining entrance into a blood-vessel, are passively conveyed into some distant part of the body and become transformed into cysts. The degree of infection depends upon the number of ova swallowed, and the extraordinary multitude of cysts and colonies found in some patients would suggest that an entire proglottis had been ingested.

The cyst-wall has a peculiar structure; it consists of an external, highly elastic, lamellar cuticle, and an internal lining consisting of granular matter, cells, muscle tissue, and a water-vascular system (Fig. 345).

The inner lining is often referred to as the parenchymatous layer. In addition to the proper tissues of the cyst, there is often a more or less complete fibrous capsule, especially when the cyst projects into the peritoneal cavity. The mode by which these adventitious capsules are formed is discussed on p. 616. The true cyst is maintained in apposition with the fibrous capsule by the pressure of the contained fluid; when this is removed by the abstraction or escape of the fluid, the mother cyst at once collapses.

The fluid is clear, limpid, colourless or slightly opalescent; specific gravity 1004 to 1015; it contains chloride of sodium, succinic acid, and occasionally, in cysts situated in the liver,

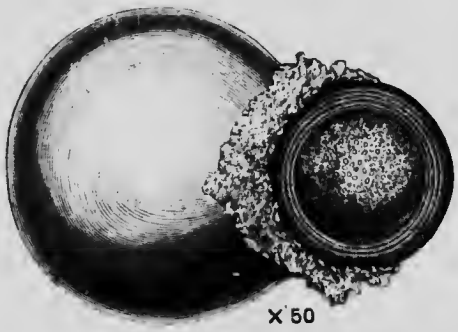

Fig. 345.—A small echinococcus cyst, showing the peculiar lamination of its wall. (*Leuckart.*)

leucin, tyrosin and sugar. Hooklets and scolices are also found.

When the hydatid attains the size of a walnut, small vesicles or **brood capsules** develop from the parenchymatous layer. These brood capsules develop numbers of heads or **scolices**. The scolex when fully developed is about 0.3 mm. long, is furnished with four sucking discs and a rostellum of tiny, blunt hooklets; it has a water-vascular system and numerous calcareous particles. The fore part of the scolex can be withdrawn into the hinder part; indeed, this is the position in which they are usually found (Fig. 346).

As fresh brood capsules and scolices are formed, the cyst enlarges, and, when seated in an organ or cavity of the body which imposes little restraint upon its growth, it may attain

enormous proportions—*e.g.* hydatid cysts of the liver have been known to acquire a capacity of sixteen pints.

In many hydatids **daughter cysts** are formed from brood capsules and probably from scolices. Cysts containing large numbers of these translucent thin-walled vesicles are known as **echinococcus colonies**.

Occasionally cysts even of large size do not contain vesicles or brood capsules; such are said to be **sterile**. The walls of sterile hydatids exhibit the characteristic lamination, and this enables the nature of the cyst to be recognised in otherwise doubtful cases.

Echinococcus Multilocularis (Virchow).—This is an exceptional mode in which echinococcus disease manifests itself,

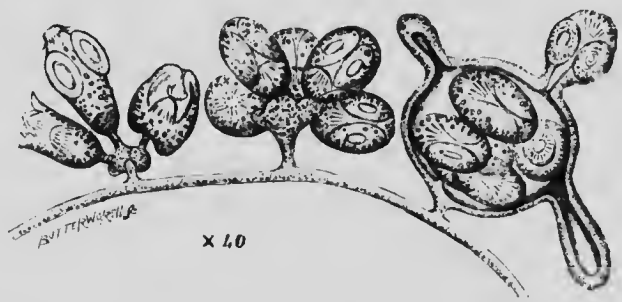

Fig. 316.—Portion of the cyst wall of an echinococcus colony showing scolices. (*Leuckart.*)

or, as Ziegler thinks, a distinct species. In this condition the vesicles are of small size, but occur in great number, and are not contained in a mother cyst. The vesicles in such cases rarely exceed a pea in size, but the majority are much smaller; very many are no larger than millet- or rape-seed. This variety occurs most frequently in the shafts of long bones. It has also been observed in the spinal canal.

The multilocular hydatid occurs in the liver as a firm tumour, which on section presents trabeculæ of dense fibrous tissue that cause it to assume an alveolar appearance. The alveoli contain a gelatinous substance in which the shrunken vesicles are embedded.

Most of these minute vesicles are sterile, but here and there a few hooklets can with patience be demonstrated.

Virchow was the first to demonstrate the hydatid nature of such tumours in the liver: previously they had been described as colloid cancer. In very rare instances contracted and shrunken vesicles embedded in gelatinous material and surrounded by a distinct cyst have been observed in the liver. *E. multilocularis* has also been found in the brain and lung (Ziegler).

