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AIDS TO SURGERY

JOSEPH CUNNING

SECOND EDITION

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SURGERY

BY

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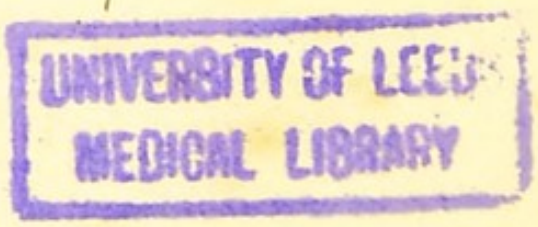

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PREFACE TO THE SECOND EDITION

THE exhaustion of the first edition and a reprint as well as an American edition has rendered a new one necessary. This has allowed of certain alterations and additions in accordance with the progress of modern surgery, and a slight increase in the number of the pages has been compulsory. The sections on Gall-Stones and Diseases of the Pancreas have been entirely rewritten.

To those of my critics who complain that there is no originality in this work, I would again point out that its aim is to aid students in preparing for examinations, and that object would be defeated if views other than those generally accepted were put forward in such a book.

To the gentle critic 'who fails to see why this book has been written' I convey my most humble apologies, but my excuse is that there are so many who, fortunate or otherwise in not possessing his hypercritical sense, have found the book useful to them. So I have ventured to offend him again instead of withdrawing into a rightly abashed obscurity.

JOSEPH CUNNING.

UPPER WIMPOLE STREET, W.,
January, 1908.

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AIDS TO SURGERY

CHAPTER I

SURGICAL BACTERIOLOGY

As many of the surgical diseases and most of the failures of surgical operations depend upon the growth of bacteria, it is necessary to have a knowledge of their life-history, the methods of preventing their access to wounds, and of combating their growth.

Bacteria are minute vegetable organisms, consisting of protoplasm enclosed in a cell wall. Some are enclosed in pairs, or fours, or larger numbers, in an outer envelope. According to differences in size and shape, they are classified as—

Cocci.—These are round or oval, and multiply by a process of division into equal parts (fission). If grouped in pairs, they are called diplococci—*e.g.*, gonococcus, diplococcus of pneumonia; if in chains, streptococci, as in erysipelas; if in clusters like a bunch of grapes, staphylococci, as in localized inflammations.

Bacilli are rod-shaped, and, if united end to end, form long filaments. If separate they may be straight rods, as the anthrax bacillus; or curved, as the comma bacillus of cholera. They multiply either by fission or the formation of spores. The spore may occupy the middle of the cell, as in the anthrax bacillus, or one end, as in the bacillus of tetanus.

The methods of examination are by the microscope,

cultivation, and inoculation. **Koch's laws** as to establishing a particular organism as the cause of a disease are :

1. The organism must be present in every case, either in the tissues or the blood.

2. It must be possible to cultivate it for many generations apart from the body.

3. Its inoculation into a suitable animal must be followed by the appearance of the specific disease.

4. The organism must be found in the tissues or blood of the animal affected in this manner.

Bacteria are found in earth, air, and water. The more crowded the population, the greater the number of organisms. In high mountains and at sea they are few in number. Certain food is required for them, the essentials of which are oxygen, hydrogen, carbon, nitrogen, and inorganic salts Organisms grow best at the body-temperature—98·4° F. Cold and desiccation arrest their growth, but do not kill. Any degree of heat above 57° C. kills bacteria if allowed to act long enough ; spores require a higher temperature. Bacteria which can grow in and require oxygen are called aërobes. Those which require an oxygen-free atmosphere are called anaërobes.

Bacterial Products.—The most important of these are **toxins**, intense poisons, which cause high temperature if absorbed into the circulation. Other products are alkaloidal (ptomaines), ferments, acid and alkaline substances, and gases.

Pathogenic bacteria are those which can develop in living tissues ; **non-pathogenic** can only develop in dead structures, such as slough, serum, or pus, though the toxins formed may be absorbed.

Sepsis.

Sepsis is a general term which indicates that an operation wound or an accidental wound has become infected with bacteria. These may be either putrefactive or pyogenic organisms.

The putrefactive organisms can only grow in dead tissues, but the toxins formed by them are so irritating as

to be able to cause sloughing of the surrounding parts, as in phagedena. If absorbed, a high temperature is produced, as when a portion of putrefying placenta is retained in the uterus.

The pyogenic organisms can grow in living tissues, and also produce toxins. The organisms may invade the tissues in the neighbourhood and give rise to erysipelas or cellulitis, or enter the circulation and cause pyæmia or septicæmia. Hectic fever, septic fever, and sapræmia, are terms used according to the amount of absorption of toxin, but the process is the same in all. Once a barrier of granulation tissue is formed by the reaction of the tissues, and so long as the septic material is not retained under pressure, the fever subsides. The symptoms are proportionate to the dose absorbed.

The **Symptoms** usually commence with a rigor about two days after infection, followed by a continuous high temperature. There is loss of appetite, dry tongue, constipation, diarrhœa in the later stages, headache, and quick pulse. If allowed to go on, the pulse becomes weak, delirium occurs, and the patient dies of exhaustion. If, however, the source of toxin is abolished in time, the patient very rapidly gets well.

Treatment.—Remove the putrefying mass or open the abscess and provide free drainage. Administer stimulants and plenty of food. If the patient be very bad, intravenous injection of 2 pints of saline solution (℥i. ad Oi.) repeatedly, produces diuresis and diarrhœa, and helps to eliminate the toxins. Purgatives also have the same effect.

Infection.

Infection is due to invasion of the living tissues by virulent pathogenic bacteria. The place of entry may be wounds or abrasions, either of skin or mucous membranes. The organisms may be insufficient in numbers to cause general symptoms, but if they find a part with its vitality sufficiently lowered by injury or cold, they obtain a suitable growing ground and produce serious disease. This is called **auto-infection**, and is seen in acute infective osteomyelitis.

Mere exposure to infection does not mean that infection

necessarily occurs. (1) The actual numbers of organisms introduced may be insufficient; (2) the virulence also varies considerably; (3) the resistance of the tissues may be lowered by injury or cold. General conditions, as chronic alcoholism, Bright's disease, and diabetes, lower resistance to infection, as also want of fresh air, exercise, and insanitary surroundings.

Local infective processes occur at the spot of inoculation. Inflammation is caused, and is a sign of the reaction of the tissues in their effort to combat the organisms. There may be no general toxæmia, as in a boil, or there may be absorption of poison, as in erysipelas.

General infective processes are those in which organisms invade and develop in the blood-stream; septicæmia is a good example.

Confusion often exists between the terms 'sapræmia,' 'septicæmia,' and 'pyæmia.'

Sapræmia is due to absorption of toxins only, and is characterized by a persistent high temperature, relieved at once by removing the source of the poison.

Septicæmia is due to organisms multiplying in the blood, and characterized by a maintained high temperature, but not relieved by getting rid of the original source.

Pyæmia is due to particles of blood-clot carrying organisms to parts distant from the original source, and there setting up abscesses. It is characterized by rigors, very high temperature, sweatings, and big remissions of temperature.

Immunity may be natural or acquired. Natural immunity is lowered by such general causes as cold and wet, starvation and malnutrition, hæmorrhage, poisons, particularly alcohol, prolonged exposure to a vitiated atmosphere, general diseases, as diabetes and Bright's disease. Local causes include injury, chemical irritants, and anything which causes a deficiency in the blood-supply.

Acquired immunity may occur from—(1) having had a previous attack—*e.g.*, syphilis and the exanthemata; (2) inoculation with small doses of a specific virus—*e.g.*, small-pox; (3) inoculation with attenuated virus; (4) inoculation with repeated doses of toxins; (5) inoculation with the serum of an artificially immunized animal—*e.g.*, antidiphtheritic, antistreptococcic serums.

The method of resistance of the body to invasion is due to both the leucocytes and substances in the blood plasma. The latter have been recently termed **opsonins**, and have the power of so influencing the invading bacteria that they can then be destroyed by the leucocytes. The opsonic power of the blood can be calculated, and in certain cases can be increased by injecting subcutaneously killed cultures of the bacteria—*e.g.*, staphylococci in cases of furunculosis, tubercle bacilli in tuberculous diseases.

The various bacteria of importance surgically are **pyogenic bacteria**. Practically all suppuration is due to organisms. Important ones : Staphylococci, streptococci, gonococci, pneumococci, *Bacillus coli communis* tubercle, anthrax, tetanus, and actinomyces.

1. *Staphylococcus pyogenes aureus*, *albus* and *citreus*. The first is the most important. They are commonly present on skin and mucous membranes. Acute but localized suppuration and pyæmia are usually due to *Staphylococcus aureus*.

2. *Streptococcus pyogenes* has a wide distribution. It is the cause of spreading inflammation, such as erysipelas, some acute abscesses, septicæmia, and sometimes pyæmia

3. *Gonococci*, the cause of gonorrhœa, are found either in the epithelial cells or pus corpuscles.

4. *Pneumococci* cause pneumonia, but may produce suppuration in other parts, such as the pleural cavity or middle ear.

5. *Bacillus coli communis* produces gas with a foul odour. It is a normal inhabitant of the intestine, and so long as it remains there it is harmless ; but if the intestine be injured, it may invade the wall and produce suppuration. Common examples are appendicitic and ischio-rectal abscesses.

6. *Tubercle bacillus* is the cause of phthisis, tuberculous bone and joint diseases, and lupus.

7. *Actinomyces* is a fungus which produces chronic inflammation and suppuration. It consists of a branching mycelium. The threads, which stick out at the periphery, have swollen sheaths forming clubs. It is supposed to exist on grasses or cereals, and is taken in with the food.

8. *Anthrax* is a large bacillus which produces very

resistant spores. It causes malignant pustule and wool-sorters' disease.

9. *Tetanus bacillus* and *malignant œdema bacillus* are found in earth, especially when manured, and are strictly anaërobic.

CHAPTER II

INFLAMMATION

INFLAMMATION is the succession of changes which occur in a living tissue when it is injured, provided that the injury is not of such a degree as to at once destroy its structure and vitality. Invasion by bacteria must be included as injury. Inflammation must be looked upon as the evidence of the fight of the tissues against invasion.

The **Phenomena of Inflammation** are dilatation of the arterioles, capillaries, and small veins. At first the blood-current is quickened, then retardation occurs, and may progress to stasis and thrombosis. During this time exudation of plasma and white corpuscles from the small veins, and perhaps the capillaries, is going on. The fate of the white cell may be either to break up and set free prothrombin, or to act as food for connective-tissue cells, or to act as a phagocyte and be transformed into a pus corpuscle. Red corpuscles may be exuded and broken up, setting free their colouring matter. The prothrombin of the white cells unites with the calcium chloride of the plasma, and forms thrombin, or fibrin ferment, which acts upon the fibrinogen of plasma to form fibrin.

The tissues are thus invaded with numbers of leucocytes. In bacterial inflammation a varying portion of the tissues is killed by the toxins produced, and is either replaced by a mass of small round cells, or liquefied into pus. In the latter case it is surrounded by a ring of small round cells. The connective-tissue cells absorb the leucocytes, and new vessels are formed, thus constituting repair. In non-bacterial inflammation, exudation may separate layers of cells to a large extent and form blebs. In chronic inflammation the formation of new fibrous tissue is the chief part of the process.

The **Terminations of Inflammation** depend on the cause and the reaction of the tissues. If non-bacterial, the termination is generally resolution or the formation of cicatricial tissue.

1. *Resolution* occurs when the vascular changes have not gone so far as stasis, and the changes only reverse their order.

2. *Organization*, or the formation of cicatricial tissue, occurs when the changes stop short of suppuration, and in the repair of all other forms of termination.

3. *Suppuration* is always bacterial in origin, and is due to the liquefying action of the toxins on the tissues and exudation.

4. *Ulceration* is suppuration on the surface.

5. *Gangrene* as a result of inflammation is due to excessive virulence or diminished resistance, or to the exudation being so placed as to cut off the blood-supply of the part by its pressure.

The **Signs** are: Pain, heat, redness, swelling, and impairment or loss of function.

Pain is due to the tension in the tissues, and so is increased if under fascia, or inside such a structure as the tunica albuginea.

Heat is due to the increased amount of blood flowing through the part.

Redness is due to the hyperæmia, and disappears on pressure, unless stasis has occurred.

Swelling is due to the hyperæmia and exudation. If the inflammation is under tense structures, like the palmar fascia, the swelling may appear in another part, as on the back of the hand.

Symptoms.—*Fever* is caused by the absorption of some 'pyrogenous body.' The heat-governing centre in the brain is upset, and there is loss of the proper relation between heat production and heat loss. Fibrin ferment is one of these bodies, and is the cause of fever in non-bacterial inflammations. The bacterial toxins are the common causes of fever, and their action upon secreting cells produces 'cloudy swelling' and impairment of function, hence the dry mouth and the loss of appetite. The pulse is increased in frequency, and full at first, but becomes increasingly rapid and soft. If the fever is long

continued or severe, or in a weakly person, delirium occurs, with wasting, ending in death from exhaustion.

Causes of Inflammation.

Predisposing Causes.—*Local:* (1) Defective circulation, as from calcareous arteries or varicose veins; (2) impaired innervation; (3) a previous attack.

Constitutional: (1) Old age; (2) weak heart; (3) such conditions as alcoholism, diabetes, Bright's disease, gout.

Exciting Causes. — (1) Bacteria, by far the most common and important; (2) trauma; (3) heat or cold; (4) electricity and Röntgen rays; (5) chemical agents, such as strong acids and alkalies, croton-oil, cantharides.

Treatment.—*Local:* 1. Remove the exciting causes. If bacterial, as a rule, they cannot be completely removed, but incisions which relieve tension help, by draining away the toxins. A localized infection, like a malignant pustule, should be completely removed. Foreign bodies or dead bone should be taken away.

2. Keep the part at rest.

3. Diminish the congestion by—(*a*) Position: place the part, if possible, at a higher level than the heart. (*b*) Blood-letting, which may be general or local. General blood-letting is done by opening the median basilic vein and bleeding to 8 or 10 ounces. Local blood-letting is done by means of leeches, which remove 2 or 3 drachms each; by wet or dry cupping; by scarifications; by cold; and, best of all, by free incisions.

4. Heat is useful in the later stages of inflammation in the form of frequently changed fomentations or the continuous hot bath.

General Treatment aims at relieving the pain and promoting the excretion of the absorbed toxins through the skin, bowels, and kidneys. A purgative, of which the best is ½ ounce of magnesium sulphate, should be given; plenty of drink, such as barley-water, to dilute the blood; Dover's powder and liq. ammoniæ acetatis should be given to induce sweating; quinine and stimulants if the patient is in a weak condition. The food should consist of milk and beef-tea at first, and a fuller diet during recovery.

Serotherapy: Injection of special antitoxins in diphtheria, tetanus, and streptococcic infection.

Chronic Inflammation.

There is hyperæmia and exudation, but to a less degree than in acute inflammation. The chief changes are in the greater reaction of the tissues; a large amount of new connective tissue is formed. Suppuration never occurs unless acute septic infection supervenes or the morbid material itself liquefies—*e.g.*, tuberculous pus.

Causes.—The common and important ones are tubercle and syphilis. Others are gout, rheumatism, foreign bodies, long-continued pressure.

Results depend upon the cause and tissue affected. In simple chronic inflammation soft structures have their connective tissue increased in quantity and converted into cicatricial tissue. Bone is thickened and condensed. Glands are enlarged and indurated.

In chronic tuberculous inflammation there is formation of much granulation tissue studded with tubercles. These may soften or caseate and break down into pus, or become calcified. The surrounding structures eventually form cicatricial tissue.

In chronic syphilitic inflammation there is either diffuse overgrowth of connective tissue or a large collection of small round cells. In the latter case there is often coagulation necrosis from chronic endarteritis in the neighbouring vessels, cutting off the blood-supply.

Treatment.—(1) Remove the cause; (2) keep the part at rest and elevated; (3) counter-irritation by friction, Scott's dressing, iodine, blisters, or the actual cautery: (4) pressure; (5) massage; (6) free incisions. Good hygiene and nourishing food are essential in all cases. Free incisions are often the most certain and speedy method.

In chronic inflammation due to syphilis, iodide of potash and mercury must always be given.

CHAPTER III

ACUTE SUPPURATION

Definition.—When inflammation, after reaching the stage of exudation of plasma and leucocytes, goes on to liquefaction of the tissues the process is called suppuration. Pus is a fluid containing in suspension living and dead leucocytes. Suppuration may occur in the tissues or on a free surface. In the tissues it may be circumscribed by a definite wall of granulation tissue, and is called an abscess; or diffused among the cellular tissues with no limiting wall, then called diffuse cellulitis.

Causes.—Pyogenic organisms are always the cause. Staphylococci generally cause circumscribed, streptococci diffuse, suppuration. The bacteria may infect an area directly from the surface through a wound, or from the circulation (auto-infection).

The conditions necessary are: (1) A sufficient number of sufficiently virulent organisms; (2) a condition of lowered vitality, either local or general.

The abscess may find its way to the nearest surface, and point, or it may travel along fascial and muscular planes. As soon as the abscess bursts or is opened, the walls of granulation tissue which surround the abscess cavity fall together, adhere, are converted into cicatricial tissue, and so close up the cavity.

Signs and Symptoms of Circumscribed Abscess.—*Local.*—There is an area in which the signs of inflammation—viz., pain, heat, redness, and swelling—are present. The pain is throbbing in character. The swelling is hard, and pits on pressure. When pus is formed, a soft spot may be felt in the middle of the hard area. If the collection of pus is large, fluctuation may be felt. If the abscess is under dense structures, such as palmar fascia, the pain is very severe.

General.—There is a raised temperature, some shivering, even a rigor. Leucocytosis—*i.e.*, an increase in the white blood corpuscles above the normal 8,000 per c. mm.—is always present in any well-resisted severe suppuration.

Varieties of Pus.—Pus may be mixed with blood,

sanious ; with mucus, muco-pus ; with gas, either by its escape from the intestine or from gasogenic organisms, as the bacillus of malignant œdema. Pus may stink from the presence of the products of the *Bacillus coli communis.*

Diagnosis.—The signs of inflammation, with the presence of fluctuation, are quite sufficient. If fluctuation is absent, the soft spot in the middle of a brawny area is equally good. Neither fluctuation nor a soft spot may be felt if the pus is under dense fascia, but the tense swelling the throbbing pain which prevents sleep, and the temperature, invite exploration. In the case of internal suppuration, where there are no such signs, a valuable indication is afforded by **Leucocytosis.** A **physiological** increase in the total leucocytes in the blood occurs during digestion, during pregnancy, and in the newly-born infant. As regards surgery, the most important **pathological** increase is met with in suppuration. A count of 20,000 leucocytes per c.mm. may be taken as almost certain proof of suppuration, given other causes of leucocytosis can be excluded. If between 15,000 and 20,000, another examination should be made in twenty-four hours, for if suppuration is occurring, there will be a rise ; if not, the count will remain stationary or fall.

Leucocytosis falls when an abscess is opened, or when the bacteria causing it have been killed. In an unresisted infection, owing to the extreme virulence of the bacteria or to the feeble constitution of the patient, there is not only no increase in the leucocytes, but there may be a **leucopenia**, or decrease. Leucocytosis does not occur in cases of chronic abscess.

Treatment of Acute Abscess.—When pus is present, it should be evacuated as soon as possible. All antiseptic precautions should be taken. The incision should be at the most dependent part. Unless the incision is in the face or neck, where the size of the scar is important, or where important structures would be endangered, the incision should open up every limit of the abscess cavity. This hastens the healing. All septa should be broken down to prevent pocketing

Hilton's method is used where important vessels and nerves might be endangered with the knife. The incision goes only through the skin. Then a probe is pushed

through the deep fascia, and a pair of sinus forceps is made to follow. These are opened on withdrawal to enlarge the opening. A counter-opening may be necessary when a large incision is impossible. Drainage is necessary after incision. For this purpose a large rubber tube with holes cut in it is the best. If the opening is large, gauze will do to keep the edges of the wound apart, but if the opening is small gauze acts as a cork, not a drain. Antiseptic dressings are necessary till healing occurs.

Chronic Abscess, sometimes called Cold Abscess, is practically always tuberculous. When the tubercle bacillus attacks a spot, there is a surrounding area of chronic inflammation. A combination of action between the bacilli and their products, and the obliteration of the neighbouring arterioles by chronic endarteritis, brings about liquefaction of the central area. This liquefied material is 'tuberculous pus.' The process may extend to the surface directly, or, if under deep fascia, spread to a spot far distant. A common example of the latter is a psoas abscess. None of the signs of acute inflammation are present. The wall of the abscess cavity is lined by pulpy, gelatinous-looking granulation tissue containing miliary tubercles.

Residual Abscess.—Sometimes an abscess occurs long after the tuberculous process has been apparently cured. This is due to a small focus taking on activity once more.

Results of Long-continued Suppuration.—These are always due to the infection of the cavity by pyogenic organisms. Hectic fever and amyloid disease are produced.

Hectic Fever is due to chronic toxæmia, where septic toxins are regularly absorbed, as in chronic suppuration of bone, phthisis, septic, cancerous, and syphilitic sores. There is a regular evening rise of temperature, with night-sweats following. These lead to a gradual exhaustion of the patient's strength.

Amyloid or Lardaceous Disease.—The walls of the arterioles are first affected, then the secreting cells of certain viscera. There is a deposit of a proteid substance —lardacein—which stains brown with tincture of iodine, red with methyl violet. The liver, spleen, kidneys, and

intestinal mucous membrane, are the organs most affected. The liver becomes much enlarged, smooth, painless, and its functions are much impaired. The kidney becomes enlarged, and at first the urine resembles that of interstitial nephritis, being pale, abundant, of low specific gravity, and perhaps containing hyaline casts. Later it is scanty, of high specific gravity, and contains albumen. Diarrhœa and decreased absorption of nutriment accompany amyloid disease in the intestine. Amyloid disease may disappear if the suppuration can be cured.

Treatment of Chronic Abscess.—The first essential is to rigidly exclude pyogenic organisms; the second, to remove the whole tuberculous area. The latter very often cannot be done; the former must always.

1. Simple aspiration seldom cures. 2. Aspiration with irrigation is only a little more successful. 3. Opening the abscess and scraping freely with a flushing spoon removes the lining wall of the cavity. Unless it be completely removed, the bacilli which it contains reinfect the cavity. The wound should be stitched up. If pus reforms, there is no limit to the number of times this operation can be repeated. 4. Tapping and injection of an antiseptic, such as iodoform emulsion. 5. Simple incision and drainage is not to be recommended. 6. Dissect out the whole cavity where possible, as in the neck. 7. Laying open the cavity, scraping the walls, and sponging with pure carbolic acid.

Sinus and Fistula.

A **Sinus** is a narrow track lined with granulations, open only at one end.

A **Fistula** is of the same structure, but open at both ends, and either leading from one cavity to another or from a cavity to the surface.

The cause must always be removed. Common causes are—(1) the presence of fæcal infection, as in fistula in ano; (2) caries or necrosis of bone; (3) a septic ligature in a wound; (4) insufficient drainage of a deep wound; (5) tuberculous infection of the wall.

1. **Congenital Fistulæ**: Branchial, umbilical, urinary, or fæcal.

2. **Traumatic Fistulæ**: Aerial, pharyngeal, salivary, recto vesical, recto-vaginal.

3. **Pathological Fistulæ** are secondary to abscess or disease: Biliary, fæcal, perinæal, urinary, fistula in ano.

CHAPTER IV

ULCERATION

Definition.—An ulcer is a progressive loss of tissue in skin or mucous membrane which has previously been the seat of inflammatory changes, which have gone on to the stage of granulation. The loss is cell by cell, not in visible portions. The latter is called gangrene. There are three main classes:

(1) Non-specific, due to traumatism and infection with pyogenic bacteria; (2) specific, nearly always tuberculous or syphilitic; (3) malignant ulcers, as rodent, epitheliomatous, scirrhus.

Causes.—1. *Predisposing:* Lowered vitality from anæmia, long-continued congestion, defective innervation, diabetes. 2. *Exciting:* An irritant, either mechanical, bacterial, chemical, or thermal, sufficient to produce inflammation and tissue destruction.

Clinical History.—*Three stages:* (1) Extension; (2) granulation; (3) repair.

1. **Extension.**—In this stage there is progressive destruction. The characters of the ulcer, taken in order, are: The edge is sharply cut and defined; the surface is covered with a slough; the discharge is abundant and thin, and may be offensive or sanious; the surrounding tissues are œdematous; the base is thickened and fixed to the deeper tissues.

Treatment.—The essentials are rest, removal of the bacterial products, and preventing the access of further infection. For this the raising of a limb and frequently changed boracic fomentations answer best.

2. **Granulation.**—This is the stage between the cessation of extension and repair. It is the preparatory stage for repair. The sloughs are removed, the surface is covered with fibrin and small round cells, which become converted into granulation tissue.

Many ulcers remain in this mid-stage; the common ones are the callous, the irritable, and the varicose ulcers.

The **Callous Ulcer** is a sore at a deeper level than the surrounding skin, with an indurated base and surroundings, a pale yellow surface, devoid of granulations and secreting thin discharge. The causes are want of rest, congestion from standing or varicose veins, contraction of already-formed cicatricial tissue cutting off the blood-supply, or adhesion of the base of the ulcer to deeper parts preventing contraction.

The **Irritable Ulcer** is a chronic ulcer with nerve terminals exposed in it.

The **Varicose Ulcer** is due to slight injury in a limb whose vitality is impaired by varicose veins, especially if the varicosity is in the skin. If neglected it becomes a callous ulcer.

The dangers of chronic ulcers are: Contraction if over a joint; permanent œdema if surrounding a limb; septic phlebitis; and occasionally the supervention of epithelioma.

Treatment is the same as in the first stage, unless the ulcer be chronic.

In **chronic ulcer** rest is absolutely necessary. Favour the venous return by elevating the part. Promote the absorption of the exudation by massage, or pressure either by strapping, elastic bandage or Unna's bandage, or by blistering. Antiseptic dressing is necessary in every case. Varicose veins should be excised or an elastic bandage worn.

The **irritable ulcer** should be scraped. If there is eczema of the surrounding tissues, lotio plumbi should be applied.

3. **Repair.**—A healing ulcer has shelving edges, an even base covered with healthy granulations, a slight discharge consisting of serum and leucocytes. The margin consists of two layers—an inner bluish one made up of only a few layers of epithelial cells, and an outer white one made up of many layers. The surrounding tissues are not infiltrated.

The deeper layers of granulations are converted into cicatricical tissue, which contracts, while the epithelium spreads in from the margin till the whole surface is covered.

Treatment.—Guard against irritation by ointment of boric acid or protective tissue ; use antiseptic dressings ; keep the part at rest and elevated. If the granulations become prominent, touch them with silver nitrate.

If the ulcer is big or speed in healing is wanted, it must be skin-grafted.

Skin-grafting.—1. *Reverdin's Method.*—Small pieces of cuticle and cutis are cut off with scissors and divided into two or three smaller pieces. These are placed here and there on the granulating surface. The ulcer is covered with aseptic protective and dressings, and left undisturbed for four or five days. The grafts form islands, from which the epithelium spreads.

2. *Thiersch's Method.*—All the granulations are scraped away. The surface is covered with protective, and pressure applied while the grafts are being cut, to stop the bleeding. The best knife to use is a medium-sized amputation knife. Thin shavings as large as possible are cut down to the tops of the papillæ. These are spread evenly over the raw surface, overlapping one another as well as the edges. The whole is covered with sterile protective and dressings, and left for five days. Antiseptics should be avoided, and only sterile saline solution used.

3. The whole thickness of the skin is sometimes used, either detached altogether or left with a pedicle, which is detached after a week or ten days.

Specific Ulcers are due each to the action of a specific organism. These are soft chancre, syphilitic ulcers (primary, secondary, intermediate, and tertiary), tuberculous ulcers, malignant pustule.

Malignant Ulcers are due, not to an inflammatory process, but to replacement of skin or mucous membrane by the growth.

CHAPTER V

GANGRENE

Definition. — By gangrene is meant death of macroscopic portions of the tissues. If of soft parts, it is called sloughing ; if of bone, necrosis.

Classification.—*Clinical:* Moist and dry gangrene. *Etiological:* direct, indirect, and specific gangrene.

Signs of Local Death.—(1) Loss of pulsation in the vessels; (2) loss of heat; (3) loss of sensation; (4) loss of function; (5) change of colour to purple or mottled if much blood be present, to waxy colour if anæmic.

Changes in the tissues depend on whether the gangrene be dry or moist.

Dry Gangrene occurs when death happens in a part which has been previously drained of its fluids. The usual cause is arterial thrombosis supervening on atheroma or calcification of vessels. If the part is quite dry sepsis does not occur, so it shrivels into a black or dark-brown mass. If putrefaction occurs it becomes very offensive.

Moist Gangrene occurs when the dead part is full of fluids, and may be either aseptic or septic, generally the latter. If septic, the tissues putrefy and foul-smelling gas is formed.

The progress of the case depends on the size of the dead part and the presence or absence of organisms. If small and aseptic, the necrotic area may be infiltrated with leucocytes, broken up and absorbed. More generally the dead tissue is cast off in one of two ways: 1. In *aseptic gangrene* the line of junction between the gangrenous and living tissues is infiltrated with leucocytes; separation occurs there through the whole thickness of dead tissue, and healing by granulation follows. 2. In *septic gangrene* there is similar ulceration, but it spreads along the living structures owing to the effect of the toxins formed in the dead tissues, till either a barrier of sufficient inflammation occurs or amputation is performed. The site of junction is called a line of demarcation, but suppuration may extend beyond this along muscular planes, or by lymphatics and veins.

General Symptoms.—(1) Those which predispose to gangrene, such as defective circulation from fatty heart, valvular lesion, or calcareous arteries—such diseases as diabetes and albuminuria; (2) those due to absorption of toxins, causing fever and exhaustion. Pain is a frequent and troublesome symptom.

Treatment is local and general. Local will be dealt

with under the various headings. General treatment consists of feeding the patient well, giving stimulants, opium for pain, and dieting the patient if diabetes is present.

Varieties of Gangrene.—1. **Direct Gangrene** may be due to—(1) crushing of the part; (2) pressure; (3) acute inflammation; (4) the action of heat or cold.

2. **Indirect Gangrene** is death of a part due to a cause acting at some distance—*e.g.*, (1) gradual diminution in the calibre of the bloodvessels; (2) sudden obstruction in the bloodvessels; (3) imperfect innervation; (4) general causes, such as diabetes, acute fevers, and the use of ergot.

3. **Infective Gangrene** is due to specific infective organisms: (1) Acute traumatic gangrene due to the bacillus of malignant œdema; (2) phagedena; (3) cancrum oris or noma.

1. Direct Gangrene.

1. **Gangrene due to Crushing.**—The part may be so injured that it loses its vitality at once. In other cases the addition of septic inflammation may turn the balance against a badly crushed part and bring about gangrene.

Treatment.—If there is no doubt that the part will die, amputate at once, provided the additional shock of operation will not prejudice the patient's chance. If there is a doubt, every antiseptic precaution must be taken till gangrene has declared itself; then amputation should be done.

If skin, bones, vessels, and nerves are destroyed, amputation is absolutely necessary. If the vessels and nerves are intact, it may be possible to save the limb, provided the wound be kept aseptic.

2. **Gangrene due to Pressure.**—Splint pressure may produce local gangrene, especially over bony prominences, such as the heel. Pain is complained of, but if this warning is neglected the pain goes off after a time, and a slough is discovered when the splint is removed some weeks later.

Bedsores occur in patients kept long in the recumbent position, or in one particular position, especially if sensation is impaired or the part is allowed to remain moist.

To prevent bedsores, the position should be changed frequently, a water-pillow or bed should be used, and the part kept thoroughly dry. If a bedsore threatens, a ring pillow should be used, the skin hardened by rubbing with spirit, and the part dusted with boracic acid. If a bedsore forms, it should be kept strictly aseptic.

3. **Gangrene due to Acute Inflammation** occurs especially in dense structures, when the pressure of the exudation is sufficient to cut off the blood-supply, as in necrosis of bone from acute infective osteomyelitis, suppuration in the tendon-sheaths of the fingers.

Treatment.—Free and early incisions are urgently called for.

4. **Gangrene due to the Action of Heat or Cold.**—The subject of **Burns** may be treated here, though gangrene, to any marked extent, is only produced by severe burns. Burns and scalds are produced by contact with solids, liquids, or gases at a high temperature.

Degrees of Burns.—Dupuytren's classification: *First degree*, reddening of the skin. *Second degree*, blistering. *Third degree*, destruction of the epidermis, Malpighian layer, and papillæ of the derma. The sensitive nerve terminals are exposed; consequently this is the most painful degree. The sweat and sebaceous glands and hair follicles are not destroyed, and from these epithelium spreads in healing, so that repair is rapid, and the scar is not a contracting one. *Fourth degree:* the whole thickness of skin and part of the subcutaneous tissues are destroyed. *Fifth degree:* the muscles are injured. *Sixth degree:* the whole limb is charred.

The *Local History* of a burn corresponds to the stages of an ulcer: (1) the stage of destruction; (2) the stage of inflammation and sloughing, ending in a healthy granulating sore; (3) the stage of repair. The process is generally a septic one, unless an anæsthetic be given at the beginning and thorough disinfection produced.

Constitutional Conditions.—1. The earliest and most important is **shock**. This depends more upon the extent than upon the depth; also upon the situation, as burns of

the body are more dangerous than burns of the limbs. Children stand burns very badly. Congestion of internal organs occurs during this stage.

2. The **inflammatory period** lasts while the sloughs are being separated. Fever is produced by absorption of toxins ; pleurisy, pneumonia, meningitis, nephritis, or peritonitis, may occur. During this stage duodenal ulcer may develop, though it must be rare. It is said to be due to the excretion in the bile of some irritating substance capable of inducing thrombosis in the vessels of the mucous membrane, and thus starting ulceration.

Any form of sepsis may occur in this stage.

3. The last stage is that **of healing**, which begins as soon as healthy granulations are formed.

Causes of Death from Burns.—1. If the patient is taken out of the fire dead, asphyxia is the cause. 2. Shock and collapse form the next stage. 3. Still later death may be due to toxæmia, or inflammation of internal organs, duodenal ulcer, exhaustion from sepsis, septicæmia, pyæmia.

Treatment.—General: If carbonic-oxide-poisoning is present, artificial respiration and administration of oxygen. For shock, opium and stimulants. Local: For burns of the first degree, powder with boracic acid, puncture blisters, and cover the part with an antiseptic dressing.

Burns of deeper degrees than the second must be made aseptic with 1 in 1,000 perchloride of mercury. Carbolic acid is absorbed readily, and must not be used. Antiseptic gauze dressings should then be applied.

Picric acid (a saturated solution) is used as a dressing. It lessens the pain, and can be left on two or three days. The continuous bath may also be used. If the burn be of any size, it should be skin-grafted, as the scars of burns contract very much, and may produce deformities.

Frost-bite is produced by severe cold, especially if a wind is blowing. It may occur in one of two ways: (*a*) From the direct effect of cold on the tissues. The circulation is completely stopped in a part, and gangrene occurs. (*b*) From the subsequent inflammation during thawing of a previously frozen part. The vessel walls are

paralyzed, and the ensuing exudation is so great that the vessels are compressed.

Treatment.—Frozen parts should be thawed gradually to allow the vessel walls to recover tone. If gangrene occurs, the dead part should be kept aseptic till separation and healing have occurred.

2. Indirect Gangrene.

1. Gangrene due to Gradual Diminution in the Calibre of the Bloodvessels.—Senile gangrene is the typical form. The arteries are diminished in calibre owing to calcification of the middle coat, atheroma or endarteritis from alcohol, syphilis or diabetes. The limb only obtains sufficient nutriment to meet ordinary requirements. Any slight injury or inflammation is sufficient to produce gangrene. The toes are most frequently affected, but the hands, nose, ears, or tongue, may be.

Symptoms.—Before gangrene occurs, evidence of imperfect blood-supply is present, such as coldness of the feet, numbness, tingling, cramps in the muscles.

Local Signs.—If due to inflammation, a red, painful area appears, and becomes a slough. If due to thrombosis of vessels, the part simply shrivels up and dies. The inner side of the big toe is a common site. The gangrene may spread to other toes and along the foot. The disease may be arrested at any stage, or sepsis may occur and add to the severity of the affection. Pain is a very marked and exhausting symptom of senile gangrene.

Treatment—Prophylaxis.—A patient with signs of malnutrition of the feet should avoid cold and injuries. Directly gangrene has occurred, the part must be disinfected and wrapped in cyanide gauze. The part must be rested, kept warm, and elevated. Opium should be given for pain, and the diet should be nourishing. The question of amputation arises always. If there is a distinct line of demarcation which does not tend to spread, and there is no absorption of toxins, the dead part may be left to separate; otherwise amputation must be done at the lowest point at which the vessels can be felt pulsating. Generally amputation through the knee-joint is necessary.

2. Gangrene due to Sudden Obstruction of the Bloodvessels.—1. From pressure outside the vessels, as ligature, tight bandages, pressure by the ends of fractured bones. 2. Rupture of the walls of the vessels, as in dislocations or attempted reduction of dislocations. 3. Blockage of the lumen, as by embolus.

In the first two the vein may be blocked as well as the artery. The part then assumes a dark colour, and becomes œdematous very quickly. If the obstruction is primarily arterial, the limb becomes pallid at first, and afterwards dark. When embolism occurs, there is violent pain at the site of blockage, but thrombosis may extend upward from this.

In all this class, if a sufficient collateral circulation is established, gangrene does not occur, but if the patient's condition is lowered, as in embolism from detachment of a vegetation during an attack of endocarditis, gangrene is very likely to follow. Emboli are commonly arrested at the site of bifurcation of arteries.

Gangrene extends upwards till it reaches a level where the circulation is sufficient to maintain vitality. Generally this is about a joint, where there is usually free anastomosis.

Treatment. — The question is that of amputation. Time for the collateral circulation to develop should be allowed, but during this time stringent disinfection should be done, and the limb kept warm and elevated. If after twenty-four hours the part does not change in colour on pressure with the fingers, gangrene has occurred, and it is better to amputate at once 2 or 3 inches above the line of gangrene.

3. Gangrene due to Imperfect Innervation.—If the trophic influence of nerves be cut off, gangrene occurs from very slight causes, such as acute bedsores after injury to the spinal cord. Also, if the nerves of sensation are destroyed, attention is not called to undue pressure, and so sloughing occurs.

Raynaud's Disease, or symmetrical gangrene, is also due to imperfect innervation. It occurs in the fingers of hysterical women between eighteen and thirty years of age. The attacks are brought on by cold. There are three stages : (1) Local syncope from arterial spasm, with

pallor and pain in the part; (2) local congestion, with blueness from venous engorgement, which may lead on to recovery; or (3) necrosis, in which small areas of skin slough.

Treatment.—Attend to the patient's general health, while locally friction and electricity are the most beneficial agents.

4. **Gangrene due to General Causes.**—*Diabetic Gangrene.*—In diabetes four causes contribute to the onset of gangrene: (1) The lessened resisting power; (2) the sugar in the tissues forms a good culture medium for anaërobic bacteria; (3) peripheral neuritis; (4) endarteritis. Any slight injury may set up gangrene in a diabetic.

Treatment.—General: Diet—All starchy food and sugar must be abolished. This must not be done too suddenly, or coma may come on. Drugs: Codeine, $\frac{1}{4}$ grain three times a day, gradually increased to 5 grains.

Local: Early amputation well above the gangrenous area. There is danger of coma after operation, but as the great majority die from sepsis or coma if not operated upon, early amputation produces the best results.

Gangrene after Acute Fevers is generally due to endarteritis and thrombosis. *Gangrene after Ergot* is due to eating rye infected with the ergot fungus (*Claviceps purpurea*). Tetanic contraction of small bloodvessels produces gangrene if kept up for a long time.

3. Infective Gangrene.

1. **Acute Traumatic Gangrene** is due to infection of wounds with the *bacillus of malignant œdema*, or the *Bacillus aërogenes capsulatus.* It occurs especially in wounds soiled with earth.

Symptoms begin about two days after the accident. Inflammation spreads rapidly along the planes of connective tissue. The limb is purple and brawny, soon becomes gangrenous, and the tissues crepitate from the gas formed by the organisms. There is high temperature and delirium, and death occurs in about three to five days.

Treatment — Prophylaxis. — All wounds soiled with earth should be thoroughly purified at once.

When the disease is established, amputation well above the diseased area offers the only chance, and a poor one even then. Stimulants and a generous diet must be given.

2. **Phagedena** is a spreading gangrene, not seen nowadays, which affected wounds in preantiseptic days.

3. **Cancrum Oris and Noma** are two forms of spreading gangrene which affect the mouth and vulva of children. It occurs in weakly children from two to five years of age, convalescing from one of the acute exanthemata, especially measles and scarlatina.

In the mouth an inflammatory spot appears on the gum. This rapidly becomes black, gangrenous, and spreading. The breath is fœtid; the foul discharge is swallowed and inhaled. There may be destruction of the whole thickness of the cheek and part of the jaw. There is a high temperature from toxæmia, and there may be septicæmia, or even pyæmia, from septic thrombosis of the facial vein. Death usually occurs in three to four days.

Treatment must be very prompt. All the gangrenous parts must be clipped away till a bleeding surface is exposed, which is then painted with strong nitric acid for ten minutes. The action of the acid is then stopped by rubbing in prepared chalk. The mouth should be frequently washed out with antiseptic lotions. The child should be well fed and given stimulants.

CHAPTER VI

INFECTIVE DISEASES

Cellulitis.

CELLULITIS is diffuse spreading inflammation in the subcutaneous tissues.

Causes.—The exciting cause is the *Streptococcus pyogenes*. The point of infection is some accidental wound, as a prick, scratch, graze, or an operation wound. If the resisting power of the individual is diminished, infection is more likely to occur.