Hydatid Rash.—When the fluid from an echinococcus cyst escapes into the peritoneal cavity it is apt to produce an urticarial eruption known as the hydatid rash. It usually appears shortly after the cyst has been ruptured or punctured: it itches intensely, lasts two or three days, and is usually accompanied by high temperature and sometimes by abdominal pain. It is referred to by several observers. Krabb writes:—"A curious phenomenon is habitually observed when hydatids rupture into the peritoneal cavity: it provokes a transient urticaria."

Finsen refers to two cases worth mentioning in relation to the rash. Paul Helgason, aged twelve years, had for four years a large tumour in the right hypochondrium extending to the umbilicus. The lad received a blow upon the belly from a cow's horn that caused the tumour to disappear. Almost immediately the body was covered with a rash like an urticaria, but it soon disappeared.

In another patient, a pregnant woman had a hepatic hydatid for six years. Three days after delivery, whilst lying quietly in bed, she was suddenly seized with acute pain in the abdomen; the tumour of the liver disappeared, and in a short time the skin presented a papular rash.

Hepatic hydatids may be accidentally ruptured in a variety of ways—such as blows, falls on the belly, by the wheels of a cart, or during an embrace in "a moment of exuberant affection" (Treves).

The usual mode of termination of an echinococcus cyst is to cease to grow: it then dies, shrivels up, and calcifies, assuming a friable appearance like old mortar.

When the cyst continues to grow its tendency is to rupture; the great tension exerted by the accumulating fluid, and especially the formation of daughter cysts, induces necrosis of portions of the cyst-wall. When contiguous to

hollow viscera, such as the intestine, stomach, trachea, and the like, the cyst is apt to come into contact with them, and the mutual pressure leads to absorption of the intervening tissue, and allows of the transmission of gas, air, or the osmosis of fluids which kill the parasite, and the entrance of pathogenic micro-organisms establishes suppuration.

In many instances the communications between the colonies and the hollow viscera are so free that the contents are evacuated. In some instances this is a fortunate termination; but frequently it is a catastrophe to be dreaded, as it may immediately cause death, or lead to secondary changes that have ultimately a fatal issue.

In rare cases the vesicles in a colony become converted into colloid material of about the consistence of gelatine.

Geographically, echinococcus disease has a very wide distribution, which corresponds with that of the dog. It is, however, far more frequent in some regions of the world than others. Iceland is notorious for the frequency with which its inhabitants fall victims to this parasite: after allowing great latitude for errors in the direction of excess in calculating its frequency, echinococcus disease must be regarded in the light of a persistent epidemic so far as that island is concerned.

Next to Iceland, Silesia is usually regarded as the most infected district in Europe. In Australia this disease is excessively frequent, and whereas most of the monographs on this disease in its clinical aspects, written thirty years ago, were founded in a large measure on observations made in Iceland, we now look to the writings of Australian physicians and surgeons for information on the pathology, diagnosis, and treatment of echinococcus colonies.

In Asia the disease is known; it occurs in India, though it is far from common; in America it is not frequent; judging from the few references to it in American literature, hydatids appear to be far rarer in North America than in the British Isles.

Zoologically, echinococcus disease is not very restricted, for it has been observed in monkeys, lemurs, cows, sheep, goats, deer, camels, antelopes, giraffes, horses, asses, zebras, hogs, squirrels, and kangaroos, in addition to man.

Topographical Distribution in Man.—Although an echinococcus cyst may form in almost any organ in the human body, it occurs with greater frequency in some organs and tissues than in others. A comparison of statistical tables compiled in Iceland, Germany, Australia, and America brings out most decisively the fact that hydatids are met with more frequently in the liver than in all other parts of the body together, whilst in other organs, such as the breast, thyroid gland, or spinal cord, the literature of a century would furnish probably under a score of trustworthy cases.

It is necessary to point out in regard to the distribution of echinococcus colonies that though on superficial examination they may appear to be lodged in the liver, kidney, uterus ...um, a closer and more critical inquiry shows that in ... all instances the parasite selects the loose subserous ...ue. For example, echinococcus cysts in the liver usually lie in the tissue beneath the peritoneum covering this organ. This is certainly true of the uterus, and a few cases reported as growing from the Fallopian tube or ovary are really cases of infection of the loose connective tissue of the mesometrium. In the case of the kidney the parasite flourishes in the connective tissue of the renal sinus.

This peculiar preference of the embryo of *T. echinococcus* for subserous areolar tissue will be further considered in describing the relationship of the cysts and colonies in various organs. Echinococcus cysts may occur singly or be distributed over the body in great numbers. The effects to which they give rise vary with the situation and dimensions of the cyst. For instance, a cyst of such a size as to cause no inconvenience when seated in the liver would, if growing in the brain or walls of the heart, soon induce death from mechanical causes. Again, a colony in the liver will often attain a very large size before causing inconvenience to the patient, whereas one only half the size situated in the pelvis would produce much distress by interfering with the function of the rectum or bladder. On the other hand, a small cyst in the liver no larger than an orange, when accidentally ruptured so that its contents escape into the peritoneal cavity, may rapidly destroy life, but a cyst the size of a melon, or larger, bursting into the rectum, will not lead to much trouble; though even

a small cyst so seated as to rupture into the trachea will, when the event comes to pass, almost inevitably cause death by suffocation. Indeed, the ways in which these cysts and colonies kill are so many and so various that they will be dealt with under each organ.

The bursting of a colony into the abdomen may lead to general infection of the peritoneum; the brood capsules en-

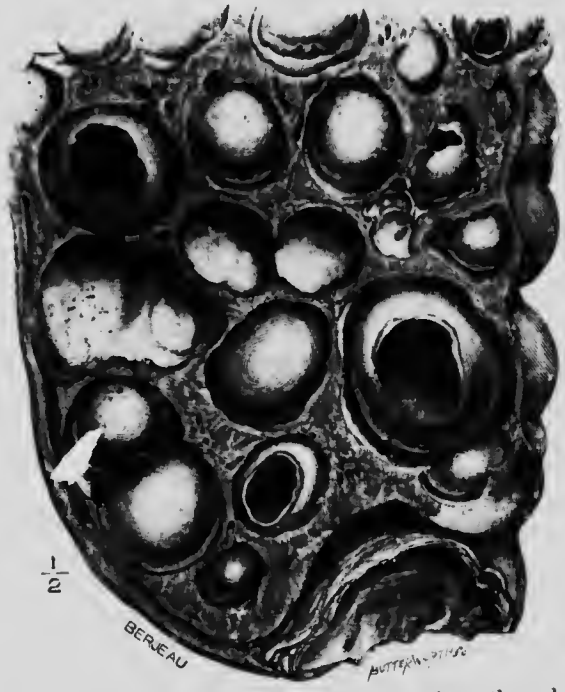

Fig. 317.—Portion of a liver in which the interlobular tissue throughout the organ was infested with echinococcus cysts. (*Museum, Royal College of Surgeons*.)

grafting themselves on this membrane produce an appearance like miliary tuberculosis.

Liver.—Echinococcus cysts and colonies, as we have seen, are most frequent in the liver. This is not due to any selective power on the part of the parasite, but to the fact that it finds its way into the gastric tributaries of the portal vein, and is passively conveyed into the gland. As a rule, a single cyst is found in the liver, though it is not uncommon to find three or four; but there is no limit to their number,

and the museum of St. Thomas's Hospital contains a liver weighing nearly twenty-five pounds, obtained from a sailor in 1864, which is occupied by hundreds of cysts. The case was carefully described by Peacock. There were cysts in the lungs, spleen, kidney, omentum and right ventricle of the heart. A portion of the liver is in the museum of the Royal College of Surgeons, and is the source of Fig. 347.

A critical examination of the distribution of the cysts and colonies in the liver demonstrates that their primary seat is in nearly all instances the connective tissue immediately beneath its peritoneal investment or in the portal fissures. In the very exceptional cases where the cysts are uniformly distributed through the organ, as in Peacock's sailor, the six-hooked embryo has selected the interlobular connective tissue. Leuckart's feeding experiments throw a good light on this specimen. His greatest success occurred with the pig, which he says "may be very readily infected by the eggs of *Tænia echinococcus*," and he points out that "it is remarkable that the cysts were all thickly distributed under the serous covering of the liver, and that upon both the concave and convex surfaces." Leuckart also clearly notices the relation of this parasite to the connective tissue of the liver, for he distinctly states in more than one place in his book that these early cysts were "everywhere in direct continuity with the connective-tissue trabecular network of the liver." And he writes:—"In all cases, moreover, it was the interlobular tissue that contained the parasites." This supports the teaching of Naunyn, that the embryos are distributed by the vascular system.

In the liver of the sailor we have an example of infection exceptionally severe, in which the interlobular connective tissue of the organ lodged the parasites, as well as the subserous tissue.

The relative frequency of these cysts in the liver, the large size they attain in this organ, and the risk they occasion to life have caused them to be very attentively studied.

When the cyst ruptures spontaneously it may take various directions. Thus, it may burst into the **pleura** and give rise to fatal pleurisy. Should the **lung** be adherent to the diaphragm, the cyst may open into it and the contents be

discharged through the bronchial tubes and trachea. Under these conditions gangrene of the lung may follow the rupture.

In a few instances the cyst has burst into the **pericardium.** Such an accident is rapidly fatal, as the inundation of the pericardial cavity by fluid and vesicles embarrasses the heart. In some cases death has followed from pericarditis.