Signs and Symptoms.—The skin becomes red, hot,

tender, brawny, and red lines of inflamed lymphatic vessels extend from it. Distinct fluctuation cannot be made out at first, but if incisions are not made it soon can be felt. Suppuration occurs under the skin, or diffuse sloughing of the cellular tissues. Even the skin itself may slough in parts. The general symptoms are due to toxæmia, and are fever, rapid pulse, loss of appetite, etc. If the toxæmia be very great, a subnormal temperature may be present, with coma supervening. Septicæmia or pyæmia may occur.

Treatment.—*Local.*—Free and early exit to the pus and sloughs must be given. Incisions exposing the whole area are essential, and no pockets should be left. The part should then be dressed with gauze fomentations of 1 in 40 carbolic or 1 in 2,000 perchloride. The continuous bath must be used if fomentations do not answer. Injection of antistreptococcic serum, 10 c.c. three times a day, is sometimes useful.

General Treatment consists of feeding the patient well with milk and eggs and giving plenty of stimulant.

Cellulitis is of special importance according to its anatomical situation.

Cellulitis of the Scalp is due to a wound which opens up the loose layer beneath the occipito-frontalis aponeurosis. The pus is limited by its attachments, and points over the eyebrow, zygoma or superior curved line. Thrombosis may extend into the cranium through perforating veins.

Cellulitis of the Orbit results from perforating wounds. Inflammation may spread through the sphenoidal fissure to the meninges. Panophthalmitis may occur. If the eye escapes, the optic nerve may atrophy afterwards from the pressure of contracting cicatricial tissue, or the movements of the eye may be interfered with by the damage to the muscles.

Free incisions must be made and drainage carried out. Fomentations form the best dressing. If panophthalmitis occurs, a crucial incision must be made. Enucleation increases the danger of meningitis.

Submaxillary Cellulitis, or Ludwig's Angina, occurs under the deep cervical fascia. There are two special

dangers in addition to the severe toxæmia: (1) Spread of the cellulitis to the mediastinal tissues and pericarditis; (2) œdema of the glottis.

Treatment consists of incisions, which must be early. Hilton's method may be used. On no account should a general anæsthetic be given, as the danger of obstruction to respiration from œdema of the glottis, which may be unsuspected, is so great. The injection of eucaine (10 per cent. solution) into the skin renders incisions painless.

Erysipelas.

Erysipelas is a spreading inflammation in the skin, and sometimes in the mucous membranes, which recover without loss of tissue. It is accompanied by constitutional symptoms due to the absorption of toxins.

Causes.—(1) A wound or abrasion; (2) lowered resisting powers, especially from a previous attack; (3) bad hygienic surroundings, especially overcrowding; and (4) the *Streptococcus erysipelatis*. In the common facial erysipelas the source of entry can seldom be found.

The streptococcus spreads in the cutaneous lymphatic vessels, and can be found just beyond the margin of the red area, while at the margin are found leucocytes as well as cocci. In the centre of the red area only leucocytes are found.

Symptoms.—Premonitory symptoms are malaise, headache, loss of appetite, shivering, and some pain about the wound. With these are some rise in temperature, a rapid pulse, foul tongue, thirst, constipation, and scanty urine. Within twenty-four hours of this a crimson flush appears around the wound. The red area is swollen, spreads along the skin, and has a distinct raised edge. There is a sensation of stiffness and burning. The pain is not severe unless tense structures are involved. Great swelling only occurs in lax tissues, as the eyelid and scrotum. Bullæ may appear, but suppuration is rare. The glands are always enlarged. The fever is continuous up to 104° F. for about six to eight days; then symptoms rapidly disappear, the redness and swelling go off, and slight desquamation occurs. These scales are the source of the great infectiousness of erysipelas.

In bad cases the temperature remains high, delirium is severe, and the patient dies of exhaustion.

In the ordinary facial, or so-called idiopathic, erysipelas there is a great tendency to recurrence.

Cellulo Cutaneous Erysipelas is due to a mixed infection. There is streptococcic inflammation both in the skin and subcutaneous tissues. The signs combine those of erysipelas and cellulitis.

Erysipelas of the Scrotum sometimes simulates extravasation of urine, but the fact that there is no difficulty in micturition or the passage of a catheter distinguishes it.

Diagnosis.—The bright-red colour and the sharply-defined raised margin are characteristic features. The *exanthemata* are never limited to one part of the body. *Lymphangitis* is characterized by red streaks. A *septic wound* may have redness around it, but the definite edge is not present. *Erythema nodosum* generally involves both legs of young women, and is not infiltrated like erysipelas. *Erythema solare*, or sunburn, is limited to parts normally unexposed, which have been acted on by sun-rays. It does not spread. *Eczema rubrum* has a viscous, clear exudation from the surface.

Prognosis.—Death is not likely to occur unless complications, such as meningitis, pneumonia, nephritis, pyæmia, or septicæmia, come on. It is more dangerous in infants and old people, and such people as drunkards, diabetics, and those suffering from Bright's disease.

Treatment.—*Prophylaxis.*—Secure the asepsis of all wounds. All cases should be isolated to prevent the infection of others.

Local.—In most cases all that is necessary is to apply lead, or lead and opium lotion. This has no curative action, but it relieves the stiffness and burning. Other applications, such as ichthyol, are used, but do not hasten the termination of the process.

A form of treatment which aims at getting ready a supply of phagocytes at a distance of 2 inches from the spreading margin is the most promising. The skin is irritated by free scarification, and the tissues then become infiltrated with leucocytes, which are ready to attack the cocci when they spread to this region. The part is kept covered with carbolic fomentations (1 in 40).

General.—Good food and stimulants. The bowels should be kept acting by magnesium sulphate, and 2 to 4 grains of quinine with 15 minims of the tincture of perchloride of iron are generally given every four hours.

Antistreptococcic serum sometimes is very useful, either injected or given by the rectum.

The treatment of cellulo-cutaneous erisypelas is that of cellulitis.

Septicæmia.

Septicæmia is an acute general infection arising from the presence of pyogenic organisms in the blood.

The *Streptococcus pyogenes* is the usual organism present, and it manufactures its toxins in the blood-stream.

In sapræmia there are toxins in the blood, but no organisms.

Septicæmia is always due to parasitic organisms, while sapræmia may be due to either saprophytic or parasitic organisms, or both.

Infection occurs through a prick, scratch, or abrasion, or through an operation wound. A surgeon may infect himself through a prick from a needle in an operation for septic peritonitis. It may arise during the course of cellulitis or any of the varieties of gangrene.

Symptoms.—A rigor is often the earliest symptom, followed by a rise of temperature to 104° F., which remains constant. The pulse is increasingly rapid, and becomes weak; there is loss of appetite, dry brown tongue, and constipation at first. Diarrhœa, which may be blood-stained, comes on later, while the urine contains albumin. The temperature may become subnormal, but if the pulse still remains rapid it is a very bad sign.

Diagnosis.—From sapræmia, or traumatic fever, it is known by the fact that opening up and draining the wound makes no difference to the condition, whereas in sapræmia the patient gets rapidly better. From pyæmia, by the fact that there are neither repeated rigors nor secondary abscesses.

The **Prognosis** is very grave.

Treatment.—The focus of infection must be dealt with

either by free incisions or amputation, but once the organisms reach the circulation this cannot be expected to do much good. Good food, stimulants and quinine must be given.

Antistreptococcic serum should be tried, 10 c.c. every four hours. Intravenous injections of large quantities of saline solution frequently, to produce diuresis and diarrhœa, with the hope of washing out the cocci and their products, may be tried.

Pyæmia.

Pyæmia is an infective disease characterized by rigors, marked intermittent fever, and the development of secondary abscesses. The organisms present are either staphylococci or streptococci.

The **Cause** is any condition which leads to the formation and detachment of infective emboli in the circulation. Two common examples are septic thrombosis of a vein, and malignant endocarditis. In acute infective osteomyelitis, particles of thrombus carrying cocci are commonly detached and cause pyæmia. Middle-ear disease sometimes causes septic thrombosis of the lateral sinus and pyæmia.

An infective embolus lodges in some vessel which is too small to allow it to pass—the lung, if it is from a systemic vein, the liver if from one of the portal system. A thrombus forms upon it, and the organisms set up a secondary abscess. In the lungs these form wedge-shaped areas, with the base to the surface of the lung, and are called infarcts. Similar emboli may lodge and form abscesses in any of the organs, serous membranes, joints, etc. If the primary focus is in the portal area, and the emboli are first lodged in the liver, the condition is called *pylephlebitis*.

The general symptoms if very severe are due to septicæmia in addition to the pyæmia.

Symptoms.—*Acute Pyæmia.*—Severe rigors repeated at intervals of one to two days. The rigors last twenty to forty minutes; the temperature rises to 103° or 104° F. and remains so for about an hour, then falls rapidly, accompanied by profuse sweating. The patient often

becomes jaundiced, and signs of abscesses in the lungs, joints, etc., become apparent. The pulse becomes rapid and weak, the appetite is bad, and delirium follows. Infective endocarditis may occur.

The secondary abscesses appear at the end of the first week, and form very rapidly. There is no barrier of granulation tissue enclosing them.

Chronic Pyæmia.—The fever is not well marked, and the abscesses, unless in important structures, are not dangerous.

Acute cases die in eight or ten days; chronic cases may go on for many months and completely recover.

Diagnosis.—No mistake can be made when a focus of infection is apparent. If such cannot be found, it may be mistaken for malaria.

Prognosis.—In acute cases it is grave; chronic cases are favourable if the abscesses are in situations suitable for treatment.

Treatment.—*Local.*—As most cases are due to septic phlebitis, the vessel should be ligatured nearer to the heart, to prevent further invasion of the blood-stream. This is done in the internal jugular vein for lateral sinus pyæmia. Sometimes amputation is necessary to get above the lesion. The secondary abscesses, if practicable, should be opened, flushed out, and drained. Joints distended with pus may recover with free mobility under early treatment.

General Treatment consists of good feeding, stimulants, quinine, and antistreptococcic serum.

Tetanus.

Tetanus is an infective disease of wounds due to a special bacillus, and characterized by painful tonic contractions of the muscles with convulsive exacerbations.

Causes.—*Predisposing.*—A hot climate favours the development and virulence of the tetanus bacillus in the soil.

Occupation, such as that of a gardener, makes a person who has a wound more liable to contamination with earth.

Overcrowding, as in field hospitals, is a predisposing

cause. This almost certainly means that due antiseptic precautions are not taken in such.

Exciting.—A wound, and practically always a septic wound, which becomes infected with the tetanus bacillus. The bacilli are present always in garden and field soil and dust. In artificial cultures a spore forms at one end, giving the bacillus the characteristic 'drum-stick' shape. The bacilli are anaërobic, and cannot grow in the tissues unless pyogenic organisms are present to use up the oxygen, and thus provide for them an oxygen-free atmosphere. The bacilli do not spread from the wound, but maufacture their toxin there. The toxin is now believed to travel by the nerves to the brain and cord, not by the blood.

Symptoms.—*Acute Tetanus* usually begins five to fifteen days after infection, preceded for a day or two by malaise and neuralgic pain about the wound. The muscles of mastication are first affected. They are contracted firmly, and there is cramp-like pain in them (**trismus**). The muscles of the neck and face are next affected (**risus sardonicus**). Dysphagia is due to contraction of the pharyngeal muscles. Contraction of the trunk muscles follows, called **opisthotonos** if the body is arched backwards; if doubled forwards it is called **emprosthotonos**; if to one side, **pleurosthotonos**. Contraction of the limb muscles follows. The muscles of respiration are, fortunately, the last to be attacked. The characteristic feature is that the spasm is never entirely relaxed, yet the least stimulus, such as a noise or a draught of air, induces violent tonic contractions, which may be so severe as to rupture the muscles. The pulse is rapid, the temperature is generally raised, sweating occurs after the convulsions, and the patient is unable to swallow. Consciousness is unimpaired till the end, which is generally due to exhaustion from the poisoning and the continuance of the convulsions, rarely to asphyxia from prolonged fixation of the respiratory muscles. Death occurs in one to four days.

Chronic Tetanus.—The symptoms begin later, convulsions are less frequent and not so general; but it may become rapidly acute, and is then fatal. About 20 per cent. recover, while in the acute variety only 1 per cent. recover.

Diagnosis.—From *simple trismus*, due to dental irritation or arthritis of the temporo-maxillary joint, by the fact that in tetanus there is also rigidity in the neck muscles. From *strychnine-poisoning*, by the fact that in tetanus there is no complete relaxation between the spasms, and the hands are rarely involved. In *hydrophobia* the contractions are never tonic.

The **Prognosis** is always **grave.** The longer a case lasts and the lower the temperature, the better is the chance. A long incubation period is favourable. If under ten days, only 4 per cent. recover ; eleven to fifteen days, 27 per cent. ; if over fifteen days, 45 per cent.

Treatment.—Prevention by careful antiseptic treatment of all wounds. The infecting wound should be freely excised and purified. Amputation is unnecessary, unless it be a finger or a very septic compound fracture of a limb. Antitetanic serum, which is the serum of an immunized horse, should be injected in doses of 20 c.c. every twelve to twenty-four hours till symptoms cease. Unfortunately, the serum only neutralizes any toxin circulating in the blood, but cannot influence the toxin already united to the protoplasm of the nerve-centres. Injection of antitetanic serum into the brain itself is practised, but the results are not more favourable. General measures consist in keeping the patient in a quiet darkened room. Fluids should be given by the nasal tube if trismus is marked. Chloral should be given in doses of 20 grains every two or four hours, and chloroform administered during the severe convulsions. Chloral and chloroform are only palliative remedies ; there are no drugs yet known which can cure tetanus.

Hydrophobia.

Hydrophobia is an acute general infective disease communicated through the saliva of rabid dogs to man, either by a bite or by the animal licking an abraded surface. The incubation period varies greatly, but is usually six weeks. The disease is ushered in by a vague sense of terror, lasting twenty-four hours. Restlessness, sleeplessness, loss of appetite, and repugnance to fluids, follow.

Then characteristic symptoms follow of convulsions and stiffness in the muscles of deglutition and respiration. These are clonic in character, never tonic, and are brought on by any slight stimulus. Swallowing is impossible, and the mouth becomes filled with ropy mucus. The respirations become catchy from spasm of the diaphragm. The convulsions become general, and the patient dies from exhaustion of the medullary centres, though sometimes from spasm of the glottis. Death occurs in two to seven days.

Treatment, Preventive.—Freely excise the region of the bite, and purify with pure carbolic acid.

Pasteur's Preventive Treatment.—By injection of an attenuated virus in increasing doses and increasing strength it is possible to prevent the development of the poison already absorbed, provided the disease has not had too long a start. Palliative treatment, once the disease is established, consists in keeping the patient in a quiet room, giving chloral and chloroform for the spasms, good feeding, and stimulants.

Anthrax.

Anthrax is due to infection with the *Bacillus anthracis*. If inoculated through the skin, 'malignant pustule' is produced; if absorbed by the lungs or intestinal mucous membrane, 'woolsorters' disease,' or anthracæmia, results.

Symptoms.—Infection occurs amongst people who have to deal with living diseased animals, such as graziers and butchers, or people who work in hides and wool.

A **Malignant Pustule** commences as a red pimple at the site of inoculation, which rapidly spreads with much infiltration. The central part is at first vesicular, but rapidly becomes a black slough, surrounded by a ring of vesicles, which contain the bacilli. The nearest lymphatic vessels and glands are enlarged. There is a certain amount of fever and malaise, which is not pronounced till the fifth day. Pulse and temperature then increase, and vomiting occurs. The patient dies from toxæmia in about a week from the onset. Usually the process

remains limited, and no general infection occurs; the slough separates, and healing by granulation follows.

Woolsorters' Disease takes the form of pleuro-pneumonia, and runs a rapidly fatal course; or that of gastro-enteritis, which is grave, but not so often fatal as the pulmonary form.

Treatment.—Treatment of malignant pustule consists in excising freely the necrotic area, and applying pure carbolic acid or cautery. Pulv. ipecac. is sometimes applied locally and given internally. The injection of Sclavo's serum has met with great success.

Gonorrhœa.

Gonorrhœa is an infective disease due to the gonococcus, and characterized by a purulent discharge from the urethra. Sexual connection with an infected person is the usual mode of infection. The cocci are found in pairs in the epithelial cells and pus corpuscles of the discharge. Infection occurs through invasion of the epithelial lining of the urethra. The cocci stain with aniline dyes, but are decolorized by Gram's method.

Symptoms.—Discharge begins two to eight days after infection, preceded for some hours by scalding pain during micturition. The discharge, at first thin, soon becomes thick and yellow. Swelling of the mucous membrane is rarely sufficient to cause retention of urine or hæmorrhage from the urethra. In most cases, if properly treated, recovery occurs in two or three weeks; if neglected, and sometimes in spite of treatment, **Posterior Urethritis** occurs, characterized by frequent and painful micturition, and perhaps extension of inflammation to the prostate and testis. **Chronic Gonorrhœa** or **Gleet** commonly remains in these cases.

Gleet is due to (1) granular urethritis, which can be seen with the urethroscope or felt as a tender spot with a bougie; (2) chronic prostatitis and vesiculitis.

A simple urethritis may be produced by ordinary pyogenic organisms.

Treatment.—Lessen the acidity of the urine by alkalies, give diuretics, and keep the bowels acting freely. Sedatives such as tinct. hyoscyami are useful.

All forms of alcohol should be forbidden, otherwise plenty of fluid taken. The patient should rest as much as possible.

No local treatment need be adopted in this stage. When scalding ceases, copaiba or oil of sandal-wood, 10 minims three times a day, or cubebs, may be given. Their action is diuretic mainly. Cubebs and copaiba may produce a bright-red, itchy, widespread rash.

Injections should be used after all irritation has ceased. The patient should pass water to wash out the discharge immediately before using the injection. A glass syringe is best, and the urethra should be distended by argyrol, 1 per cent. solution, or zinc sulphate, 2 grains to 1 ounce. Silver nitrate, $\frac{1}{4}$ grain to 1 ounce, is very painful. The injections should be used every two hours at first, and not left off till five or six days after the discharge has ceased.

The **Treatment of Gleet** commences with an accurate diagnosis of the seat of the disease. For practical purposes the urethra is divided into anterior and posterior portions by the constrictor urethræ. It is found that whatever secretion is poured into the posterior urethra becomes intimately mixed with the urine in the bladder, as if the constrictor urethræ formed the true sphincter of the bladder. This fact, though open to dispute, at any rate, is useful in diagnosis. The patient must come with a full night's urine. The anterior urethra is then thoroughly irrigated with boiled water, and the fluid examined for the presence of threads, which indicate there is anterior urethritis. The contents of the vesiculæ seminales and of the follicles of the prostate are then expressed, by a finger in the rectum, into the prostatic urethra. The patient then passes his water into a clean glass, and this is examined for threads. It is now known whether the patient has anterior or posterior urethritis, or both. The next step is to make a careful search of the urethra with the inflating urethroscope for the presence of narrowing, granulations, or distended follicles. Finally, a large bougie should be passed, so that any constriction, if present, may be detected. It must be remembered that even an early constriction may be enough to keep up a discharge, and that there are 'strictures' in the urethral surgeon's lexicon which will admit a No. 12 English bougie.

If the patient has anterior trouble, it is easily cured by the regular use of astringent injections; but if he has posterior urethritis, it is of no use his continuing injections, for they never reach the part beyond the constrictor. Strictures even of large calibre must be dilated; granulations may be touched with silver nitrate, and distended follicles should be opened through the urethroscope.

Combined with this, irrigation of the whole urethra daily by the method introduced by Janet should be carried out. The urethra is cocained, then the nozzle of an irrigator, raised 3 or 4 feet above the patient, is inserted into the meatus. The fluid at this pressure will overcome the constrictor and distend all the pockets in the urethra, and then fill up the bladder. The patient then empties the bladder, and the process is repeated until 2 pints have been used. It is usual to begin with 1 in 8,000 solution of pot. permang., and gradually increase the strength to 1 in 500. Weak solutions of protargol or argyrol may be used. If no progress is being made, a few drops of silver nitrate (10 grs. to 1 oz.) may be instilled into the cocained posterior urethra. This sets up a smart reaction for a few days, during which irrigation must be suspended.

Treatment may have to be continued many weeks, but it is of the utmost importance that these cases should be cured, not only to prevent stricture, but to prevent that train of diseases of women which has such a disastrous effect upon their health.

Complications of Gonorrhœa.—(1) From direct extension; (2) from direct transmission; (3) from general absorption.

1. *From Direct Extension.*—**Balanoposthitis**, or inflammation of the prepuce and glans, which may result in inguinal bubo, is due to ordinary pyogenic organisms. Phimosis and paraphimosis may also occur.

Lacunar Abscess occurs in the follicles of the urethra. A painful swelling forms, and the abscess bursts into the urethra, or externally, or both. In the latter case a penile fistula is produced. To prevent this, the abscess should be opened early.

Chordee, or painful erection, is due to inflammation in the corpus spongiosum or corpora cavernosa. A suppository of morphia, ½ grain at bedtime, prevents this. Applications of ice relieve it.

Inflammation of Cowper's Glands may go on to suppuration. The symptoms and treatment are that of acute prostatitis.

Acute and Chronic Prostatitis and **Acute and Chronic Vesiculitis** (see Chapters XXXVII. and XXXIX.).

Epididymitis is due to extension along the vas (see Chapter XXXIX.).

Acute Cystitis (see Chapter XXXVII.).

In the female, **Vulvovaginitis, Inflammation** spreading to the uterus and Fallopian tubes, and possibly to the ovary and pelvic peritoneum.

2. *From Direct Transmission.*—**Gonorrhœal Proctitis,** from spread to the rectum, especially in females, is treated by irrigation with boric acid solutions.

Gonorrhœal Rhinitis is treated by irrigation.

Gonorrhœal Conjunctivitis is rare in adults. In infants (ophthalmia neonatorum) infection occurs during birth, from the maternal vagina. The eye becomes injected, and discharges first mucus, then pus. There is great œdema of the conjunctiva (chemosis). The cornea may ulcerate and the eye be disorganized.

Treatment.—Protect the other eye by Buller's shield—a watch-glass fixed in mackintosh, kept in place by plaster. The affected eye must be irrigated with boracic lotion every hour, and in addition silver nitrate, 5 to 10 grains to 1 ounce, should be dropped in after the application of cocaine. In infants, Crédé's preventive treatment for the new-born infant—viz., washing out the conjunctival sac in all cases with 1 in 4,000 perchloride immediately after birth—prevents infection.

3. *From General Absorption.*—**Gonorrhœal Affections of Joints** occur in the subacute stages. Synovitis may occur, or arthritis, with or without suppuration. For treatment see Chapter XX. Any ligaments and fasciæ may be inflamed, especially those which support the arch of the foot. Flat-foot may result.

Pyæmia and **Septicæmia** may occur, but are probably due to dissemination of ordinary pyogenic organisms.

Gonorrheal Sclerotitis.—Atropine and leeches to the temple are the treatment.

Soft Chancre.—A soft chancre is a localized infective sore on the genitals, due to a specific bacillus. It usually

begins as a papule within a day or two of infection, soon becomes a vesicle, while within four or five days it has become a pustule. The ulcer left when the pustule discharges is a cleanly cut one, and, if kept clean, is healed in about three weeks. The sores are usually seen about the corona and prepuce, but if the secretion comes in contact with other parts a similar lesion is produced.

If the ulceration takes place under a long foreskin the prepuce may be perforated by sloughing. It is also occasionally found that at the end of a few weeks the sore takes on a typically indurated syphilitic character, if the two poisons have been inoculated at the same time.

The lymphatic glands in the groin become swollen and tender, and may suppurate. If only pyogenic organisms are absorbed, the pus is found in the gland tissue, whereas if the specific bacillus has been absorbed, not only is there suppuration within the glands, but there is ulceration around them, so that there is a large soft chancre in the groin as well.

The treatment consists in dressing the sore with lotio nigra. If there is a long prepuce it should be slit up, so that free drainage can occur. If suppuration occurs in the glands a vertical incision should be made, as this remains open better. In those cases where there is ulceration around the glands, it is found that the only way to get healing is to make a free removal of all the diseased glands.

Syphilis.

Syphilis is an infective disease, acquired generally from connection with an infected person, or else it is hereditary. The specific organism is believed at present to be the *Spirochæta pallida*. There are three stages: 1. The primary stage. 2. The secondary stage, characterized by lesions of skin and mucous membranes. 3. The tertiary stage, characterized by gummata in any part of the body.

Infection is almost always from sexual connection, and the primary sore appears on the genitals. Occasionally extragenital sores occur, as on the lips, face, tonsils, fingers, nipple. The discharge from the primary sore is infective, so are the blood and all pathological exudations in the secondary stage. Secretions, such as milk or

urine, unless mixed with exudation from a lesion, are not infective. Semen infects the ovum. One attack usually confers immunity. There are very few exceptions to this rule.

Incubation lasts from ten days to eight weeks, usually four weeks.

The Primary Stage is characterized **by the** hard chancre, which appears on the prepuce or glans penis near the corona, or on the frænum. In the female it appears on the inner side of the labia majora or nymphæ. The vaginal wall is generally immune. Bullety lymphatic glands in the groin, with hardened lymphatics running from the sore, are characteristic. The typical hard or Hunterian chancre is a sore with a very indurated base, which may feel as hard as a button. Rarely only a papule, which does not ulcerate, is formed. A urethral chancre just inside the meatus may occur. The glands do not suppurate unless there are also present pyogenic organisms or the virus of soft chancre. On the female genitals a primary sore must not be diagnosed where the lesion present is a psoriasis papule, inflamed sebaceous glands, eczema, lupus, epithelioma, or gummatous ulceration.

Phagedena is spreading ulceration which may accompany a primary sore, especially in people with phimosis. The body of the penis, and even the inguinal glands, may be destroyed if not promptly treated.

Treatment. — Relieve all tension by incisions, and dilute the toxins by keeping the patient in a bath for one or two days. If this cannot be done, the surface must be scraped and fuming nitric acid rubbed in.

The **Diagnosis** of a hard or syphilitic from a soft or non-syphilitic sore is always the first question which crops up. A typical very indurated sore may be simulated by a soft sore which has been irritated by strong applications, or a soft sore may be present for some weeks, and then become indurated. Therefore it is generally wiser to wait for the first manifestation of the secondary stage before beginning general treatment.

Treatment.—Excision and cauterization of the primary sore are useless to prevent syphilis. Cleanliness and the application of lotio nigra or iodoform are all that is necessary till the diagnosis is confirmed. Then, under

the influence of mercury, the sore very soon heals. But little scar remains. A well-marked cicatrix is more suggestive of a soft chancre.

Secondary Syphilis begins from five to eight weeks after the induration of the sore, except (1) if mercury is given early ; (2) if some intercurrent illness occurs, which may postpone its appearance ; (3) idiosyncrasy. This period lasts usually two years. There is some constitutional disturbance, malaise, febrile symptoms, anæmia. The chief manifestations, however, are lesions of the skin and mucous membranes, with general glandular enlargement and thinning of the hair.

Skin Eruptions.—1. Erythema or roseola is the simplest, and is due to spots of hyperæmia. 2. Papular syphilides are infiltrated papillæ. 3. Nodular or tuberculous syphilides. 4. Pustular syphilides. 5. Rupia is a late secondary manifestation. Ulceration occurs, and the discharge is heaped up in a crust like a limpet-shell.

Characteristics.—1. Polymorphism : several distinct types appear on different parts of the body. 2. Rough symmetry. 3. Tendency to disappear spontaneously. 4. Absence of pain or itching. 5. Copper or raw-ham colour of lesions. 6. The lesions occur especially on the flexor aspects, front and back of abdomen, and edge of the hairy scalp. 7. Scars from rupia are thin, depressed, white, and round, with a surrounding ring of pigmentation.

The Mucous Membranes. — Mucous patches are shallow ulcers which occur on the pillars of the fauces, tonsils, uvula, soft palate, tongue, inner side of cheeks, and lips. These ulcers are shallow, with sharply-cut edges and a grayish base. They must be diagnosed from follicular tonsillitis, dental ulcers, smokers' and drinkers' ulcers, and lupus.

Condylomata are infiltrated papillæ in situations which are always moist, as about the anus or vulva. They form soft and warty moist, grayish patches. Two patches usually form opposite one another if the surfaces lie naturally in contact.

Syphilitic Iritis forms 50 per cent. of the cases of iritis. There is ciliary congestion, pain, photophobia, lachrymation, discoloration of the iris, sluggish or irregular pupil, adhesion of the iris to the lens or cornea, and a

deposit of yellowish nodules of lymph in the iris. Treatment by atropine and pushing the mercury always absolutely cures. If neglected, adhesions, blocked pupil, and secondary cataract occur.

Periostitis, leading to the formation of nodes, and a mild synovitis, may be found.

In the late secondary stage choroido-retinitis, lesions of the central nervous system, rupia, and occasionally epididymitis, may occur.

Treatment.—If induration of the primary sore is characteristic, with bullety glands and hardened lymphatics, treatment should be begun at once. If not, wait till secondary symptoms appear.

1. Mercury should be given for one to two years. 2. Alcohol should be given up. 3. The teeth should be kept very clean. 4. Smoking should not be allowed.

Mercury is given in various ways. 1. By the mouth: Hydrarg. c. creta, 1 to 4 grains daily, or with equal parts of pulv. ipecac. co.; green iodide, $\frac{1}{4}$ to $\frac{1}{2}$ grain, three times a day. 2. Inunction: A portion of unguentum hydrargyri about the size of a hazel-nut is rubbed into the arm, leg, or abdomen, avoiding the hairy parts and choosing a different situation each day. 3. Fumigation: The patient is covered with a blanket held tightly around the neck and reaching to the floor. Calomel (20 to 30 grains) is sublimed under his chair. The calomel is deposited on the skin and absorbed. 4. Intramuscular injection of $\frac{1}{8}$ grain of perchloride of mercury dissolved in water, succinamide, or grey oil two or three times a week.

Overdosage or idiosyncrasy produces toxic effects called **mercurialism**. The gums are swollen and spongy, and bleed readily on pressure. The first warning is pain on clenching the teeth. Salivation, acute stomatitis, and offensive breath follow. The teeth may become loose, and the jaw may even necrose. Colicky pain and diarrhœa are symptoms of intestinal derangement. At the first sign of mercurialism the drug must be suspended for a time, and a saline purge and an astringent mouth-wash given.

Local Treatment.—A mouth-wash of perchloride of mercury, or alum, or potassium chlorate. There is nothing which relieves the pain of mucous patches so well as painting them with chromic acid (gr. x. to ℥i.). Con-

dylomata should be washed twice a day, and dusted with equal parts of calomel and boric acid.

Tertiary Syphilis.—The phenomena of this stage may follow immediately upon those of the secondary stage, or may not occur till after a period of even twenty to thirty years. Their characteristics are infiltration of the tissues with small round cells. If this process is localized a gumma is produced; if diffuse, fibrous tissue is formed, which contracts and destroys the structure of whatever organ it occurs in.

A **Gumma** may arise in any tissue. The structure of a gumma is a mass of small round cells grouped in special profusion around bloodvessels. The surrounding vessels become narrowed by the accompanying endarteritis, and so the blood-supply of the central part is cut off, and coagulation necrosis occurs. This is the reason the central dry, whitish-yellow slough is seen. The surrounding area is composed of granulation tissue. Under proper treatment the necrosed portion may be absorbed, and only a cicatrix left; but if the gumma be very large or near the surface, it breaks down and the slough is discharged.

Skin and Subcutaneous Gummata.—*Characteristics.*—1. A swelling precedes the ulcer. 2. The edges are sharply cut. 3. The outline is rounded. 4. There is a 'wash-leather' sloughy base. 5. They yield to anti-syphilitic treatment, and there is no tendency to local recurrence. 6. The scars are thin and supple and white. There is a pigmented ring if the ulcer has lasted any length of time.

Syphilitic Lupus appears about the nasal aperture, lips and forehead especially. It is very much more rapidly destructive than ordinary lupus.

Gummata commonly occur in the mouth, pharynx, tongue, rectum, larynx, testis.

Sclerosis occurs in the spinal cord (locomotor ataxy), liver, tongue, rectal wall, arteries, and testis.

Bones may be affected by sclerosing osteitis, gumma, or necrosis, especially those of the palate, nose, and cranium.

The **Prognosis** of syphilis is good if the patient comes under treatment early and is treated thoroughly. If there

is an idiosyncrasy, which prevents the patient taking mercury or iodide, the prognosis is less favourable. If tuberculous disease is present, or the patient continues to take alcohol in excess, the outlook is bad.

Death may rarely occur in the secondary stage from œdema of the glottis. In the tertiary stage it may occur from involvement of such viscera as the brain, liver, spinal cord, or larynx.

Curability.—90 per cent., if treated thoroughly, escape tertiary lesions.

Treatment of Tertiary Syphilis.—Iodide of potassium in doses of 5 grains three times a day, gradually increased to 30 or 40 grains. It is better taken with 15 minims of sp. ammon. aromat. and plenty of water. Coryza and a papular or pustular eruption may be caused Increasing the dose may relieve this condition; if not, sodium iodide should be substituted. Iodide only causes the disappearance of tertiary lesions, but has no permanent curative effect, so mercury should always be given with it.

In those cases where there is an idiosyncrasy to the ordinary form of treatment by iodides and mercury, the only hope lies in the method introduced by Zittmann, which consists in keeping the patient in a room at a temperature of 80° F. for a fortnight, during which time he drinks large quantities of decoctions containing sarsaparilla and some mercury. It is astonishing how bad cases, which resist every other form of treatment, will clear up under this method.

The *Local Treatment* of tertiary syphilitic sores is by mercurial preparations, such as ung. hydrarg. ammon. Necrosed bone should be removed. Marriage should not be permitted till two years after the disappearance of the last symptom.

Inherited or Congenital Syphilis.—Syphilis may be conveyed to the ovum either by direct transmission from the father or mother, or both. When the ovum is infected by the father, and the mother escapes, she is rendered immune (Colles's law); the child would infect a wet-nurse during suckling, but does not infect its mother.

Miscarriage is a common occurrence when the fœtus is syphilitic, owing to syphilitic changes in the decidua,

or a dead child is born at full time. In many cases, however, a living child is born, and may appear healthy at birth. In the first three weeks to three months symptoms appear, preceded by wasting and anæmia. The manifestations resemble those of acquired syphilis, except that there is no primary sore. The skin eruptions are roseolous or papular on the buttocks, genitals, and legs. They may be bullous (pemphigus). The more coppery and the more the infiltration of the skin, the more is the likelihood of the rash being syphilitic.

Mucous tubercles about the angles of the mouth leave radiating scars, which are characteristic. Ulceration in the mouth, on the tongue, and condylomata about the anus and in moist folds occur.

Catarrhal rhinitis (snuffles) is an early sign, and may go on to ulceration and destruction of the nasal bones and cartilages, leaving the characteristic depressed nasal bridge. Many die of malnutrition in the first year unless treated.

After the first year tertiary symptoms appear, and also some peculiar to congenital syphilis, especially those of the teeth, cornea, and bones.

The permanent teeth sometimes show a notch in the cutting edge, which is a large segment of a small circle. If present, it is characteristic.

Affections of bones in the first two years are **Craniotabes**, **Periostitis**, and **Epiphysitis** (Parrot's nodes, and separation of the epiphyses).

Diseases of the Eye.—**Interstitial Keratitis** occurs about puberty. The cornea is infiltrated with cells, and when new vessels are formed a 'salmon patch' is produced. Nebulæ or leucoma may remain permanently. Ulceration is rare. Both eyes are affected.

Diseases of bones which occur after the first two years are the same as in acquired syphilis.

Diagnosis of Inherited Syphilis.—Some lesions resemble those of rickets and tuberculosis. The points to rely on are: (1) Permanent central incisor tooth-notch is conclusive; (2) eyes—interstitial keratitis; (3) periostitis of tibiæ and nodes on the skull; (4) depressed bridge of the nose, and scars about the mouth, palate, and fauces; (5) persistent enlargement of the liver; (6) history of

snuffles and rash in the child, and miscarriages in the mother.

Treatment.—The child must never be suckled by a wet-nurse, or the latter will be infected. Mercury in the form of hyd. c. creta, 1 grain per day, or inunction of mercurial ointment. Mercury must be given for three to six months after cessation of all symptoms. Cod-liver-oil, iron, and phosphates, also are advisable. Iodide of potassium and mercury for the tertiary symptoms, as in the acquired form.

Tuberculosis.

Tuberculosis is an infective disease, due to the growth of the tubercle bacillus in the tissues, and characterized by the formation of nodules or tubercles, which amalgamate and caseate.

Etiology.—1. *Hereditary Predisposition.*—The children of tuberculous parents do not inherit tuberculous disease, but have less resisting power against the tubercle bacillus.

2. *Age.*—Surgical tuberculosis occurs mostly in children under the age of ten, but no age is exempt.

3. *Unhealthy surroundings* and bad hygiene predispose.

4. *Local predisposing causes* are—(1) Injury, especially when only slight: severe injuries lead to a good reaction on the part of the tissues; (2) exposure to cold, which lowers the vitality and resistance of a part.

5. *The exciting cause* is the tubercle bacillus. To infect a tissue, the organisms must be introduced in sufficient numbers and of sufficient virulence. The organisms gain access by inhalation, ingestion, or inoculation.

Pathology.—Miliary tubercles are tiny grayish nodules, and each consists of a collection of cells. The bacillus is brought to the tissues by a bloodvessel. The bacilli set up changes in the tunica intima and the connective tissue around the vessel, which result in the formation of a collection of cells, which are bigger than leucocytes. They are derived from connective-tissue cells and endothelial cells. One or more of these in each tubercle

increase in size or coalesce to form a giant cell. The giant cell forms the centre of the tubercle; it has many nuclei arranged around its periphery, and contains bacilli. Around it are arranged layers of epithelioid cells. Beyond these are collected many leucocytes, which merge through granulation tissue into the normal structures. The structure is not so typical in all cases, as giant cells may be absent. No bloodvessels are present in tubercles, and the surrounding vessels are narrowed or obliterated by endarteritis.

Caseation is a result of progressive action of the bacilli. Two factors contribute to this: (1) The destructive action of the bacillus; (2) the defective blood-supply from endarteritis. The centre of each tubercle softens and becomes yellow or caseous. Neighbouring tubercles after caseating coalesce, and a tuberculous abscess is formed, and in its walls further miliary tubercles are found.

Retrogressive Changes.—The resistance of the tissues is considerable, and if circumstances are favourable the bacilli are destroyed or their growth inhibited and retrogressive changes occur. The tubercle may be converted into fibrous tissue, and only a cicatrix remains; or the caseous matter may become encapsuled, and perhaps resume activity at some later date, if the capsule is ruptured by some injury. Sometimes calcification occurs.

Diffusion is a marked feature. This may be—(1) local, by direct extension; (2) to distant viscera by minute emboli; (3) acute general tuberculosis may occur in any case. Tubercles are scattered throughout the body, and the disease is fatal in a few weeks.

Treatment.—Only general treatment can be considered here. Two main objects are aimed at: (1) To increase the resisting powers of the body, so as to limit the progress of the disease; (2) to act directly on the tuberculous process, as by operations and Koch's tuberculin. The latter in the form of Tuberculin R. is being used in doses of $\frac{1}{800}$ milligramme to raise the opsonic index, with moderate success.

General treatment to increase the resisting powers consists of—1. Hygiene: fresh air, sunshine and exercise are most important. 2. Diet should be nourishing and easily digestible, and cream should be a constituent.

3. Drugs: cod-liver-oil, iron, nux vomica, and guaiacol, are given.

When exercise cannot be taken, massage should be a substitute.

Glanders.

Glanders is primarily a disease of horses, asses and mules, which is transmitted to man by direct inoculation. The disease is due to the *Bacillus mallei*, and produces swellings which break down and ulcerate.

In man glanders may start in the hands, face, or nasal mucous membrane. In acute cases the incubation period is three to five days, followed by malaise, fever, and general pains. Swellings form at the site of inoculation, which break down and ulcerate. Similar swellings may occur in the viscera. Severe toxæmia leads to a fatal termination in seven to ten days. In chronic cases general symptoms are not so severe, and 50 per cent. recover.

Diagnosis.—From small-pox by the presence of *Bacillus mallei* in the discharge and by the extensive character of the pustules. The history of exposure to infection distinguishes it from syphilis and tuberculosis. Injection of mallein, a sterilized culture of the bacilli, causes a sharp febrile reaction if glanders is present.

Treatment.—Extirpation of the local foci before general infection occurs is the only treatment of any use.

Leprosy.

Leprosy is an infective disease due to the *Bacillus lepræ*, and producing localized formations of granulation tissue. It is contagious, but not to a marked degree.

Symptoms.—(1) Tuberculated, (2) anæsthetic, varieties.

Tuberculated or Cutaneous Leprosy.—Malaise and fever are first noticed, followed by shiny, red, hyperæmic spots which are infiltrated, raised and hyperæsthetic; the usual situations are the forehead, forearms and thighs. They may disappear, but always return with

febrile symptoms. After a time the patches become nodular, and may cicatrize or ulcerate. The viscera and glands may be similarly affected. Death is due after many years to sepsis, laryngeal obstruction, lung or kidney disease.

The bacilli are found in the large cells which are scattered amongst the granulation tissue of the nodules.

Anæsthetic or Non-Tuberculated Leprosy begins with malaise and fever, followed by pains and tenderness along the course of peripheral nerves. Muscular weakness, paralysis, alterations of sensation, and trophic changes, follow. Spreading yellowish-white patches appear in the skin. The ordinary changes due to destruction of nerves follow. Fingers and toes may disappear by absorption of their bones. The affected nerves can be felt as large and tender cords. General debility causes death after many years.

Treatment is unsatisfactory. Chaulmoogra-oil, both externally and internally, is at present being used.

Actinomycosis.

Actinomycosis is a disease generally of cattle, sometimes of man, and is due to the growth of the ray fungus. Man is inoculated by chewing corn contaminated with the fungus or inhaling the spores. The disease generally occurs about the tongue, jaws and neck, producing chronic induration and suppuration; in the lungs producing cavities; in the pleura producing empyema; in the intestinal tract and in the liver.

Granulation tissue is formed wherever infection occurs, and generally suppuration follows. In the pus the characteristic granules, which resemble iodoform grains, can be found. The process is a chronic one, and the induration and cicatrization are striking features.

Treatment.—Large doses of potassium iodide, up to 1 drachm doses three times a day, for prolonged periods will cure these cases. In addition, if the sinuses are in a position where vigorous scraping can be done the process of cure is hastened.

CHAPTER VII

TUMOURS AND CYSTS

Tumours.

TUMOURS are new formations which tend to grow or persist, which fulfil no function, and appear without apparent cause. Inflammatory swellings and hypertrophies are thus excluded.

Causes are but little known. Injury, irritation, infection, and heredity, are factors which have received consideration. Tumours are either innocent or malignant.

Innocent Tumours exhibit the following characters: 1. They are encapsuled, or, when diffuse, do not infiltrate. 2. They do not infect the lymph glands. 3. They do not recur after complete removal. 4. They do not disseminate. 5. They only imperil life by their mechanical action—*e.g.*, a thyroid adenoma pressing on the trachea.

Malignant Tumours.—1. They infiltrate the surrounding structures. 2. They infect adjacent lymph glands. 3. They tend to recur after removal. 4. They become disseminated in distant organs. 5. They inevitably destroy life unless removed in time.

The way in which death is produced is commonly said to be due to pain and the absorption of some theoretical toxin formed in the tumour; but if one looks at a series of cases it will be found that death is due to the accidental situation of the primary or secondary growth. For instance, a tumour of the brain kills by increasing the intracranial pressure, whether it is innocent or malignant; a cancer in the mouth brings about death by causing septic pneumonia or hæmorrhage; a cancer of the œsophagus leads to a fatal termination through starvation, or, if perforation into the trachea occurs, from septic pneumonia; cancer of the pylorus causes starvation; cancer of the intestine usually causes obstruction, and the patient, if let alone, dies from peritonitis. Then there is the large class of cases who die from visceral deposits, but there, again, we find a mechanical explanation, for if the liver is almost entirely replaced by a mass of new growth it cannot perform its important metabolic functions. In the same way, if there is a secondary nodule in, or pressing on, the spinal cord, the troubles of a transverse myelitis follow.

Classification of Tumours.—

I. Tumours derived from mesoblastic tissue—the **Connective-Tissue Group** :

1. Angeioma (composed of bloodvessels).
2. Chondroma (composed of hyaline cartilage).
3. Fibroma (composed of fibrous tissue).
4. Lipoma (composed of fat).
5. Lymphangeioma (composed of lymphoid tissue).
6. Myoma (composed of muscle).
7. Myxoma (composed of mucoid tissue).
8. Neuroma (tumour arising from the sheath of a nerve or which contains nerve cells).
9. Osteoma (composed of bone).
10. Odontomes (arising from the germs of the teeth).
11. Sarcoma (malignant, composed of embryonic connective tissue).

II. Tumours derived from epiblastic or hypoblastic structures—the **Epithelial Tumours.**

1. Innocent : (*a*) Papilloma, (*b*) adenoma.
2. Malignant, or carcinomata, the varieties of which are : (*a*) Epithelioma (arising from stratified epithelium) ; (*b*) rodent ulcer (arising from sebaceous glands) ; (*c*) columnar-celled carcinoma ; (*d*) spheroidal-celled carcinoma.

I. The Connective-Tissue Tumours.

A Lipoma is a tumour composed of fat. It may be localized or diffuse. When localized it forms a soft and semi-fluctuating swelling, which is irregularly lobulated and encapsuled, and may or may not be adherent to the skin. If there has been pressure over the lipoma, the tumour becomes adherent to surrounding structures.

They may be multiple and occur in many situations. The commonest situation is in the subcutaneous tissue, but they may be in subserous tissues, beneath synovial or mucous membranes, between or in muscles, in connection with periosteum and the meninges of the brain and spinal cord.

A **Diffuse Lipoma** is an overgrowth of fat in the subcu-

taneous tissue which occurs in drinkers. It is not encapsuled, is always symmetrical, and generally beneath the chin or at the back of the neck.

A lipoma may be a mixture of fat and other tissues, such as fibro-lipoma, myxo-lipoma, nævo-lipoma.

The treatment of lipomata is removal, and this is the simplest of operations. The diffuse form must be treated by stopping alcohol and advising exercise.

A **Chondroma** is a tumour composed of hyaline cartilage. Three species: (1) Chondroma; (2) ecchondrosis; (3) loose cartilages in joints.

1. **Chondromata** occur in connection with long bones in the neighbourhood of the epiphysial cartilages. They are lobulated and encapsuled, are firm and grow slowly, and are most frequently seen in children and young adults. Chondromata may begin in the interior of bones, and cause expansion, especially in the small bones of the hand, and they may undergo mucoid change.

2. **Ecchondroses** are overgrowths of cartilage, as in osteo-arthritis.

3. **Loose Cartilages** may be detached ecchondroses or synovial fringes in which the normally present cartilage cells have developed into palpable masses.

Treatment consists of incising the capsule of the chondroma and shelling it out. Occasionally amputation is necessary.

An **Osteoma** is a bony tumour which has a cap of hyaline cartilage so long as it is growing, and from which it grows. There are two kinds—the cancellous and the ivory.

Cancellous Osteomata are derived from pieces of epiphysial cartilage displaced by rickets, and so are found near the ends of long bones, especially the radius and femur. They may be pedunculated or sessile. Growth usually ceases at the time the epiphysial cartilage is ossified from ossification of the cap of cartilage. They are hard and painless unless pressing on nerves. They may be multiple, and a bursa may form over an osteoma subjected to pressure.

Exostoses are—(1) ossification of tendons at their attachments; (2) subungual exostosis (from last phalanx of big toe, appearing under the nail).

The treatment consists in exposing the growth and chiselling it away.

Ivory Osteomata are composed of very dense bony tissue, and occur most frequently in the orbit, frontal sinus, external auditory meatus, mastoid process, and angle of the jaw. They may give rise to severe pressure symptoms from their situation. Treatment consists of removal where the situation renders this possible.

An **Odontome** is a tumour composed of dental tissues arising from some abnormal condition of the tooth germs or growing teeth.

The species are: (1) Epithelial odontome, from the enamel organ; (2) follicular odontome; (3) fibrous odontome; (4) cementome; (5) compound follicular odontome; (6) radicular odontome; (7) composite odontome.

The only two which are common are the epithelial and follicular odontomes, and will be considered under Diseases of the Jaws (Chapter XXV.).

A **Fibroma** is a tumour composed of fibrous tissue. It may be hard or soft. The hard fibroma is commonly seen on the gum of the lower jaw (**Fibrous Epulis**). The soft fibroma is commonly seen on the skin as a pedunculated growth or as pendulous folds, and then called **Molluscum Fibrosum**.

A **Myxoma** is a tumour composed of connective-tissue cells, separated by a large amount of mucoid intercellular substance, so that the cells appear spider-like. They are found in the face, bladder, intestine, nerves, and spinal canal. Myxomatous growth is frequent in connection with sarcoma.

A **Neuroma** is a tumour growing in connection with the sheath of a nerve. A true neuroma consisting of nerve tissue is extremely rare.

1. **Solitary Pseudo-Neuroma**, either fibroma and innocent, or myxo-sarcoma and malignant. A tumour is formed in the course of, and attached to, either a subcutaneous twig or the main trunk of a nerve. Neuralgic pain or paralysis may be caused. Complete paralysis or anæsthesia generally indicates malignancy.

Treatment.—Removal, if possible, without dividing the nerve.

2. **Neuro-Fibromatosis.**—Multiple tumours or thickenings are found in connection with any part of the

peripheral nervous system. The tumours may be tender or not, and may be fibromatous or sarcomatous. Treatment is useless. Molluscum fibrosum bears some relation to this disease.

3. **Plexiform Neuroma** is fibromatosis confined to a particular nerve or plexus of nerves. A plexus of thickened, tortuous, soft, mobile subcutaneous strands can be felt. The overgrowth is myxo-fibromatous. Treatment consists of dissecting out the affected portion if it is disfiguring.

4. A **Traumatic Neuroma** is the enlargement which occurs on the end of a nerve after its division. It consists of scar tissue containing coiled-up newly-formed axis cylinders. If adherent to the bone or scar severe pain is caused.

A **Glioma** is due to localized neuroglial overgrowth. It grows in the retina, brain, and spinal cord. It is dangerous only because of its situation.

An **Angeioma** is a tumour composed of an abnormal formation of bloodvessels : (1) Simple nævus ; (2) cavernous nævus ; (3) plexiform angeioma.

A **Simple Nævus** consists of a mass of dilated capillaries held together by connective tissue, is usually congenital, and may increase in size during the first few months. It may be cutaneous or subcutaneous, and is either bright red or dusky. Ulceration and hæmorrhage may occur. Treatment consists of excision where possible. In other cases cautery, scarification, or electrolysis may be tried.

The **Cavernous Nævus** consists of dilated spaces intervening between the arteries and veins instead of capillaries, thus resembling erectile tissue. It may be cutaneous or subcutaneous, and diffuse or circumscribed. It can be emptied by pressure.

A **Plexiform Angeioma**, 'aneurism by anastomosis, or 'cirsoid aneurism,' consists of a number of abnormal bloodvessels of moderate size arranged parallel to each other. The common situation is the scalp.

A **Lymphangeioma** is a tumour composed of a number of dilated lymphatic vessels or lymphatic spaces. (1) Lymphatic nævus occurs on the skin or tongue ; (2) cavernous lymphangeioma ; (3) lymphatic cyst ;

generally occurring in the neck, axilla, or chest wall, and always congenital.

A **Myoma** is a tumour composed of unstriped muscle, and is usually met with in the uterus or prostate, rarely elsewhere. Secondary changes, such as mucoid softening or calcification, may occur.

A **Sarcoma** is a malignant connective-tissue tumour; the others are all innocent. A sarcoma consists of cells between each of which a minute quantity of intercellular tissue can be demonstrated. The cells differ in size and shape in different growths. Bone and cartilage may be developed in any of them.

It is always developed from mesoblastic tissue; it may be at first defined or encapsuled, but always in its later stages infiltrates the surrounding tissues. The blood-supply is always abundant, even to producing a pulsating tumour. The vessels are only clefts between the cells of the growth, so that interstitial hæmorrhage is frequent, and dissemination by the veins is rendered easy. It follows from this that secondary growths occur first in the lungs, unless the primary growth is in the portal area. Other organs may be affected after the lungs. Occasionally lymphatic glands are implicated, especially in melanotic sarcoma, lympho-sarcoma, sarcoma of tonsil, testis, and thyroid. Secondary changes, such as myxomatous, fatty, and hæmorrhagic, may occur.

A sarcoma when cut appears homogeneous, and varies according to its vascularity from the grayish-white of a fibro-sarcoma to the deep maroon of a myeloid sarcoma. Sarcoma may be congenital or appear at any age. The species are determined according to the prevailing type of cell.

1. **Round-celled Sarcomata** consist of a mass of round, nucleated cells with very little intercellular substance. The tumours grow rapidly, infiltrate and disseminate. There are three varieties: (*a*) The small round-celled; (*b*) the large round-celled; (*c*) the lympho-sarcoma, in which the cells are small, but the intercellular substance consists of retiform tissue. It begins in lymphatic glands or lymphoid tissue.

2. **Spindle-celled Sarcomata.**—The cells vary in size, but they are all oat-shaped, or fusiform. When much

fibrous tissue is present, they are called fibro-sarcomata. Frequently patches of immature hyaline cartilage are present.

3. **Myeloid Sarcomata** consist of round or spindle cells with large multinucleated cells scattered amongst them. The intercellular substance is gelatinous. The nuclei of the giant cells are scattered throughout, not arranged around the periphery, as in the giant cells of tubercles. They are very vascular, and may pulsate, or hæmorrhage may occur in them. No secondary deposits occur, and they do not recur if completely removed. They always grow from bones, and are the least malignant.

4. **Alveolar Sarcomata** are round-celled, but the cells are grouped in alveoli by distinct stroma.

5. **Melanotic Sarcomata** are the most malignant. They originate from pigmented structures, the skin, and the retina. The tumour consists of round or spindle cells arranged in alveoli, the cells containing a deposit of brown pigment—melanin. The primary growth may be only slightly pigmented, and either shaped as a flat plaque or a papilloma ; but the secondary deposits are of an inky-black hue. Pigmented moles are the commonest site of origin.

Treatment of sarcoma consists of complete removal as early as possible.

II. The Epithelial Tumours.

The **Innocent** varieties are papilloma and adenoma

A **Papilloma** consists of an axis of fibrous tissue containing bloodvessels, surmounted by epithelium, projecting from an epithelial surface. It may be simple or covered with secondary offshoots. The epithelium never grows down into the subcutaneous or submucous tissue, thus differing from epithelioma. Clinically it differs from epithelioma in the base being free from infiltration. If irritated, malignant change may occur. Growing on the skin, warts and corns are formed ; on mucous membranes, villous papillomata, as in the bladder, intestine, rectum, and sometimes in the ducts of the breast.

An **Adenoma** is an innocent tumour constructed on

the type of, and growing in, a secreting gland. It cannot, however, produce the secretion of the gland, has no ducts, is encapsuled, and the epithelium never passes beyond the basement membrane. The alveoli may be distended with fluid, producing a cysto-adenoma. They are only dangerous when situated where they may compress important structures.

Malignant Epithelial Tumours.—Carcinoma.—The varieties of carcinoma are: Epithelioma, rodent ulcer, columnar-celled and spheroidal-celled carcinoma.

A carcinoma is a malignant growth arising in epithelium. There is unlimited multiplication of epithelial cells, but the essential characteristic is that the epithelial cells invade the structures in the neighbourhood. An epithelioma of the skin invades the subcutaneous and muscular layers; a scirrhus of the breast has epithelial cells invading the connective tissue of the breast, and even the pectoral muscles. The cells are arranged in alveolar spaces. These spaces were originally lymphatic spaces, and carcinoma spreads by extension along such, so it is easy to understand that carcinoma is disseminated by the lymphatics. The individual cells have no intercellular tissue separating them, and always resemble the cells of the part from which the original growth is derived. Well-developed bloodvessels are present in the stroma which bounds the alveoli. It is rarely possible to define the limits between a carcinoma and the surrounding tissues, and this is the reason for such extensive operations as are now practised.

Etiology.—Nothing definite is known as to the causation, but local irritation has probably some effect, as in epithelioma of the lip from clay-pipe smoking.

The infection theory is being worked at, but nothing as yet is proven.

Epithelioma, or squamous-celled carcinoma, may arise on any surface covered with stratified epithelium. It usually arises in the middle-aged or elderly, but may also occur in the young. It often results from long-continued irritation, and may arise in old scars or ulcers. It may appear in one of three forms: (1) A wart-like growth with an indurated base; (2) a small circular ulcer with raised, rampart-like edges; (3) an indurated fissure. The growth

extends to the deeper structures; the surface ulcerates and becomes foul from contamination with putrefactive organisms. The nearest lymphatic glands always become infected sooner or later, and a fatal termination occurs rapidly unless treatment is early and thorough. Secondary deposits, except in the glands, are rarer than in glandular carcinoma. The glands sometimes undergo cystic change, invade the skin, ulcerate, become foul, and may cause death by secondary hæmorrhage from ulceration into large bloodvessels.

Microscopically, columns of cells are seen extending from the epithelium into the underlying tissues, and interlacing with one another. In some of the columns concentrically arranged masses of flattened, cornified cells occur, called 'cell nests.' The tissues immediately surrounding the growth are infiltrated with small round cells.

Treatment.—Early and free removal of the growth and the adjacent lymphatic glands, if affected.

Rodent Ulcer is a carcinoma beginning in sebaceous glands. It generally occurs in patients over forty, and is of very slow growth. It begins as a smooth, rounded knob in the skin about the nose, eyelids, orbital angles, or cheeks, slowly increasing in size. In time ulceration occurs. The ulcer has a smooth, depressed base covered with ill-formed granulations, and bounded by a slightly raised, indurated, rolled-over edge. There is little discharge if sepsis is prevented, and little or no pain. The lymphatic vessels and glands are not affected, and dissemination does not occur. The ulcer spreads and destroys surrounding structures; even bone is not spared, so that the brain may ultimately be exposed.

Microscopically the growth resembles epithelioma, but the cells are never of the 'prickle-cell' type, and no 'cell nests' are found. The cell columns spread more laterally than deeply, and there is less small-celled infiltration around.

Treatment.—Free excision, allowing a margin of ½ inch all around. If the situation or extent do not allow of this, Röntgen rays should be used for ten minutes daily till healing occurs.

Columnar Carcinoma occurs most commonly in the

intestinal tract. Multiplication of the columnar cells occurs on the surface, as in a papilloma, but the cells also invade the deeper tissues, passing beyond the basement membrane to the submucous and muscular coats. In the slow-growing forms there is much fibrous tissue, separating the cells into alveoli ; in the rapidly growing forms there is very little. Ulceration occurs with the usual hard, everted, raised edges. Neighbouring lymph glands are infected, and dissemination to the viscera follows. Columnar carcinoma may appear in the ducts of the breast, of the liver, and in the cervix uteri.

Acinous Carcinoma (glandular carcinoma) occurs in secreting glands. The epithelium of the acini at the site of growth multiplies and extends beyond the basement membrane into the lymphatic spaces of the interacinous tissues. There are two varieties, according to the amount of fibrous tissue present : (1) Scirrhus, in which there is much ; (2) encephaloid, where there is little.

Scirrhus is very common in the breast. On section it is hard and creaks ; its limits are ill-defined, and it looks like a section of an unripe pear. Microscopically there is a well-marked stroma, the alveoli of which are filled with cells. At the periphery of the growth small-celled infiltration is present. Fatty degeneration may occur in the middle of the growth, causing cystic degeneration.

There is a special variety called atrophic scirrhus, in which the fibrous tissue is so excessive that its contraction compresses the cells and bloodvessels, and so causes atrophy of the cellular portion. This accounts for the extreme slowness of its growth.

Encephaloid is very rapidly growing. There is little stroma present. Ulceration and infection of lymphatic glands quickly occur. On section it is soft and whitish, resembling brain. It is very vascular, and interstitial hæmorrhage may occur.

Colloid degeneration may occur in the cells of glandular and columnar-celled carcinomata. This appears as translucent patches in the growth.

Treatment.—Removal of the tumours with a wide margin of tissue around it. If possible, the whole organ, its nearest lymphatic glands, and the intervening lymph vessels, should be removed in one piece.

Where the growth cannot be removed, some benefit may be got from the application of Röntgen rays.

The Endothelial Tumours.

The endotheliomata arise in connection with the endothelium of the blood and lymph vessels, and though, in general, their characteristics resemble those of the carcinomata and the sarcomata, they, on the whole, do not run such a malignant course. They tend rather to recur locally than to affect glands and form secondary growths. According to the method of development, they are classified as **endotheliomata** or **peritheliomata.** The interstitial tissue in these tumours often becomes altered by mucoid change or conversion into a hyaline substance resembling cartilage, so that complex growths are formed. A typical instance is what used to be called **mixed parotid tumour.** Any part of the body may be affected, but the common situation besides the parotid is the mucous membrane of the mouth. A special form is that known as *psammoma*, which occurs in connection with the meninges of the brain and cord, so called because of the presence in it of calcareous matter.

Cysts.

Cysts result from the abnormal dilatation of pre-existing tubules or cavities. The varieties are: (1) Dermoid cysts, (2) retention cysts, (3) tubulo-cysts, (4) hydroceles, (5) synovial cysts, (6) neural cysts, (7) cysts of new formation.

Dermoid Cysts are tumours whose cavities are lined with skin or mucous membrane, occurring in situations where such structures are not normally present. Any of the cutaneous appendages may be developed in a dermoid —*e.g.*, hairs, teeth, nails, and sebaceous matter or mucus. Usually only sebaceous matter is found, except in ovarian dermoids. There are three varieties :

1. **Sequestration Dermoids** arise in detached portions of skin where during embryonic life coalescence has taken

place between cutaneous surfaces. Thus, the middle line of the body, the situation of the facial and branchial clefts, are common sites. Sequestration dermoids are rounded, elastic, movable swellings. The skin moves freely over them, but they may have pedicles going deeply, even to the dura mater, through the skull. They are generally filled with sebaceous matter, rarely having hair or teeth in them. They should be completely dissected out, or the growth recurs.

Implantation Cysts resemble sequestration dermoids. They are caused by accidental implantation, through punctures or wounds, of portions of skin in the subcutaneous tissues. Small cysts lined by skin form. They are commonest on the fingers, cornea, and iris.

2. **Tubulo-Dermoids** occur in connection with embryonic canals, many of which normally disappear before birth. These are the thyro-glossal duct, the post-anal gut, the branchial clefts.

3. **Ovarian Dermoids are** usually unilocular and of large size, and are formed from included embryos, or part of a second embryo, formed by dichotomy. They are lined with skin, and may contain hair and teeth. Sebaceous matter is always present; even nipples and mammæ are sometimes found. Similar tumours, **Teratomata**, are rarely found in other parts of the body, chiefly in the sacral region and the testis.

Retention Cysts are caused by some obstruction in the duct of a gland, which prevents escape of the secretion. Distension of the duct and acini occurs. If obstruction is complete and permanent, atrophy of the gland is produced; if incomplete, or only intermittently complete, a retention cyst. Mammary, renal, and pancreatic cysts and ranulæ are examples.

Tubulo-Cysts occur in connection with embryonic ducts and canals. These are—(1) Cysts of the vitello-intestinal duct, (2) cysts of the urachus, (3) paroöphoronic cysts, (4) parovarian cysts, (5) cystic disease of the testis, (6) cysts of Gärtner's duct, (7) cysts of Müller's duct.

Hydroceles are cysts due to accumulation of fluid in diverticula of the peritoneum. They are—(1) Hydrocele of the tunica vaginalis, (2) hydrocele of the canal of Nuck.

Synovial Cysts arise in three ways: (1) Hernial protrusions of the synovial membrane of joints, or Baker's

cysts ; (2) bursæ in the neighbourhood of joints ; (3) hernial protrusions of the synovial sheaths of tendons.

Neural Cysts are those which arise in connection with the central nervous system—*e.g.*, meningocele, syringomyelocele.

Cysts of New Formation, such as blood cysts, hydatid cysts. **Hydatid Cysts** are due to the *Tænia echinococcus*, which inhabits the intestine of dogs, especially in Iceland and Australia. The parasite is ½ inch long, and consists of four segments. The embryos pass out in the fæces, and contaminate water or food. The embryo is contained in a capsule, which, after it enters the human stomach, is dissolved by the gastric juice. The free embryo then bores its way into a bloodvessel, and gets carried generally to the liver, but sometimes to other organs. There it develops into the cystic stage. An adventitious capsule is formed around it by conversion of the structures in the immediate neighbourhood into fibro-cicatricial tissue. The true hydatid mother-cyst consists of two layers—ectocyst and endocyst. From the endocyst tænia heads, or scolices, each provided with four suckers and a ring of hooklets, are formed, and often daughter-cysts. Occasionally the cyst is sterile. The fluid contained in the cyst is colourless, of low specific gravity, contains only a trace of albumin, but hooklets always.

Hydatid cysts may (1) rupture, (2) die spontaneously, shrinking up into a pultaceous mass, or (3) suppurate.

Treatment.—The adventitious cyst should be freely opened. The mother-cyst and its contents, which have no attachment to the adventitious cyst, can then be lifted out.

CHAPTER VIII

WOUNDS AND CONTUSIONS

A **Wound** is a forcible solution of continuity involving the skin or mucous membranes. It is called a contusion if the deeper structures are injured but the skin or mucous membranes escape.

A **Contusion** generally means an injury of the subcutaneous tissues due to violence. Pain, swelling, and discoloration from extravasation of blood are the signs. In lax tissues, as the eyelid, scrotum, and vulva, extravasation is greatest, and the part becomes black. A deep bruise may take several days in showing itself. The black colour changes to brown, green, and yellow before it disappears. The colour is due to changes in the pigment of the red corpuscles.

When the blood is not distributed through the tissues, but collected in a fluid swelling, it is called a hæmatoma.

A **Hæmatoma** resembles an abscess in being fluid, but differs from it in that it immediately follows some injury, is not preceded by signs of inflammation, and that there are signs of bruising sometimes around it. A deposit of fibrin can generally be felt at the periphery of the swelling. The subsequent history is either that (1) the whole swelling becomes absorbed, (2) the fluid part is absorbed and the fibrinous part converted into scar tissue, (3) a cyst containing serous fluid is left, or (4) suppuration occurs by infection from without or by auto-infection.

Treatment usually consists in applying lotio plumbi or some evaporating lotion and keeping the part at rest. There is usually no need to puncture a hæmatoma, unless there is much pain or a speedy recovery is necessary.

Open Wounds.

Open wounds are divided into incised, punctured, contused, lacerated, gunshot, or poisoned. It is of more importance whether they are septic or aseptic.

Incised Wounds are made by sharp-cutting instruments. The hæmorrhage is free, the wound gapes, and bruising of the margins is absent. The operation wound belongs to this variety.

Treatment.—1. *The Arrest of Hæmorrhage:* Capillary bleeding is arrested spontaneously. Arteries and veins are closed by ligatures, pressure with forceps, or torsion.

2. *Purification* of the wound and its neighbourhood. This is not necessary where the skin has been prepared for operation. In accident cases the surrounding skin should be shaved, scrubbed with a nail-brush and soap,

and it and the wound freely irrigated with spirit lotion (biniodide, 1 in 500) or 1 in 40 carbolic.

3. *The wound surfaces should be apposed by sutures* of silk, catgut, horsehair, silver wire, or silkworm gut. Buried stitches should be used if the wound is deep. If there is much tension on the edges, deeper and wider ones should be put in to relieve this.

The surface stitches may be (1) interrupted, (2) continuous.

4. *Drainage* must be provided for where there is likely to be much oozing, as when a tourniquet has been used for a long time, or when there is a doubt as to the sterility of the wound. A rubber drainage-tube or a strip of rubber protective answers best.

5. *Antisepic or aseptic dressings* must be applied to prevent infection from outside sources, and to keep the deep parts in apposition by their pressure.

6. *Rest* to the part and attention to the *general health* are necessary.

An aseptic incised wound is healed sufficiently in seven days to have the stitches removed. In the face they should be removed in four or five days, to prevent scarring. Conditions which prevent healing by first intention are: (1) Non-arrest of hæmorrhage; (2) sepsis; (3) the edges not being in apposition; (4) not draining a wound when necessary; (5) lack of rest to the part. The common cause is septic infection, and the effect of it is usually inflammation, confined to the edges of the wound, with suppuration. However, severe cellulitis may spread from the wound, and even septicæmia or pyæmia may result.

When a wound has become septic, all the stitches must be removed. Only by this means, and by regular irrigation, can the toxins be got rid of. The wound should be kept open by lightly packing it with gauze, or large drainage-tubes should be used.

Punctured Wounds are made by narrow instruments. The external opening is small, but arteries, veins, nerves, viscera, and serous cavities, may be injured. The results depend on (1) whether the wound be septic, and (2) on what deep structures are damaged. If an artery be punctured, free bleeding may occur, or a traumatic aneurism may be produced. If serous cavities are opened, septic infection

may occur, or severe hæmorrhage if viscera are punctured.

Treatment.—The wound should always be enlarged, to give thorough access to the deeper parts, so that hæmorrhage may be stopped and the wound thoroughly disinfected and drained.

Lacerated or Contused Wounds are produced by blunt instruments and crushing. The edges of the wound are ragged and bruised, and the deep parts are infiltrated with blood. There is little free bleeding, as the vessels are torn, and the tearing causes the middle and inner coats to curl up and block the opening in the outer coat. Should the wound become septic, there will be suppuration and sloughing of portions of the contused tissues; if it remain aseptic, the healing is mainly by granulation, and therefore slow.

Treatment.—Secure asepsis if possible by administering an anæsthetic, shaving and scrubbing the surrounding skin with soap and water, and then impregnating the skin and every interstice of the wound with 1 in 500 biniodide solution or 1 in 20 carbolic. All foreign matter must be removed, and ragged tissues clipped away. The wound may then be partially closed, but it must be drained.

Should sepsis occur, the patient is exposed to all the dangers of sepsis, including secondary hæmorrhage.

Amputation may have to be considered in the more serious lacerated and contused wounds. The points to be considered apart from that of the injury itself are: (1) The age and vitality of the patient: young people have greater recuperative power than the old, healthy people than those broken down by alcohol and diabetes; (2) an arm stands injury better than a leg; (3) sepsis may seal the fate of a limb which otherwise might recover.

Amputation is necessary—(1) to trim up a stump when the limb has been crushed off; (2) when a limb has been crushed to pulp; (3) where gangrene is present; (4) when severe sepsis is present after an attempt has been made to save the limb.

Amputation may be necessary—(1) in compound comminuted fractures, if the age and vitality of the patient do not justify an attempt to save the limb; (2) if there is

no reasonable probability of a useful limb resulting, even though it be saved; (3) laceration of the main artery does not necessitate amputation, but if the bones, nerves, and veins are injured in addition, amputation should be done at once.

As to the **period** at which amputation should be done: In most cases this should be at once. But if the shock is profound it is better to wait a few hours, in the meantime giving stimulants, getting the patient warm, and giving saline solution intravenously.

Gunshot Wounds vary according to the variety of weapon, the nature and velocity of the projectile, the distance from which fired, and the part of the body struck. With modern rifles, unless fired point-blank—*i.e.*, within 500 yards—a clean hole is drilled in the tissues. Arteries may be cut through and bleed, or button-holed and produce traumatic aneurism; or artery and vein wounded simultaneously, producing an arterio-venous aneurism. Cancellous bone is drilled, compact is much splintered. Very much depends on whether the wound is allowed afterwards to become septic. Head wounds at close range have a fatal disruptive effect; at long range the damage is less. The inner table, even if perforation does not occur, is more splintered than the outer. Abdominal wounds are not necessarily fatal. Peritonitis may not occur if the wounded intestine is empty. Soft-nosed bullets mushroom when they strike, and produce widespread destruction.

Treatment.—The wound should be enlarged, foreign bodies removed, and asepsis aimed at. Bleeding should be stopped, fractures fixed, and divided nerves sutured. Amputation may be necessary. In skull wounds the apertures of entry and exit should be trephined, and splinters removed. In abdominal wounds in war, exploration is only done if indications, such as hæmorrhage or peritonitis, call for it, but there is no reason for waiting in civil practice.

Poisoned Wounds, other than those described as due to definite micro-organisms, are insect stings, snake-bites, butcher's wart, or post-mortem wounds.

Insect Stings produce swelling which is only dangerous when about the glottis.

Snake-Bites are very dangerous if the snake be a venomous one, provided the dose injected be sufficiently large. Extreme collapse, leading to death, occurs. The blood loses its coagulability.

Treatment consists in preventing absorption by tying a ligature above the part, excising the wound, and giving stimulants. Antivenine is on trial.

Butcher's Wart is a nodular tuberculous development, and should be excised.

Post-mortem Wounds may give rise to—(1) local affections, such as pustules, abscess, or diffuse cellulitis; (2) general affections, such as septicæmia, especially if the wound was infected from a case of septic peritonitis.

The immediate treatment of a post-mortem wound is most important. A ligature should be tied round the finger to prevent absorption, and it should then be soaked in a strong antiseptic solution for five minutes.

Whitlow is a common result of poisoned wounds of the fingers. There are four varieties: 1. *Subcuticular* in which pus forms under the cuticle. Incision and fomentations are the treatment. 2. *Subcutaneous*, in which spreading cellulitis occurs in the finger. An early free incision rapidly relieves this condition. 3. *Thecal* form, in which the suppuration is in the tendon sheath. There is swelling, severe pain, sleeplessness, and inability to bend the finger. The trouble may spread to the common palmar sheath if it begins in the little finger. An early free incision is necessary. If this is delayed, the tendon may slough, stiffness remain, or suppuration extend into the forearm. 4. *Subperiosteal* whitlow may lead to necrosis of the phalanx. Again an early free incision is necessary. All should be treated afterwards with antiseptic fomentations.

Healing of Wounds.

Wounds are repaired by fibro-cicatricial tissue. True regeneration may occur in bone, tendon, nerves, and striped muscle.

There are five methods: Healing by (1) first intention, (2) granulation, (3) blood-clot, (4) under a scab, (5) by union of granulations.

The particular form of healing depends on whether the edges of the wound are brought together or remain apart, and whether the wound is aseptic or septic.

A wound always produces a microscopic layer of injured tissue, and, in this, inflammation proceeds as far as the stage of exudation.

1. **Healing by First Intention** occurs in an aseptic wound when the edges are in apposition. Exudation of plasma from the neighbouring bloodvessels occurs, and its fibrinogen is converted into fibrin, which glues the edges of the wound together. Leucocytes are poured out and infiltrate the wound, absorbing any blood-clot present. These are followed by fibroblasts (connective-tissue cells), which take their place. New capillaries form by budding out from adjacent ones, and vascularize the new tissue. Fibrous tissue is formed by intercellular exudation from the fibroblasts, and so the fibro-cicatricial union is complete, for at the same time epithelium is spreading over the narrow surface line.

2. **Healing by Granulation** occurs (1) when the edges of the wound have not been brought together, (2) when the edges have been so damaged that sloughing occurs, (3) when sepsis has prevented healing by first intention.

Exudation of plasma and leucocytes occurs, followed by fibroblasts and budding from the capillaries, thus forming granulation tissue. The dead tissues or sloughs are separated, and a red area of granulations is then exposed. The deeper layer of granulation tissue is converted into fibro-cicatricial tissue, which contracts, and so the wound gradually lessens in size. In the meantime epithelium spreads in from the edge over the surface, and so the scar is completed.

3. **Healing by Blood-Clot** takes place only in an aseptic wound, where there is a space left amongst the tissues, which becomes filled with blood-clot. It may be covered in by the coming together of the superficial parts or be quite open. Leucocytes invade and eat up the blood-clot, replacing it by granulation tissue.

4. **Healing under a Scab** is the same as healing by granulation, but it occurs only in superficial wounds. The coagulated blood on the surface dries and forms the scab, which protects the subjacent part during the process of healing.

5. **Healing by Union of Granulations** occurs when two surfaces have been kept apart till granulations are formed, and are then brought in contact. Adhesion occurs, and union then goes on rapidly.

Complications of Scars are the following :

1. **Excessive Contraction.**—This is especially troublesome if in the flexure of joints. Treatment consists of dissecting out the scar and Thiersch-grafting the bare area. The results are not always satisfactory. Preventive treatment consists of early skin-grafting of all granulating surfaces of any size in regions where excessive contraction is likely to give trouble.

2. **Keloid Growth in the Scar** occurs most often in the scars of young tuberculous patients, and consists of overgrowth of fibrous tissue in the scar and suture holes. It is no use dissecting out a keloid scar, as more only forms; whereas spontaneous disappearance often occurs after a time.

3. **Ulceration of Scars** is due to defective nutrition from obliteration of the arteries by the contraction of the scar tissue.

4. **Epithelioma** sometimes appears in a scar.

General Conditions connected with Wounds.

Shock is a state of great depression of the vital activity, which results from severe irritation of the peripheral nerves, especially of the sympathetics. Loss of blood at the same time increases the risk of shock.

The amount of shock depends on—(1) the severity of the injury ; (2) the part injured : severe shock is produced by injury of abdominal viscera ; (3) the nervous susceptibility of the patient.

Symptoms. — The patient is pale and cold, and the forehead is covered with sweat. The patient may be faint or insensible. The pulse is small, and, though at first slow, soon becomes rapid and irregular. The pupils are dilated, and the temperature is subnormal, but there is no restlessness. The breathing is shallow till reaction occurs, when it increases in depth and frequency, and the other symptoms gradually subside. If in addition there has been loss of blood, great restlessness is a marked sign.

Shock may be deferred in people under the influence of alcohol till the intoxication has passed off.

Pathology.—Post-mortem appearances indicate that there is a loss of control by the brain centres over the vasomotor nerves, which results in accumulation of the blood in the splanchnic bloodvessels, and so causing anæmia of the brain and superficial parts of the body. Three processes combine to produce this condition: (1) Reflex inhibition of the heart's action through the medullary centre; (2) inhibition of the vasomotor centre in the medulla; (3) hæmorrhage increases the susceptibility to shock by producing anæmia of the nerve centres.

Diagnosis.—The condition resulting from hæmorrhage is similar, but with the addition of great restlessness and sighing respirations, and that the patient is generally quite sensible. In concussion of the brain, in addition to the signs of shock, unconsciousness is present.

Treatment.—In mild cases, rest in the recumbent position is all that is necessary. In severe cases, the head should be kept lower than the body, hot bottles placed around the patient, stimulants—viz., alcohol and strychnine—given.

In very severe cases sterilized saline solution, at a temperature of 105° F., must be given intravenously or by the rectum. Two or three pints are used. Crile advises the addition of adrenalin, 1 part to 50,000 of normal saline solution.

Operations, unless urgent, should be deferred till the symptoms of shock are lessening. Shock is prevented during operations by keeping the patient warm, minimizing the loss of blood, and by quick operating.

Traumatic Fever may follow the receipt of an injury or an operation.

1. **Aseptic Traumatic Fever** is due to the absorption of fibrin ferment which is set free when blood is extravasated. The temperature rises to 100° or 101°, generally, the second day after the injury or operation, and comes down after twenty-four hours.

2. **Septic Traumatic Fever** is produced by the absorption of toxins from an infected wound. The temperature rises, and remains high, and in addition there is head ache, pain, and rapidity of pulse.

Traumatic Delirium is of two kinds—(1) due to toxæmia, (2) alcoholic delirium.

Toxæmic Delirium comes on in patients who have septic injuries or wounds and are absorbing toxins. The delirium may be of the **active type**, in which the patient is restless and talkative, especially at night; or of the **low muttering type**, in which the patient is exhausted from long-continued suppuration, or of low vitality. He picks at the bedclothes, mutters, and has a dry, brown tongue.

Treatment.—The septic wound must be thoroughly drained and the patient fed up and stimulated.

Alcoholic Delirium often comes on when people of intemperate habits receive injuries. The delirium comes on about the second or third day, but is preceded by tremulousness and sleeplessness. Violent shouting is a marked sign, due to the hallucinations, and struggling and attempts to get out of bed. The skin is moist and the bowels are confined. Great exhaustion follows, and may end in coma and death.

Treatment.—Many cases can be prevented if warning is taken by the tremulous state and sleeplessness. If the bowels are made to act by repeated doses of magnesium sulphate, and then a mixture of chloral, 20 grains, and potassium bromide, 20 grains, is given every two hours till sleeping occurs, there is not much likelihood of alcoholic delirium coming on. If delirium does come on the patient must be restrained, and sedatives given. He must be fed with fluids either by the mouth or rectum, and the bowels opened. Morphia, $\frac{1}{4}$ grain, may be necessary.

Surgical Technique.

The principle of antiseptic surgery is to use chemical agents, which either destroy or inhibit the growth of organisms. Of these, carbolic acid, perchloride of mercury, biniodide of mercury, chinosol, and lysol are most used.

The principle of aseptic surgery is to substitute heat as a sterilizing agent for the irritating chemicals, which, no doubt, to some extent, do injure the surface of the wound. Still, it is to such a small extent that, given no

germs are introduced by the surgeon's hands or instruments, this may be neglected.

As there are two regions in the conduct of an operation which cannot with certainty be sterilized—viz., the surgeon's hands and the skin of the patient—it is as well to eliminate one, at least, of these sources of trouble by covering the hands with rubber gloves sterilized by boiling. After a little practice no difficulty is found in working with them.

The **hands** and **forearms** of the surgeon and his assistant should be scrubbed for three minutes in ether soap and hot water, paying particular attention to the nails after they have previously been cut short. The hands should then be soaked for one minute in 1 in 500 biniodide of mercury dissolved in spirit, and then sterilized rubber gloves donned. A sterilized linen gown should be put on, and the hair should be covered by a linen cap to prevent epithelial scales from falling into the wound. If the surgeon cannot resist talking during the operation, he should wear a linen mask to prevent tiny drops of saliva from being exuded over the wound. The arms should be covered with sterilized linen sleeves or rubber gauntlets, in case ligatures, etc., touch them.

The **skin** of the **patient** must be shaved the day prior to the operation, a large area scrubbed with soap, washed with ether to dissolve out the grease, then washed with biniodide of mercury, and covered with a compress of 1 in 40 carbolic until the operation.

Instruments should be boiled for ten minutes in weak bicarbonate of soda solution, and then either put in a tray containing boiled water or 1 in 40 carbolic, or laid on a dry sterilized towel.

Sponges. — Gauze swabs sterilized by heat are the safest, on the whole, and they may be used dry or wrung out of perchloride (1 in 2,000).

Ligatures. — Silk or linen thread or Pagenstecher thread must be boiled for half an hour, and kept in 1 in 40 carbolic. Catgut should be soaked in 1 in 20 carbolic for forty-eight hours before use.

The area around the operation must be covered with sterilized towels. If the wound requires irrigation during the operation, there is no necessity to use anything but

sterilized saline solution, and this applies especially to the abdominal cavity, where the delicate serous membrane may be injured by strong chemical irritants.

Wounds should be left as dry as possible, and if there is much oozing, as in a breast operation, a drainage-tube should be inserted.