Rupture of a large cyst into the peritoneal cavity leads to serious consequences, but even when the cyst is small it may lead to general infection of the peritoneum. In a case under my care there was reason to believe that a hepatic colony had ruptured into the lesser bag of the peritoneum, for the whole of the small omentum was thickly beset with little vesicles. Graham records a similar observation. A cyst has been known to rupture into the **stomach,** the vesicles being afterwards vomited; and some have burst into the **intestine,** the contents of the cysts being discharged by the anus.

Among the rarer directions, hydatids have been known to rupture into the **biliary passages,** the obstruction caused by the vesicles has induced jaundice, and their subsequent passage along the common duct has produced biliary colic. This is a serious complication and often terminates fatally. In several cases which have been carefully investigated the colony opened into the hepatic duct. The Museum of the Middlesex Hospital contains a specimen illustrating this, and the common bile duct is sufficiently dilated to admit an index finger. The patient was under the care of Murchison.

Another excessively rare direction is for the cyst to rupture into the **inferior vena cava,** the contents reaching the right side of the heart.

Cases have been reported in which the pressure of a cyst has induced atrophy of the intercostals, and its contents have been discharged externally. Cysts have also been known to burst externally near the umbilicus. Suppurating cysts may terminate in any of the directions mentioned above.

Hepatic hydatids may cause death by their size embarrassing respiration, or by pressure on important organs, such as the **vena cava,** producing **anasarca**; or by hindering the circulation through the **vena portæ** and causing **ascites,** whilst suppuration will lead to exhaustion or induce death by septicæmia or pyæmia.

Heart.—Echinococcus cysts and vesicles are met with in the heart under two conditions: (1) the cyst arises in the loose areolar tissue of the organ, and is then termed "primary"; or (2) the vesicles are conveyed into the cavities of the right side of the heart as emboli in consequence of the bursting of a colony into some large efferent vessel like the vena cava.

In most descriptions of "hydatids of the heart" attention is in the main directed to the relation of the cysts and colonies to the chambers of this organ, but a critical examination of the reports and specimens serves to show that the parasite exhibits the same fondness for abiding in loose areolar tissue in this organ as in others.

The heart contains in the auriculo-ventricular groove a large amount of loose adipose tissue which is strictly subserous. This loose tissue, which serves as a bed for the coronary vessels, penetrates deeply between the adjacent walls of the auricles, and indicates on the ventricular surface of the heart the line of the interventricular septum.

A critical examination of some of the available specimens makes it clear that in the majority of instances the parasite lodges in the loose tissue of the auriculo-ventricular septum

A man, æt. 19 years, died in Guy's Hospital with extreme suffering and the ordinary symptoms of mitral imperfection. On examining the heart, Moxon found a projection the size of an apple on the back of the auricles, "off their septum near where it joins the septum of the ventricles; from its extent it implicated all those parts mentioned." It had completely blocked the coronary sinus. The cyst, which contained daughter vesicles, was unbroken (Fig. 348).

A study of this specimen shows that the colony arose in the loose tissue of the auriculo-ventricular groove and came into close relation with the four cardiac cavities. It is a noteworthy fact that the cyst is in very intimate relation with the interventricular septum. I have come across several records in which the cyst is described as occupying this septum, and, on examining the specimen described by Peacock, which is preserved in the Museum of the Royal College of Surgeons, the cyst will be seen to occupy its upper (auricular) end.

The effects of echinococcus colonies on the heart and circulation are important. A cyst may exist for a long time and give no indication of its presence, and then death occurs suddenly and the cause is manifest at the *post-mortem* examination (Peacock's case). In others the cyst, or colony, embarrasses the action of the heart and produces serious symptoms of valvular lesion (Moxon's case). More often the cyst bursts into one of the cavities of the heart, the

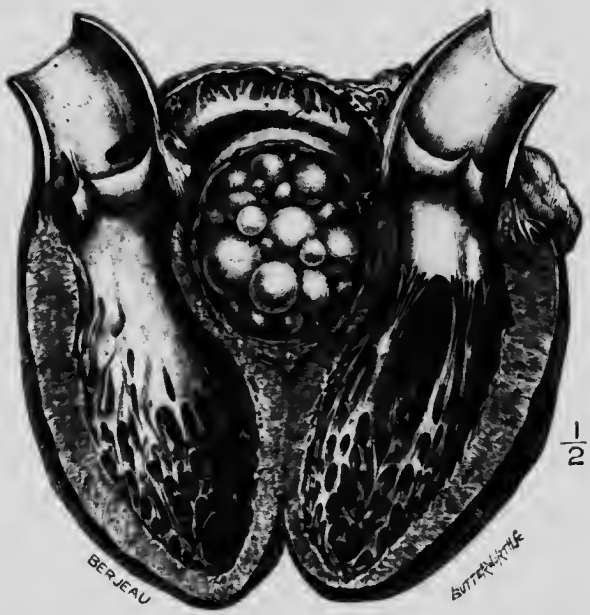

Fig. 318.—Left ventricle of a heart opened vertically to expose an echinococcus colony growing in the loose tissue of the auriculo-ventricular septum on the posterior aspect of the heart. (*Museum of the Middlesex Hospital.*)