Dressings should be sterile and absorbent. They may be of plain gauze sterilized by heat, or gauze impregnated with a chemical agent which is non-irritating and inhibitory to the growth of organisms. The best one is double cyanide of mercury and zinc. If any discharge comes through the dressings, it is of the utmost importance to apply some dressing outside the original one till the surgeon can redress the wound, for the track of blood or serum through the dressings acts as a suitable medium for germs to grow along to the wound.

CHAPTER IX

HÆMORRHAGE

BLEEDING may be arterial, venous, or capillary in nature. In arterial bleeding, blood of a bright-red colour spurts from the cut vessel synchronously with the systole of the heart, and flows continuously during the diastole. In venous bleeding there is a steady flow of dark blood, except in the cervical veins, where it flows in jets at each expiration, with a steady flow between. Capillary bleeding is oozing from the surface of the wound. Bleeding into the tissues is called **Extravasation**; if small and subcutaneous or submucous, **Petechiæ**. Bleeding from the nose is called **Epistaxis**; vomiting of blood, **Hæmatemesis**; coughing up of blood, **Hæmoptysis**; blood in the urine, **Hæmaturia**; in the fæces, **Melæna**.

Effects of Hæmorrhage.—If severe, death may result from syncope, more especially if the loss of blood be rapid. The skin becomes pale, cold and clammy, the respirations quick and sighing, and there is *marked restlessness*. If the hæmorrhage is not sufficient to be fatal, the patient recovers from the faintness, but remains in a

condition of collapse for some time, with a frequent empty, collapsible pulse, subnormal temperature, and pale, cold skin.

The blood-pressure falls at first, but soon rises again, because (1) the vessels diminish in size, especially in the splanchnic area; (2) lymph enters the circulation in large quantities—hence the leucocytosis which is present for some days after bleeding.

Children and old people stand hæmorrhage badly, but children soon recover if they can be kept alive for a little time, whereas old people have not that power.

Treatment is local and general.

General.—The patient must be kept recumbent, with the head low, and if there is no fear of restarting the bleeding, stimulants may be given. No patient should be allowed to die of hæmorrhage if there is any possibility of injecting normal saline solution intravenously. Two or three pints at a temperature of 105° F. are allowed to flow in, and this may be repeated if necessary (see p. 83).

Mode of Spontaneous Arrest of Hæmorrhage.—1. When an artery is cut or torn transversely, the middle or muscular coat contracts, and the inner and middle coats retract within the outer, so diminishing the size of the opening. 2. The blood coming in contact with the outer sheath clots, and the clot extends up the vessel to its nearest patent branch. 3. The coagulability of the blood is increased in proportion to the loss. 4. The force of the heart's action is diminished, so that the clot is not forced out. It must be clearly understood that this forms only temporary arrest. Permanent arrest is brought about by the ordinary changes described in healing by blood-clot. The clot is infiltrated by leucocytes, which eat up the clot; fibroblasts, which come from multiplication of the endothelial cells of the vessel wall, follow, and the clot is replaced by fibro-cicatricial tissue, and so the artery is closed permanently.

When an artery is only partially divided, contraction and retraction of the middle coat increase the size of the opening, and bleeding goes on.

Capillary bleeding stops quickly by coagulation. Venous bleeding is stopped by the walls falling together and coagulation, unless the vein be large.

Means of Controlling Hæmorrhage.—If instruments are not at hand, a tourniquet may be tied around a limb or digital pressure applied at the bleeding-point or in the course of the bleeding artery. The usual methods are:

1. **Pressure by Spencer Wells' Forceps, and Subsequent Ligature of the Vessel.**—The material of the ligature may be sterilized chromic gut, sterilized silk, linen thread, celluloid, kangaroo tendon, or strips of ox aorta. The cut end should be picked up cleanly, and the ligature tied in a reef-knot.

Effects of Ligature.—The middle and inner coats are generally cut through and curl up inside the outer. The changes which bring about permanent arrest then appear, and the end of the artery is converted into a fibrous cord. The ligature itself is gradually infiltrated by leucocytes, and eventually broken up and removed. In all arteries the ligature may be tied only so tight as to produce occlusion, but not tight enough to divide the middle and inner coats. The permanent arrest still takes place by exudation from the endothelium and its vessels, and the formation of fibro-cicatricial tissue, though the blood-clot is absent. This, however, is only necessary in such big vessels as the innominate and subclavian, where it is not so safe to cut through the middle and inner coats.

2. **Torsion.**—If the artery is large, it must be pulled out from its sheath, and grasped by one pair of forceps above the point where torsion is to be employed, while the open end is twisted by another pair till the middle coat is felt to give way. The artery is thus occluded temporarily by curling up of the inner coats. If the artery is small, twisting with one pair of forceps is sufficient. Torsion is unnecessary nowadays, as aseptic ligatures are more secure.

3. **Cautery.**—In vessels situated where ligatures cannot be applied, as in bones and tissues thickened by inflammation, cauterization with the iron at a dull red heat will stop the bleeding.

4. **Acupressure.**—A needle is passed under the vessel, and a figure-of-eight loop of silk is twisted around the ends.

5. **Cold** in the form of ice, cold water, or exposure to the air, will stop oozing.

6. **Hot Water** (130° F.) is a powerful hæmostatic.

7. **Elevation** of a limb brings about reflex contraction of the arteries and aids the arrest of bleeding.

8. **Direct Pressure**, either by plugging the wound tightly with sterile gauze or bandaging gauze dressings on firmly, is often effectual.

9. **Chemical Agents** : (*a*) **Styptics**, which act locally by causing coagulation of the blood—*e.g.*, liq. ferri perchlor., tincture of matico, fibrin ferment ; suprarenal extract and cocaine cause local contraction of blood-vessels. (*b*) **Hæmostatics**, which increase the coagulability of the blood or cause constriction of the blood-vessels—*e.g.*, opium, ergot, turpentine, chloride of calcium, adrenalin.

All these means of controlling hæmorrhage are but temporary. There is only one means of permanent arrest—*i.e.*, the closing of the open end of the blood-vessel by fibro-cicatricial tissue. Hæmorrhage which occurs as a result of failure of the temporary means of arrest is spoken of as **Reactionary Hæmorrhage**, and usually occurs in the first twenty-four hours. Common causes are—(1) the slipping of a ligature ; (2) forcing out of the blood-clots when the heart's action recovers its force, or by movements of the patient. The wound should be opened up if the bleeding is free, and the bleeding-point picked up and ligatured, or the wound plugged.

Secondary Hæmorrhage is due to failure in the permanent means of arrest, and the cause is sepsis.

Arterial Hæmorrhage.

Three forms are described : Primary, reactionary, and secondary.

Primary Arterial Hæmorrhage may be from an open wound or from a subcutaneous injury, such as rupture of an artery.

Treatment (from an Open Wound).—The two elementary laws which must be observed are : (*a*) *The vessel must be exposed and secured at its bleeding-point.* This is absolutely necessary, as it may be uncertain, without free exposure, what vessel is bleeding, so that ligature at

a distance of what is supposed to be the bleeding vessel may be useless, and even if the right artery is ligatured, the collateral circulation may soon start the bleeding again. (*b*) *Both ends of the cut artery must be secured*, as the collateral circulation is quickly established, and bleeding from the distal end is then free.

Exceptions to this are, when a deep dissection might endanger deeper parts, as in wounds of the palmar and plantar arches, or of the secondary branches of the carotid. While the bleeding spot in any case is being found, hæmorrhage is controlled by digital pressure. The common carotid is pressed back against the transverse process of the sixth cervical vertebra. The third part of the subclavian is pressed against the first rib by the fingers or thumb from behind the clavicle, or a padded door-key may be used instead of fingers. The abdominal aorta may be compressed by the fist against the vertebræ in a thin person. Other arteries may be compressed against the bones where they happen to lie in convenient places for pressure. If pressure has to be kept up for long in a limb, a tourniquet should be applied.

Recurrent or Reactionary Arterial Hæmorrhage results from failure of the temporary means of arrest.

Secondary Arterial Hæmorrhage results from septic infection of the wound, and so is only now seen where wounds cannot be kept aseptic, as in the mouth. Instead of the active process of repair going on, which brings about permanent closure of the cut vessels, there is the destructive action of the toxins formed by the cocci, which leads to liquefaction of the vessel wall in the neighbourhood of the ligature.

Clinical History.—The wound shows signs of septic infection, and one day warning is given by a slight loss of blood from it. This is generally succeeded in a few hours or a day by a severe gush of blood, from which the patient may quickly die. Bleeding from arteries ligatured in continuity is generally from the distal end, as, when the collateral circulation is established, the pressure is greater there. Secondary hæmorrhage commonly occurs from the eighth to the twelfth day.

Treatment.—If a large artery in a limb has been tied, and the wound becomes septic, a tourniquet should be

applied loosely on the proximal side, so that it can be tightened at a moment's notice. In an amputation stump the wound should be opened, cleansed, and the bleeding-point ligatured. The wound should be left open and irrigated frequently. If the vessel cannot be ligatured, the cautery should be applied. If this does not stop the bleeding, the artery must be ligatured on the proximal side by a separate incision.

If the secondary hæmorrhage is from an artery ligatured in continuity, the wound must be opened up, every precaution taken to render it aseptic, and the bleeding ends retied. If this is impossible, proximal ligature should be done if the situation allows of this ; if it does not, pressure must be applied. In the arm, if retying in the wound and proximal ligature fail, amputation must be performed. In the leg, if retying in the wound fails, amputation is generally necessary, for proximal ligature fails to stop the bleeding if a sufficient collateral circulation becomes established. If it is not established, gangrene is likely to occur.

Venous Hæmorrhage.

Small veins collapse, and bleeding soon ceases. Large veins and those whose walls are rigid, as in varix, continue to bleed.

Treatment is the same as for arterial hæmorrhage, with the exception that if a vein be punctured or torn slightly a ligature can be applied to the opening without occluding the vein. Bleeding from a large vein can be easily stopped by plugging the wound, if it cannot be tied, as in wound of the lateral sinus.

The **Dangers of Venous Hæmorrhage** are—(1) from loss of blood ; (2) from displacement of the thrombus, producing an embolus ; (3) pyæmia from pieces of a septic thrombus being carried off as emboli ; (4) from the entrance of air into veins, which is most likely to occur in the neck or axilla. The air and blood become churned up into froth in the right auricle and ventricle, and the heart cannot eject it, so the patient dies very rapidly. During inspiration the thorax has an aspiratory action. so that if veins are held open air is drawn in.

Veins are held open in the neck where they pierce the deep fascia, or in inflammatory tissue where the walls are rigid, or if a piece of the wall is removed while traction is being made on the vein. If intravenous pressure is high, air does not enter.

Signs.—The air enters with a sucking noise. If much enters, the patient becomes faint; there is great dyspnœa, rapidity and weakness of pulse, convulsions, and death rapidly supervenes.

Treatment.—To prevent entry of air, veins should be secured before division. If entry occurs, a finger should be placed on the point at once to stop further entry, or the wound filled with lotion. The vessel should then be secured at once. The head should be lowered, the body and limbs raised, stimulants given, and artificial respiration carried on.

Capillary Hæmorrhage is only free from inflamed parts, and can be arrested by pressure, cold or heat, styptics or cautery.

Hæmophilia is a congenital and hereditary disease, in which severe bleeding occurs from slight wounds. The bleeding may be from the surface, subcutaneous, or into joints. The disease is transmitted through the females, who are not affected, to the males of the succeeding generation.

Treatment.—In addition to the ordinary methods of arresting hæmorrhage, means to increase the coagulability of the blood should be adopted—*e.g.*, giving ½ to 1 drachm of calcium chloride by the mouth or rectum three times a day. Fibrin ferment, suprarenal extract, or cocaine should be applied locally.

CHAPTER X

THE SURGICAL AFFECTIONS OF VEINS

WOUNDS of veins have already been dealt with. The immediate dangers are hæmorrhage and entry of air. The remote dangers are thrombosis, embolism, pyæmia,

and œdema of the part corresponding to the distribution of the vein.

Phlebitis and Thrombosis.

Phlebitis means inflammation of a vein, and **Thrombosis** means the formation of a coagulum, either white or reddish-black, or both, within the lumen of a bloodvessel, usually a vein. If the inflammation is confined to the endothelium, it is called **Endophlebitis**; if all the coats are affected, **Phlebitis**; if the surrounding tissues are inflamed, **Periphlebitis.**

Causes.—1. It may follow injury which causes bruising of the wall of the vein, especially in gouty subjects.

2. It may follow debilitating diseases, such as typhoid fever, where the circulation is feeble, and is probably of an infective character. The 'white leg' of a puerperal woman is probably of the same character, and due to toxins circulating in the blood.

3. It may occur in degenerated veins, notably those that are varicose.

4. It may occur in connection with a septic wound, and produce septic phlebitis and thrombosis, which may cause either localized suppuration in and around the vein or pyæmia.

Pathological Changes.—The wall of the vein is thickened, there is proliferation of the endothelial lining, and formation of a red thrombus if the blood coagulates *en masse*. If the process is slow, the clot is formed mainly of fibrin, and is then white. If some red corpuscles are entangled in it, it is called a mixed thrombus. The clot extends to the next branch, and, if close to a main vein, may project into its lumen, and be detached by a sudden movement, giving rise to an embolism. If large enough to block the pulmonary artery, it may cause immediate death.

The later history depends on whether or not the thrombus is aseptic. In aseptic cases the thrombus is (*a*) replaced by fibro-cicatricial tissue, and the venous channel is obliterated at that spot; or (*b*) new venous spaces are formed through the clot as the fibro-cicatricial tissue is being developed, so that the lumen of the vein is

restored ; (*c*) thrombi lying behind the valves of varicose veins may be infiltrated with calcareous salts, and form **Phleboliths.**

In septic cases the clot may be disintegrated and washed off into the circulation, and set up pyæmia.

The distal changes are congestion of the terminal veins. If a main trunk is affected, œdema of the part occurs, and unless the collateral circulation is adequate gangrene may follow. The development of the collateral circulation is often very obvious when situated superficially, as when the femoral is blocked the internal saphenous carries on the circulation through its superficial epigastric branch, either to the opposite side or up to the axillary.

Symptoms.—In an ordinary case of phlebitis there is pain and tenderness in the part, and the formation of a hard cord in the course of the vein, with redness or dusky discoloration of the skin over it ; the patient is otherwise well, and there is little or no pyrexia. There is little or no œdema unless the deep veins are involved. If deep veins are involved, it may be impossible to feel them, but there is deep-seated pain in the situation of the veins, fever, and œdema of a more or less solid character.

Septic phlebitis is accompanied by high temperature, diffuse redness of the skin over the vein, and œdema in the vicinity ; suppuration occurs later, and if emboli are carried off pyæmia is produced.

Treatment.—1. *Simple Phlebitis.*—Absolute rest and elevation of the part is necessary for three to six weeks after subsidence of inflammation, so that embolism may not occur. For the pain, the application of cold or hot fomentations, or glycerinum belladonnæ, or even opium, may be necessary. In phlebitis occurring in varicose veins, the vein should be tied above the thrombus and the affected portion then excised.

The œdema which results from phlebitis is troublesome, and must be treated by massage and elastic bandages.

2. *Septic Phlebitis.*—The vein must be exposed on the proximal side of the thrombus, ligatured in two places, and divided between. The suppurating area must then be thoroughly opened up, and the thrombus scraped out or the vein excised.

Varicose Veins, or Varix.

A vein is varicose when it is dilated, elongated, and tortuous. The veins commonly affected are the superficial veins of the leg. Other common situations are the hæmorrhoidal plexus — piles; and the pampiniform plexus —varicocele. Here only varicose veins in the leg will be dealt with.

Causes.—Anything which induces prolonged distension of veins, such as long standing, pressure of tight garters, pressure in the pelvis from pregnancy or tumours, occlusion of the deep veins, may cause varix. An abnormal communication between an artery and a vein will produce distension of the vein, as in aneurismal varix. Congenital overgrowth of veins, or tendency to the development of varix, is a contributing factor.

Pathological Changes.—Before the actual development of varicosity, the walls are weakened by chronic inflammation. The elastic coat is replaced by fibroid tissue, so that the wall is no longer able to resist the pressure of the blood from above, and consequently dilatation occurs and the valves become incompetent. The veins also elongate, and therefore become tortuous. The pressure of the column of blood from above is the chief factor in bringing about the dilatation.

Varieties.—(1) Where only the large subcutaneous veins are affected; (2) where the veins in the skin itself are affected, with or without dilatation of the main veins: this condition is the one most likely to be associated with ulceration.

Complications.—Œdema of the lower part of the leg and ankle may appear after standing for some time. A feeling of tension and heaviness is generally present. Phlebitis, eczema and ulceration are common. Hæmorrhage may follow ulceration, and if not treated promptly may be severe.

Treatment.—*Palliative treatment* is advisable when the varix is very extensive. All conditions which produce obstruction should be removed, and the veins supported by wearing an elastic stocking or a perforated rubber bandage.

Operative treatment is advisable when the varix is limited to one vein or set of veins; for young men wanting to enter the services; when the veins above the knee are affected; when there have been frequent attacks of phlebitis; and in the treatment of varicose ulcers. An impulse or thrill on coughing indicates that there are no competent valves above the varix.

There are three methods of operation: 1. By small incisions over the dilated veins, through which 2 or 3 inches may be removed after ligaturing. 2. By long incisions, through which large clusters of veins may be excised and the collateral branches ligatured. 3. By *Trendelenburg's* operation, in which the internal saphenous vein is ligatured in two places and divided just below the saphenous opening. This cuts off the column of blood from above, and is necessary where there is an impulse in the varicose veins on coughing.

Nævus.

A nævus is an overgrowth of vascular tissue developing in the skin, subcutaneous or submucous tissues, and is either congenital or appears soon after birth. It may either disappear after a time, persist, or grow rapidly. There are two varieties—the capillary and the cavernous.

The **Capillary Nævus** occurs as a bright-red or purple area in the skin or mucous membrane, consisting of a mass of capillaries held together by connective tissue. They vary from tiny spots to very large areas, even half the body being covered with nævoid tissue.

Treatment.—Small nævi in places where scarring does not matter are best dissected out. Some form of cautery, such as liq. sodii ethylatis, nitric acid, the actual cautery, or electrolysis, will cure capillary nævi.

The **Cavernous Nævus** involves the subcutaneous as well as the cutaneous tissues. It is generally bluish in colour, and consists of spaces lined by endothelium, with arteries opening directly into them without the intervention of capillaries. It appears as a soft, non-pulsating swelling, which is easily diminished by pressure, but which refills on removing the pressure.

Treatment.—Excision is the best treatment where prac-

ticable. In other cases electrolysis must be used. Both needles are inserted into the nævus in several places, and a current of 100 milliampères is used for ten minutes. The blood is coagulated in the spaces, and is afterwards replaced by fibro-cicatricial tissue. Several applications at intervals of a few weeks are necessary.

A Nævo-Lipoma is a tumour, usually congenital, composed of fatty and nævoid tissue. It has the lobulated character of a lipoma, but with dilated veins or capillaries on the surface, and it can be diminished in size by pressure. The treatment is excision.

Venesection.

Venesection is used in medical cases for letting blood, in surgical cases for the infusion of saline solution after hæmorrhage. The median basilic is the best vein to choose. A piece of bandage is tied around the arm sufficiently tightly to stop the venous return; an incision is made parallel to the length of the arm, so as to cross the vein. The front wall of the vein is picked up with forceps, and a flap is cut with scissors. The cannula can then be slipped into the vein along the floor formed by the deep wall of the vein. The cannula is then tied in, the bandage removed, and infusion begun.

CHAPTER XI

INJURIES AND DISEASES OF ARTERIES—ANEURISM

Contusion of an artery, as a rule, does little harm, unless the artery is atheromatous or calcareous, when thrombosis may occur and lead to gangrene.

Rupture of an artery may be caused by blows, strains, attempting to reduce old-standing dislocations, or bending stiff joints if the artery be adherent to the structures of the joint. If only the inner and middle coats are ruptured, thrombosis occurs at that spot, and either occlusion of the artery follows or a weak spot is left, from which an aneurism may grow.

Complete or partial rupture subcutaneously often gives rise to extensive extravasation, forming a **Diffuse Traumatic Aneurism.**

Symptoms.—The patient feels something give way, and has pain localized to the injured part and along the course of the injured artery. A large pulsating swelling is rapidly formed, and the skin becomes distended and blue. If left, œdema and redness appear. Distally pulsation of the vessels is absent, the limb becomes cold, and sensation is impaired. The colour of the limb is white, or blue if the venous return is interfered with by the swelling. If much blood is extravasated, the patient is pale and restless, with a rapid pulse.

Terminations.—1. Rupture, if the swelling increases so much that the skin gives way or sloughs ; if into the abdomen or pleura, death may occur rapidly. 2. Suppuration may occur either from direct infection or auto-infection, and it then simulates a large abscess. 3. Gangrene of a limb may be produced by the pressure of the swelling. 4. Limitation of the swelling may occur, and the clot and the hole in the artery are replaced by fibro-cicatricial tissue.

Treatment.—Expose the ruptured artery and tie both ends. If suppuration has occurred, it may be necessary to tie the main trunk on the cardiac side away from the wound. Gangrene or secondary hæmorrhage may necessitate amputation.

Penetrating Wounds of Arteries.—If completely divided in an open wound, the treatment is that of arterial bleeding. If the wound is valvular, conditions similar to subcutaneous rupture are produced. If an artery is incompletely divided, hæmorrhage continues, so the first part of treatment is to completely divide it. If a small artery is divided so close to its main trunk that a ligature cannot be applied safely, the trunk must be ligatured above and below the branch. Small wounds of big arteries have been sutured with fine silk. Punctured wounds may be closed at first by blood-clot, then by a cicatrix, which may subsequently yield and form an aneurism.

Arterio-Venous Wounds result from penetrating wounds which involve an artery and vein lying in contact. There are two conditions which follow :

1. **Aneurismal Varix**, in which the artery opens directly into the vein. The vein and its branches are unable to resist the arterial pressure, so they dilate and pulsate. A loud systolic bruit is heard.

Treatment.—An elastic bandage generally relieves this condition; but if pain or inconvenience still exists, the artery should be tied above and below the opening into the vein. In the orbit, electrolysis must be tried.

2. **Varicose Aneurism**, in which an aneurismal sac exists between the openings in the artery and vein. The sac is formed of laminated clot and fibro-cicatricial tissue. The signs are those of aneurismal varix, but the sac may be felt and the bruit is softer.

Treatment.—The artery must be tied above and below the sac. If possible, the sac and the parts of the artery and vein at the site of abnormal communication should be excised.

Inflammation of Arteries.

Arteritis may be either acute or chronic.

Acute Arteritis involves all the coats of an artery, and is due to the presence of sepsis, as in a wound where the sepsis spreads to the artery from without; or as in pyæmia, where a septic embolus becomes lodged, and the arteritis spreads from within. Secondary hæmorrhage may result from the first kind, aneurism from the second.

Chronic Arteritis may take one of several forms.

Atheroma is a condition found in the arteries of those who drink alcohol excessively, or where gout, Bright's disease, or syphilis, is present. It is supposed that it is primarily set up by the strain of the high-tension pulse which is present. The large arteries are chiefly affected. The earliest changes are a small-celled infiltration of the subendothelial tissue, which may be either replaced by fibroid tissue or undergo fatty degeneration.

Degeneration usually occurs, and the softened mass either bursts into the artery or becomes converted into a calcareous plate. The process extends to the middle coat, which is at first softened, and the muscular tissue is destroyed in patches. The result is either weakening of the

wall and dilatation into an aneurism, or the deposit of lime salts and calcification of the middle coat. The external coat is thickened, and helps to prevent dilatation. The conditions which are secondary to atheroma are thrombosis, detachment of a plate forming an embolus, or 'dissecting aneurism,' due to the blood-stream getting under a plate and tunnelling under the tunica intima.

Endarteritis Obliterans is a condition in which the internal coat becomes very markedly thickened, and ultimately either obliterates the lumen of the vessel or leads to thrombosis. There is no tendency to degeneration of the newly-formed tissue. It occurs in various diseases, especially in syphilis, where the smaller arteries are affected, in the brain, and around gummata. It occurs also in diabetics and alcoholics, and then larger arteries, like the posterior tibial, are affected, leading to defective nutrition of the limb, and even gangrene. In the neighbourhood of tubercles there is always a condition of chronic obliterative arteritis.

Degeneration of Arteries.

Primary Calcareous Degeneration is mostly seen in the smaller arteries of the extremities of old people, and is due to the deposit of lime salts in the middle coat. Ultimately the middle coat is converted to a rigid, inelastic calcareous tube, so that only a minimal quantity of blood can pass. The effect of this is to produce anæmia, impaired nutrition, and coldness of the limb affected. Thrombosis may result from very slight injury, and senile gangrene is a common termination.

Fatty Degeneration is rare and unimportant. **Amyloid Degeneration** occurs in amyloid disease.

Aneurism.

An aneurism is a cavity containing blood, and communicating with the lumen of an artery. There are two kinds—the true and false. A true aneurism is due to dilatation of part of the arterial walls, and is preceded by degeneration. A false aneurism is one which is due

to a wound of the arterial wall, and the arterial wall takes no part in the formation of the sac. The false or traumatic aneurism has already been described in wounds of arteries.

Causes of True Aneurism.—Some preceding disease is always present, usually atheroma ; and dilatation occurs only after the middle coat has been weakened. Contusions or strains may rupture the middle coat, and so produce weakness, which subsequently allows dilatation to occur. Increase in the blood-pressure by sudden and violent exertions tends to the production of aneurism.

Structure of an Aneurism.—In the first instance the sac is formed by one or more of the arterial coats, but as it increases in size the sac is solely formed of the condensed cellular tissue around. Soon the endothelial lining disappears, and fibrin becomes deposited around the walls of the cavity in a laminated manner. Often there are alternate layers of red and white clot.

Varieties.—There are three forms : Sacculated, fusiform, and dissecting.

A **Sacculated Aneurism** is one in which the dilatation springs from one side of the artery only, and in which the sac communicates with the artery by a comparatively narrow opening.

A **Fusiform Aneurism** is due to a general dilatation of the whole circumference of an artery. Its progress is slower than that of the sacculated variety, and there is little or no laminated clot at first. It usually ends in the formation of a sacculation at one part.

A **Dissecting Aneurism** is due to blood getting into the middle coat and stripping it up. It cannot be recognised during life.

Symptoms and Signs of a Circumscribed Aneurism.—*Intrinsic Signs.*—An expansile tumour, pulsating synchronously with the heart, associated with a bruit and in the course of a vessel, is present. If the artery is compressed on the cardiac side, pulsation ceases, and the tumour becomes softer and can be diminished in size by pressure. On removal of the compression the tumour regains its size in two or three beats. Pressure on the distal side of the sac makes it more tense.

Extrinsic Signs are due to pressure produced by its increase in size, and to interference with the circulation. The pulse on the distal side is diminished and delayed. Pressure on the veins may cause congestion and œdema, and even gangrene. Pressure on nerves produces pain, anæsthesia, or paralysis. Bones are eroded, and spontaneous fracture may occur. Cartilage is less affected than bone. Tubes, such as the trachea and œsophagus, are compressed and ulcerated, so that the aneurism may burst into them. The heart is hypertrophied because of the increased work thrown upon it. Emboli may be detached, or gangrene may occur from pressure on the surrounding vessels.

Differential Diagnosis.—Aneurism may be simulated by—1. A **Tumour** or **Chronic Abscess** receiving transmitted pulsation from an artery near it, but is distinguished by the impulse not being expansile, by the impulse ceasing if the tumour is so moved that it does not receive an impulse from the artery, by the size of the tumour not diminishing on compression of the artery above. The pulse below is not delayed as in aneurism. 2. A **Pulsating Sarcoma**, which may be easily distinguished if it is away from the line of an artery; by its consistence not being uniform; by pressure on the afferent trunk diminishing its size only slightly; and by its infiltration of the surrounding tissues. 3. The pain caused by aneurism may be ascribed to **Rheumatism** or **Neuralgia** if no proper examination be made.

Results.—Spontaneous Cure occurs rarely. It may be due to laminæ of fibrin being deposited till the whole sac is filled up and obliterated. This only occurs in arteries of the smaller sizes, and where the opening into the sac is small. More commonly it is due to the sac bulging, so as to compress the artery above or below the sac, so that the blood coagulates in it. An embolus may block the trunk below, and produce the same condition. Very rarely suppuration of the sac may cause spontaneous cure.

The usual history, however, if an aneurism is left alone, is that it increases in size, causing absorption of the tissues, till it bursts either on a free surface or subcutaneously, and is then known as **Diffuse Aneurism.**

Rupture of an internal aneurism usually causes severe pain, and death ensues rapidly. Rupture of an external aneurism may be sudden or gradual. If gradual, the tumour slowly increases, and its outline is less defined; pulsation is diminished, and signs of pressure on nerves and veins increase till gangrene may occur. If sudden, there is severe pain in the part, the swelling rapidly increases, and becomes tense, brawny, and non-pulsating, and gangrene follows from pressure on the vessels of the collateral circulation. Suppuration and external rupture may also occur.

Suppuration is a serious complication. It may arise from infection during operation, or by auto-infection when an aneurism has become diffuse. The tumour becomes red, hot, swollen, painful, and œdematous, and if left alone it points, pus and blood are discharged, and the patient may die at once, or later from repeated hæmorrhages.

Treatment—Medical.—An attempt is made to produce conditions which will favour the occurrence of coagulation in the sac. The force and rapidity of the circulation must be lowered by diminishing the amount of diet, especially of the fluids; and the coagulability of the blood must be increased.

Tufnell's Method.—The patient is kept strictly in the horizontal position, and receives 10 ounces of solid and 8 ounces of liquid in the twenty-four hours. If possible, this is kept up for two or three months.

Drugs.—Iodide of potassium, 15 to 60 grains t.d.s., and chloride of calcium, 5 to 10 grains twice a day, are intended to aid coagulation. The hypodermic injection of gelatine is said to aid coagulation in the sac.

Surgical.—If internal aneurism coexists, it is unwise to interfere except for diffusion.

1. **Complete Extirpation of the Sac** is the best operation where this is possible. The limb is rendered bloodless, and the sac is exposed, dissected out, and the artery tied above and below the opening into the sac. If the sac is large, it should be incised and emptied. If the vein is adherent to the sac, it should also be removed, and in such cases there is little danger of gangrene, as an efficient collateral circulation has probably been de-

veloped. Extirpation produces less danger of gangrene than ligature at a distance, as only one collateral circulation has to be established instead of two.

2. **Ligature of the Artery** affected is divided into four groups :

(1) Ligature of the artery in close proximity to the sac, or Anel's operation.

(2) Ligature of the artery at such a distance from the sac that at least one branch intervenes between it and the ligature, or Hunter's operation. Only a small amount of blood can enter at first, and the sac contracts and fills up with fibrin. It is contra-indicated when internal aneurism is present; when there is so much collateral circulation that pressure does not control the circulation through the sac; where gangrene is threatening or present; where bones or joints are seriously involved.

(3) Ligature of the artery or its main branches on the distal side of the aneurism—Brasdor's or Wardrop's operations. This is practised in the neck when the artery is so placed that proximal ligature is impossible.

In all these three cases pulsation may return after a few days, and disappear spontaneously. Sometimes it persists and the operation is a failure, so that the artery has to be retied or the sac dissected out, or even amputation performed, if gangrene occurs.

(4) Incision of the sac, and ligature of the artery above and below, or the operation of Antyllus, as now practised, is extirpation of the sac.

3. **Compression** may be continuous or intermittent, and either digital or mechanical, but is now rarely used. Pressure is applied to the artery, if possible, on the proximal side, and at some distance, and maintained either continuously or intermittently for twenty-four to thirty-six hours. The objections are that it is difficult to satisfactorily compress the vessel; it causes great pain, and there is risk of damaging the artery at the seat of compression.

4. **Galvano-puncture** by means of needles introduced into the sac and connected with the poles of a constant-current battery is not satisfactory.

5. **The Introduction of Foreign Bodies into the Sac.**—Fine steel wire is introduced through a small cannula

into abdominal aneurisms, with success in some cases, especially if combined with electrolysis. Colt's apparatus is most satisfactory. A trocar and cannula are thrust into the sac. The trocar is withdrawn, and another cannula, loaded with a sheaf of fine wires, is fixed to it. With a ramrod this sheaf is pushed into the sac, when it immediately expands into a double umbrella shape.

6. **Acupuncture** by Macewen's method. Fine needles are introduced and left for a time, so that the pulsations make the needles scratch the posterior wall, and cause inflammatory thickening.

7. **Amputation** may be required (*a*) when gangrene has occurred; (*b*) when joints have been opened or bones are so eroded as to destroy the utility of a limb; (*c*) in some cases of subclavian aneurism, to diminish the amount of blood flowing through the sac.

Treatment of Diffuse Aneurism.—If the leaking is gradual, the artery should be tied and the limb kept at rest. If this is not successful, it should be treated like the cases of sudden rupture. The limb should be rendered bloodless, the sac freely exposed, and the artery tied above and below, as well as any branches opening into the sac. If gangrene is coming on or secondary hæmorrhage occurs, amputation must be undertaken.

Treatment of Inflamed Aneurism. — The artery should be ligatured and the limb kept at rest. If this is not successful, it must be treated as a diffuse aneurism. If sepsis has occurred, the cavity should be plugged with gauze, and a close watch kept for signs of gangrene.

Ligature of Vessels.

Three essentials in ligature for aneurism are, the determination of the point at which the ligature should be applied; the method of applying it; and the material of which the ligature is composed.

1. The point at which the ligature should be applied is the proximal side of the aneurism, where this is feasible.

2. The force with which the ligature should be tied is of moment in the larger arteries, like the innominate, where only just sufficient force should be used as will bring the inner coat into apposition. If more force is used, the inner and middle coats are divided, and the external coat is then not strong enough to withstand the

blood-pressure. In arteries of the size of the femoral and downwards, dividing the inner and middle coats with the ligature does no harm. The *stay-knot* is the best method of insuring that the coats are not divided.

3. Silk, catgut, and kangaroo tendon are the materials most used for the ligature, and, to insure success, must be aseptic. It is always better to use a double ligature, as in the stay-knot, to insure non-slipping, and to avoid dividing the coats.

The **Risks of the Operation** are—(1) secondary hæmorrhage, which is due solely to septic infection of the wound ; and (2) gangrene, which is due to failure in the establishment of the collateral circulation.

The Operation.—An incision is made to expose the artery at the point chosen. Its sheath should then be incised for an inch and stripped from the artery with an aneurism needle till the needle passes round easily and includes nothing but the artery. A ligature or two ligatures are then threaded through the eye, and the needle withdrawn. If the main artery of a limb is tied, the limb should be purified and warmly wrapped in sterile dressings, so that, should gangrene occur, septic complications are avoided.

Special Aneurisms.

Aneurism of the Thoracic Aorta cannot be fully dealt with in a surgical book. It manifests itself either by producing a pulsating swelling or by its pressure effects. Aneurism of the transverse part of the arch may appear at the episternal notch, or may erode the sternum and project through it, or press backwards upon the trachea and œsophagus, causing dyspnœa and dysphagia. Dyspnœa may also be produced by pressure on the recurrent laryngeal nerve, paralyzing the abductor muscles of the larynx. Aneurism of the descending part of the aorta may produce a swelling projecting posteriorly, or press upon the œsophagus and cause difficulty in deglutition. For this reason an œsophageal bougie should never be passed till thoracic aneurism is excluded.

Treatment.—Beyond medical treatment, nothing can be done except galvano-puncture, the introduction of Macewen's needles or gelatine.

Innominate Aneurism is nearly always combined with aneurism of the arch. It presents a pulsating tumour, which rises above the suprasternal notch and behind the sterno-mastoid. The pulse is diminished and delayed in the right temporal and radial pulses. Œdema of the right arm and right side of the head and neck may be caused by pressure on the right innominate vein. This may extend to the left side if the left innominate vein or superior vena cava are compressed. Pain in the neck and right arm may be caused by pressure on the cervical and brachial nerves. Irritation of the sympathetic trunk is shown by hyperæmia and unilateral sweating of the face and dilatation of the right pupil. Dyspnœa and dysphagia may be present. Death results from rupture of the sac or asphyxia.

Treatment—Distal Ligature.—Simultaneous ligature of the common carotid and third part of the subclavian does good in some cases. If an interval is allowed to elapse between the ligation of the two vessels, the collateral circulation is so enlarged that failure is certain. Operation is of no use for fusiform aneurism. Rest, iodide of potassium, galvano-puncture, or Macewen's needles may be tried.

Aneurism of the Common Carotid is usually near the bifurcation, and on the right side, and is commoner in women than in men. The ordinary signs distinguish it, but if at the root of the neck it may be difficult to distinguish carotid aneurism from that of the aorta, innominate, or subclavian. Percussion and auscultation of the upper part of the chest may reveal that the tumour is also intrathoracic; aneurism of the carotid never is. The pressure signs must be weighed. Pressure on the left recurrent laryngeal nerve is due to aortic aneurism; on the right, to aneurism of the right vessels. 'Tracheal tug' is due to aortic aneurism. Compression of the internal jugular vein only, or subclavian vein only, point to either carotid or subclavian aneurism. Differences in the pulses must also be weighed to try and locate the site of dilatation. If only the temporal pulse is altered, then the aneurism is in the common carotid, whereas if both right radial and temporal are changed the aneurism is in the innominate. Weakness may be caused in the pulsa-

tion of arteries not aneurismal by pressure of the sac upon their trunks.

Glands, tumours, and abscesses lying over the carotid artery, and receiving pulsation from it, are distinguished by careful examination.

A pulsating goitre is easily distinguished by the fact that it moves on swallowing. A tortuous condition of the terminal portion of the common carotid sometimes gives rise to mistake ; but it is usually symmetrical, and is easily distinguished.

Treatment.—Proximal ligature, but if the aneurism is at the base of the neck distal ligature only may be possible.

Aneurism of the External Carotid is rare, except as an extension of similar disease from the common carotid. When present, it appears as a pulsating swelling at the angle of the jaw, which causes pressure on the hypoglossal nerve.

Treatment.—It is best to tie the artery above and below and excise the sac. If this is not possible, the external carotid and as many of its branches as can be found should be tied.

Aneurism of the Internal Carotid in the Neck appears, like that of the common carotid, at the bifurcation, or that of the external carotid, only it projects more into the pharynx.

Treatment.—Ligature the common carotid.

Intra-orbital Aneurism appears as a pulsating swelling in the orbit, which causes exophthalmos ; vision gradually becomes impaired, and the cornea is inflamed when the eyelids can no longer cover and protect the eyeball. A penetrating wound or a blow is the usual cause, or the artery is felt to give way with a definite snap. Various conditions besides true aneurism may resemble it, such as aneurism by anastomosis (congenital), and aneurismal varix between the internal carotid and cavernous sinus.

Diagnosis from pulsating sarcoma is not easy unless a definite growth can be felt. In sarcoma vision is not impaired early, and there is more distortion of the eyeball.

Treatment.—Electrolysis should be first tried, but if that fails, and it still causes trouble, the common carotid should be tied.

Subclavian Aneurism is more frequent in men and on

the right side, and usually in the third part. A pulsating swelling forms in the subclavian triangle, and spreads downwards towards the axilla, compressing the brachial plexus and veins, and causing pain and œdema.

Diagnosis is easy, but in the early stages it may be simulated by a normal artery pushed forward by a cervical rib.

Treatment.—The ideal treatment where the aneurism is limited is extirpation. Ligature on the proximal side is generally necessary, and, as there is rarely sufficient room to tie the first part of the subclavian, the innominate must be tied. It is then always necessary to tie the common carotid as well, as, if it is not tied, there is so much reflux of blood along it that the quantity flowing through the sac is not diminished. Distal ligature is only of service if the arm be amputated at the same time. Where operation is inadvisable, galvano-puncture or Macewen's needles should be tried.

Aneurism of the Axillary Artery is generally traumatic, and due to falls, fractures, dislocation, or attempts at reducing dislocations.

Treatment.—If the aneurism be of the third part, ligature of the third part of the subclavian ; if of the first part, ligature of the first or second part of the subclavian should be practised. Aneurisms in the artery below the axilla are usually traumatic, and should be extirpated.

Abdominal Aneurism may affect either the aorta or its branches. An expansile pulsating swelling is formed, which does not alter its characters on change of position. Pressure effects are pain, congestion, and œdema. Any new growth lying in front of the aorta may receive pulsation from it, but this disappears if the patient is examined in the genu-pectoral position.

Treatment.—Cases have been successfully treated by using Macewen's needles and by introducing wire into the sac combined with electrolysis.

Iliac Aneurism may be of the common or external iliac arteries. Pressure effects are mainly experienced in the veins and nerves of the legs.

Treatment.—Ligature of the external iliac artery on the proximal side, if possible ; if not, transperitoneal ligature of the common iliac.

Gluteal and Sciatic Aneurisms have to be distinguished from pulsating sarcoma.

Treatment.—Transperitoneal ligature of the internal iliac artery.

Femoral Aneurism may be either in the common or superficial femoral, and offers no difficulties in diagnosis or treatment.

Popliteal Aneurism is common, and nearly always in men. It gives rise to a pulsating tumour in the ham, which causes difficulty in using the knee and pain along the course of the nerves. It either extends forwards and erodes the knee-joint or backwards and tends to become diffuse. If diffusion occurs, gangrene is very likely to follow. It has to be diagnosed from enlarged popliteal glands, abscess, pulsating sarcoma, and enlarged bursæ.

Treatment may be either by compression or ligature. Extirpation is difficult, but the next best thing is to tie the popliteal artery at its upper part. If this is not possible, ligature of the femoral at the apex of Scarpa's triangle or in Hunter's canal is usually successful.

CHAPTER XII

DISEASES OF THE LYMPHATICS

Affections of the Lymphatic Vessels.

Wounds of lymphatics are only of importance when it is the thoracic duct which is injured. There is then a free escape of chylous fluid. If the opening be stitched up, the wound closed, and firm pressure applied, no more trouble is caused.

Acute Lymphangitis is always due to sepsis. Generally the inflammation is due to the action of organisms, but occasionally to toxins only. It is never primary, but always secondary to some focus of infection, such as a wound or a boil. The process is often limited by the nearest lymphatic glands, but may spread beyond.

Pathology.—The walls of the lymphatics are acutely inflamed, and the surrounding tissues are also affected,

so that when suppuration occurs the pus is outside as well as inside the lymphatic vessels.

Symptoms.—Shivering and rise of temperature, with headache and loss of appetite, accompanied by the presence of red lines in the skin, running from the primary focus to the nearest lymphatic glands. The inflamed lymphatics are painful and tender. Small abscesses may occur at intervals along this course, or suppuration in the glands, and the patient may die from septicæmia or pyæmia.

Treatment.—The primary focus must be purified to cut off the supply of poison. The lymphangitis must be treated with hot fomentations, and abscesses opened when found. Rest, quinine, and good feeding, form the remainder of the treatment.

Chronic Lymphangitis may occur in gonorrhœa, soft chancre, primary syphilis, and tuberculous disease of the skin. The treatment is that of the primary disease, except in the tuberculous form, where all nodules should be excised as well as the primary focus.

Lymphangioma is nearly always of congenital origin, and consists of a mass of lymphatic vessels and connective tissue. There are two varieties—the capillary and the cavernous.

1. **Capillary Lymphangioma**, though usually congenital, often grows rapidly. Smooth-topped or warty yellowish-brown patches mark this form. The treatment is excision.

2. **Cavernous Lymphangioma** is made up of lymph spaces, into which the lymphatic vessels open, and may occur in the skin, forming small vesicles like those of herpes, but without any inflammation. Incision and cauterization is the treatment. In the deeper structures large multilocular swellings may occur, especially in the neck, and called **Cystic Hygroma**. It is difficult to dissect them out, as they are often very extensive and not circumscribed, but an attempt should be made if they are rapidly increasing.

Lymphangiectasis is a varicose condition of the lymphatic vessels, due to obliteration of the main trunk by inflammation or the pressure of cicatrices. The most marked cases are due to the presence of the *Filaria san-*

guinis hominis. Obstruction to the thoracic duct may cause rupture, and chylous fluid is then found in the abdominal or pleural cavities. Chylous hydrocele is probably due to some lymphatic obstruction.

Elephantiasis Arabum is due to filariæ obstructing the lymphatic trunks. Pseudelephantiasis is due to repeated attacks of lymphangitis, as in chronic ulcer of the leg or obstruction by cancerous growth. In both cases there are—(1) solid œdema, (2) great thickening of the skin and subcutaneous tissues, (3) lymphatic fistulæ occasionally. Elastic pressure is the best means of relieving this condition when it is due to chronic ulceration.

Elephantiasis Arabum is a tropical disease, and affects mainly the leg, scrotum, and vulva, which may become of enormous size. The condition is due to obstruction of the lymphatics by filariæ and their embryos.

Treatment.—As a rule but little can be done. If the adult parasites can be localized, they should be excised. When the scrotum is affected, it may be removed, enough skin being left to cover the testes. In the leg elastic bandages should be first tried. Good results have followed dissecting out the dilated lymphatics and implanting them into a tributary of the internal saphenous vein. Failing this, ligature of the main artery, and, as a last resource, amputation of the limb.

Surgical Affections of the Lymphatic Glands.

Acute Adenitis is common, and is caused by the absorption either of toxins or organisms.

Pathology.—The glands become redder, firmer, and larger, from hyperæmia and exudation. When pyogenic organisms are the cause, a number of spots of suppuration appear; periadenitis rapidly follows, and the pus bursts through the capsule of the gland and makes its way to the surface.

Symptoms.—The general symptoms of inflammation are present, and the glands can be felt as enlarged and tender masses. If no suppuration occurs, the pain subsides and the swelling slowly disappears. Should suppuration occur, the glands become fixed to surrounding structures and the skin; redness appears over them, and fluctuation is evident. In loose tissue diffuse cellulitis may be set up, as in the axilla or neck.

Treatment.—The primary focus must be treated, with rest, and fomentations for the inflamed glands. If an abscess forms it must be incised.

Chronic Adenitis is either simple, syphilitic, or tuberculous.

1. **Chronic Simple Adenitis** results from peripheral irritation from chronic ulcers, lice, eczema, and bad teeth. The glands are enlarged and tender, but not adherent to one another, and with little tendency to suppuration. Treatment consists in removing any source of irritation and placing the part at rest. If the glands still remain enlarged or increase, they are probably tuberculous.

2. **Chronic Syphilitic Adenitis** may be—(1) In the nearest glands to a primary sore. Suppuration never occurs unless pyogenic organisms in addition are absorbed. (2) In the secondary stage many glands are enlarged, especially the post-cervical chain. They are small, hard, painless, and do not suppurate. (3) In the tertiary stage gumma of glands may occur, or suppurative adenitis, through organisms absorbed from a broken-down gumma. The treatment is that of syphilis.

3. **Chronic Tuberculous Adenitis** most commonly occurs in people under twenty years, but may occur at any age. The predisposing factors are a hereditary disposition or a condition of lowered vitality from lack of fresh air or improper food. Simple chronic adenitis generally 'prepares the soil for the seed.' The bacilli gain access by some breach of the surface or through healthy mucous membrane, and are conveyed by blood or lymph to the gland. The glands most commonly affected are the cervical, bronchial, and mesenteric, but any in the body may be infected.

Pathology.—The glands are at first simply enlarged and firm, and tubercles can only be seen with the microscope. Subsequently these run together and caseate. Either calcification of the caseous mass follows, or, what is more frequent, suppuration ensues. By suppuration of tuberculous glands is meant emulsification of the tuberculous tissue; now and then pyogenic infection occurs. At first the pus is confined within the capsule of the gland, but afterwards several glands may unite and form a large cavity. In the later stages, peri-

adenitis fixes the mass to the deeper structures and to the skin. Still later the abscess bursts on the surface, leaving one or several openings with thin, undermined edges, and discharging pus for a very long time. After healing, a puckered keloidal scar is left.

Treatment.—1. *When periadenitis is absent:* Improve the general health by fresh air, sunshine, arsenic, cod-liver-oil, iron, and good nourishing food. Rest of the affected part and removal of all sources of irritation are necessary. Local applications are best avoided. If increase occurs during this treatment, it is better then to excise the glands.

2. *Where periadenitis is present*, suppuration will occur in most cases; so it is better to at once dissect out the whole glandular chain involved, together with the surrounding fat. In the neck, if the internal jugular vein is adherent to the glands, it should be ligatured and removed where adherent.

3. *When there is an unopened abscess*, excision can be done if the abscess is small; but if large it is better to open the abscess, drain it, and in a week or two dissect out the whole glandular area.

4. *When a sinus is present*, it is probably septic; so it is advisable to thoroughly scrape out the cavity and secure healing before undertaking excision of the mass of tuberculous glands: otherwise septic infection of a large wound will result.

Tumours of Lymphatic Glands.

The **Primary New Growths** are lymphadenoma and lympho-sarcoma.

Lymphadenoma is a condition in which new growths occur in lymphatic glands resembling normal lymphoid tissue. It is thought to be an infective disease, and occurs in two forms—the benign or localized, and the generalized or pseudo-leukæmic.

Benign or Localized Lymphadenoma usually affects young people, and occurs in the glands of the neck without leukæmic blood-changes. The glands are enlarged, without any tendency to adhere to one another, without pain or tenderness, and with no tendency to caseate or suppurate. The glands are firm, and when cut show a pink cortical portion with a grayish central area.

Treatment.—Arsenic pushed to full doses sometimes produces retrogression of the glands. If this fails, excision should be done.

Generalized Lymphadenoma, Pseudo-Leukæmia, or Hodgkin's Disease, is most common in adults, and is characterized by overgrowth of nearly all the lymphoid tissues of the body. Marked blood-changes occur, consisting of a great increase of leucocytes, with a diminution of the red corpuscles and of the hæmoglobin contained in them. The proportion of whites to reds rarely exceeds 1 to 40 or 50.

Lymphatic leukæmia is distinguished from pseudo-leukæmia by the character of the leucocytes. The glands and spleen enlarge slowly and painlessly, and the disease usually goes on to a fatal termination from exhaustion.

Treatment.—Arsenic is usually given, but treatment generally is hopeless.

Lympho-Sarcoma is most often seen in the tonsil, sometimes in the mediastinum. It forms a firm, rapidly-growing, painless tumour, which soon infiltrates surrounding structures, and gives rise to secondary growths in the nearest glands. If left alone, the skin becomes involved and fungates; dissemination to the viscera follows.

Treatment.—Removal of the primary and secondary growths where this is possible.

Secondary Growths in Lymphatic Glands are usually carcinomatous. In the sarcomata, gland affection is less common, except in lympho-sarcoma, sarcoma of the tonsil, testis, and thyroid.

CHAPTER XIII

THE SURGICAL AFFECTIONS OF NERVES

Injuries of Nerves.

THERE are three classes of injury · Compression, contusion, and division.

Compression of Nerves may be of such a degree as to interfere with their function. The part compressed may be either the trunk or the terminal filaments. The compression may be sudden or gradual, and either due to injury or pathological processes, such as aneurism or malignant growths : 1. **Rapid Traumatic Compression**, such as of the musculo-spiral from a drunkard sleeping with his arm over the back of a chair, is probably contusion of the nerve. Paralysis lasting for some time is produced. Fractures and dislocations produce the same effect. 2. **Gradual Traumatic Compression**, as in crutch palsy, is probably due to a slowly developing neuritis. 3. **Pathological Compression** of nerve trunks comes on slowly from contraction of scar tissue, from the pressure of callus or tumours. 4. Compression of terminal filaments occurs in cicatrices and malignant tumours of the skin.

Symptoms.—If the nerve is sensory, pain is first produced in the area supplied by the nerve, followed by numbness, hyperæsthesia, and finally anæsthesia. If a mixed nerve, the sensory disturbance is followed by paralysis of the muscles supplied. Trophic changes follow later.

Treatment consists in removing the compressing cause, and using electricity and massage for a prolonged period. It may be many months before recovery occurs.

Contusion or Rupture of Nerves.—Complete rupture is rare and as a rule only some of the fibres are torn. Blood is effused into the sheath, and disintegration of the injured nerve fibres follows. This injury usually results from fractures or dislocations.

Symptoms.—If a sensory nerve, anæsthesia ; if a motor

nerve, paralysis. If the contusion is slight, only tingling occurs, and not anæsthesia.

Treatment is the same as for compression.

Complete Division of Nerves.—Immediate effects are paralysis, anæsthesia, and vasomotor paralysis. The secondary effects are—

1. **Changes in the Nerve.**—On the proximal end is formed a bulb consisting of connective tissue and a large number of newly formed nerve fibrils coiled up in loops, which represent an attempt at regeneration of the nerve. In the distal end degeneration occurs; the myelin is broken up and converted into oil globules which are absorbed by the connective-tissue cells. The axis cylinders degenerate and disappear; the neurilemma cells multiply and form a fibro-cellular cord.

2. **Changes in the Muscles.**—Complete paralysis occurs at once, and atrophy follows. Deformity occurs from the unopposed action of muscles with opposite actions. Response to the Faradic current disappears in two or three weeks, while with the galvanic current the reaction of degeneration is evident. As long as there is any electrical response there is still hope of cure, but when response to galvanism is lost the case is hopeless.

3. **Sensation** is completely lost.

4. **Trophic Changes** occur. The part becomes blue and cold, with a shiny skin; injuries occur readily, because the normal protective sense of pain is lost; injuries are less readily repaired owing to the diminished vitality. Atrophy of the bones and ankylosis of joints may follow.

Changes that occur when Union takes place between the Divided Ends.—New axis cylinders are formed either by down-growth from the proximal end, or independently from the distal portion, with subsequent union to those of the proximal portion. Sensation is first restored, and then motion, the latter taking from several months to two years.

Treatment.—Only main and important nerves need be treated, and this should be by primary nerve suture. Asepsis is absolutely necessary for success. Fine catgut and a small round needle are the best means of obtaining union. Secondary nerve suture is done when a consider-

able time has elapsed since the injury. The nerve ends are freely exposed, the bulbs excised, and traction is made so that the ends come into apposition. The limb is then put up so that there is no tension on the stitches. If the ends cannot be brought together, the gap may be bridged either with an animal nerve graft or simply with strands of catgut. During the stage which precedes restoration of function, the nutrition of the muscles must be kept up by electricity and massage. Perfect return of power probably never occurs.

Nerve anastomosis has been used in cases of facial paralysis. The distal end of the facial is stitched into a slit in the hypoglossal, and in some cases motor power is said to return.

Neuritis.

Neuritis is either acute or chronic. Acute inflammation of nerves is generally due to a septic wound; in most cases neuritis is chronic.

Chronic Neuritis.—*Causes.*—1. Local: Injury, the presence of a foreign body, pressure, and the extension of inflammation. 2. General: Alcoholism, syphilis, gout, diabetes, and influenza.

Pathology.—There is an increase of the connective tissue in and around the nerve bundle, which contracts and causes atrophy and degeneration of the nerve fibres.

Symptoms.—Neuralgic pain is at first noticed, with hyperæsthesia of the skin and tingling. This is followed by anæsthesia, and perhaps trophic lesions. If a mixed nerve is affected, there is at first impaired motor power, followed by atrophy of muscles, and eventually paralysis.

Treatment.—The cause should be removed if possible, and the general health treated. Counter-irritation by blisters or the cautery, massage and galvanism. Morphia may have to be given for the pain. If these means fail, operative measures, such as acupuncture, nerve-stretching, neurotomy, or neurectomy, are necessary.

Neuralgia.

Neuralgia is a condition characterized by darting pain along the course of a nerve without any co-existing pathological changes in the nerve itself, whereas in neuritis these changes are always present. The attacks are paroxysmal, and last from a few minutes to some hours.

Causes.—Predisposing causes are anæmia and debility. Exciting causes may be inflammation or foreign bodies in the neighbourhood of the nerve, pressure, or disease of the spinal cord or brain.

Treatment consists in improving the general health and applying counter-irritants or sedatives. For the pain morphia may have to be given. Antipyrin and phenacetin sometimes do good. Gout, rheumatism, or syphilis should be treated if there is any history. If this medical treatment fails, the operations of neurotomy or neurectomy are necessary.

Neurotomy consists in dividing the nerve above the seat of pain, but, as union quickly occurs, it is not of such use as **neurectomy**, in which portion of the nerve is removed. In many cases there is a central origin for the pain, so that ganglia, such as the Gasserian, have to be removed eventually; or if spinal, the posterior root and ganglion on it are removed.

Affections of Special Nerves.

1. **The Cranial Nerves.**—The **Olfactory Nerve** may be torn in fracture of the cribriform plate, producing loss of smell.

The **Optic Nerve** may be ruptured in fracture of the base of the skull, producing blindness; it may be compressed by blood, exudation, gummata, aneurisms, or tumours, producing optic neuritis at first, and, if the pressure is not relieved, blindness.

The **Third Nerve** may be injured by central lesions, such as gumma, or peripheral lesions, such as aneurism, tumour, or trauma anywhere in its course. Paralysis of all the muscles supplied occurs, and so there is ptosis, external squint, dilatation of the pupil, and loss of accom-

modation. Most cases, except those of traumatic origin, are syphilitic, so the treatment is iodide of potassium and mercury.

Paralysis of the **Fourth Nerve** causes defective movement downwards and outwards.

The Fifth Nerve. — Trigeminal neuralgia, or tic-douloureux, is characterized by paroxysmal attacks of violent pain, beginning as a rule in the infra-orbital or inferior dental branches, and radiating to all the branches. Hyperæmia of one side of the face and lachrymation are accompaniments. The patient's condition becomes one of nearly constant agony when the attacks are frequent.

Causes.—In the milder cases dental caries is a common cause ; other causes are pressure on the root or trunk of the nerve or changes in the Gasserian ganglion.

Treatment.—The teeth and general health should be attended to, especially if syphilis, gout, malaria, etc., be present ; remedies like croton-chloral given for the pain. If these fail, neurectomy must be done in whatever trunk is affected. The supra-orbital and supratrochlear branches are easily attacked. The infra-orbital should be divided behind Meckel's ganglion and at its emergence at the infra-orbital foramen, and extracted from the pterygo-maxillary fissure. The lingual can be divided in the mouth, and the inferior dental by trephining the lower jaw for half its thickness. In the very severe cases, after portion of one branch has been removed, pain occurs in another branch, so that eventually the Gasserian ganglion has to be removed. As this is a severe and dangerous proceeding, thorough neurectomy should first be tried.

The **Sixth Nerve** may be ruptured by injuries and cause internal squint.

The **Seventh** or **Facial Nerve** may be paralyzed from —(1) Intracranial lesions. If the lesion is a supranuclear one—*i.e.*, in the cortex, corona radiata, or internal capsule —it is usually associated with hemiplegia, and the orbicularis palpebrarum escapes, as its nerve fibres come from the third nerve nucleus. If the lesion is an infra-nuclear one—*i.e.*, between the nucleus and the internal auditory meatus—the whole side of the face is paralyzed

without hemiplegia. (2) Cranial lesions. There are two common causes—(*a*) Fracture of the base of the skull through the petrous bone tearing the facial nerve across, or pressure from callus two or three weeks later; (*b*) sclerosing osteitis in chronic otitis media. Paralysis is complete, as the lesions are infranuclear. (3) Extra-cranial lesions—*e.g.*, exposure to cold (Bell's paralysis), injury, and the pressure of tumours.

Signs of facial paralysis are: smoothing out of all the folds and wrinkles of the paralyzed side, with loss of power in the muscles; epiphora from drooping of the lower lid, and paralysis of the tensor tarsi. There is marked asymmetry when the muscles of the other side are put into action, and whistling is impossible.

Treatment.—Massage and electricity, with mercury and iodide of potassium. If any obvious cause can be removed, it should be operated upon.

Facial Tic consists of clonic spasm of some or all of the facial muscles, due to a lesion in the nucleus or cortex. If not relieved by nerve tonics, nerve-stretching or neurotomy may be tried.

The **Auditory Nerve** may be divided in fractured base, and cause deafness.

The **Pneumogastric Nerve** may be injured in fractured base, in operations about the neck, or by pressure of aneurisms in the thorax. One-sided injury causes paralysis of one side of the larynx. If both are divided, death speedily occurs from laryngeal paralysis or œdema of the lungs.

The **Spinal Accessory Nerve** may be injured in fractured base or operations in the neck. Clonic spasm of the sterno-mastoid and trapezius (spasmodic torticollis) is due to central changes, and may require neurectomy.

The **Hypoglossal Nerve** may be divided in operations or injured by the pressure of an external carotid aneurism. Paralysis or weakness of one side of the tongue is the result.

2. **The Spinal Nerves.**—Injuries of the **Cervical Nerves** are not dangerous, except in the case of the phrenic, where division may cause death from paralysis of half the diaphragm.

The **Brachial Plexus** may be injured by blows, falls on the shoulder, dislocations of the cervical spine, and shoulder, or big wounds.

Paralysis of the muscles supplied, and anæsthesia of the skin, according to which nerves are injured, follow.

Treatment.—Occasionally it is possible to cut down and unite a divided cord of the plexus with success, but they are generally not hopeful cases.

The **Circumflex Nerve** is often injured in dislocations of the shoulder and fracture of the surgical neck of the humerus. Paralysis and wasting of the deltoid follow.

The **Musculo-Spiral Nerve** is most often injured by pressure against the back of a chair during drunken sleep. It may be injured in fractures of the shaft of the humerus, or compressed by callus during union.

Symptoms of complete division are 'wrist-drop,' from paralysis of the extensor group of the forearm ; paralysis of the triceps ; and anæsthesia of the outer side of the forearm and back of the thumb, index, middle, and radial side of the ring fingers, and radial half of the back of the hand.

Treatment.—If division is certain, the nerve should be sutured ; if not, massage and electricity should be used.

The **Median Nerve** may be injured in any part of its course, but frequently just above the wrist, by the bursting of bottles. Paralysis of all the muscles whose nerve-supply comes off below the point of division, and anæsthesia of the outer three and a half fingers on their palmar aspect, follow. The patient is unable to oppose the thumb to the little finger.

Treatment.—Primary suture is always necessary. Secondary suture is worth trying in cases which have not been treated by primary suture, or where this has failed.

The **Ulnar Nerve** is often injured at the wrist. Anæsthesia of the front and back of the little finger and ulnar half of the ring finger, and paralysis of all the palmar muscles to the inner side of the flexor longus pollicis tendons, except the outer two lumbricals, follow. The patient is unable to spread out his fingers from one another, and the hand becomes clawlike. The anæsthesia and paralysis vary according to the site of division.

Treatment.—Primary or secondary suture.

The **Great Sciatic Nerve** is often the seat of neuralgia (sciatica).

Causes.—(1) Inflammation from gout, syphilis, cold, or injury; (2) pressure by aneurisms or new growths either in the pelvis or in its extrapelvic course; (3) pressure in the spinal canal on the nerve roots from caries or new growth; (4) locomotor ataxy.

Symptoms.—Paroxysmal pain along the course of the nerve and its terminal branches, and the limb is kept slightly flexed.

Treatment.—The general health must be treated, and any cause which can be found removed. Electrical treatment, blisters, cautery, and sedatives locally, and morphia internally, should be tried. If these fail, the nerve should be stretched by flexing the thigh upon the abdomen, and then extending the leg; or by operation. The nerve should be exposed where it comes out from under the gluteus maximus; the fingers should then be hooked under it, and the nerve pulled firmly both proximally and distally.

The **External Popliteal Nerve** may be divided in operations or injuries. Anæsthesia of the dorsum of the foot with paralysis of the extensor and peroneal group follow. Talipes equino-varus results from the overaction of opposing muscles.

The **Internal Popliteal Nerve** is seldom divided. Anæsthesia of the sole and paralysis of the flexor group of the ankle and toes follow, and talipes calcaneo-valgus is the result.

The **Sympathetic Nerve Trunk** may be compressed in the neck by aneurisms or tumours. If irritated, sweating of the head and face on that side is produced, with dilatation of the pupil. If divided, the pupil is contracted, and there is ptosis, which can be overcome by voluntary action.

CHAPTER XIV

SURGICAL DISEASES OF THE SKIN AND CUTANEOUS APPENDAGES

A Boil or **Furuncle** is a localized inflammation, beginning in a hair follicle and resulting in a limited slough. Staphylococci are the common cause.

Signs.—A small red pimple begins around a hair, and rapidly increases in size, accompanied by great pain and tenderness. A whitish spot appears at the apex, and soon it bursts and discharges pus and a tiny slough, with consequent relief to the pain. Healing occurs by granulation. The neighbouring lymphatic glands are generally enlarged and painful, but do not suppurate.

Treatment.—The boils should be incised when pus is formed, and an antiseptic dressing applied. The general health often requires treatment by fresh air, sunshine, and tonics. Inoculation with killed staphylococci to raise the opsonic index is very successful in those cases in which crops of boils defy ordinary treatment.

A **Carbuncle** is a localized inflammation of the subcutaneous tissue, which goes on to sloughing, and is of a more extensive character than a boil. Staphylococci are the common exciting cause, while the predisposing causes are lowered vitality from diabetes, albuminuria, or after infective fevers. Inoculation is by auto-infection or directly from the surface.

Signs.—The disease begins as an infiltration of a patch of subcutaneous tissue, which is hard, painful and tender, and the skin over it red and hot. The infiltration may extend till it is the size of a dinner-plate, and the inflammation ends in sloughing and suppuration, not only of the subcutaneous tissues, but of small areas of the skin over it, so that openings develop in the skin, and allow of the exit of pus and sloughs. The openings extend, the sloughs separate, and the wound heals by granulation. The back is a common situation. Sometimes the face is affected, and there is then a danger of thrombosis extending to the cavernous sinus and producing pyæmia.

Toxæmia is usually very marked. Septicæmia and pyæmia rarely occur.

Diagnosis.—From Boils: By the facts that they involve the subcutaneous tissue primarily; they are single, while boils are often multiple; and they are much larger than boils.

From Gummata: Gummata are not very painful, are often multiple, have a sharply-cut edge and rounded outline when broken down, and other signs of syphilis may be present.

The *Prognosis* is serious if there is albuminuria or diabetes, or if the carbuncle is on the face.

Treatment is very satisfactory if properly carried out. An anæsthetic should be given, the slough thoroughly scraped away, the surface left treated with pure carbolic acid and dressed with antiseptic gauze. The patient should be fed on eggs, milk, cream, meat-juice, and brandy. Codeia is necessary in diabetics.

A **Corn** consists of hypertrophied layers of the epidermis surrounding a central hard, horny plug, which compresses and causes atrophy of the papillæ of the dermis. Abnormal pressure by badly-fitting boots is the usual cause. Corns are hard unless situated in moist situations, as between the toes.

Treatment.—Relieve the pressure, pare down the corn, and then paint it with salicylic acid, 30 grains to the ounce of collodion, night and morning.

Perforating Ulcer of the Foot is due to some persistent slight injury, such as tight boots or pressure, which is not felt owing to anæsthesia. It occurs, therefore, in—(1) tabes dorsalis, spina bifida, syringomyelia; (2) in peripheral neuritis from diabetes, alcoholism, syphilis; (3) after traumatic affections of sensory nerves. Any spot may be affected, but the usual situation is under the head of the first metatarsal bone. A deep septic ulcer is formed, surrounded by thickened epidermis, and may extend to the bones or joints. With antiseptic treatment and removal of pressure healing soon occurs.

Tuberculous Disease of the Skin.—Lupus begins in children and young adults. Its common situation is about the nose and cheeks, but it may affect the trunk and limbs. The mucous membrane of the nose and mouth are only affected by extension from the skin.

Signs.—Lupus begins with infiltration and hyperæmia

of the deeper layers of the skin. Shotty, brownish-yellow nodules make their appearance. As the disease extends, the infiltrated areas become converted into granulation tissue, and ulceration frequently is produced. Healing is often occurring at one place, spreading at another. The nodular character of the edges of a lupoid ulcer and of the surrounding infiltrated tissues is distinctive. The disease is generally painless and very chronic, and tends sooner or later to natural cure. It may extend from the skin, and destroy either cartilage or bone.

Microscopically, typical tubercles can be seen, but bacilli are few.

Diagnosis.—The diagnosis of lupus from tertiary syphilis of the skin is made by observing the nodular characters of the edge of the ulcer and surrounding tissues and the thin character of cicatrized parts. Syphilis is much more rapidly destructive. Lupus seldom begins after thirty. Rodent ulcer and epithelioma begin late in life, and have not a nodular character, and never heal in one part while spreading is going on in another.

Treatment.—Complete excision where this is possible, with subsequent Thiersch grafting. In other cases free scraping, with subsequent use of caustics, such as nitric acid or the cautery. Better results are obtained by frequent exposure to the Finsen or Röntgen rays.

Lupus Erythematosus is not tuberculous. Symmetrical patches of hyperæmia appear on the cheeks and nose, with a desquamating surface, the scales being of dried sebaceous matter. The parts first affected become pale from conversion into cicatricial tissue without ulceration, while the spreading margin is hyperæmic. It is a chronic affection confined to adults, and is more frequent in women than in men.

Treatment.—Improve the general health and apply ung. hydrarg. ammon. The Röntgen rays and Finsen light are useful.

Tuberculous Ulcers result from the breaking down of subcutaneous or submucous tuberculous foci. They are characterized by thin, ragged, undermined edges.

Treatment.—Excision of the ulcer or free scraping and paring of the undermined edges.

Affections of the Nails.

Onychia is due to infection of the nail matrix with pyogenic organisms. Suppuration occurs under and loosens the nail, and is accompanied by severe throbbing pain. The nail must be removed over the region affected, the granulation tissue scraped away, and antiseptic fomentations applied.

Ingrowing Toenail is not due to ingrowth, but to ulceration of the soft part, which curls over the edge of the nail of the big toe owing to the pressure of tight boots. Septic infection increases the trouble, and onychia may result. In the early stages cure may be brought about simply by cleanliness and square-toed boots. In other cases, half of the nail should be removed as well as the soft tissues which have been overhanging the nail.

Affections of the Sebaceous Glands.

Sebaceous Cysts are due to obstruction of the ducts of sebaceous glands, and, though common on the scalp, may occur on any part of the skin. They form rounded, elastic swellings, movable on the deep structures, and always adherent to the skin at one spot. Often the mouth of the follicle can be seen and sebaceous matter squeezed out. The cyst wall consists of fibro-cicatricial tissue lined by epithelium. The contents are sebaceous matter. If the contents slowly ooze out and dry on the surface, a sebaceous horn may be formed. Suppuration sometimes occurs in sebaceous cysts, and if a septic ulcer is left it may be mistaken for epithelioma.

Diagnosis.—From a chronic abscess by its long history, and by the presence of the mouth of the follicle. From a dermoid by its not being congenital, and that a dermoid is limited to certain localities and not often attached to the skin. A lipoma is lobulated, more movable, more solid, and may not be adherent to the skin.

Treatment.—Sebaceous cysts, if large or giving trouble, should be dissected out. This is simplified by emptying them and then removing the sac.

Molluscum Contagiosum.—Small firm, umbilicated nodules appear on the skin, usually of the face. The disease is apparently contagious. The nodules consist of wedge-shaped lobules of polygonal nucleated epithelial cells supported by a fibrous stroma. The cells towards the centre undergo hyaline degeneration and contain rounded bodies resembling psorosperms. Treatment consists of snipping off the nodules.

CHAPTER XV

DISEASES OF MUSCLES, TENDONS, AND BURSÆ

Injuries of Muscles and Tendons.

Contusion of Muscles leads to extravasation of blood amongst the fibres and pain on active movement. The treatment is rest for a few days, massage, and passive movements. Tearing of muscle fibres due to violent efforts produces the same effects.

Rupture of the Sheath occurs occasionally in the biceps cubitis, or rectus femoris. A hernia of the muscle through the hole in the sheath occurs during contraction. Treatment consists of relaxing the muscle and keeping it at rest till the gap is healed. In old cases the hole should be sutured.

Displacement of Tendons from their osseo-fibrous canals occurs rarely—*e.g.*, that of the peronei as they pass under the external malleolus. Sudden pain is felt during some exertion, movement is impaired afterwards, and the tendon may be felt out of its place. If the tendon is relaxed and replaced, and the part kept at rest, the fibrous sheath unites, but recurrence occasionally happens. It is then necessary to expose the sheath and stitch it.

Rupture of Muscles and Tendons may occur from sudden excessive violent action.

Signs.—The patient feels a localized pain, as if struck by a stone. Inability to use the muscle, extravasation of blood, and swelling, occur. If a muscle has been torn, a

gap can be felt when the muscle is put into action ; if the tendon has been torn off, the muscle can be felt as a rounded tumour when it contracts.

Repair takes place by fibro-cicatricial tissue, which in time may be replaced by true muscle tissue.

Treatment.—The parts must be relaxed to bring the divided ends of muscle or tendon into apposition, and kept so for three weeks.

Passive movements and massage then remove the stiffness. Tendons or muscles divided in open wounds should be stitched. If a gap occurs owing to loss of substance, it may be bridged by turning down a flap of tendon from one end, and stitching it to the other.

Diseases of Muscles.

Inflammation of Muscles.—Simple Traumatic Myositis is the reaction of the muscle after contusion or laceration, and ends in the production of fibro-cicatricial tissue.

'Rheumatic' Myositis may result from exposure to cold, and is treated by dry heat and massage.

Acute Suppurative Myositis is due to infection from wounds, auto-infection in pyæmia, or extension from abscesses in the neighbourhood. Deformity may follow from contraction of the cicatrix.

Chronic Tuberculous Myositis is due to an abscess spreading into a muscle, a common example being psoas abscess.

Gummata occur in muscle, especially in those of the tongue and sterno-mastoid. Gummata are painless, grow slowly, may be multiple, are hard at first, and soften subsequently. They have to be distinguished from sarcoma of muscle by their rapid disappearance under treatment by iodide of potassium and mercury.

Myositis Ossificans is rare, and consists of ossification of the connective tissue of muscles, with atrophy of the muscle fibres. Extensive ankylosis is produced when the bony plates are well developed. Often the proximal phalanx of the great toe is congenitally absent. Treatment is useless, and death occurs from difficulty in breathing producing repeated bronchitis and bronchopneumonia.

Tumours of Muscles.—Primary growths are rare, and consist of angioma, lipoma, myxoma and sarcoma. Tumours of muscle are usually secondary, and result either from direct extension or dissemination. Treatment consists of shelling out simple tumours, removing the whole muscle if malignant.

Diseases of Tendon Sheaths.

Inflammation of the synovial lining of tendon sheaths is due to either injury or infection.

1. **Acute Simple Teno-Synovitis** is due to strain or overuse. Pain and fine crepitus on movement are the distinctive signs. Dense and troublesome adhesions may be formed in cases of severe injury, especially when associated with fractures about the ankle. Rest and hot fomentations form the early treatment, and massage the later.

2. **Acute Suppurative Teno-Synovitis** is due to infection through wounds or from suppuration of neighbouring tissues. If not incised early the tendon sloughs, and the suppuration may spread to neighbouring bones and joints. In any case firm adhesions occur which impair movement.

3. **Chronic Simple Teno-Synovitis** is characterized by effusion into the sheath without pain, and is common in the hand. The sac should be opened, washed out, and stitched up. If fluid collects again, antiseptic drainage should be resorted to for about fourteen days.

4. **Chronic Tuberculous Teno-Synovitis** is met with in two forms, in one of which the wall is lined with pulpy granulation tissue, with caseous foci in it, and free fluid, so that a fluctuating, painless swelling is formed. In the other kind melon-seed bodies consisting of fibrin, together with fluid, are present, and distinguished by the presence of a curious crepitus.

Treatment consists of immobilizing the part and applying pressure. Usually this fails. Incision and drainage may cure the condition; if not, the diseased tissue must be dissected out.

A **Ganglion** is a sac containing a glairy fluid, whose wall is in connection with and resembles the structure of

a tendon sheaf. It appears as a firm elastic swelling, which is due to a hernia of the synovial membrane through the sheath, or to a dilatation of crypts in the synovial membrane. Some are in connection with the wrist-joints, like Baker's cysts.

Treatment.—Forcible rupture sometimes cures the condition, so does puncture; but the best treatment is excision of the sac.

A **Compound Palmar Ganglion** is a chronic teno-synovitis of the common palmar sheath, and usually tuberculous in origin. It forms a fluctuating swelling, which is felt above and below the annular ligament, and extends along the sheath of the flexor longus pollicis tendon. Rest and pressure may be tried at first, but if this fails incision and drainage should be resorted to. Finally, division of the annular ligament, with complete removal of the synovial sheath, may have to be performed, but stiffness from adhesion of the tendons will probably remain.

Operations on Tendons.

Tenotomy, or the division of tendons, may be done by an open wound or subcutaneously, to remedy deformities or to do away with the contraction of a muscle which keeps up the displacement of a fracture. Strict asepsis is necessary. A sharp tenotomy knife is passed down to the tendon, then a blunt-ended one is introduced through the same hole, and, while an assistant keeps the tendon taut, division is performed. The open method is the better if there is any danger of dividing important structures.

The tendo Achillis is divided from the inner side 1 inch above its insertion. The tibialis anticus is divided an inch above its insertion, where it lies on the scaphoid; the tibialis posticus just above the base of the internal malleolus; the peronei tendons just above the base of the outer malleolus. The biceps cruris is divided by the open method to prevent injury to the external popliteal nerve, which lies just to its inner side. The sterno-mastoid is divided by the open method, to prevent division of the anterior jugular vein.

Lengthening a tendon may be done by turning down a flap from one end after division, or by making a Z-shaped incision, and sliding the flaps a certain distance and then suturing them.

Shortening a tendon may also be done by the Z-shaped incision.

Tenoplasty consists of stitching the tendon of a healthy muscle to the tendon of a paralyzed one—*e.g.*, that of the peroneus longus to the tendo Achillis in paralytic talipes calcaneus.

Diseases of Bursæ.

Bursæ are present normally over bones where they are exposed to pressure. Adventitious bursæ are those developed over bones where normally no pressure occurs, but, owing to occupation or deformity, they are subject to constant pressure.

Wounds of bursæ must be scrupulously cleansed to prevent septic infection.

Bursitis.—Bursitis may be acute or chronic.

Acute Bursitis may be simple or suppurative. Simple bursitis is due to contusion, especially in gouty and rheumatic people. Effusion of serous fluid into the sac, together with pain, tenderness, and increased heat, are the signs. Treatment consists of rest and fomentations, and, if these fail, excision of the bursal sac.

Acute Suppurative Bursitis is due to a wound or to auto-infection of a chronically inflamed bursa. All the signs of an abscess are present, and the pus may spread beyond the bursa itself. Treatment consists of free incision and drainage.

Chronic Bursitis may follow the acute form, or be chronic from the beginning. The usual cause is repeated slight injuries, such as by kneeling on the prepatellar bursa. In the early stages the cavity is merely distended with fluid, but lymph becomes deposited on the walls, till they may be very thick. Adhesions may form across the cavity, so that it becomes reticulated. 'Melon-seed' bodies may be formed if flakes of lymph become detached.

Treatment.—It is best to excise the bursa completely.

If this is declined, rest and counter-irritation should be tried.

Tuberculous Bursitis is of two forms, in one of which there is a thickening of the walls by deposit of lymph and effusion containing 'melon-seed' bodies; in the other there is pulpy, caseous granulation tissue lining the sac and ending in the formation of a chronic tuberculous abscess. These may or may not be secondary to tuberculous disease of a joint. Treatment consists of excision if possible; if not, free incision, scraping with a flushing spoon, and subsequent stitching up.

Syphilitic Bursitis occurs in the secondary stage; in the tertiary stage a gummatous deposit may occur.

Tumours are rare. Sarcoma and myxoma may occur, and should be completely removed.

The special bursæ which are commonly affected with chronic inflammation are—1. The prepatellar, which lies over the lower half of the patella and upper part of the ligamentum patellæ. 2. The bursa which lies between the ligamentum patellæ and the tubercle of the tibia, and projects when distended on either side of the ligament during extension of the leg. 3. The semi-membranosus bursa, which projects into the popliteal space from under the semi-membranosus tendon, and is tense during extension, flaccid on flexion of the leg. It may communicate with the joint. Others are the semi-tendinosus bursa, the tendo Achillis bursa, the psoas, the gluteal—which is situated between the insertion of the gluteus maximus and great trochanter—the bursa over the tuber ischii, the bursa over the olecranon, and the subdeltoid bursa.

CHAPTER XVI

DEFORMITIES

Torticollis, or wry-neck, is a deformity produced by an affection of the sterno-mastoid mainly, and sometimes of the other cervical muscles, in which contraction occurs, which may be constant or spasmodic. The head is drawn

down towards the shoulder, and the face is turned towards the sound side. The condition may be acute, permanent, or spasmodic.

Acute Torticollis is due to cold, producing the ordinary stiff neck, or is secondary to inflamed glands lying under the sterno-mastoid or to caries of the cervical spine.

Congenital Torticollis is present at, or more often appears soon after, birth. In the former case it is caused by developmental arrest, and is accompanied by asymmetry of the face; in the latter case it is due to partial rupture of the sterno-mastoid during delivery, and subsequent cicatricial contraction.

Treatment.—The sterno-mastoid and its sheath must be divided, and an open incision is absolutely necessary to do it safely and effectually. The best point for division is ½ inch above the clavicle. The position of the head should then be rectified and fixed by plaster of Paris over the dressings. In ten days voluntary movements and massage can be begun. In bad cases some apparatus has to be worn for a time, and the best is a band around the forehead, with a rubber cord running down from the mastoid process on the sound side to be attached to the front of a band running round the upper part of the chest.

Spasmodic Torticollis is marked by clonic spasms of the sterno-mastoid, and sometimes of the other cervical muscles, especially those in the suboccipital triangle. The pathology is unknown, and the prognosis is unfavourable, as extension to other parts follows cure by operation of the first part affected.

Treatment.—Medicinal: Bromides and chloral and the galvanic current are the most likely to be of use.

Operative treatment consists of neurectomy of the spinal accessory nerve. If the posterior muscles are affected, resection of the posterior cervical nerves (first, second, and third) must follow.

A Cervical Rib is occasionally met with running from the transverse process of the sixth or seventh cervical vertebra to the scalene tubercle on the first rib. No symptoms are produced unless by its growth it lifts up and compresses the brachial plexus and subclavian artery, producing neuralgia, weakness, paralysis, or gangrene, in

the arm. If causing symptoms it should be excised; but great care should be exercised to avoid wounding the pleura, which lies just below it.

Deformities of the Spine.

Scoliosis.—By true scoliosis is meant lateral curvature of the spine with rotation of the vertebræ.

Causes.—The most essential factor is the transmission of the weight of the upper part of the body through the vertebral column, which, by the weakness of its muscles or by the habitual maintenance of a faulty position, has allowed a lateral deviation to occur. There are four main classes :

1. Cases due to inequality in length of the supports of the spine. The pelvis is tilted, and the curve is a compensatory one. Such cases are due to hip disease, congenital dislocation of the hip, contractions of the knee, etc.

2. Cases produced by inequality of the weight borne on the two sides of the spine, when the muscular system is weak or the weight is excessive—*e.g.*, a nursemaid carrying a heavy child.

3. Cases due primarily to weakness of the spinal muscles, aided by the habitual assumption of a faulty position. The majority of cases are due to this cause, and occur in girls of twelve to seventeen years of age.

4. Cases in which the deformity is secondary to other affections of the spine or thorax, and of mechanical origin—*e.g.*, where it is secondary to empyema, rickets, or caries of the spine.