vesicles and membrane being deported as emboli. When the cavities on the left side of the heart are invaded the vesicles are distributed by the systemic vessels. Oesterlin recorded a case in which a girl, æt. 23 years, developed gangrene of the right leg; this was amputated, and she died of pyæmia. An echinococcus colony the size of a pigeon's egg, situated in the wall of the left auricle, had burst into the cavity of the auricle, a piece of the cyst wall was discovered in a thrombus in the right common iliac artery, and an entire vesicle had lodged in the deep femoral artery.

Altmann has recorded a case which illustrates the tragic way in which an echinococcus colony of the heart may destroy life. A servant-girl was gathering chips at a wood-heap; she fell down as if in a fit, and died within ten minutes. On *post-mortem* examination an echinococcus colony as big as an orange was found on the posterior aspect of the left auricle, and had ruptured into the auricular cavity. A daughter cyst had been conveyed into the left internal carotid artery and blocked it at its entrance into the cranium. A complete examination was not permitted.

When a "colony" bursts into one or other cavity on the dextral side of the heart the vesicles and fragments of membrane are carried as emboli into the lungs (Budd, Barclay).

Echinococcus cysts seated in the tissues of the heart are said to be primary, but the vesicles and membrane of a colony may find their way into the heart as emboli. This, however, is a very rare phenomenon, and after a careful search I can only refer to one — the classical observation reported by Luschke to Professor Leuckart. A woman, æt. 45 years, died suddenly. In the posterior border of the liver there was an echinococcus cyst about the size of a child's head, which had burst through the walls and discharged some of its contents into the inferior vena cava. The daughter cysts had reached the right chamber of the heart, and had been driven thence into the pulmonary arteries and caused rapid death.

The most impressive feature connected with the clinical side of echinococcus colonies in the heart is the dramatic suddenness with which they may cause death, but this is no novelty in connection with grave cardiac disorders of all kinds.

The Lungs.—Echinococcus cysts occur in the lungs under two conditions. (1) The cyst, for it is usually single, may be situated wholly within the substance of the lung, and in most cases chooses the lower lobe, especially of the right lung, or (2) it may grow in the tissue immediately beneath the pulmonary pleura and project as an outgrowth from the lung into the pleural cavity. When the cysts are small they occasion little inconvenience, but increasing in size they compress the lung and lead to haemoptysis.

Apart from the mere pressure effects produced by the cyst, it is liable to rupture into the bronchial tubes; pieces of membrane and vesicles are coughed up and indicate the nature of the case. When the cyst communicates with a bronchial tube, suppuration of the cyst is the inevitable consequence. Should the cyst rupture into the pleural cavity, empyema is the usual result.

It is well to bear in mind that because vesicles and membrane are coughed up it does not necessarily follow that the

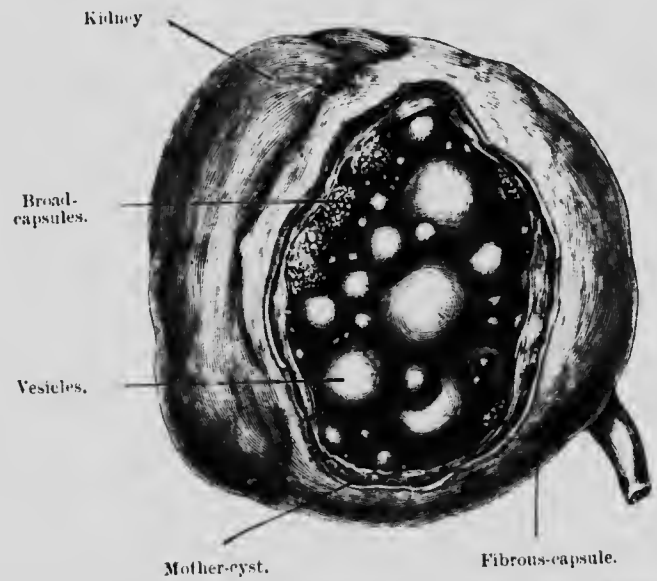

Fig. 349.—Echinococcus colony occupying the sinus of the kidney. (*Museum, Middlesex Hospital.*)

cyst is seated in the lung. Hepatic cysts are sometimes evacuated by this route.