Pathological Changes.—The ligaments become stretched on the convexity of the curve, and shortened on the concavity. In advanced cases the vertebral bodies become wedge-shaped, the base being directed towards the convexity. There is often a secondary or compensatory curve in addition to the primary one. The vertebral bodies are rotated to the convexity, the spines to the concavity, so that the ribs are thrown backwards on the convex side and forwards on the concave. The scapula on the convex side is higher and more prominent than its fellow, and this is popularly called 'growing out of the

shoulder.' The ribs are widely separated on the convex side and crowded together on the concave. Neuralgic pain and weakness are present.

Examination.—The patient should be stripped to the waist and the spinous processes examined by marking each with a pencil. Obliquity of the pelvis should be looked for, and also flat-foot and knock-knee. It should then be noted whether the curve can be obliterated by standing as straight as possible or by hanging from a trapeze or bar.

Prognosis.—If the curve is obliterated by suspension, it can be cured; if only partially obliterated, no complete cure can be obtained, though the trouble may be arrested. The large single curve is of worse import than the double.

Treatment.—The cause must always be treated—*e.g.*, a high boot for a short leg, the removal of weight-carrying, the correction of a habitually faulty position. The general health must be treated by fresh air, good food, and tonics. Massage and exercises of the spinal muscles, with avoidance of fatigue, are very important. Rest in the recumbent position for two hours a day is necessary. Various forms of spinal support should be used only in bad cases and those progressing in spite of treatment, and only worn at intervals during the day. In cases in which the curve cannot be diminished by suspension, a poroplastic jacket is of most use.

Kyphosis is a condition of increased dorsal convexity of the spine. In infancy, and associated with muscular weakness and rickets, it is often temporary, but in bad cases the curvature may persist. The absence of rigidity and tenderness on pressure distinguish it from spinal caries. Kyphosis in later life is due to habitual stooping for reading or writing or other form of occupation. Senile kyphosis is due to atrophy of the intervertebral discs.

Kyphosis may complicate general diseases, such as osteo-arthritis, osteomalacia, osteitis deformans, and acromegaly.

Treatment of the general health is the only hope. Habitual faulty position should be remedied or prevented in young people by making them use proper desks and chairs. The erector spinæ must be exercised and massaged; fatigue must be prevented.

Lordosis is increase forwards of the lumbar curve, and is brought about to compensate for flexion of the thigh, either from hip disease or congenital dislocation of the hip.

Spondylolisthesis is a rare condition, in which the lumbar vertebræ slip downwards and forwards over the sacrum, either from fracture of the articular processes of the lumbo-sacral joint or from imperfect development of the laminæ or pedicles of the last lumbar vertebra. The weight of a pregnant uterus brings about the displacement. The stature is shortened, and there is a marked hollow over the top of the sacrum. Treatment consists of prolonged rest in bed, and then allowing the patient to get up with a leather jacket which has axillary crutches to take off the weight of the upper part of the body.

Deformities of the Upper Extremity.

Sprengel's Shoulder, or congenital elevation of the scapula, is a condition in which this bone, usually smaller in size than the other one, and rotated so that its lower angle is nearer the mid-line, is also situated higher than its proper position. The serratus magnus and lower third of the trapezius are often defective, and the whole arm on that side may be smaller. The condition is a congenital one, and its cause is not known, but it bears a resemblance to the conditions left after infantile paralysis. As a rule it causes little disability and needs no treatment.

Club-Hand is most often due to congenital absence of the radius. The hand is pushed over to the radial side, and the lower end of the ulna is expanded to articulate with the wrist bones.

Congenital Deformities of Fingers (or Toes).—Polydactylism consists in the presence of supernumerary fingers or toes. Treatment consists in removing the digits which give trouble or are unsightly. Occasionally there is congenital absence of one or more digits.

Macrodactyly is due to congenital overgrowth of a finger or toe. Amputation may be necessary.

Syndactylism, or webbed fingers or toes, need not be treated if in the foot, but in the hand this is usually necessary. In operations for this condition, unless the

angle at the base of the fingers is covered with a flap of skin, so that healing by first intention occurs, the fingers join up again. If the web is thin, mere division will suffice; if thick, two flaps must be raised—one from the front and one from the back—and each is then stitched to the finger to which its base is attached.

Snap-Finger is a condition in which one finger remains flexed when the patient opens his hand, and when he extends it with the other hand it flies open with a jerk. A ganglion or an increase in the size of the sesamoid bones is the usual cause, and it can easily be removed by an incision.

A **Mallet Finger** is one in which the terminal phalanx remains flexed, owing to separation of the insertion of the extensor tendon into the bone. To remedy this the tendon should be isolated and stitched to the periosteum.

Acquired Deformities of the Hand occur after burns. The cicatrix contracts and produces hopeless deformity.

Dupuytren's Contraction, or contraction of the digital processes of the palmar fascia, is met with in middle-aged gouty people, and is commonly hereditary. People whose work produces pressure in the palm are more liable. It is due to a chronic inflammatory change, which brings about contraction, usually commencing in the ring finger and spreading to the little finger. The fingers are eventually drawn down into the palm, and extension becomes impossible. The skin becomes involved in the contraction and is attached to the fascia. The condition is easily diagnosed from contraction of the flexor tendons by the fact that attempting to straighten the fingers does not produce tension of the tendons above the wrist.

Treatment.—Subcutaneous division of the bands by a tenotome, with subsequent fixation in the straight position, is unsatisfactory, in that relapse soon occurs. Excision of the whole of the affected fascia and skin, with skin-grafting of the raw surface left if the skin cannot be united, gives better results, but permanent cure cannot be guaranteed.

Deformities of the Lower Extremity.

Coxa Vara is a condition in which the neck of the femur is horizontal, or even directed downwards, and usually backwards. It is met with at two ages : in infants of three or four years of age, and due to rickets; in adolescents of thirteen to eighteen years, who have to stand much or carry heavy weights. Separation of the epiphysis from injury is a cause in some cases. The neck is bowed forwards, and the trochanter is thrown backwards, so that the leg is everted.

Symptoms begin with some pain in the hip and limping. The trochanter is raised above Nélaton's line, and there is marked rotation outwards of the limb. True shortening is present. The movement of external rotation is increased ; flexion, abduction, and internal rotation are diminished, as the trochanter is stopped by the rim of the acetabulum. There is no swelling or tenderness, as in hip disease, or sliding of the head of the bone, as in congenital dislocation. Skiagraphy clears up any doubt about the diagnosis.

Treatment.—1. In young children the abnormal curve may be rectified by extension. If this fails, the femur should be divided below the great trochanter, and fixed in a corrected position.

2. In young adults the progress of the deformity should be prevented by rest, extension, good feeding, and tonics, with operation after the bones have become consolidated. The best operation is to take a wedge with its base upwards from the neck of the femur, then correct the malposition, and put the limb in plaster of Paris for six weeks.

Genu Valgum, or knock-knee, is a condition in which the leg is deflected outwards to form an angle with the thigh smaller than normal. It may be single, but is usually double, and occurs either in young children or in adolescents. The genu valgum of children is due to rickets. The softened part of the diaphyses close to the epiphyses bend at the lower end of the femur and upper part of the tibia. This produces an appearance of increased growth downwards of the internal condyle. The genu valgum of adolescents is due to softness of the

bone, and bending because of weight carrying or prolonged standing. Flat-foot is a frequent accompaniment, and may be an exciting cause. If genu valgum is one-sided, scoliosis may be present as a compensating change. Genu valgum may also be produced by injury or disease of the epiphysis, which prevents growth from the outer part; by fracture in the lower third of the femur or upper third of the tibia. It may follow rupture of the internal lateral ligament of the knee or excision of the knee-joint.

Signs.—The inner condyle is prominent, and extends further down than the outer. On flexion the deflection disappears. The malleoli are wide apart when the patellæ look forwards, but come together when the legs are flexed. The patella may be thrown outwards so much that dislocation is produced.

Treatment.—In children the rickets must be treated. Rest in bed, massage, and manipulation, will usually remedy the deformity. When the malleoli are separated less than 4 inches manipulation will be sufficient. If over 6 inches apart operation is necessary. If the child cannot be kept off its feet, use a Thomas's hip-splint, with an outside bar reaching from the pelvis to beyond the foot, so that a pull can be obtained by fixing the knee to the outside bar with elastic webbing. Treatment must be persisted in till the active stage of rickets has passed off—*i.e.*, till the child is four or five years of age. If after the age of four or five there is still a separation of more than 3 inches, osteotomy should be done, as mechanical treatment is then unsatisfactory.

In young adults mechanical means are expensive, and generally useless, while operation is satisfactory.

Osteotomy is usually done by Macewen's method. Macewen makes an incision ½ inch in front of the adductor magnus tendon, and a finger's-breadth above the superior tip of the external condyle. An osteotome is introduced, and the bone cut through for three-quarters of its diameter. The remainder is broken by bending. The bone may also be divided by a saw either from the inner or outer side. The limb, having been straightened, is put up either on a long Liston or Gooch's splint, or in plaster. An immovable apparatus should be kept on for three months to prevent subsequent bending. In some

cases it may be necessary also to divide the tibia to straighten the limb.

Genu Varum, or bow-leg, is due to bending from rickets in the opposite direction to genu valgum, and the treatment is similar.

Genu Recurvatum is hyperextension of the knee-joint, and is due to congenital displacement or to irregular growth from disease affecting portion of the epiphysial line.

Contractions of the Knee arise from intra- or extra-articular causes. **Extra-articular** causes are—(1) contraction of cicatrices in the flexure of the joint; (2) contraction of the flexor muscles, from suppuration in their bellies, from infantile paralysis of the extensors, or secondarily to disease in the joint; (3) hysterical contraction, in which physical signs of disease are absent, but hyperæsthesia is a marked feature. Under general anæsthesia, or when the patient's attention is distracted, the joint can be moved quite freely.

The **Articular** causes are—(1) gonorrhœal inflammation of the capsule and ligaments; (2) fibrous adhesions between the joint surfaces following acute synovitis, tuberculous or acute arthritis; (3) osseous ankylosis following tuberculous or acute arthritis: in these cases the limb may be straight or flexed, or in the position of triple displacement, in which the tibia is flexed, displaced backwards, and rotated out; (4) after partial excision in early life, irregular growth at the epiphysial line may produce flexion.

Treatment.—Unless the condition is due to bony ankylosis, the limb may be straightened under an anæsthetic. If bony, a wedge must be removed to straighten the limb. In the triple displacement excision and wiring the bones must be resorted to.

Curvature of the Tibia and Fibula is commonly due to rickets, and the convexity is forwards and chiefly at the lower end. The anterior edge is sharp, and a thick buttress is formed in the concavity. Osteotomy should be performed after the bones have consolidated.

Curvature is sometimes due to inherited syphilis, and the curve then occupies the middle of the tibia, and the anterior edge is rounded, not sharp as in rickets.

Talipes.

Talipes, or club-foot, is a permanent deformity, in which the foot is inclined at an angle to the leg, so that the sole no longer rests on the ground in the normal position when the patient bears his weight on it. The displacements are various: (1) **Talipes Equinus**, where the heel is drawn up and the patient walks on the heads of the metatarsal bones; (2) **Talipes Calcaneus**, where the front part of the foot is drawn up and the patient walks on the heel; (3) **Talipes Varus**, where the foot is inverted and the patient walks on the outer border; (4) **Talipes Valgus**, where the foot is everted, and the patient walks on the inner border: there are also combinations, as equino-varus, equino-valgus, and calcaneo-valgus; (5) **Pes Cavus**, or hollow club-foot, is due to exaggeration of the arch of the instep.

Causes.—Talipes is either congenital or acquired.

Congenital cases are due in most instances to faulty development of the neck of the astragalus, so that its axis is directed too much inwards, carrying the front of the foot with it and producing talipes varus or equino-varus. Congenital absence of either the tibia or fibula and spina bifida are rare causes.

Acquired cases are usually due to infantile paralysis of certain groups of muscles. The unaffected, unbalanced muscles become permanently shortened after a time, and thus produce various deformities. Another paralytic form comes on after injury of nerve trunks in the leg. Spastic contraction, due to central nerve lesions, will sometimes produce talipes. Other causes are suppurative myositis, with subsequent cicatricial contraction; a compensatory change for a short leg, as talipes equinus; lastly, the prolonged maintenance of a bad position from pressure of the bed-clothes on the foot, as talipes decubitus. Destruction of the epiphysial line of one of the leg bones, which stops the growth while the other bone goes on growing, produces deflection of the foot to one side or the other.

Talipes equino-varus is by far the most common variety.

Talipes Equinus is rarely congenital. It is usually due to infantile paralysis of the extensor muscles or cicatricial contraction of the calf muscles; as a compensa-

tion for the shortening of hip disease; or the form known as talipes decubitus. It varies in degree, from inability to flex the ankle beyond a right angle to walking on the heads of the metatarsal bones. The astragalus is partially displaced forwards and forms a prominence; the plantar fascia is shortened, and produces the condition of pes cavus in marked cases; callosities and bursæ are formed under the heads of the metatarsal bones. The obstacle to reduction is the tense tendo Achillis at first, and in advanced cases the shortened plantar fascia and posterior ligament of the ankle-joint.

Talipes Varus or Equino-Varus is the most important form. It is either of congenital origin or acquired, and in the latter case is due to infantile paralysis of the extensor and peroneal muscles. The heel is drawn up, and the anterior half of the foot is drawn inwards and inverted. The inner border of the foot is shortened, and in neglected cases the patient walks on the outer side of the cuboid, causing a bursa to form there. Secondary contraction of the plantar fascia, ligaments, and short plantar muscles, follows. There is a great increase in the obliquity of the neck of the astragalus in congenital cases, so that the scaphoid and anterior half of the foot are carried inwards, and the dorsal tendons with them. As a result of the equinus, the upper surface of the astragalus projects forwards, and only its posterior portion comes in contact with the tibia and fibula. The ligaments on the inner side of the foot are shortened, and the shape of the other tarsal bones is secondarily altered.

Points of Distinction between Congenital and Acquired Talipes Equino-Varus.

	Congenital.	Paralytic.
History:	Affection has existed from birth.	Not developed till second or third year.
Feet affected:	Bilateral.	Generally unilateral.
Circulation:	Good.	Limb cold and blue.
Muscles:	Little wasting.	Marked wasting.
Electrical reactions:	Not much impaired.	Absent in paralyzed muscles.
Growth of bones	Unimpaired.	Impaired.

Talipes Calcaneus is rare as a congenital deformity. It is usually the result of infantile paralysis of the calf muscles. The patient walks on the heel, and the anterior half of the foot is drawn up. Valgus is usually associated with it.

Talipes Valgus is rare as a congenital deformity. The anterior half of the foot is deflected outwards, and the inner border comes in contact with the ground. The scaphoid is displaced outwards, and the head of the astragalus projects into the sole. The acquired variety results from paralysis of the tibialis posticus and flexors, with secondary contraction of the peronei.

The *Treatment* of talipes requires persistent care and patience. In congenital cases the aim must be to rectify the altered position of the bones while they are still soft. The nurse should be taught to manipulate the foot into good position, and hold it so for some time daily as soon after birth as possible. This should be combined with massage of the foot and leg. If the leg is not treated in this way, some operation becomes necessary. In paralytic cases massage and faradization of the paralyzed muscles must be persisted in, and steps taken to prevent deformity by the wearing of special apparatus. If deformity has occurred, division of tendons, fascia, ligaments, and even bones, may be necessary to correct the deformity.

Talipes Equinus, if early, can be treated by Sayre's apparatus, which is a foot-splint, by which traction is made from the anterior end by a strip of plaster fastened to the upper part of the leg. The traction is increased daily. Tenotomy of the tendo Achillis and division of the plantar fascia is necessary in more advanced cases. Where these fail, excision of the astragalus gives a very good result.

Talipes Equino-Varus may be treated in the early stages by fixing the foot in good position by a series of plaster-of-Paris casings, or by using a malleable metal splint. Tenotomy of tendons which hinder reduction in some cases is necessary, with the subsequent application of plasters. If the ligaments on the inner side of the ankle hinder reduction, they should be divided. In the neglected cases, where the patient has been walking on the outer side of the foot, **tarsectomy** is necessary. A

wedge of bone, with its base outwards, is removed by a chisel or saw, irrespective of the joints, from the tarsus in front of the peroneal groove on the cuboid. The foot can then be brought into good position, and maintained so by plaster of Paris.

Phelps' operation consists of an incision on the inner side down to the bones, with subsequent rectification of the deformity ; but its ultimate results are not so good.

Excision of the astragalus gives excellent results, but apparatus has to be worn for six months to prevent deflection of the foot.

Talipes Calcaneus is rectified by tenotomy of the extensors and the wearing of apparatus. In paralytic cases the peroneus longus tendon may be grafted into the tendo Achillis. The tubercle of the os calcis has been sawn off, and pegged on lower down.

Talipes Valgus may need tenotomy and plaster of Paris, or even tarsectomy.

Flat-foot is most common in adolescents, and is primarily due to giving way of the arch of the foot from inability to support the weight of the body. It affects those whose occupation entails prolonged standing, especially if there is any deterioration of the general health. It is also met with in rickets, together with genu valgum. Acute flat-foot is due to gonorrhœal inflammation affecting the inferior calcaneo-scaphoid ligament.

Pathological Changes.—The structures which support the arch of the foot—viz., the inferior calcaneo-scaphoid ligament, the tendon and insertions of the tibialis posticus, the plantar ligaments and fascia—become stretched, and allow the head of the astragalus to be displaced downwards, obliterating the arch. In bad cases the anterior part of the foot becomes abducted, the scaphoid being partially dislocated outwards from the head of the astragalus. The sole is flat, the inner border of the foot is convex, severe pain is felt on walking, and the gait is shuffling. The pain is either in the arch or about the heads of the metatarsal bones.

Treatment.—In the early stages, when pain with only slight flattening of the arch is present, rest and massage of the calf muscles, with tiptoe exercises twice a day.

Where there is deformity, but the natural arch can be restored by manipulation, exercises should be practised, and in the intervals a support worn, such as Whitman's steel instep support or Golding Bird's webbing sling for the arch. In worse cases, where there is secondary shortening of the ligaments on the outer side of the foot and of the peronei, the deformity must be forcibly rectified during anæsthesia, and the foot kept in plaster for several weeks. In the worst cases, which cannot be wrenched into position, a wedge must be removed, with its base to the inner side of the foot, either from the neck of the astragalus or from the tarsus, irrespective of joints.

Pes Cavus is a condition of increased concavity of the arch of the foot, and is usually associated with and caused by talipes equinus.

Treatment consists of massage of the calf muscles in mild cases, of tenotomy of the tendo Achillis and division of the plantar fascia in advanced cases.

Hallux Valgus consists of abduction of the great toe, so that the head of the first metatarsal bone is exposed to pressure from the boot. The joint soon undergoes degeneration similar to that of osteo-arthritis, and the structures around become thickened. An adventitious bursa forms over the most prominent part, and when inflamed is called a bunion. The bone is thickened under the bursa from periostitis. The bursa may suppurate, and the abscess may extend to the joint.

Treatment.—As the affection is produced by wearing boots which have not a straight inner margin, suitable boots will relieve early cases. In more advanced cases a toe-peg in the boot serves to keep the hallux in good position; or a bunion spring, which is a lever acting on the outer side of the hallux. In the worst cases free excision of the head of the first metatarsal bone gives the best results.

Hammer-toe consists of hyper-extension of the first phalanx, marked flexion of the second, and extension of the third. The first interphalangeal joint projects, and is pressed on by the boot, so that a corn forms over it. Corns form on the other points of pressure—viz., the tip of the toe and the under surface of the head of the metatarsal bone. The second toe is the one usually affected.

Causes.—Sometimes it is hereditary, but most cases are acquired. The acquired cases are due to hallux valgus crowding the other toes, so that the second is drawn up to get out of the way; it becomes secondarily fixed in that position from shortening of the inferior portion of the lateral ligaments, the flexor tendons, and the prolongations of plantar fascia.

Treatment.—As a rule, attempts at straightening by splints fail, so that operative treatment has to be undertaken, of which excision of the head of the first phalanx and amputation are the best. When hallux valgus is the exciting cause, it must be treated simultaneously.

Metatarsalgia, or Morton's Disease, is marked by pain about the heads of the middle metatarsal bones, which diminishes or ceases when the boots are taken off. Callosities are found under the heads of the third and fourth metatarsal bones, and add to the pain. The cause of the disease is attributed to the wearing of narrow boots, and the pain is due to compression of the digital nerves between the metatarsal bones and the boot.

Treatment consists of rest at first, and then wearing broader boots. In bad cases the head of the metatarsal bone which is causing trouble should be excised.

CHAPTER XVII

FRACTURES OF BONES

A FRACTURE is defined as a sudden solution of continuity in a bone brought about by some form of violence.

Causes. — 1. *Predisposing.* — Numerous pathological conditions of the bones produce a liability to fracture, such as senile changes, new growths in bone, locomotor ataxy, mollities ossium, scurvy, rickets, fragilitas ossium, insanity, and inflammatory conditions of bone which lead to necrosis or rarefying osteitis.

2. *Exciting Causes.*—(1) Direct violence, in which fracture occurs at the point struck; (2) indirect violence, in which the bone is broken at some distance from the

application of violence, because the bone has been bent beyond its limits of elasticity: the line of fracture is oblique or spiral; (3) muscular action is a common cause of fracture of small bones and osseous prominences, such as the patella; of the olecranon rarely.

Classification.—There are three great classes: Simple, compound, and complicated.

A **Simple Fracture** is one which has no communication with the external air, and which is uncomplicated by injury to important structures in its neighbourhood.

A **Compound Fracture** is one which communicates with the exterior through skin or mucous membrane.

A **Complicated Fracture** is one which is associated with injury to the vessels, nerves, or joints, in the neighbourhood.

Fractures are either incomplete or complete. Incomplete fractures are either 'green-stick' or fissured. Complete fractures may be transverse, oblique, spiral, or longitudinal. Comminution is a term used to describe the condition when the bone at the seat of fracture is broken into a number of small pieces. Impaction means that one fragment is driven into another.

Separation of an Epiphysis from its junction with the shaft occurs only in people under twenty-five, and in many cases the line of separation runs partly through the epiphysial cartilage and partly through the shaft. The separation is usually due to violence, but may be predisposed to by disease of the epiphysis, as in syphilitic infection or tuberculous epiphysitis. As a rule, the epiphysis is still connected to the diaphysis by the stripped-up periosteum. Loss of growth may result from separation, though this is not so frequent as supposed.

Signs of Fracture.—There is a history of an accident, producing sudden pain, increased on attempting to move the limb.

1. Signs of local injury—viz., pain, swelling, and bruising from effusion of blood where the soft structures have been torn by the ends of the bone or the direct violence. Large blebs of serum may appear in the neighbourhood in a day or two.

2. Abnormal mobility in the course of a bone. This is not present in impacted fractures.

3. Crepitus.
4. Loss of function.
5. Some deformity is nearly always present. The displacements which produce deformity are angular, lateral, overlapping, rotation, or separation. In most cases the primary displacement is determined by the **direction and force of the injury**; but the displacement is kept up, and may be increased, by the **contraction of the muscles**. The **weight of the limb** aids displacement, especially in the lower limb, by producing rotation outwards.

When there is any doubt as to the presence of fracture, the limb should be skiagraphed.

Constitutional Effects.—1. Immediate effects consist of shock and hæmorrhage, which vary according to the fracture.

2. Secondary effects are aseptic traumatic fever, coming on a day or two after the accident, and due to absorption of fibrin ferment from the effused blood. Delirium tremens is a common complication of fractures in drinkers. The premonitory signs should be taken as a warning, and the delirium obviated by treatment (see p. 68). If delirium is allowed to come on, the limb should be placed in plaster of Paris to prevent movement. Fat embolism, leading to fatal dyspnœa, is a rare complication.

Complicated Fractures.

Fracture implicating a Joint.—The joint becomes filled with blood in a few hours. This becomes absorbed during the period the limb is kept at rest, but adhesions are apt to form, and if the bones are not kept in accurate apposition the movements of the joint may be permanently limited. Early passive movement is always necessary, to prevent adhesions.

Dislocation may be produced by the injury which causes the fracture. The dislocation must be treated at once by attempting reduction under anæsthesia. If the limb can be fixed by splints before attempted reduction, sufficient leverage can be obtained; but if the fracture is close to the dislocation, it is necessary to reduce it by an open operation, and wire the bones at the same time.

The **main artery** may be compressed, contused,

punctured, or ruptured. Thrombosis results, and, provided the peripheral vessels are healthy, no harm is done, unless the main vein is also injured, when gangrene is likely to occur.

Treatment.—The artery should be exposed at the site of injury and tied above and below. If no such operation is done, the limb should be purified, raised, and kept warm by wrapping it in antiseptic dressings, so that, if gangrene occurs, it may not be septic. If gangrene comes on, amputation will be necessary.

Injury to **veins** may produce extravasation of blood and great œdema from interference with the return of blood from the peripheral parts, and gangrene if the main vein is lacerated.

The **nerves** of a limb may be ruptured at the time of the injury, producing paralysis and anæsthesia. Recovery usually occurs. If the nerve is included in the callus during repair, it is compressed ; neuralgia and paresis are followed by anæsthesia and paralysis of the muscles supplied. Treatment should always be expectant, as the nerve sheath is not usually divided, so restoration of the nerve fibrils is common. If symptoms persist, the nerve should be exposed and freed from the callus.

Repair of Fractures.

The broken ends of the bone are rough and irregular, and the periosteum is torn more or less, but some portion usually remains as a bridge between the fragments. The soft structures in the neighbourhood are lacerated, so that the parts are infiltrated with blood-clot, which fills up the spaces between the bone ends. As in repair of any other part, the blood-clot in a few hours is infiltrated with leucocytes, whose duty it is to absorb the clot. The connective-tissue cells in the surrounding parts proliferate, and the bone undergoes rarefying osteitis, so that the place of the blood-clot is taken by granulation tissue. The granulation tissue becomes calcified, and the calcified tissue is ultimately replaced by bone. The periosteum plays a large part in the ossification of the new tissue. It becomes stripped up for some distance, hyperæmic, and thickened. Granulation tissue is formed from it, and unites with that which has

replaced the blood-clot. This mass binds the bone together and forms the **provisional** or **ensheathing callus**, which is subsequently ossified by the growth of the periosteal osteoblasts spreading over the mass. The medulla becomes plugged with granulation tissue or **internal callus**, and this, as well as the granulation tissue lying between the fragments of compact bone, becomes ossified, the bone cells of the compact tissue probably proliferating to take part in the repair.

As a rule, the repair is firm enough to resist bending in three or four weeks, and, though at first the new tissue is soft and spongy, it soon becomes dense. The ensheathing callus and the internal callus disappear after a time if the ends are in good position. If the part is not kept immobile, the amount of ensheathing callus is increased, and the same thing occurs if the apposition is imperfect. If the bones overlap or their ends are not in apposition at all, the main bond of union is the ensheathing callus, while the medullary cavity is permanently closed by plates of bone. New bone commences to be formed at the end of a week, and the fracture is firm enough at the end of six weeks in a healthy person to be able to dispense with splints. In small bones, like the radius and ulna, three weeks suffices. Adhesions of the surrounding soft structures at the site of their laceration are troublesome sequelæ.

Treatment.—In simple fractures there are four essentials: (1) Reduction; (2) coaptation; (3) immobilization; (4) promote the nutrition of the part and prevent adhesions in the neighbouring joints and muscles.

Reduction and **Coaptation** are necessary whenever there is any displacement. Some fractures may be brought into good position by manipulation with the fingers; others require relaxation of muscles which are keeping up the deformity, and forcible extension; while anæsthesia and tenotomy are necessary to reduce others. The obstacles to reduction are spasm of the muscles, impaction, the presence of loose fragments, and the interposition of muscles or tendons between the fragments.

Immobilization is maintained by—(1) the application of splints, which may be made of plaster of Paris, wood, metal, leather, or poroplastic; (2) bandages and

strapping ; (3) extension ; (4) operation to mechanically fasten the bones together. General rules in relation to splints are : (1) Immobilize the joints above and below a fracture ; (2) the splints should be broader than the limb ; (3) the splint must be padded, so that pressure is removed from subcutaneous bony points and the site of fracture. No bandage should be put on under the splint except to fix a dressing. The parts below the fracture should always be examined next day as regards blueness, coldness, and numbness, which indicate that the bandages are too tight.

Mechanical Fixation of the Fractured Ends should nearly always be used for fracture of the patella and olecranon, and in most cases of oblique fracture at the junction of the lower and middle thirds of the tibia ; for in the latter there is such difficulty in maintaining a good position, and so much stiffness and œdema after the fracture is united, that a working-man is useless for a very long time. Most compound fractures should be wired, and also simple fractures about joints, when the bones cannot be kept in apposition by splints. The operation consists of freely exposing the ends of bone, fixing them with Peters' forceps, drilling and wiring or screwing them, or tacking aluminium plates around.

Prevention of Adhesions in Joints and Muscles by Massage and Passive Movement is necessary. Where splints are employed, this should be begun in about three weeks, care being taken not to break down the union. In the case of fracture near joints, such as the wrist and ankle, massage should be begun at the end of three days, due care being taken to fix the fracture with one hand. If massage be not used, the patient's troubles from stiffness, œdema, and wasting of muscles are very trying.

Complications arising during Treatment.—1. Hypostatic pneumonia arises especially in old people with intracapsular fracture of the neck of the femur, and results in non-union, as the patient must be propped up or got out of bed altogether. 2. Bedsores. 3. Crutch palsy, from pressure of the crutch on the brachial nerves, especially the musculo-spiral. Spring pads and cross-bars for the hands are the best preventative. 4. Ischæmic contraction or intrinsic atrophy of muscles, from too firm

compression by splints, especially on the forearm. Certain deformities of the fingers result, according to the muscles affected. The electrical reactions often remain, and there are no sensory or trophic phenomena, so distinguishing the condition from a nervous lesion. Massage and electricity should be tried first, with lengthening of the tendons as a last resort. 5. Gangrene may arise from direct injury to vessels, from spreading gangrenous infection of a compound fracture, and from too tight bandaging.

Compound Fractures.

A compound fracture is one which communicates with the external air. The danger is chiefly that of sepsis. Small fragments necrose when the wound is septic, and if osteomyelitis supervenes the patient is liable to all the dangers of pyæmia.

The **Method of Union** is the same as that of simple fractures if kept aseptic, and if primary union of the wound occurs the fracture soon becomes a simple one. If suppuration occurs, there will probably be some necrosis ; but the wound is gradually closed by granulation tissue, and that part lying between the bones becomes ossified, though the process is much slower than in aseptic cases, for the sepsis interferes with the osteogenetic powers of the periosteum.

Constitutional Symptoms are : Aseptic traumatic fever in sterile cases ; a marked febrile disturbance for a week or two in septic cases.

Treatment.—The most important thing is to render the wound aseptic by enlarging it and washing its depths and surroundings thoroughly with 1 in 20 carbolic or 1 in 500 biniodide. An anæsthetic is nearly always necessary. Loose fragments should be removed, hæmorrhage dealt with, and the bones fixed by wires or screws. The wound should be drained by a tube at the most dependent spot, and the rest of the wound closed. The limb should then be fixed on a splint, and in most cases will be found to do well.

Ununited Fractures.

There may be (1) **absolute non-union**, the ends of the bones becoming thin, pointed, and atrophied; (2) **fibrous union**; or (3) the formation of a **false joint** by the fragments becoming covered with cartilage, and the surrounding fibrous tissue forming a capsule. Common situations for fibrous union are the patella and olecranon; for non-union, the middle of the shaft of the humerus.

Causes are either local or general. The local causes are the most important: (1) Want of apposition; (2) imperfect immobilization; (3) the presence of muscle, fibrous tissue, tendon, or loose bone, between the fragments; (4) imperfect blood-supply to one or both fragments; (5) local diseases of bone, such as new growths; (6) general bone disease, as osteomalacia. Constitutional causes are the specific fevers, scurvy, and alcoholism.

The **Prognosis** is favourable, except in children, if treatment is properly carried out.

Treatment.—A fracture cannot be said to be ununited till twelve months have elapsed. During that time the limb should be massaged two or three times daily, and in the intervals kept in a plaster splint. Massage is the best aid to union. The general health should be attended to by fresh air, good food, and tonics. If this treatment fails, the ends of the bone must be exposed, a thin layer chiselled or sawn off each, and wires or screws inserted to fix them together. The limb must be immobilized for two or three months, as union even after wiring is very slow.

Vicious Union is a term applied to a fracture when it is consolidated in such a bad position that deformity or loss of function is produced. If of sufficient severity, the site should be exposed, the bones divided, and wired or screwed in good position.

Special Fractures.

Bones of the Face.—The **Nasal Bones** are often fractured transversely by direct violence. Occasionally the base of the skull is fractured in addition. The signs

are swelling and pain, crepitus, and lateral displacement, with epistaxis and sometimes surgical emphysema. As the fracture consolidates quickly, it is important to recognise its presence and reduce the deformity at once. The septum may be broken alone or with the nasal bones.

Treatment consists in immediate reduction by the introduction of guarded forceps into the nasal cavity, combined with external pressure. A splint is then moulded over the nose.

The **Malar Bone** is only broken when other bones of the face are also fractured.

The **Zygoma** is depressed when fractured, and interferes with the mobility of the jaw. It should be dragged into position by passing a loop of wire around it.

The **Superior Maxilla** is broken by direct violence, and is then nearly always a compound fracture. Treatment consists in keeping the mouth as clean as possible by frequent washing with antiseptics. Union occurs readily, though there may be some necrosis. Septic pneumonia is the one danger.

The **Inferior Maxilla** may be fractured by direct or indirect violence, commonly the former. The most usual situation is at the weakest part, in the neighbourhood of the canine tooth. The signs when the dental portion is affected are easily made out—viz., laceration of the gums, irregularity in the line of the teeth, abnormal mobility, and crepitus. The inferior dental nerve and artery are not often torn across. The fracture is always compound if the dental portion is fractured, and some suppuration occurs. If the fracture is at the angle or in the vertical ramus, there is little displacement. If the fracture is through the neck of the condyle, the latter is drawn forwards by the external pterygoid muscle, and the body of the jaw is displaced to the fractured side. Septic pneumonia, osteomyelitis, or pyæmia, may occur.

Treatment.—If there is little displacement, the jaw can be efficiently fixed by a four-tailed bandage which supports the lower jaw. Two of the tails are tied over the vertex, two just above the occipital protuberance, and the two upper ends are then tied to the lower to prevent slipping. The patient should be fed by fluids for four or five weeks and the mouth frequently washed out. A mou'ded gutta-

percha, cardboard or poroplastic splint of the same shape as the four-tailed bandage may be used. If there is much displacement, Hammond's wire dental splint must be used. It consists of a wire frame which fits over the whole of the lower teeth, and to which the teeth are fixed by intermediate encircling wires. Wiring of the fragments is sometimes undertaken.

Fracture of the Hyoid Bone is produced by squeezing it laterally. Symptoms produced are, pain on moving the tongue, jaw, or neck ; alteration of the voice ; and perhaps deformity. Bleeding into the pharynx and œdema of the glottis may follow. The neck should be fixed by a poroplastic collar after reduction by manipulation.

Fracture of the Ribs is usually due to indirect violence, such as pressure on the chest with the back against some unyielding support. The ribs first bend and then break at their most convex part, in front of the angle. Injury to the viscera is uncommon. When ribs are broken by direct violence, the fragments are driven inwards, and may puncture the pleura, lungs, liver, spleen, or diaphragm. The fifth to the eighth ribs are those most commonly broken.

Symptoms.—The patient feels a snap at the time of injury, and suffers from localized pain, which is increased during inspiration. If the back is fixed and the sternum firmly pressed back, pain is felt at the middle of the rib. Crepitus may or may not be felt. (For Complications, see Chapter XXX.)

Treatment.—Strips of plaster reaching from the spine to the sternum should be placed over the injured side during deep expiration. The strips should overlap, and a bandage should be put on over the plaster. If the fracture is due to direct violence, no strapping should be used, but the patient kept still by placing sand-bags on either side. Ribs always unite readily.

Separation of a costal cartilage produces the same symptoms as fractured rib.

Fracture of the Sternum is usually due to direct violence, but may be from indirect violence by bending when the spine has been broken. There may be displacement, which compresses the trachea and causes dyspnœa. Treatment consists of rest in bed, with a pillow between

the shoulders. If there is displacement, it must be remedied by manipulation.

Fractures of the Upper Extremity.

Fracture of the Clavicle.—This is very common, and is usually the result of indirect violence, such as a fall on the hand or shoulder. In children the fracture is common, and may be of the 'green-stick' variety. The fracture may be in one of three places :

1. **Through the Greater Convexity** is by far the most common. The fracture is oblique and the displacement characteristic. The shoulder, and with it the outer fragment, is depressed, rotated forwards, and drawn inwards. The inner fragment retains its normal position, being held by the rhomboid ligament, so that the outer end of the inner fragment is easily felt under the skin, and appears to be drawn up. The patient usually comes in supporting the elbow on the injured side, and with his head bent over to the side of the fracture to relax the muscles. The displacement is due to the weight of the arm pulling down the outer fragment.

2. **Fracture of the Acromial End** produces little displacement if between the conoid and trapezoid ligaments, but crepitus and signs of local injury are present. If outside the trapezoid ligament, the outer fragment is displaced downwards and forwards.

3. **Fracture of the Sternal End** is uncommon, and produces little displacement.

Complications are rare, as they only occur when direct violence is the cause of fracture. Pressure on the brachial plexus is the most common, but the subclavian artery or vein, the pleura, or lung, may be injured.

Treatment of the Ordinary Form.—The displacement must be corrected by drawing the shoulder upwards and backwards and maintaining it in that position by—

(1) Sayre's method ; viz., a broad strip of adhesive plaster is stitched loosely around the middle of the arm, so that the arm can be pulled backwards by it. The plaster is then carried round the back, beneath the opposite axilla, and across the front of the chest, and is finally pinned to itself just beyond the loop for the arm. The loop acts as a

fulcrum, so that when the elbow is pushed forwards the shoulder and outer fragment are carried backwards. This position is maintained by a broad piece of plaster, with a hole cut in it for the olecranon, which supports the elbow, and is fastened back and front over the opposite shoulder. The apparatus should be worn for three weeks, and a sling for two weeks more.

(2) The three-handkerchief method. A handkerchief is folded and tied over each shoulder, and the two are then pulled upon from behind and fastened together by the third handkerchief.

(3) Recumbency for three weeks, with the head low, a pad between the shoulders, and the arm bound to the side, is the best means of avoiding deformity in ladies.

Fractures of the Scapula.—The **Body** of the scapula is rarely broken, and then only by direct violence. Crepitus may be felt on manipulation. Treatment consists in fixing the arm to the side.

Fracture of the Neck is rare, and generally due to a fall on the shoulder. It produces flattening of the shoulder and lengthening of the arm. The deformity is reduced, and crepitus is felt by pushing up the elbow, but deformity returns when the elbow is released. The elbow must be kept pushed up and fixed to the side till union occurs.

The Coracoid Process is rarely fractured, and only by direct violence. The arm should be kept in a sling for three weeks.

The **Acromion Process** is broken by direct violence on the point of the shoulder. The arm hangs powerless, and the shoulder is flattened. Irregularity, abnormal mobility, and crepitus, are present. Treatment consists in keeping the elbow pushed up and the arm fixed to the side.

Fractures of the Upper End of the Humerus.—These include fracture of the surgical neck, anatomical neck, and separation of the epiphysis or the great tuberosity.

Fracture of the Surgical Neck is the most common. It results from direct or indirect violence, is transverse, and may be impacted. The displacements produced are due to the direction of the violence, and kept up by the contraction of the muscles. In most cases the lower fragment is drawn up in front of the upper, and is felt

below the coracoid process. A depression is felt below the lower end of the upper fragment, and the elbow is directed away from the side. There is no loss of fulness of the shoulder, as the head is still in the glenoid cavity. Crepitus is felt by manipulation, and the arm is shortened an inch or more. If impaction is present there is only slight shortening, and the other signs are absent, so that a skiagram has to be relied upon. The axillary vessels and nerves may be injured.

Treatment.—The fracture should be reduced during anæsthesia, and fixed by an axillary pad and shoulder-cap of leather or poroplastic. The hand is supported by a sling, and the elbow is allowed to hang to produce extension. The apparatus should be worn three weeks, and then daily passive movement and massage begun. If displacement recurs after reduction, extension should be tried, and if that fails, an operation to mechanically fix the fragments is imperative.

Fracture of the Anatomical Neck is always due to direct violence, of which there are local signs. The head, felt from the axilla, is irregular; there is crepitus and shortening. If there is impaction, the head is driven into the tuberosities. The shoulder is somewhat flattened. Manipulation should be gentle, as it is not advisable to tear through the shreds of capsule which hold the fragments together, or break down the impaction.

Treatment.—As good union is not to be expected, owing to the bad blood-supply of the upper fragment, it is better to resort to early passive movement and massage rather than risk a stiff joint. Retentive apparatus should be used, as in fracture of the surgical neck, but without the axillary pad. If the head can be seen loose in the glenoid cavity by a skiagram, it is better to cut down and remove it, as it is certain union will not occur.

Separation of the Upper Epiphysis resembles fracture of the surgical neck, but only occurs before the age of twenty. The crepitus is softer. Arrest of growth may follow. Treatment is the same as for fracture of the surgical neck.

Separation of the Great Tuberosity is due to direct violence, and detachment is seldom complete. A sulcus can be felt between the two bony masses. The most satisfactory treatment is pegging or wiring.

Fractures of the Shaft may result from direct, indirect, or muscular violence. Usually, if the bone is broken above the insertion of the deltoid, the upper fragment is drawn inward by the pectoralis major; if below the insertion of the deltoid, the upper fragment is drawn outwards; but the direction of the force and line of fracture have most influence on the primary displacement. The musculo-spiral nerve is sometimes injured primarily, sometimes secondarily by involvement in the callus.

Treatment.—Apply an internal angular splint from the axilla to the wrist with a piece of Gooch splinting over the outer side of the arm, and fix the arm to the side. Union occurs in five or six weeks. Ununited fracture is not uncommon, mainly from not obtaining proper immobilization at the site of fracture. Middeldorpf's triangle is the most useful apparatus for this purpose.

Fractures of the Lower End of the Humerus.—In examining an injury to the elbow, the injured side should be compared with the uninjured. The two condyles and the tip of the olecranon should receive first attention. During extension they form one line; during flexion they form a triangle of which the apex or olecranon is towards the hand. The head of the radius should be felt just below the external condyle. When the arm is flexed to a right angle, a ruler placed along the back of the arm does not touch the olecranon. The forearm is naturally in a position of slight abduction relatively to the arm.

Supracondyloid Fracture is the most common, and is usually oblique in direction, so that the lower fragment is drawn up behind the upper. This condition resembles backward dislocation of the radius and ulna, but (1) the relative positions of the bony points are unaltered; (2) the arm is shortened; (3) the projecting end of the upper fragment is felt above the crease of the elbow; (4) the deformity is reduced with crepitus, but readily reappears. If there is much swelling, it is impossible, without a skiagram, to come to a proper conclusion. Sometimes the lower fragment is displaced forwards.

Treatment is mainly aimed at preventing stiffness of the elbow-joint and deformity. The displacement should

be reduced under anæsthesia, and the limb put up in plaster in the fully flexed position. In two or three days it should be skiagraphed, to see that the fragments are in good position. Massage and passive movement should be begun at the end of a week.

Separation of the Lower Epiphysis occurs in children. After puberty the internal condyle is not separated with the rest of the epiphysis. The displacement is backwards, with some lateral deviation. Treatment consists of putting the limb up fully flexed after reduction, and early passive movement.

T-shaped Fracture is the result of direct violence, and consists of a transverse supracondyloid with a vertical fracture running into the joint and separating the condyles. The condyles are widened, and can be moved on each other; great swelling comes on rapidly. Good results as regards movement of the elbow-joint can only be obtained by open operation and wiring or pegging together the fragments. Early massage and passive movement must be practised.

The **Condyles** may be broken by direct violence. Fracture of the external always involves the elbow-joint. Abnormal mobility and crepitus distinguish fracture of the condyles. Fracture of the internal condyle may or may not involve the joint. Treatment is the same as for supracondyloid fracture.

Fractures of the Ulna.—The **Olecranon** is usually broken by direct, sometimes by muscular, violence. If separation is complete, the upper fragment is drawn up; if the fibrous expansion of the triceps is untorn, there is no displacement. The base of the olecranon is the usual site of fracture. There is inability to extend the forearm, and effusion of blood into and around the joint quickly follows.

Treatment.—Unless the bones are wired or screwed together, fibrous union occurs. This stretches, and so the arm is weakened. Passive movement should be done in ten days. If for any reason operation is inadvisable, a straight anterior splint with strapping, to try and bring the fragments in contact, is the best apparatus.

The **Coronoid Process** is only fractured in some cases

of backward dislocation of the radius and ulna, and is diagnosed by the fact that after reduction the deformity easily recurs. Union is always fibrous. Treatment consists in keeping the arm flexed, but passive movement should be early.

The **Shaft of the Ulna** is fractured by direct violence. The posterior border is subcutaneous, so deformity, abnormal mobility, and crepitus, are easily detected. Treatment consists in correcting the deformity, and fixing the forearm by anterior and posterior splints midway between pronation and supination.

Fracture of the **Styloid Process** may complicate Colles's fracture or be due to direct violence. The limb is put up in the adducted position, and union is fibrous.

Fractures of the Radius.—The head of the radius is broken by direct violence or in connection with dislocation. Separation of the epiphysis occurs in children. If the head is completely detached, it does not move with rotation of the lower fragment, and crepitus is felt. Treatment consists in fixing the arm midway between pronation and supination; but if the fragment is detached and loose in the joint, it is better to cut down and remove it at once. Passive movement must be resorted to early to prevent stiffness.

The **Neck** is rarely broken. The lower fragment is drawn upwards and forwards by the biceps, and projects on the front of the elbow, while the head of the bone cannot be rotated. The arm is put up flexed on a posterior angular splint.

The **Shaft** is generally broken by direct violence, and the signs are pain, deformity, abnormal mobility, and crepitus. If the fracture is above the pronator radii teres, the upper fragment is supinated by the biceps, and the lower pronated by the two pronator muscles.

Treatment.—As the position of the upper fragment cannot be altered, the lower is brought into a corresponding position; so the arm is put up in the supinated position if the fracture is above the insertion of the pronator radii teres, midway between pronation and supination if below.

Fracture of the Lower End of the Radius, or Colles's Fracture, is common, especially in old women, and is due to falls on the outstretched palm. The line of fracture is

about an inch above the wrist, and runs obliquely downwards from behind. The lower fragment is driven backwards and upwards, and rotated to the radial side, carrying the hand with it into the position of abduction, and leaving the tip of the radius at the same level as, or higher than, the tip of the styloid process of the ulna. The internal lateral ligament of the wrist is ruptured or the styloid process torn off. The fracture is usually impacted, the upper fragment being driven into the lower. The deformity is characteristic, viz.: (1) the hand is abducted ; (2) the styloid process is on the same level as, or lower than, the tip of the radius ; (3) the upper end of the lower fragment projects above the back of the wrist ; on the front is a corresponding depression, while above it the upper fragment projects forwards. Union occurs readily, but it is common to get deformity and adhesions about the site of fracture.

Treatment.—Disimpaction and reduction are brought about by grasping the hand by the 'shaking-hands' grip, extending and adducting the hand and lower fragment. The arm is then fixed on a Carr's splint or by Gooch splinting. It is very important in this fracture to start massage and passive movement not later than the end of the first week, to prevent stiffness. Union is firm in three weeks.

Separation of the Lower Epiphysis in children resembles Colles's fracture, and a skiagram should always be taken to distinguish it, as loss of growth may follow. Treatment is the same.

Fracture of Both Bones of the Forearm is more commonly due to direct violence. In treatment it is important to fix the elbow, and to prevent lateral compression of the fragments, or the four ends may unite in one mass. If above the insertion of the pronator teres, the arm must be put up supinated ; if below, midway between pronation and supination.

Fractures of the Pelvis.

1. **Fracture of the Pelvic Ring as a Whole** is commonly caused by crushing, such as by a cart running over the pelvis. The common sites for fracture are just to the

outer side of the symphysis and close to the sacro-iliac synchondrosis. Complications are frequent, and consist of rupture of the membranous urethra, the bladder, rectum or vagina, and the femoral or iliac vessels. Abnormal mobility, crepitus, and localized pain, are produced by pressing outwards or inwards the iliac crests. The patient is unable to stand, and there is often severe shock.

Treatment.—Any deformity should be reduced, and the pelvis fixed by putting on a broad bandage and tying the knees together. Complications should be searched for at once, especially those of the urethra and bladder, and treated accordingly. Union occurs in six weeks.

2. **Fractures of the Individual Bones of the Pelvis.**—**Fracture of the Ilium** occurs from direct violence, and is limited to the false pelvis. Treatment consists of rest in bed with the knees flexed and tied together.

The **Ischium** may be fractured from falls in the sitting position. Rest in bed or wiring are the methods of treatment.

The **Acetabulum** is broken in two ways: 1. The posterior lip is broken off in conjunction with direct posterior dislocation from falls on the knee. 2. The head of the femur is driven against the acetabulum and fractures it, and may even project into the pelvis between the fragments. When the rim is broken, it is treated by reduction and the application of extension to the leg for six weeks. Fracture of the acetabular cavity is rare and dangerous from the visceral complications. An attempt should be made to disengage the bone and treat it as a fracture of the neck of the femur.

Fracture of the Sacrum is due to direct violence, and is often compound. Damage to the sacral nerves may lead to paralysis of the sphincter ani and incontinence of fæces. The lower fragment is displaced forwards, and may press on the rectum. The deformity is reduced by manipulation from the rectum, and the patient is kept at rest; but not on any account must he lie on the back for three weeks.

Fracture of the Coccyx is caused by falls or blows. There is pain on walking, straining, or defæcation. By rectal examination abnormal mobility, crepitus, and deformity, can be made out.

Treatment consists of rest in bed till union occurs. If the bone has united in bad position and gives pain on defæcation, it should be excised.

Fractures of the Upper End of the Femur.

Fractures of the Neck are called (1) intracapsular, (2) extracapsular; but in the extracapsular variety the fracture is only outside the capsule posteriorly.

Intracapsular Fracture most commonly occurs in people over fifty, especially women, owing to senile changes in the bone rendering it brittle. As a rule, indirect violence is the cause—*e.g.*, slipping off a kerb or catching the toe in a carpet. The patient falls, and is unable to walk or raise the limb. The head may be held at first by the retinacular fibres. If impaction, which is uncommon, occurs, the neck is driven into the head. The displacement consists of drawing up of the lower fragment and external rotation. The rotation is due to the weight of the limb and to greater breaking up of the posterior surface than of the anterior. Shortening is rarely more than three-quarters of an inch.

Treatment.—Fibrous union nearly always occurs in old people, as the blood-supply of the upper fragment depends solely on the obturator branch running in the ligamentum teres. Then, old people often die of hypostatic pneumonia if kept lying long upon the back. If the patient be young, he should be put upon a long Liston splint, with extension, for six weeks. The same should be tried with old people, but the moment the respirations begin to increase the patient must be got up, wearing a Thomas's hip-splint. Impaction favours bony union, and so should not be broken down.

Extracapsular Fracture means fracture of the neck near the trochanter, and often is associated with splitting up of the trochanter. The usual cause is a heavy fall on the great trochanter, and impaction is common. Shortening always occurs, up to as much as 3 inches; external rotation of the limb is always present, and if there is impaction the trochanter is broadened.

Signs and Symptoms of Fractures of the Neck.—1. Pain, bruising, and swelling are more marked in extracapsular fractures. 2. Crepitus is present in the unimpacted fractures. 3. Loss of power usually occurs in

both, but patients have walked with impacted fractures. 4. Eversion is a striking feature in both. 5. Shortening is much more marked in extracapsular fractures. 6. The position of the great trochanter is altered. It is raised, everted, nearer to the mid-line, and rotates in the arc of a smaller circle than the opposite one. Its position is demonstrated as follows : **Nélaton's line** is drawn from the anterior superior iliac spine to the tuber ischii. The top of the trochanter should touch this line if the limb is placed in the axis of the body. **Bryant's line** : Drop a vertical line to the bed from the anterior superior spine, and measure off the length of a line running at right angles from this to the trochanter, and compare it with a similar line on the sound side. **Morris's bi-trochanteric test** : Measure and compare the distances of the trochanter from the mid-line. 7. Broadening of the trochanter only occurs in extracapsular fracture.

Treatment.—Unless there is great deformity, it is not advisable to break up impaction. Bony union always occurs. The patient should be anæsthetized, and traction kept upon the leg during fixation. A stirrup extension is first put on, and then the leg is firmly bandaged to a long Liston splint, with the eversion corrected. The chest is fixed to the splint by a binder ; the foot of the bed is raised, and a weight of 8 or 10 pounds is put on to the cord of the stirrup extension. Hodgen's splint may also be used. Union occurs in six weeks.

Fracture of the Great Trochanter without fracture of the neck is very rare. If the fragment is displaced, it should be wired or pegged.

Separation of the Epiphysis of the head of the femur resembles intracapsular fracture. Impairment of growth may follow.

Fractures of the Shaft of the Femur may be due to either direct or indirect violence. The displacement varies according to the situation and obliquity of the fracture. In **the upper third** the upper fragment is flexed, abducted, and rotated out by the psoas, iliacus, and glutei, while the lower is drawn up and adducted by the adductors, and rotated out by its own weight. In **the middle third** the displacement is less marked. In

the lower third the lower fragment is often tilted backwards by the gastrocnemii, and may puncture, compress, or rupture, the vessels and cause gangrene.

Treatment.—In fractures near the upper or lower ends, the smaller fragment, as a rule, is tilted, and cannot be controlled by an ordinary splint, so the longer fragment must be placed in a plane corresponding to that in which the shorter lies. For this purpose Macintyre's and Hodgen's splints are useful. In the middle third, extension and a long Liston splint, with a short Gooch splint over the inner part of the thigh. For children a double Bryant splint is necessary. The 'gallows' splint and plaster are also useful for children.

Fractures of the Lower End of the Femur.

Supracondyloid Fracture is the same as fracture in the lower third.

T-shaped Fracture of the Lower End separates the two condyles, as well as produces transverse fracture above them. The condyles can be moved on one another, with crepitus, and the joint is rapidly distended with blood. The only satisfactory treatment is to open the joint and peg the condyles together.

Separation of either Condyle produces distension of the joint with blood, abnormal lateral mobility of the knee-joint with crepitus, and perhaps deflection of the leg to the injured side. The leg should be put in plaster after reduction; but the most satisfactory treatment is operation and mechanical fixation.

Separation of the Lower Epiphysis is rare, and simulates transverse fracture; but the epiphysis is displaced forwards, and the diaphysis may compress the popliteal artery. The injury is often compound. Reduction by traction and manipulation should be performed, and the limb put up fully flexed without a splint. The limb is fixed by a bandage and laid on its outer side, with an ice-bag over the knee. In a fortnight passive movement is begun.

Fractures of the Patella.

The patella is commonly broken by muscular violence, but sometimes by direct violence.

Fracture by Direct Violence is often star-shaped, and the aponeurosis is not torn, so that the fragments are not separated. Signs of local injury, pain, and bruising, are apparent. Treatment consists in keeping the limb at rest on a back-splint and applying an ice-bag. Early passive movement and massage are advisable.

Fractures due to Muscular Violence are more common. They are always transverse ; the aponeurosis and capsule on either side of the patella are torn, and the fragments are separated. The patella is broken when poised on the condyles in the semiflexed position. It is then held down by the ligamentum patellæ, and when the quadriceps is suddenly contracted, as in a person trying to regain the upright position, the patella snaps.

Signs.—There is loss of the power of extension, separation of the fragments, and pain, followed by distension of the joint with blood, and synovitis. The aponeurosis is torn at a different level to the fracture, and hangs over between the fragments. The lower fragment is tilted forwards.

Treatment.—The best method is open operation, and wiring four or five days after the accident ; for only by this means can bony union be obtained. The obstacles to bony union, without open operation are that the tilting of the lower fragment cannot be overcome in any other way; the aponeurosis cannot be removed from between the fragments, nor the blood-clot from the joint, except by slow absorption. If no operation is done the union is fibrous, and the fibrous bond will stretch unless the patient be condemned to a stiff knee for six to twelve months. A working man is badly off with either a stiff knee for that time or a stretched bond for ever.

The **open operation** must necessarily be aseptic. The knee may be washed out with 1 in 40 carbolic or 1 in 2,000 perchloride without injury, or sterilized saline solution may be used. The joint is opened by a horse-shoe incision, the blood-clot is removed, the aponeurosis clipped away, the bones drilled and fixed in accurate apposition with silver wire, and the wound is closed without drainage. As atrophy of the quadriceps occurs early, massage and passive movements must be begun in ten days. The patient may go about on crutches in three weeks. Bony union is firm in six weeks.

Retentive apparatus is used where operation is inadvisable or refused. This may be plaster of Paris, but does not admit of massage. Another plan is to use moleskin plaster covering the thigh, and kept fastened to the lower part of a back-splint by elastic extension. Or poroplastic may be moulded, one piece over the thigh, the other over the leg, the upper piece being cut out to fit around the upper part of the patella, and the lower to fit around the lower part. These are bandaged firmly to the limb, and fastened together on either side of the patella by Malgaigne's hooks, which are screwed up daily as they become loose. At the end of six weeks the patient is allowed up, but must wear a knee-splint to keep the joint stiff for six to twelve months.

Subcutaneous operations are also done, but have no advantages. A wire may be passed above and below the patella and twisted. Mayo Robson's knitting needles may be passed through the quadriceps insertion and the ligamentum patellæ, and the ends then pulled together by elastic bands. None of these are, however, to be recommended nowadays.

Fractures of the Leg.

Fractures of the Tibia.—The upper end is broken transversely by direct violence. From falls on the heel T-shaped fracture of the upper end, with separation of the condyles, may occur. The displacement should be reduced and the leg put up on a back-splint, slightly flexed and with extension. Fracture of the shaft without fracture of the fibula is due to direct violence. There is little displacement, but irregularity of the skin, crepitus, and abnormal mobility, can be felt. The leg should be fixed on a Neville's splint with wide side-splints or in Croft's plaster splints. Fracture of the internal malleolus apart from any other injury is rare, and is treated by a plaster splint, wiring, or pegging.

Fractures of the Fibula alone are due to direct violence. The pain is localized to the site of fracture both on direct pressure and on 'springing' the fibula at some distance. Treatment consists in applying a plaster splint.

Fracture of both Tibia and Fibula may be due to either direct or indirect violence. If to direct, any part may be broken ; if to indirect, the weakest parts give way, the tibia at the junction of its lower and middle thirds, the fibula a little higher. The fracture by indirect violence is always oblique or spiral ; the lower fragment is drawn up behind the upper and rotated outwards. The sharp point of the upper frequently pierces the skin, and makes the fracture compound.

Treatment.—The fracture is reduced by flexing the leg to relax the calf muscles, and then combining manipulation with traction. If necessary, the tendo Achillis should be divided. A Neville's splint with side-splints should be applied, or, better still, Croft's splint put on during anæsthesia. The foot must be at right angles to the leg, the heel raised off the splint by pads placed just above it, and the three points must be in line—viz., the inner border of the patella, the subcutaneous surface of the inner malleolus, and the inner border of the ball of the big toe. Union occurs in six weeks, but it is well to begin massage in three weeks to prevent œdema and stiffness. This is the fracture above all in which union in a bad position, and even delayed union, are frequent, so that in oblique or spiral fractures it is better treatment to screw at once.

Fractures in the Neighbourhood of the Ankle-Joint.—(1) *Pott's Fracture* is very common, and is due to indirect violence, such as turning over on the inside of the foot. The strain tears through the internal lateral ligament of the ankle or tears off the tip of the malleolus ; then the astragalus is pressed against the inner side of the external malleolus by the continuation of the violence. The fibula is overbent, and breaks about 3 inches above the tip of the malleolus. At the same time the foot is displaced outwards or outwards and backwards. In many cases, however, the displacement is slight. (2) In some cases the tibia may be broken transversely, just above the ankle-joint ; or (3) the interosseous tibio-fibular ligament may be ruptured, and the astragalus displaced upwards, between the tibia and fibula. Rarely the foot is displaced inwards by turning over on the outer side of the foot, and again producing similar injuries to that of

Pott's fracture. The foot may be displaced backwards without any eversion in fracture of the bones at the same sites as in Pott's fracture.

Treatment.—An anæsthetic should always be given, and the fracture reduced by relaxing the calf muscles and applying traction to the foot. The limb must then be fixed on a back-splint, with side-splints in addition. The foot must be at right angles to the leg, the bony points in line, and the posterior displacement corrected. The surest way of maintaining the foot in good position is to at once apply plaster of Paris. Other splints used are Dupuytren's and Syme's horseshoe splint. Massage and passive movement at the end of ten days are advisable, the fragments being firmly grasped to prevent displacement.

Fracture of the Os Calcis is due to direct violence usually, but the piece of bone into which the tendo Achillis is inserted may be torn off by muscular violence. Treatment consists in applying a plaster splint or wiring.

Fracture of the Astragalus is due to falls on the foot from a height, and is often comminuted and compound.

Treatment.—As immobilization will probably produce a stiff ankle, it is better to excise the fragments at once. If the bone is only fissured without displacement, massage and passive movements only will suffice.

CHAPTER XVIII

DISEASES OF BONE

Inflammation of Bone.

INFLAMMATION may affect the periosteum, producing periostitis, the bone itself producing osteitis, or the medulla producing osteomyelitis ; but as all three parts are usually affected together, the name given to the particular affection varies according to the tissues principally affected.

Inflammation of bone may be (1) acute : suppurative or non-suppurative ; (2) chronic : simple, tuberculous, or syphilitic.

Acute Inflammation of Bones.

Acute Localized Periostitis is due to—(1) Traumatism, in which case there is hyperæmia and exudation into the periosteum, causing it to be thickened. This may terminate in resolution or chronic periostitis, with thickening and a deposit of new bone over the inflamed region. (2) Infection with pyogenic organisms may follow traumatism, the organisms getting in directly through an abrasion over the spot affected or through the blood-stream (auto-infection). As the vessels of the periosteum, bone, and medulla are continuous with one another through the Haversian canals, suppurative periostitis always extends into the bone as well. The pressure of the exudation upon the vessels entering and running in the superficial layer causes thrombosis, and this, combined with the peptonizing power of the bacterial products, destroys the vitality of the area affected. This is called **Necrosis**. The pus bursts through the periosteum in time, or has an exit made for it by the knife. If the process has been slight, the bone may recover; if not, the necrosed portion, or **sequestrum**, is separated from the living bone by the formation of granulation tissue. The stripped-up periosteum lays down a new layer of bone called the **involucrum**; the openings through which the pus escaped remain in the involucrum, and are called **cloacæ**. Healing occurs when the sequestrum has been removed.

The *Signs* are those of acute inflammation. The pain is severe, worse at night, and increased by lowering the limb or on pressure. If the bone is subcutaneous, redness and œdema make their appearance, the centre of the swelling softens, and the abscess bursts or is opened. Bare bone can then be felt at the bottom of the abscess, and this usually dies. It takes five or six weeks at least for the sequestrum to become loose.

Treatment.—Rest, elevation of the limb, and hot fomentations, are used in the early stages; but if the presence of pus is suspected, an incision down to the bone will relieve the condition and prevent or limit the amount of necrosis. When necrosis has occurred the wound must be dressed antiseptically till the sequestrum

is loose; then the cloaca is enlarged, the sequestrum removed, and the cavity heals by granulation.

Acute Suppurative Osteitis.

Acute Infective Osteomyelitis usually begins in the medulla, but occasionally in the deepest layer of the periosteum. It is most common in children, following an attack of measles or scarlatina, and is a very fatal disease.

Causes.—The general vitality is lowered, and there is some focus of ulceration in the mouth or throat, by which organisms enter and circulate in the blood. All that is now necessary is that some part of a bone should have its vitality depressed by a blow, strain, or exposure to cold, and the organisms then attack it. The bacteria most commonly found are the staphylococci, but streptococci are present occasionally. The disease usually begins in the new growing bone at the end of the diaphysis, rarely in the epiphysis. The lower ends of the femur and radius, the upper ends of the tibia and humerus, are the commonest seats.

Pathological Changes.—The area of the medulla affected becomes hyperæmic; exudation occurs in the cancellous spaces, Haversian canals, and under the periosteum. Pus soon forms in these three situations. If the disease begins in the superficial part of the bone, the pus may only be subperiosteal, the deeper part of the bone escaping, though large areas of the superficial portion may die from the combined action of (1) stripping up of the periosteum by the pus, (2) strangulation of the vessels in the bone by the pressure of the exudation, and (3) the toxic action of the bacterial products. The subperiosteal abscess rarely extends beyond the epiphysial line, where the periosteum is tightly adherent, so that the joints are not affected, except in the hip, where the epiphysial line of the head is withint he joint. If the affection remains localized in young children to the neighbourhood of the epiphysis, the latter may be separated and the growing portion destroyed. This is called **Acute Epiphysitis.** When the disease begins in the deeper layers of the bone, the pus may reach the periosteum, or extend along the medullary cavity, so that the veins become filled with septic thrombus, which may be disintegrated and carried off as septic emboli

(pyæmia). There is profound toxæmia, and necrosis of the whole diaphysis may occur. If the epiphysial line lies within the joint, as in the femur and ulna, septic arthritis will follow the bursting of a subperiosteal abscess. In infants the pus may reach a joint by burrowing through the epiphysis or along the soft tissues around the joint. If the infection is mild, a chronic abscess may be formed in the cancellous tissue. The usual course of an acute case if a patient survives, is that there is some necrosis of the shaft of the bone. The abscess bursts externally, and there are numerous openings in the skin leading through openings (cloacæ) in the periosteum and involucrum down to the sequestrum. The sequestrum becomes loose in six weeks to six months.

Symptoms.—The disease begins with a rigor, high temperature, and severe pain. The part becomes swollen, infiltrated, and congested, with distended veins over it. The pulse is rapid and small and the tongue dry, and delirium soon comes on. It should be distinguished from acute rheumatism by the fact that the interarticular and not the articular region is affected. Fluctuation can be detected if the bone be superficial, or the abscess may burst on the surface. The bone is then found to be bare over the extent of the abscess cavity. When the bone is deeply seated or the disease confined to the medulla, the swelling is later in evidence, but the pain and toxæmia are very severe, and the child may die from this before local signs show themselves. When the epiphysis is attacked, septic arthritis often quickly follows, and a loose flail joint may result.

Results.—The course depends upon the virulence of the infection and the time at which proper treatment is adopted. The patient may die in the first few days from toxæmia, septicæmia, pyæmia, infective endocarditis or pericarditis, or, at a later stage, from exhaustion due to prolonged suppuration.

In any case the *Prognosis* is grave, both as regards life and the subsequent utility of the limb. The limb may be stunted from interference with the epiphysial cartilage, or may have to be amputated because of destruction of the osteogenetic layer of the periosteum, or of suppurative arthritis.

Treatment must be very prompt. A free incision must

be made through the periosteum and the pus evacuated. In any case, whether pus is found or not, the surface of bone must be gouged away to expose the medulla freely, and any gangrenous tissue scraped out. The cavity must then be washed out and freely drained. The wound in the soft structures is not closed in any part. If symptoms of pyæmia occur, it may be necessary to amputate the limb through the joint or bone above, so as to cut off the source of the emboli.

When a large portion of, or the whole diaphysis is necrosed, there are two courses: either to cut short the disease by removing the dead portion at once, or to leave the sequestrum to stimulate the formation of an involucrum. Where there is a single bone, as in the arm and thigh, the sequestrum is left; where there is a double set of bones, as in the forearm and leg, the sequestrum is removed at once. Celluloid, zinc, and ivory rods, have been inserted to stimulate osteogenesis. In most cases it is doubtful how much bone is actually dead, so that it is better to provide free drainage, wait six weeks or longer, and then open up the cloacæ in the newly-formed involucrum to remove the sequestrum. The cavity heals by granulation.

Acute Septic Osteomyelitis arises from infection of the bone in compound fractures, amputations, osteotomy, or excision. The wound has already become septic, and the bone is acutely painful. Symptoms of pyæmia may be present. The bone is found to be bare, and the medullary tissue gangrenous. Portion of the bone dies, and the sequestrum usually consists of a ring of the end of the bone and a tapering portion of the interior of the shaft. Unless death occurs from septic poisoning, the sequestrum separates and the wound heals by granulation.

Treatment consists in freely draining and frequently irrigating the part. If pyæmic symptoms occur, the limb must be amputated through the joint or bone above.

Typhoid Osteitis may occur from the third week to several months or years after the attack. The abscess is subacute or chronic, and the sequestrum small.

Necrosis of bone is due to—(1) acute periostitis; (2) acute infective osteomyelitis; (3) acute septic osteo-

myelitis ; (4) tuberculous disease of cancellous tissue ; (5) syphilis ; (6) mercury or phosphorus poisoning.

Caries, or rarefaction of bone, is due to subacute or chronic inflammation, and renders the bone spongy. The causes are (1) subacute simple, septic or infective osteitis of cancellous tissue ; (2) tuberculous or syphilitic disease of cancellous tissue or periosteum. The medulla is replaced by granulation tissue, and the cancellous spaces become enlarged.

Sclerosis of bone is due to chronic inflammation from —(1) chronic periostitis, either simple or syphilitic ; (2) chronic osteitis, either simple, syphilitic, or tuberculous. In tuberculous disease the sclerosis is at some distance from the active disease. The bone becomes thickened and hard, the cancellous spaces and Haversian canals diminished in size.

Chronic Inflammation of Bone.

Chronic inflammation of bone results in thickening and condensation. It may begin in the periosteum, medulla, or bone substance. In chronic periostitis there is a marked thickening of the periosteum, and formation of new bone under it. In chronic osteomyelitis the bone is either softened (rarefying osteitis) or condensed, or there is localized suppuration with condensation around it. Tubercle and syphilis are the common causes of chronic inflammation.

Symptoms begin with aching pain in the bone, which is increased at night, with some tenderness over the spot. The bone itself is thickened, either diffusely, or the swelling is localized, forming a node. The symptoms may subside for a time, but exacerbations are frequent.

The **Diagnosis** is difficult in some cases, and lies between chronic inflammation and sarcoma of bone. A tumour often has more defined limits. A skiagram may help, but often exploration with the knife and gouge is necessary to clear up the diagnosis.

Treatment consists in first trying the effect of rest and the administration of mercury and iodide of potassium in large doses. If no effect is obtained in a fortnight, a free incision should be made through the periosteum, which

should be stripped up. The inflamed bone is then gouged away to make a free opening into the medullary cavity. If an abscess cavity is opened, it should be drained ; if not, the wound should be at once stitched up, and a cure will result. In old subjects it may be necessary to amputate the limb.

Tuberculous Disease of Bone.

Young people are mostly affected, and the disease may begin in the epiphysis, the end of the diaphysis, the medulla, or the deep portion of the periosteum.

Tuberculous Periostitis.—Tubercles are formed in the deeper part of the periosteum, and, as elsewhere, go on to caseation and liquefaction, so that a tuberculous abscess is formed. The disease extends partly into the bone, and partly to the soft tissues around, so that caries, or even limited necrosis, may follow. The bones chiefly affected are the ribs and vertebræ.

Symptoms.—There is some pain, which is worse at night, and a soft swelling which fluctuates, but may or may not be tender. A striking point about the swelling is its **chronicity**. If the abscess has burst, there are sinuses leading down to carious bone.

Treatment.—In the early stages, before an aoscess has formed, rest and constitutional treatment may cure the case, but in most cases, and always where an abscess has formed, an incision is needed. The granulation tissue and softened bone must all be scraped away, and the wound allowed to heal by granulation.

Tuberculous Osteitis always arises in cancellous tissue, and most commonly in young children who are in a condition of lowered health. Tubercles are formed in the cancellous spaces, and rarefying osteitis is an accompaniment. The tubercles caseate and run together. Sequestra may be formed by the blood-supply being cut off as a combined result of condensation around and tuberculous endarteritis. The bone may undergo so-called **expansion** by a process of absorption of the interior with a simultaneous deposit of new bone on the surface. The abscess cavity may open on the surface, or make its way through the epiphysis into a joint.

Tuberculous Dactylitis is a condition of osteitis, in children, of the short bones of the hands and feet. The bone becomes enlarged and painful, and an abscess forms. When it bursts or is opened, a probe can be passed down to carious bone. Joints or tendon sheaths may be secondarily involved.

Treatment in the early stages consists in local rest, strapping with Scott's dressing, and attention to the general health. If the disease progresses or an abscess forms, the medullary cavity must be exposed and scraped out thoroughly, but taking care not to damage the epiphyses. The wound is allowed to heal by granulation.

The **Tarsal Bones** are often involved similarly, but extension to the joints is more common. The os calcis, astragalus and scaphoid are those most affected. The foot is swollen and painful over the part affected, and the pain is increased by movement and pressure. In the later stages suppuration increases the symptoms.

Treatment.—In the early stages the foot is immobilized in plaster, and the general health is improved by fresh air, sunshine, and proper feeding. If in spite of treatment the disease does not improve, an operation is required. The os calcis is opened and scraped out; the astragalus is excised, and the neighbouring joints are scraped out if necessary; or Syme's amputation is done if the disease is extensive.

Tuberculous Epiphysitis.—When tuberculous osteitis affects the ends of long bones, it usually begins in the epiphysis, but it may originate in the end of the diaphysis and secondarily affect the epiphysis. 1. If treated in the early stages, the disease may be cured with only slight interference with growth. 2. A chronic abscess may form, as described in writing of chronic osteitis. 3. The abscess may burrow into a joint and infect it, or towards the surface outside a joint and produce an abscess in the soft structures. 4. The disease may extend along the medullary cavity and cause diffuse osteitis.

Treatment consists in the early stages of immobilization and attention to the general health. As soon as it is clear that improvement is not likely to occur, or that the disease is increasing, an opening must be made into the tuber-

culous area and the softened bone scraped and gouged away, taking care not to open the joint, and damaging the epiphysial cartilage as little as possible.

Syphilitic Diseases of Bone.

Syphilitic affections occur in the secondary and tertiary periods, and also in the inherited form. The treatment is essentially that of syphilis itself.

In **Secondary Syphilis**, flying pains, probably due to congestion, are early symptoms. At a later period syphilitic periostitis leads to the formation of **nodes** commonly on the tibiæ and frontal bones. These are accompanied by nocturnal pain, due to the increased warmth of bed. If treated early, the nodes disappear; if not, new bone is formed and remains permanently.

In **Tertiary Syphilis** the changes consist of infiltration of the tissues with small round cells. If localized, gummata are formed; if diffused, general osteitis and sclerosis occur.

Subperiosteal Gummata may produce caries of the underlying bone. Diffuse infiltration produces sclerosis around a central area of necrosis. The skull is frequently affected; the gummata break down on the surface, and leave sinuses leading down to dead bone, which takes a long time to separate. The admixture of septic organisms in a broken-down gumma increases the amount of necrosis.

The *Treatment* is that of tertiary syphilis, but operation hastens the cure. The diseased part is opened up, the unhealthy portion scraped and chiselled away, and the wound allowed to heal by granulation.

A gumma in a long bone may be mistaken for sarcoma, but if other signs of syphilis are present they help the diagnosis. In any case of doubt an exploratory operation is advisable.

In **Hereditary Syphilis** any of the manifestations of the acquired form may occur. In addition there are special forms, the earliest of which is **Osteo-chondritis**, a symmetrical enlargement of the ends of the diaphyses of the long bones in infants. The swelling is tender, near the epiphysial line, and resembles rickets, but comes on at

an earlier age. The changes may go on to separation of the epiphysis and destruction of the epiphysial line. Sometimes suppurative arthritis is a sequela.

In the first year, bosses of spongy bone may form around the anterior fontanelle (Parrot's nodes). In the first six months **Craniotabes**, or localized absorption of the bones of the skull, sometimes occurs. A symmetrical overgrowth of the tibiæ may also occur in syphilitic children.

The *Treatment* is that of syphilis.

Rickets.

Rickets is a disease of the period of growth associated with malnutrition, and characterized by alterations in the bony tissues as well as by various internal disorders. The disease commences in infancy, and begins to show itself during and after the second year.

Causes.—Improper feeding and lack of fresh air are the most important factors in its production, so that it is common amongst the poorer classes. Too early administration of farinaceous with insufficient albuminous food is the chief fault.

Symptoms are the early or general and the later or osseous. The *general symptoms* are gastro-intestinal irritation, paleness of the mucous membranes, general flabbiness, sweating of the head during sleep, and enlargement of the spleen. Convulsions, tetany and laryngismus stridulus may occur.

The earliest *osseous changes* are indicated by the child kicking off the bed-clothes, as the bones of the legs are tender. The articular ends of the long bones and the junction of the ribs with the costal cartilages become enlarged. Later the shafts of the long bones bend, and **deformities** are produced. The **head** appears square in shape, and bosses form on the frontal bones. The **fontanelles** remain open after eighteen months, the **teeth** erupt late, and may be stunted or notched. The **spine** may be kyphotic or scoliotic from habitual maintenance of a bad position. **Beaded ribs** are always present, and if there is any obstruction to the entry of air into the chest, the ribs may be pushed inwards by atmospheric

pressure, so that the sternum is prominent (pigeon breast). The **pelvis** is flattened, and the **long bones** are curved so that genu valgum or varum are common as well as antero-posterior curvature. As the acute stage passes off the bones become ossified in the deformed positions.

Pathological Changes consist in excessive preparation for the formation of new bone, but the ossifying process is inefficiently carried out; the epiphysial line is thus very much thickened and increased in breadth. In addition, the tissue in the Haversian canals and medullary spaces is increased, while the dense bone is less than normal, so that the bones readily bend under the weight of the body and from the pull of muscles.

Treatment.—Diet should consist entirely of milk for the first nine months; then a little farinaceous food may be added. At the end of twelve months raw beef juice, cream, and eggs, should be given in addition to the milk. Fresh air and sunshine are essential. Syr. ferri phosph. co. and cod-liver-oil may be useful. Deformities must be prevented by keeping the child recumbent or by the use of apparatus. Osteotomy is required when the deformity persists after the acute stage has passed off.

Scurvy Rickets is a disease of the children of parents who can afford to feed their infants on prepared and peptonized foods, with the exclusion of fresh meat and vegetables. Milk, sterilized by boiling for twenty minutes, has its antiscorbutic powers spoiled. The rickets is no special part of the disease of infantile scurvy, but only an accompaniment.

The child is pale, fretful, and tender when handled. There may be swellings on the bones, petechiæ, bruises, and sponginess of the gums, if the teeth are present. The age is generally from six to eighteen months. The subperiosteal hæmorrhage may be large, the epiphyses may be separated, or spontaneous fractures may occur. Hæmaturia, epistaxis, or hæmorrhages in the orbit, may also appear.

Treatment is very successful, and consists in giving fresh food, such as vegetables, fruit-juice, and fresh milk.

Osteomalacia may occur in women during pregnancy, and leads to softening of the bones. Rarefaction and loss

of the calcareous salts render the bones liable to fracture or extraordinary bending. The pelvis may be so deformed that Cæsarean section is necessary in pregnant women. Death often occurs in two years from exhaustion or pulmonary complaints.

Treatment is not of much avail. Opiates for the pain may be necessary. Bone-marrow tabloids have been used.

Osteitis Deformans is a rare affection of the bones which comes on after the age of forty-five. It begins with aching pains in the tibia or femur, and goes on to bowing forwards of the bones, which are at the same time enlarged. The spine becomes bent and rigid, and the chest is sunk on the pelvis. All the bones, including the cranial, may be thickened. The progress is slow, but the patient may die from the development of multiple sarcomata of the bones. The changes consist of rarefying osteitis, enlargement and irregularity of the Haversian canals. There is no known treatment of any use.

Acromegaly is also a rare affection of the osseous system. It begins in young adults, and consists in enlargement of the hands and forearms, feet, jaws, and perhaps other bones. The spine is usually kyphotic, and there is mental slowness or imbecility. The anterior half of the pituitary body has been found hypertrophied in some cases, and to this is ascribed the cause. Many giants are acromegalic. Treatment by thyroid or pituitary extract does no good.

Hypertrophic Pulmonary Osteo-arthropathy is a condition of swelling of the bones just above the wrists and ankles, due to toxic absorption in long-standing cases of bronchiectasis and empyema. The cause must be treated.

Tumours of Bone.

The chief primary tumours are sarcomata, exostoses, and chondromata. Secondary tumours are sarcoma and carcinoma. Hydatid cysts and various tumours in connection with the teeth also occur.

Sarcomata are the most important, and there are two classes—(1) periosteal, (2) endosteal.

Endosteal Sarcoma begins in the medullary cavity or

the cancellous tissue, and results in expansion of the bone. The growth usually begins near the end of a long bone, and when there is only a thin shell of expanded bone over it 'eggshell crackling' may be felt on pressure. The soft structures are invaded in the later stages, and dissemination occurs. Spontaneous fracture may result from sarcoma of bone. Round-celled, spindle-celled, or myeloid sarcomata occur, but myeloid tumours never cause secondary growths. The commonest sites for myeloid tumours are the lower ends of the femur and radius, the upper ends of the tibia and humerus. Bone and cartilage may be found in the round and spindle celled growths.

Periosteal Sarcoma is either round or spindle celled, and of extreme malignancy; its growth is rapid, and secondary growths in lymphatic glands and viscera occur early. These tumours often contain fine trabeculæ of ossified tissue, and are so extremely vascular that they sometimes pulsate.

The *Diagnosis* of endosteal sarcoma of bone in the early stages from chronic abscess and gumma of bone is very difficult, and should always be cleared up by an exploratory incision in doubtful cases. A periosteal sarcoma usually has a more definite edge and less regular consistence than a periosteal node or subperiosteal abscess. Skiagraphy may help, as a tumour will present itself as a lighter patch.

Treatment, to be successful, depends so much on early diagnosis, that an exploratory incision must always be made in a doubtful case of swelling of bone. The affected limb must be removed high above the growth, except in the case of myeloid tumours, which are only locally malignant, so that free local removal where possible serves.

Carcinoma of bone is always secondary, and it, as well as secondary sarcoma of bone, may cause spontaneous fracture. Treatment, except of symptoms, is useless.

Pulsating Tumours of Bone.—1. **Sarcomata** may be so vascular as to cause pulsation. 2. **Aneurism by Anastomosis** may occur in the medullary cavity. 3. A **Blood-Cyst** formed from a broken-down sarcoma in the cancellous end of a bone may pulsate.

Treatment consists of incision and either amputation if

the cause is sarcoma, or scraping out and packing with gauze if not.

Hydatid Disease rarely occurs in bone, but when it does the daughter cysts are exogenous. Treatment consists of removal of all the cysts, but if much bone has been destroyed amputation may be necessary.

CHAPTER XIX

INJURIES OF JOINTS—DISLOCATIONS

Sprains, or rupture of some of the ligamentous fibres around joints, are due to violence. Severe pain, followed by hæmorrhage into and around the joint, and synovitis, are the features of the case. The joint should be kept at rest and cold applied till the pain is eased; then passive movement and massage should be commenced, to prevent troublesome adhesions.

Penetrating Wounds of Joints.—If the wound is aseptic, only a small amount of inflammation follows; if septic, acute arthritis develops. If glairy synovial fluid is seen escaping from the wound, it is certain that the joint is opened; if it is doubtful as to whether or not a wound leads into the joint, the skin should be purified, the opening enlarged, and a careful examination made to settle the point. If the joint is opened, the aperture should be enlarged, the joint washed out, and drained with a rubber tube, which can be removed in a day or two if no septic inflammation supervenes.