Kidney.—Echinococcus disease of this organ has often been recorded. The colony may lodge in the loose areolar tissue of the renal sinus (Fig. 349), or grow immediately beneath the capsule. In each situation it may attain a very large size and lead to extensive atrophy of the renal tissue. When of small size they rarely give rise to trouble or even inconvenience during life, and their existence is only known in the course of a *post-mortem* examination.

There are good reasons for believing that an echinococcus colony of the kidney may rupture into the pelvis of the organ, the fluid and vesicles passing down the ureter to be discharged by the urethra. This is, of course, the most satisfactory mode of termination, except perhaps death of the parasite with subsequent calcification.

In the case of the right kidney, when the cyst wall calcifies, it may form close adhesion to the walls of the inferior vena cava, and make it extremely dangerous to strip the capsule from the vein. In at least one instance the vein has been torn in the process, with a fatal result.

Pancreas.—An echinococcus colony of the pancreas is extremely rare. In an example under my care the colony was opened, emptied, and drained, as its enucleation was impracticable. The patient, a woman, died four weeks later from hæmorrhage due to ulceration of the inferior pancreatico-duodenal artery. *Post mortem*, the dissection established the fact that the colony occupied the head of the pancreas.

The Thyroid Gland.—The echinococcus cysts are rare in this situation, and they have been known to cause death by bursting into the trachea.

The Subperitoneal Tissue and Omenta.—These are extremely favourable situations in which the parasite can flourish, especially the great omentum, mesentery, meso-colon, and the connective tissue of the pelvis.

Birch-Hirschfeld reported an instance of an echinococcus cyst in the cavity of the **vermiform appendix**, which was dilated to twice the thickness of the thumb. It contained the remains of membrane, which presented under the microscope the characteristic lamination. The appendix contained a great number of semi-transparent vesicles, varying from a pin's head to a pea in size: most of these were sterile. The communication between the appendix and the cæcum was obliterated. The walls of the appendix and its mucous membrane were atrophied from the pressure exerted by the cyst, and presented mosaic-like impressions caused by the pressure of the vesicles. The patient was a man thirty-eight years of age.

Scrotum.—A man supposed to have a hydrocele as big as

an emu's egg was tapped by Moloney: it was an echinococcus cyst.

Connective Tissue of the Trunk and Limbs.—Many cases have been recorded in which echinococcus cysts have been found in the axilla, orbit, posterior triangle of the neck, etc. Their nature is rarely suspected until the swelling is incised.

The Mamma.—Echinococcus cysts in this gland are very rare; records of about twenty cases are accessible. The patients were in nearly all instances adult women. The

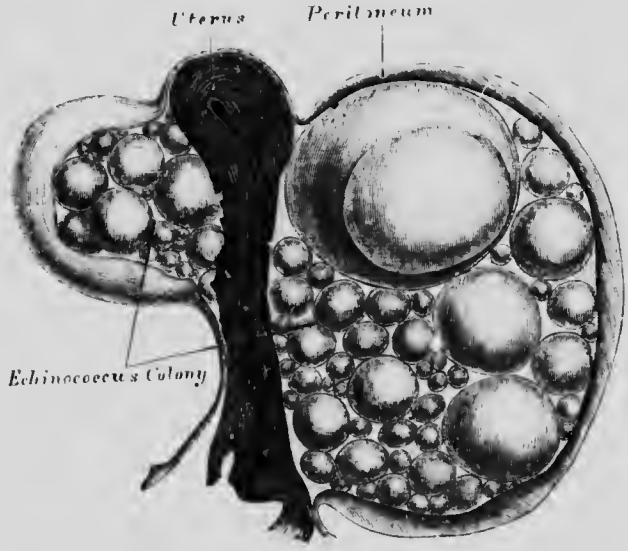

Fig. 350.—Echinococcus colonies in the mesometrium. (*After Freund.*)

disease takes the form of a slowly increasing, painless swelling, which may involve the whole breast or project as a smooth, elastic, fluctuating tumour from some portion of its circumference. These cysts may exist in the breast for ten years or longer without producing much inconvenience; they have been reported with a capacity of twenty ounces. Occasionally the cyst suppurates. Diagnosis in countries where the echinococcus is not common is very difficult without the assistance of an exploratory puncture.

Drawings of echinococcus colonies of the mamma are given by Astley Cooper, Bryant and others.

Uterus.—Echinococcus colonies have on several occasions been observed growing beneath the peritoneal investment of the uterus and forming a tumour as large as the patient's head (Fig. 350). Cysts of this character clinically simulate ovarian and uterine tumours, especially subserous fibroids (Altormyan). In one remarkable instance an echinococcus cyst 11 cm. in diameter grew beneath the serous covering of the fundus of the uterus and opened into the right Fallopian tube, which was greatly distended, thrown into con-

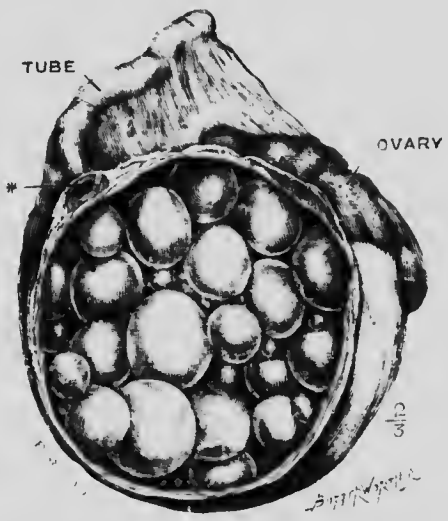

Fig. 351.—A mesosalpinx with the tube and ovary in transverse section. The ovary is flattened upon the wall of an echinococcus colony occupying the mesosalpinx. * The cut surface of the Fallopian tube.

volutions, and filled with vesicles (Moloney). Freund has published an admirable report of some examples of pelvic hydatids; it is the best contribution to the literature of this subject. His unique experience is probably due to the circumstance that his observations were made in Silesia—a European region second only to Iceland in the frequency with which the inhabitants become infected by echinococcus. It is exceptional to find vesicles in the Fallopian tubes, but in a woman thirty-two years of age Doleris found them so stuffed with vesicles that they formed a large tumour reaching above the umbilicus. The mass weighed 2 kilogrammes, and

consisted of the two tubes coiled upon themselves like small intestines, and so elongated that one measured 57 and the other 53 cm.

Ovary.—Neisser collected seven records of supposed hydatid cysts of the ovary, but an examination of the original reports shows that there was little reason in most of the cases to class them with hydatids. Indeed one of the cases was an ordinary multilocular ovarian cyst. Even in the examples recorded in recent years now that the term "hydatid" is almost restricted to the true echinococcus cyst, the cases recorded as "hydatid of the ovary" are conditions where the colony has grown primarily in the mesometrium, and implicated the ovary secondarily.

The specimen represented in Fig. 351 was removed by the author from a woman forty-four years of age. It was as large as a turkey's egg, and freely movable in the belly. The colony arose in the mesosalpinx, and flattened out the ovary. As far as could be ascertained at the operation, there were no other cysts in the abdomen.

Testis.—Echinococcus colonies have been seen in the scrotum, but I have never found any record of one within the tunica albuginea.

Brain.—Echinococcus cysts occur in connection with the membranes of the brain; the loose tissue of the pia mater is favourable to their growth. They are more frequent in relation with the cerebrum than the cerebellum. The pressure of such cysts produces a bay in the cortex of the cerebrum. It is often remarked by those who have recorded examples of intracranial hydatids that the damage produced by the cyst on the brain is out of proportion to the symptoms; but the same is equally true of almost all cerebral tumours. Hydatid cysts of the brain are nearly always sterile, and they are not furnished with the thick fibrous capsule which surrounds them in the liver and omentum.

Bones.—Echinococcus colonies are very rare in bones, and they seem to prefer the medullary cavities of long bones; the variety found in the bones of man is that known as *Echinococcus multilocularis*, in which there is no mother cyst, but the medullary cavity of the bone is occupied by a multitude of vesicles (Fig. 352). The effect of these colonies on the

Fig. 352.—*Echinococcus multilocularis* in the shaft of the humerus; from a woman 35 years of age who suffered amputation through the shoulder joint. (*After Graham.*)

Fig. 353.—Remnants of a femur and tibia fenestrated by a colony of *Echinococcus multilocularis*. (*Museum of the Royal College of Surgeons.*)

bone is very extraordinary; they induce atrophy of its shaft, and at length the bone breaks from some trivial injury. In some instances operations have been undertaken for the relief of abscesses supposed to be due to necrosis, and when the bone has been opened up vesicles have escaped. When the colony occupies the end of a bone, the vesicles may invade the adjacent joint (Fig. 353).

The Spine.—Echinococcus cysts occur in connection with the spine under three conditions:—

1. *The cysts are situated entirely within the canal.* Such are divisible into two sets: (*a*) Cysts lying inside the dural

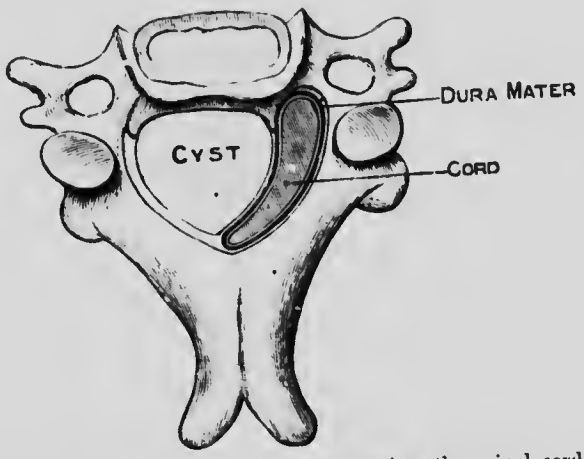

Fig. 354.—An extradural echinococcus cyst compressing the spinal cord at the level of the third cervical vertebra. (*Modified from Colman.*)

sheath, and (*b*) those which grow in the loose areolar tissue between the bone and the dura mater (Fig. 354). The majority belong to the latter division.

Schlesenger tabulated the variety and position of four hundred tumours of the spinal canal: forty-four were echinococcus cysts, five were intradural and thirty-nine extradural.

2. *The cysts arise in a vertebra and extend into the neural canal.* Primary echinococcus colonies of the vertebræ are examples of *E. multilocularis* (Fig. 355).

3. *Echinococcus colonies growing in tissues adjacent to the spine may involve the vertebræ and extend into the spinal canal.*

Symptoms and Diagnosis.—The localising symptoms depend entirely on the situation of the cyst. For example, when the cyst or colony is in the spinal canal the symptoms will be those common to any tumour large enough to compress the spinal cord and produce paraplegia. In the cranial cavity the symptoms are identical with those produced by any tumour which compresses the brain.

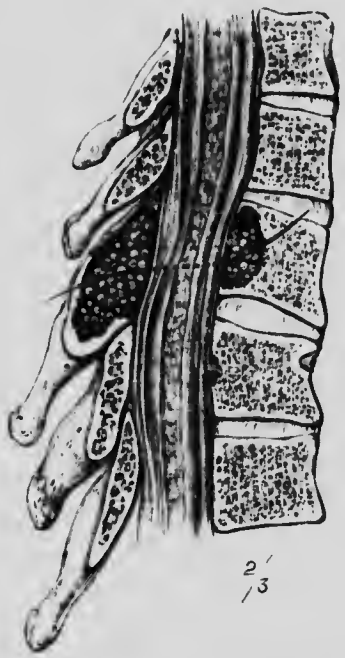

Fig. 355.—*Echinococcus multilocularis* in the seventh cervical vertebra. (*Museum of St. George's Hospital.*) (*After Bennett.*)

In the abdomen, especially when the cysts are connected with the liver, the nature of the swelling may be suspected when it is painless, slowly increasing, and especially if a peculiar vibratory thrill is produced by percussing the middle finger of the left hand when it is laid firmly over the tumour.

When the colonies burst into hollow viscera and the characteristic vesicles are discharged by the bowel, urethra, vagina, trachea, or through suppurating sinuses, then the nature of the disease is self-evident. In countries where

echinococcus disease is endemic, it is usual in cases where a tumour or swelling exhibits negative characters to regard it as an echinococcus cyst. More than half the examples of this disease occur as surprises in the course of surgical operations.

Treatment.—This is always surgical, and the particular method of carrying it out varies with the situation of the cyst. When they hang as big as apples from the omentum it is only necessary to expose the cysts through an incision in the belly wall, ligature the pedicle, and remove them. In many cases they are firmly adherent to surrounding structures. In these circumstances the fibrous capsule should be freely incised and the mother cyst enucleated; the empty capsule rarely gives trouble. Suppurating cysts demand free incision and drainage.

In removing colonies it is wise to avoid soiling the edges of the wound with brood capsules, for there are reasons for believing that they may give rise to cysts of some size in the cicatrix.

In the case of the *liver*, echinococcus colonies treated by incision, enucleation of the capsule, and free drainage give but little trouble. Great care should be taken thoroughly to remove the mother cyst, for decomposition of this tissue when left is a source of grave danger. All meddling methods—as punctures with trocars, aspiration, and electrolysis—cannot be too strongly condemned.

Echinococcus cysts in the *lungs* require to be treated on the principles of empyema, and in this situation Lendon particularly insists on the necessity of removing the mother cyst.

The contents of dead colonies are sometimes so firm that they require removal with a scoop. When the cyst wall is calcified it often leads to a persistent sinus.

In the case of *bones* the treatment consists of incision, evacuation of vesicles, and drainage. Exceptionally, when the bone is seriously damaged, fractured, or a large joint is invaded, amputation has been found a necessity.

Echinococcus cysts within the *cranium* have been localised, exposed by trephining, and after evacuating the fluid, the cyst has been successfully extracted (Verco, Rennie and Crago, Mills and MacCormick).

Echinococcus cysts in the *spinal canal* have been successfully submitted to surgery (Tytler and Williamson). The difficulty of localising and treating some of these cases is well shown by a case recorded by Stewart McKay.

Single echinococcus cysts and colonies give, as a rule, admirable results when treated surgically, but in cases where the patient suffers from a general infection the disease is very inveterate, and demands much persistence on the part of the surgeon, and calls for great courage and fortitude on the part of the patient.

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