Dislocations.

A dislocation is a condition of displacement of the ends of the bones which enter into the formation of a joint, and may be either traumatic, congenital, or pathological in origin.

Congenital Dislocations are due to an error in development, and normal articular surfaces do not exist in these cases.

Congenital Dislocation of the Hip is not uncommon,

and is probably due to the maintenance of malposition in the uterus. The defect is only noticed when the child begins to walk. The leg is shortened and flexed, and there is some lordosis ; but the movements are not impaired, and there is no pain or tenderness, so that it is easily distinguished from hip disease. The gait is waddling, and the head may be made to 'slide' an inch or two on the pelvis by pulling. The deformity may be unilateral or bilateral.

Pathological Anatomy.—Before the child has walked, the acetabulum is shallow, and the head of the femur is small and flattened. After the child has walked, the head rests on the dorsum ilii, above the acetabulum, which is shallow and triangular. The head is misshapen, the adductor muscles are shortened, the capsule is thickened and lies over the acetabulum.

Treatment is not very satisfactory. If the deformity is discovered before the child walks, an attempt should be made to get the head into the acetabulum and keep it there by fixing the leg in plaster in the fully abducted position for twelve months. From two to five years of age **Lorenz's bloodless method** has its advocates. (1) The adductors which prevent reduction are ruptured subcutaneously by manipulation ; (2) the head is replaced in the acetabulum by flexion and abduction, and fixed by plaster with the leg in that position ; (3) at the end of six months the leg is gradually brought down into the straight position.

After five or six years of age, **Hoffa's operation** may be done ; *i.e.*, the joint is freely opened, the acetabulum is enlarged, and the head is shaped up to fit it. The limb is then immobilized in the abducted and everted position.

In many cases, a high boot on the side of the deformity is perfectly satisfactory.

Pathological Dislocations may follow such diseases as tuberculous and pyæmic arthritis, osteo-arthritis, Charcot's disease.

Traumatic Dislocations.

Causes.—*Predisposing.*—(1) The **nature of the joint**, such as the shallow socket for the head of the humerus ; (2) the **age of the patient** : youths are more likely to

have separation of the epiphysis, adults dislocation, and old people fracture, as a result of violence; (3) **the condition of the muscles around the joint**: wasted muscles are less hindrance to dislocation than strong, healthy ones.

Exciting.—The **cause of the dislocation is violence**, which may be indirect, direct, or muscular.

The dislocation may be **complete** or **incomplete**; **compound** or **complicated** by injury to big vessels or nerves. A **fracture-dislocation** is a condition of fracture near the dislocated end of one of the bones.

Signs.—(1) Those of pain, bruising and swelling from laceration of the soft structures; (2) deformity from the altered position of the bones; (3) limitation of movement.

The damages produced by dislocation are tearing of the capsule and surrounding muscles, and perhaps fracture of the cartilaginous or bony surfaces. The joint and surrounding soft tissues are infiltrated with blood. Vessels and nerves in the neighbourhood may be contused or compressed.

The difficulties in reduction are due to the shape of the articular surfaces, to capsule and tendons getting in the way, and to the contraction of the injured muscles. The latter, which presents the chief difficulty in the early stages, is easily overcome by the use of an anæsthetic.

If **allowed to remain unreduced**, the displaced head becomes surrounded by a false joint capsule, the true articular cavity becomes filled up with fibrous tissue, and the muscles and tendons around become shortened, while adhesions to big vessels close at hand constitute a danger in attempted reduction.

Treatment.—All dislocations should be reduced in the earliest stages, either by manipulation or extension.

Manipulation aims at making the bone retrace the course by which it left its proper position. Anæsthesia renders this very easy by overcoming the spasmodic contraction of the muscles.

Extension is employed to overcome muscular contraction. The hands, a jack-towel, or pulleys are used for this purpose. The reduction is usually marked by a distinct snap. The bones are then felt to be in their

normal relation, and normal mobility is restored. Rest for a few days and early passive movements soon repair the damage done.

Unreduced Dislocations.—As a rule, it is not safe to attempt reduction by manipulation and extension after four to six weeks. If movement is fairly free and painless, it may be as well to allow the patient to go on with a false joint; but if movement is limited or there is pain from pressure upon nerves, an operation should be done. This consists in reduction by an open operation, or excision of the head of the displaced bone.

Compound dislocations should be treated by taking extreme care to render the wound aseptic.

Dislocation of the Lower Jaw results from muscular action or from a blow on the chin with the mouth open. The condyle slips forwards over the eminentia articularis into the zygomatic fossa. The dislocation may be unilateral or bilateral. The mouth remains widely open and the jaw projects. Mobility is impaired and the saliva dribbles. The condyle can be felt in front of its natural position, and its place is taken by an unnatural hollow. If unilateral, the jaw is displaced to the sound side.

Treatment.—The surgeon covers his thumbs with a thick fold of towel to prevent them being bitten, presses the lower molar teeth firmly downwards, to free the condyle, and then raises the chin by the fingers. The condyle then slips back into place, and the chin is kept at rest by means of a four-tailed bandage for a few days.

Dislocations of the Clavicle—Of the Sternal End.—This is rare, owing to the strength of the rhomboid ligament. Falls or blows on the point of the shoulder are the usual cause. The displacement may be forwards, backwards, or upwards.

The **forward** displacement is reduced by forcibly carrying the shoulder outwards and backwards, and at the same time pushing the sternal end into place. The bone is then best kept in place by the 'three handkerchief' plan, as in fractured clavicle.

The **backward** displacement causes trouble from pressure of the bone on the trachea, œsophagus, and blood-vessels. Reduction is accomplished by extension of the

shoulders, and this restored position is maintained as in the forward type.

The **upward** displacement is rare, and is reduced by placing a pad in the axilla to act as a fulcrum. The arm is then pressed inwards over it, to lever out the shoulder.

Of the Acromial End.—The acromion is usually forced below the outer end of the clavicle from falls or blows on the scapula. Reduction is easy, but maintenance is difficult. Strapping should be applied over the shoulder and under the elbow, the arm being kept in a sling. The bones may be wired if persistent displacement causes pain.

Dislocation of the Shoulder is the commonest dislocation met with in adults. Falls on the hand or elbow, with the arm abducted, throw the head of the humerus upon the weak lower and inner part of the capsule; this gives way, and the head passes downwards below the glenoid cavity. The continuation of the force then either causes the head to travel forwards or backwards.

The *Signs* are—1. The shoulder is flattened, the acromion process prominent, and a hollow takes the place of the rounded head below the acromion. 2. The head of the bone is felt in some abnormal position. 3. The elbow is displaced from the side and cannot be made to touch the side at the same time that the hand is placed on the opposite shoulder. 4. The axillary folds are lowered and the vertical measurement around the axilla is increased. 5. A straight-edge can be made to touch at the same time the acromion process and the external condyle of the humerus. This cannot be done normally, but can be done in fracture of the anatomical neck. 6. Impaired mobility and bruising are present.

Subglenoid Dislocation is the primary displacement in all cases, but is rarely seen. The head rests below the glenoid cavity, where it is easily felt from the axilla, and may press on the axillary vessels and nerves. The arm is lengthened, the forearm is flexed, and the fingers may be numbed from the pressure on the axillary nerves.

Subcoracoid Dislocation is the commonest of all dislocations. The head lies in front of the glenoid cavity, below the coracoid process, with the tendon of the sub-

scapularis either torn or stretched over it. The elbow is displaced backwards and outwards, and the head of the bone can be felt below the outer third of the clavicle.

Subclavian Dislocation is rare, and due to the head passing further inwards. The elbow is much displaced from the side and there is distinct shortening.

Subspinous Dislocation is also rare. The head lies in the infraspinous fossa, and can be felt there; the elbow is displaced forwards and can be made to touch the chest wall.

Treatment consists in reduction by manipulation or extension. For reduction by manipulation chloroform is advisable, and in most cases, as soon as the muscular spasm is relaxed, the slightest movements are sufficient to produce reduction.

Kocher's Method.—The forearm is flexed and the elbow pressed to the side; the arm is then fully rotated outwards. The arm is now brought forwards and upwards to a right angle with the body, and then rotated inwards, while the elbow is brought down over the body so that the fingers sweep the opposite shoulder. These movements relax in turn the tense parts of the capsule, and bring the head of the bone down to the rent, and then through it back into the joint.

Extension.—The patient is placed flat on a mattress on the floor, while the surgeon firmly grasps the arm and places his unbooted foot in the axilla. Traction is then applied till the contraction of the muscles is overcome and the bone slips back into its socket. Outward or upward traction may also be used.

Dislocations of the Elbow-Joint occur from direct or indirect violence, and mostly in young people. If seen before the swelling comes on, a careful survey of the bony points renders the diagnosis easy.

1. **Dislocation of both Bones backwards** is the most common variety. As a rule, the coronoid process is unbroken, and hitches in the olecranon fossa. The forearm is semiflexed, and the olecranon and radius project at the back of the joint, while a hollow is present just above the projection. The lower end of the humerus projects in front, and the tip of the olecranon is higher than the intercondyloid line, instead of lower.

Dislocation of both Bones forwards is rare without fracture of the olecranon. The forearm is flexed and lengthened, and the position of the bones is easily made out.

Lateral dislocations are either outward or inward, and usually incomplete.

2. **Dislocation of the Ulna alone** backwards is rare.

Treatment.—The patient is placed in a sitting position, with the surgeon's knee in the bend of the elbow against the lower end of the humerus. The patient's forearm is pulled on to relax the muscles, and then flexed, while the knee makes extension by pressing against the humerus.

3. **Dislocations of the Radius alone.—Forward** dislocation is not uncommon in children from falls on the hand or being lifted by the hands. The head of the bone rests in the hollow above the capitellum, and prevents full flexion, while a hollow can be felt behind below the external condyle.

Treatment.—Under anæsthesia the elbow is bent to a right angle, and traction combined with pressure over the head of the radius then produces reduction. Fixation for some weeks is necessary, as the ruptured orbicular ligament allows of recurrence.

Backward or Outward Dislocations are rare, easily recognised, and the process of reduction is simple.

'**Pulled Arm**' is a frequent condition in children, in which the radius is partially withdrawn from the orbicular ligament, so that the synovial folds lying over it become nipped between the humerus and radius. Severe pain is felt as a result of traction upon the hand. The limb is semiflexed, and the powers of pronation and supination are lost. Treatment consists in pronating, supinating, and flexing fully, and then extending the arm.

Many *complications* of dislocation of the elbow may occur. Common ones are fractures of the articular ends of the bones, so that if there is much swelling a skiagram should be obtained. In many cases wiring or pegging the fragments is the best method of obtaining a useful joint.

Dislocation of the Wrist may be backward or forward, but is very rare. The normal relative positions of the styloid processes distinguish it from Colles's fracture.

Dislocations of the Carpal Bones.—That of the os

magnum backwards is the only one at all common. If irreducible, it should be excised.

Dislocations of the Metacarpal Bones and Phalanges are easily recognised and reduced.

Backward Dislocation of the First Phalanx of the Thumb, however, sometimes presents difficulty, owing to the hitching of the long flexor tendon around the neck of the metacarpal, and the carrying of the glenoid ligament backwards, so that it lies behind the head of the metacarpal.

Treatment.—The thumb should be hyperextended to a right angle; then, still maintaining traction, rapidly flexed. If this fails, the glenoid ligament should be divided freely by a tenotome passed between the bones close to the phalanx from behind, and reduction will then be found easy.

Dislocation of the Hip is rare, and occurs in young adults from indirect violence. Older people are more liable to fractures. The acetabulum is shallowest at its lowest part, and the ligaments are weakest below and behind, so it is at that point that the head escapes in dislocation. The ilio-femoral or Y ligament, in front, is the strongest in the body, and is untorn in regular dislocations. The tendon of the obturator internus plays a part in determining the variety of posterior dislocation. If the head lies below, it is called the sciatic variety; if above, the dorsal variety.

The four varieties of regular dislocation are—(1) Anterior: obturator or thyroid, and pubic; (2) posterior: sciatic and dorsal. Dorsal is the most common, pubic the least.

The head of the bone in all these cases escapes at the lower and hinder part of the capsule, either from a fall on the abducted leg or from forcible abduction. From the continuation of the violence the bone passes into one of the four positions, either anteriorly or posteriorly. If the leg is inverted and flexed, the head travels backwards, and the sciatic or dorsal variety is produced; if the leg is everted and extended, the obturator or pubic variety occurs. For the dorsal variety to occur, either the tendon of the obturator internus must be ruptured or the head slips under it. For dislocation to occur while the leg is adducted, it is usually necessary to have also fracture of the posterior lip of the acetabulum.

1. **Dorsal Dislocation.**—The head may be felt on the dorsum ilii, unless the patient is very fat or very muscular. The leg is in a position of flexion, adduction, and inversion, and the ball of the toe rests on the other instep. The great trochanter lies above Nélaton's line, and is nearer to the anterior superior spine than that of the sound side. The limb is shortened two or three inches, and there is a marked hollow over the front of the joint.

2. **Sciatic Dislocation.**—The head lies on the sciatic notch. The signs are the same as those of the dorsal variety, but there is less shortening.

Treatment.—The patient is placed on a mattress on the floor and anæsthetized. The leg and thigh are flexed in the position of adduction. This rolls the head down to the lower part of the acetabulum. The leg is then circumducted outwards and brought down straight ; this carries the head through the rent into the acetabulum. Failing success by this method, the body must be fixed and direct upward **traction** must be exercised upon the flexed thigh. As a rule these manœuvres are successful ; if not, extension by **pulleys** must be made use of.

3. **Thyroid Dislocation.**—The head can be detected in the perinæum, lying on the obturator foramen, and the limb is in a position of eversion and abduction, and is lengthened and flexed. Mobility is impaired, and there is great pain from pressure on the obturator nerve.

4. **Pubic Dislocation.**—The head lies on the horizontal pubic ramus, where it can be felt below the anterior inferior spine. The limb is markedly abducted and everted, and slightly flexed. There is pain from pressure on the anterior crural nerve, impaired mobility, and, as in all dislocations, tearing of muscles in the neighbourhood.

Treatment is as for the dorsal varieties, except that the thigh is flexed in the abducted position and the circumduction is inwards. The tendency to recurrence is slight, so the patient is kept in bed with the legs tied together ; after three days passive movement is commenced, and the patient may get up in a week, but no exertion is allowed for several weeks.

Recurrence is usually due to fracture of the lip of the acetabulum, and may come on immediately after reduction, with crepitus.

Irregular dislocations are those in which the Y-ligament is ruptured or the acetabulum fractured. The bone may take up any position in the neighbourhood.

Dislocation of the Patella usually occurs in patients with genu valgum, and is of the **outward** variety. **Inward** dislocation and **vertical rotation** may also occur.

In the **Outward** variety, muscular action is the cause in people with knock-knee; but direct violence may also produce it. The bone lies on the outer surface of the condyle, the knee appears broader, and the intercondyloid notch is easily felt. Reduction is effected by extending the leg and flexing the thigh to relax the quadriceps, when slight pressure will cause the bone to slip back into place. A back-splint and the application of cold is necessary for the synovitis which follows. The **Inward** dislocation is rare, and results from blows. The treatment is similar to that of the outward variety. **Vertical Rotation** is due to direct violence, and is reduced by relaxation and pressure during anæsthesia.

Dislocations of the Knee, when traumatic, are due to very severe violence, and are then of the **forward** variety. **Posterior** and **lateral** dislocations are more commonly of pathological origin. The displacements may be complete or incomplete, and are easily recognised and reduced. The knee must be kept fixed for several weeks after reduction.

Displacement of a Semilunar Cartilage results from strains while the knee is flexed and excessively rotated, as in sudden turning at football or hockey. The internal cartilage is that most frequently displaced. The anterior or posterior attachments, or both, may be torn through, its attachment to the edge of the tibia may be torn, or the cartilage may be split longitudinally or transversely. As a result, a portion of the cartilage during some sudden movement slips in between the surfaces of the condyle of the femur and tibia and becomes nipped.

Symptoms.—When nipping occurs, severe pain is felt in the joint, which becomes 'locked' in the flexed position. The patient may be able to straighten the joint in a few minutes, or the 'locking' may last hours or days. It is reduced with a snap spontaneously or by manipulation. An attack of synovitis follows, and there is liability to

recurrence. As a rule, tenderness can be detected on the inner side of the joint over the position of the cartilage.

Treatment.—1. *Of the first attack:* The cartilage is reduced by fully flexing the leg, rotating it in, and then extending. The knee is then kept fixed by a back-splint or poroplastic for two months, to allow union to occur, but massage and gentle passive movement should be commenced at the end of three weeks.

2. *When the displacement constantly recurs*, operative measures only are likely to effect a cure. If operation is refused, Howard Marsh's knee-clamp or Griffith's knee-splint, which permits flexion and extension but not rotation, should be worn constantly. If an operation is done, nothing short of excision of the loose portion of the cartilage is satisfactory, as stitching of the cartilage back in place is far from being a certain means of keeping it there.

After excision of the cartilage, it is surprising how good the movement is and the freedom from further trouble. The reason probably is that, instead of the semilunar cartilages being ingenious mechanical devices of Nature, they are only vestigial structures.

Dislocations of the Ankle-Joint are usually complicated with fracture of the tibia and fibula. The displacement may be **outwards, inwards, backwards, forwards,** or **upwards.**

The common displacement is the **Outward,** described in connection with Pott's fracture (p. 151). The **Backward** dislocation may be unaccompanied by fracture, and results from indirect violence. The heel projects unduly backwards, and the tibia rests upon the scaphoid bone. The **Forward** dislocation is rare, and produces apparent lengthening of the foot. The tibia rests on the os calcis, and the prominence of the heel is lost.

Treatment.—Under anæsthesia the dislocation is reduced by relaxing the muscles and making extension. If there is a fracture, the limb must be fixed with the foot at right angles. Passive movement and massage should be begun next day if there is no fracture, in ten days if there is a fracture.

Upward dislocation is very rare, and the inferior tibio-fibular ligament must be ruptured to allow the astragalus to lie between the bones. Its recognition and reduction are easy.

Dislocations of the Astragalus alone are either forwards or backwards.

Forward dislocation is produced by severe violence, and the bone may be completely displaced, lying under the skin and on the dorsal surface of the scaphoid and cuneiform bones. It may be compound from the beginning, or secondarily from sloughing of the skin over it. **Backward** dislocation is usually complete.

Treatment.—Reduction is impossible in the complete forms, so that excision of the astragalus is necessary. The incomplete forms can be reduced by traction and pressure during anæsthesia.

Subastragaloid Dislocation is displacement of the whole of the foot with the exception of the astragalus. The displacement is usually backwards, and either inwards or outwards. The head of the astragalus lies on the dorsal surface of the scaphoid bone ; the anterior part of the foot is shortened and the heel projects backwards. Treatment consists in reduction by manipulation. The tendon of the tibialis anticus may be hitched under the neck of the astragalus and prevent reduction, so that an incision over the front of the joint, to free the tendon, becomes necessary.

CHAPTER XX

DISEASES OF JOINTS

Acute Synovitis.

INFLAMMATION affecting the synovial membrane alone is called synovitis.

Causes.—Injury, gonorrhœa, rheumatism, specific fevers, gout, and syphilis. As in acute inflammation elsewhere, there is hyperæmia and exudation firstly into the membrane, and secondly into the joint, so that the joint becomes distended with fluid, which consists of plasma and leucocytes and some synovia. The lymph which may become deposited from the plasma is either absorbed or organized to form adhesions.

Symptoms.—The joint becomes hot, distended, and

painful, and the limb is maintained in the position in which the joint capacity is greatest, usually that of slight flexion. The muscles which move the joint rapidly waste from some reflex disturbance of their trophic centres in the cord. The joint usually remains weak for some time after the acute stage subsides, from softening of the ligaments. Adhesions may render the joint stiff and painful.

Treatment.—Absolute rest is necessary. The limb should be so fixed on a splint that, should adhesions occur, it will be in the most useful position. The limb should be **elevated** and **hot fomentations** applied, or the treatment may be begun by the application of a few **leeches**. When the pain has subsided, pressure aids the absorption of the fluid, and this is best followed up in a few days by massage and passive movement, to prevent adhesions. If adhesions have formed, they should be broken down under chloroform.

Chronic Synovitis.

This may follow an acute attack or be chronic from the first. In the latter case the cause may be a sprain, excessive use, the presence of hypertrophied synovial fringes, a loose body, or some injury of an interarticular cartilage. The disease is accompanied by either (1) marked effusion into the joint or (2) hypertrophy of the synovial membrane. Where there is effusion, the bursæ communicating with the joint may also be distended. When the effusion has lasted some time, laxity of the capsule and ligaments is produced, so that the joint is disabled.

Treatment is difficult. The cause should be removed if possible. The fluid should be removed by fixing the limb on a splint and elevating it. Blisters, followed by pressure and massage, are then applied, and when the fluid has disappeared strapping with Scott's dressing. If the fluid reaccumulates, open the joint and wash it out with 1 in 2,000 sublimate solution, or drain it for a few days. If hypertrophied synovial fringes are present, they should be clipped away.

Hydrarthrosis, or chronic distension of a joint with fluid, may be due to—(1) chronic synovitis, with effusion ;

(2) osteo-arthritis; (3) Charcot's disease; (4) secondary syphilitic synovitis; (5) rarely to tuberculous synovitis.

Baker's Cysts are hernial protrusions of the synovial membrane through rents in the capsule. It is commonly due to osteo-arthritis or tuberculous disease of the joint with effusion. The pouch, filled with synovia, may burrow to some distance amongst the muscles, and eventually lose its communication with the joint. If causing any trouble, excision of the cyst is necessary.

Acute Arthritis.

By arthritis is meant any inflammation which involves all the structures of a joint.

Causes.—Pyogenic organisms are always the cause of acute arthritis. The joint may be infected by wounds, or without a wound in such diseases as pyæmia, and acute epiphysitis; or by auto-infection if the vitality of a joint is lowered while organisms are floating about in the blood-stream. It may result from gonorrhœa or from extension of inflammation from the end of a neighbouring bone.

Symptoms.—Very severe pain and fever characterize the onset. The joint is distended with fluid, which rapidly becomes purulent, and the surrounding tissues become œdematous. The joint is usually fixed by muscular contraction in the position of greatest ease—semiflexion. If the disease is allowed to progress, the pus bursts through the capsule and burrows amongst the muscles and towards the surface. A characteristic sign is **starting pain at night.** When the patient is awake the contracted muscles prevent the joint surfaces rubbing on one another; but if the patient falls off to sleep the relaxed muscles allow rubbing, and the pain produced causes spasm of the muscles, and consequent severe pain which wakes the patient. The ligaments become infiltrated and softened, so as to allow of abnormal movements; the cartilage becomes ulcerated and the bones carious; dislocation may follow. The patient becomes exhausted from toxæmia or pyæmia.

Terminations.—1. Recovery, with a movable joint, if treated early. 2. Ankylosis is the usual most favourable termination. 3. Death from toxæmia, pyæmia, or chronic suppuration leading to amyloid disease.

Pathological Changes. — The synovial membrane becomes hyperæmic and pours out synovial fluid and pus; the cartilage becomes inflamed, softened and ulcerated, and its place is taken by granulation tissue; the underlying bone becomes inflamed and carious, and at the articular margins osteophytes are formed; the ligaments are softened and allow of displacement, and the muscles rapidly atrophy.

Treatment.—As soon as suppuration is diagnosed, the joint must be opened freely, washed out, and drained. Two openings are usually necessary. The limb should be immobilized in the position which will be most useful should ankylosis occur. Frequent irrigation, or even continuous irrigation, should be practised till all signs of inflammation have passed away. Excision may be required to remedy faulty position or to cure chronic suppuration. Amputation may be necessary, if toxæmic symptoms threaten life or if pyæmic symptoms show themselves.

Special Forms of Synovitis and Arthritis.

Rheumatic Synovitis.—Fever, acid sweats, and a tendency to the affection of several joints in succession, distinguish it. Chronic rheumatic synovitis may lead to thickening of the ligaments and more or less impairment of mobility.

The treatment is medical, and mainly consists in administering large doses of salicylate of soda, 20 grains every four hours till the pains cease, and applying hot soda fomentations to the joints. In the chronic forms, iodide of potash, counter-irritation and hot-air baths are beneficial.

Gouty Arthritis usually begins suddenly during the night, and the first attack takes place in the metatarso-phalangeal articulation of the big toe. The soft structures become swollen, the skin bluish-red, shiny and excessively painful. The attack subsides gradually in a few days. Treatment consists in applying hot fomentations and giving colchicum.

Pyæmic Synovitis is due to the lodgment of a septic embolus, which soon leads to distension of the joint with

pus. The integrity of the joint may possibly be saved by promptly opening, washing out and draining it.

The **typhoid bacillus** in rare cases is the cause of synovitis and arthritis. **Pneumococcal** inflammation is another rare cause of infective arthritis.

Gonorrhœal Disease of Joints occurs sometimes during the course of gonorrhœal urethritis. One or several joints, especially the knee, ankle, and wrist, may be attacked. In one form mainly the synovial membrane is attacked, and the case is practically one of acute synovitis, for suppuration is uncommon. In the other, the periarticular structures are chiefly affected, the ligaments being infiltrated and softened, and the soft structures œdematous. The disease resists treatment, so that termination in ankylosis or displacement is not uncommon.

Treatment.—The urethral discharge must be cured as soon as possible. The joint is kept at rest with fomentations, and when the pain is less pressure is applied. In the severe cases it is better to open, wash out and drain the joint.

Tuberculous Disease of Joints.

Tuberculous Arthritis commences either in the synovial membrane or the epiphysis, or spreads to the membrane from the periosteum.

Causes.—The disease is due to the growth of the tubercle bacillus in a person predisposed either by inheritance or by lowered general health. Some slight injury provides the area of lowered vitality which enables the tubercle bacillus to settle and grow.

Pathological Changes.—As a rule, the deposit of tubercle begins at one spot, and only in the later stages is the disease general. In the **synovial membrane** tubercles form, caseate, run together, and burst into the joint, so that general infection occurs. In the meantime the synovial membrane has become thickened and the fringes hypertrophied. The synovial membrane is converted into granulation tissue, which spreads over and erodes the cartilage. When the cartilage has been removed by ulceration and necrosis, the disease spreads into the bone and along the periosteum. In the **bone** the disease begins

with a deposit, which leads to rarefying osteitis. The tuberculous focus may caseate and form a chronic abscess, or a sequestrum may occur as a result of surrounding sclerosis. It is only when the disease burrows through the articular cartilage that the joint becomes infected.

Symptoms.—In the early stages the signs are not at all well marked, especially in those where the primary stage is osseous, and consist of slight aching after use. Soon, however, the cardinal signs appear: (1) Increased heat over the joint; (2) the presence of some fluid in the joint; (3) impaired mobility; (4) *wasting of the muscles which move the joint;* (5) thickening of the ends of the bones. The joint is usually maintained in the position of ease, viz., slightly flexed. In the late stages abscesses form, and the pain becomes severe, even to 'starting pains' at night. If the abscesses burst and are allowed to become septic, a hectic temperature follows, and amyloid degeneration may lead to death from exhaustion. The joint itself may be disorganized, the relaxation of the ligaments allowing dislocation to occur.

Results.—1. The disease may be cured, leaving a movable joint if treated early. 2. A cure may terminate in ankylosis if the articular surfaces have been damaged. 3. If sepsis has been admitted, the patient may recover after a time, with ankylosis and deformity; but as a rule, unless treated, death occurs from amyloid degeneration. 4. General tuberculosis may bring about a fatal termination.

The **Prognosis** depends on the stage at which treatment is begun, and whether the patient can afford good feeding, sunshine, and fresh air for prolonged periods. Babies, old people, and those who have phthisis as well, are the worst subjects, so that for them conservative treatment is not advisable.

Treatment.—1. *General.*—In all cases plenty of fresh air, sunshine, and good food, play a great part in the cure of early cases of tuberculosis. Cod-liver-oil, iron, and guaiacol are useful.

2. *Local.*—The co-existing chronic inflammation around the tuberculous area paves the way for the spread of the disease. The object of expectant treatment is to diminish this, and the method adopted is **rest** to the joint

by some fixation apparatus, plaster, poroplastic, leather or other form of splint. At the same time, if there is any displacement, **extension** is used to gradually tire out the tonically contracted muscles and prevent them pressing the inflamed bony surfaces together. Benefit may also be derived from **counter-irritation** by blisters and the cautery.

Pressure, by strapping with Scott's dressing, is of value in early stages. The injection of iodoform emulsion into the synovial membrane and joint is said to do good. Bier's method of producing **venous engorgement** by applying an elastic bandage above and below the joint for two hours daily is also practised.

Operative Measures. — Abscesses outside the joint should be incised, scraped out, and stitched up. Where the disease progresses in spite of expectant treatment, three operations are open to employment : arthrectomy, excision, and amputation.

Arthrectomy means removal of the whole of the tuberculous material with as little disturbance as possible of the surrounding healthy parts. The joint is opened, the entire synovial membrane dissected out, and diseased areas in the bone gouged away. The joint will often be a stiff one, but the growing ends of the bones are not interfered with.

Excision.—The synovial membrane must be removed as in arthrectomy. The ends of the bones are sawn off and all the cartilage-covered surfaces removed. Bony union is obtained between the sawn surfaces.

The choice between excision and arthrectomy depends mainly upon three things : 1. *The chance of successfully eradicating the disease* is greater with excision than with arthrectomy. 2. *The ultimate utility of the limb* is greater after arthrectomy in such joints as those of the upper extremity, ankle, and hip, if some movement is left; while in the knee a firm leg after excision is better than a weakly ankylosed joint after arthrectomy. 3. *The subsequent development of the limb* is stopped by excision, and not by arthrectomy, so that excision should not be done till after the sixteenth or eighteenth year. Infants and old people stand excision badly, from having insufficient recuperative powers. Infants should have arthrotomy or arthrectomy done; old people, amputation.

Amputation is indicated in old or broken-down people; where there is extensive disease of the bone and soft tissues; where amyloid disease is advanced; where excision has failed, or sepsis is present as well as tubercle.

Tuberculous Disease of Special Joints.

The **Shoulder-Joint** is not often affected. Abscesses point in front and behind the edge of the deltoid. Excision of the head is required.

The **Elbow-Joint** is often affected, the disease beginning in the olecranon or synovial membrane of the superior radio-ulnar joint. Immobilization or arthrectomy in children or excision in adults constitutes the treatment. Enough bone must be removed to leave an inch separation between the extremities. If expectant treatment is adopted, the joint must be fixed at a right angle, as, should the joint become stiff, this is the most useful position.

In the **Wrist** the disease may be primarily osseous or synovial. Prolonged immobilization should be tried; failing this, excision; but in old people amputation is often necessary.

Disease of the **Hip-Joint** and **Sacro-iliac Articulation** are considered separately (pp. 188, 191).

The **Knee-Joint** is commonly affected, the disease beginning either in the bone or synovial membrane. In late stages there is often a triple displacement of the tibia. It is flexed, rotated outwards, and partially dislocated backwards. Prolonged immobilization by means of a Thomas's knee-splint, together with general treatment, cures many cases. If this fails, free arthrectomy should be done in young people, but careful after-treatment must be carried out to prevent subsequent deformity, such as flexion or genu recurvatum from irregular growth. Excision is a most satisfactory operation when growth has ceased.

The **Ankle-Joint**.—The disease is primarily synovial, or in the astragalus. Swellings appear in front of the joint, pushing forward the tendons, on either side of the tendo Achillis, and in front of the malleoli. Impaired mobility, heat, and wasting of the muscles, are also present.

Immobilization should be tried in the early stages. Failing this, arthrectomy, combined with removal of the astragalus, should be adopted. In cases which progress in spite of this treatment, supramalleolar amputation is necessary.

Syphilitic Diseases of Joints.

Secondary Syphilitic Synovitis is not very common, is often symmetrical, and usually responds to treatment.

Gummatous Synovitis may be confined to one part of the membrane or generalized. The condition resembles that of tubercle, but the onset is more rapid, the wasting is less in proportion to the extent of the disease, and other signs of syphilis are present.

Chondro-arthritis is a rare form, characterized by fibrillation of the matrix, and proliferation of the cartilage cells.

The surfaces of the bone are pitted after the softened cartilage is worn away. The pain is slight, crepitus is absent, and there is no 'lipping' of the cartilages, so that it should be distinguished from osteo-arthritis. The treatment is that of syphilis, combined with rest to the joint.

Osteo-arthritis.

Under this heading are included a number of degenerative affections of joints whose origin is obscure.

Causes.—Exposure to damp and cold is thought to have some influence. That it is of nervous origin is suggested by the similar condition developing in diabetes where peripheral neuritis is present, and that an exaggerated condition occurs in locomotor ataxy in the form of Charcot's disease. A bacterial origin is suggested, and also that it is of toxic origin. Some cases can be definitely traced to an injury, such as a sprain, fracture, or dislocation.

Pathological Changes.—The cartilage cells proliferate and burst into the joint, leaving the matrix, which has become fibrillated, looking like coarse velvet or plush. The softened cartilage is worn away at the points of pressure, and the underlying bone becomes hard and polished (eburnated). In spite of this hardness.

the bone becomes worn away and perhaps grooved. At the same time there is overgrowth of the cartilages at their margins, which produces 'lipping,' while new bone is formed underneath. These osteophytes may lead to impairment of mobility, or may become broken off and form loose bodies in the joint. The synovial membrane is thickened and its villi hypertrophied. Cartilage may develop in the synovial fringes, and then, if detached, another type of loose body in the joint is formed. Effusion may or may not be present.

Symptoms of the common **chronic** type. This may be monarticular or polyarticular. The **monarticular** variety is often traceable to injury. Pain at the beginning of exercise and during damp weather, together with creaking on movement, and perhaps some effusion, constitute the symptoms. The cartilages are 'lipped' in the later stages, and there are exacerbations of pain. The limb may become useless from the pain, limitation of movement, and wasting of the muscles. The **polyarticular** variety is not due to injury, and affects chiefly females in middle life. The interphalangeal joints are first affected, becoming swollen and stiff. Bony outgrowths occur around the joints. Other joints are affected, and the patient in time may be entirely crippled.

An **acute polyarticular** variety may occur in young people after some infective fever. The smaller joints are first affected, and there is accompanying pyrexia, anæmia, and pigmentation of the skin, while the muscles are wasted, and neighbouring lymphatic glands may be enlarged.

Diagnosis.—From **chronic synovitis** by the pain being diminished by exercise, by the presence of creaking and 'lipping' of the cartilages. From **Charcot's disease** by the longer history, the presence of pain, and absence of signs of locomotor ataxy ; while the local signs of Charcot's disease are always well marked. **Gout** is always sudden in its onset, and usually begins in the big toe.

The **Prognosis** is unfavourable. The monarticular variety is least so, but in the polyarticular variety, in spite of treatment, there is bound to be crippling sooner or later.

Treatment should aim at removing any source of septic absorption, such as pyorrhœa alveolaris, endometritis, urethritis, etc.; otherwise it is confined mainly to alleviation of the symptoms. The joints should be kept warm by flannel coverings, frequently massaged, and on no account must movement be limited by apparatus. Good feeding and a dry climate are necessary, while of drugs iodide of potassium is of the most use. Where the disease is confined to one joint, and cripples the patient, excision may be advisable. In the hip-joint thickening of the trochanter and absorption of the head occur, so that the limb is shortened. If the patient falls upon the hip, some difficulty may be found in diagnosing it from fracture of the neck. The previous history, undue prominence of the trochanter, and normal rotation, distinguish it.

Neuropathic Arthritis.

Charcot's Disease is met with in cases of locomotor ataxy, and is an early manifestation. A rapid painless distension of the joint occurs, and may soon lead to dislocation. The distension may alternately disappear and recur, or, what is more common, the bones become greatly eroded, atrophied, and displaced from softening of the ligaments. Bony plates may be formed in and about the synovial membranes, and lead to false ankylosis; or osteophytes around the edges of the cartilages may also limit movement.

The *Diagnosis* depends on the rapid onset, the rapid effusion, absence of pain, the marked local changes, and the presence of signs of tabes. The pathological changes are only those of osteo-arthritis, but exaggerated in degree.

Treatment consists in applying some form of splint to prevent displacement, so that the limb may be of some use.

Syringomyelia produces a similar neuropathic arthritis, but usually in the upper limb. There is loss of the sensations of pain, heat, and cold, but not of tactile and muscular sense. Atrophy of muscles and trophic lesions are present.

Similar chronic arthritis is met with where the nervous

supply of a limb is impaired, either by central or peripheral lesions, such as spina bifida, hemi- or paraplegia, peripheral neuritis, or division of peripheral nerves.

Hæmophilic Diseases of Joints.—In hæmophilia a joint from slight injury may be distended with blood. Changes akin to osteo-arthritis and adhesions may occur.

Loose Bodies in Joints.

The varieties met with are : (1) The fibrinous or melon-seed bodies, which consist of laminated fibrin ; (2) detached hypertrophied villous processes ; (3) loose bodies due to the development of cartilage in synovial fringes which have either become pedunculated or detached ; (4) detached fibro-cartilage or articular cartilage ; (5) detached ecchondroses in osteo-arthritis. The knee and elbow are the joints commonly affected.

Symptoms are produced when the loose body is caught between the articular surfaces. Sudden severe pain occurs from stretching of the ligaments, and the joint is temporarily locked. The joint is quickly freed, and synovitis follows. The patient can often, by some movement, get the loose body into a position in which it may be felt.

The **Diagnosis** from a displaced semilunar cartilage is difficult unless the loose body can be felt, but the fact that locking is momentary is in favour of a loose body ; that a tender spot remains over the site of the internal semilunar cartilage is in favour of that as the cause. Also there is no history of a primary twist or strain in cases of loose bodies.

Treatment consists in opening the joint and removing the loose body. It is well, if possible, to fix the body with a hare-lip pin before opening the joint, as there is a great tendency for it to slip into some inaccessible portion of the joint.

Ankylosis.

True ankylosis means absolute rigidity of a joint from actual union between the bones, but it is usual practically to include cases where the interference with movement is less extensive.

1. **Ankylosis due to union between the articular surfaces** may be fibrous or bony. Fibrous union follows erosion of the cartilages, and some movement is possible. Bony union occurs after complete destruction of the articular cartilage, and no movement is possible.

2. **Ankylosis due to partial or complete obliteration of the synovial cavity by adhesions** may follow synovitis.

3. **Ankylosis due to contraction of the ligaments or periarticular structures** may follow gonorrhœal affections of joints, cicatricial contraction in the neighbourhood of joints, fractures near or into joints, myositis ossificans.

Joints may become fixed by interlocking of osteophytes in osteo-arthritis, Charcot's disease, or other forms of neuropathic arthritis.

Treatment of **bony** ankylosis aims either at correcting deformity or obtaining a movable joint. At the elbow movement is most important, and excision after growth has ceased is usually successful. If the knee is ankylosed in bad position, a cuneiform osteotomy should be done ; if the hip is in a bad position, either Adam's operation of removing a wedge from the neck of the femur, or, if there is insufficient neck, Gant's operation of dividing the femur just below the lesser trochanter. The femur can then be fixed so that it unites in the straight position.

Fibrous ankylosis is usually treated by bending the joint under an anæsthetic, with subsequent massage and passive movement ; but if there are extensive adhesions between the articular surfaces no good is done, as reunion quickly occurs. With elastic traction more good is done in a few days than by any number of forcible corrections under an anæsthetic. In tuberculous cases it is unwise to attempt forcible manipulation.

Hip-Joint Disease.

Although the hip-joint is subject to any of the diseases of joints, the term 'hip disease,' usually implies tuberculous arthritis.

Tuberculous Disease of the Hip-Joint is most common in children under ten years of age. The disease

commences in the synovial membrane or the bone. If in the latter, the primary focus is often at the lower part of the neck, just external to the epiphysial line. The trochanter, the epiphysis of the head, and the Y-shaped cartilage of the acetabulum, may also be the sites of origin. If the disease begins in the bone, it extends to the synovial membrane and produces general infection of the joint. Acetabular disease may extend inwards and produce an intrapelvic abscess. The muscles around the joint become tonically contracted and press the head against the posterior and upper part of the acetabulum, causing absorption of the parts which are in contact.

The acetabulum thus becomes enlarged, but the periosteum deposits new bone in advance, so that a rim is always present. The head of the bone in the later stages is drawn up on the dorsum ilii, and the limb is therefore much shortened.

Chronic abscess is very common, and usually points in front of or behind the great trochanter or near the origin of the adductor longus tendon.

Clinical History.—The patient limps and complains of pain in the hip, inner side of the thigh or the knee. The muscles of the thigh and nates are found to be wasted slightly. The limb is apparently lengthened and is flexed, everted, and abducted. The gluteal fold is lost owing to the flexion. There is pain on movement and limitation of movement. The position of flexion, abduction and eversion is assumed because the ligaments are most relaxed in this position and the capacity of the joint is greatest. The patient compensates for the deformity of abduction by tilting the pelvis downwards on the diseased side, so that the leg is apparently lengthened, but becomes parallel to the other, and at the same time producing a lateral lumbar curvature of the spine; he compensates for the flexion by tilting the pelvis forwards and downward, and at the same time producing lordosis. The true position of the limb is found by putting the two anterior superior spines on the same level and raising the leg till the lordosis disappears. The limitation of movement is shown by the pelvis moving with the limb in attempts at flexion, rotation,

abduction or adduction. As the disease extends the pain increases, and there may be starting pains at night, fever, and abscesses. The flexion increases, and the limb now becomes adducted and inverted. The pelvis is then tilted upwards on the diseased side to maintain the parallelism of the legs, and so **apparent shortening** is produced. As the disease progresses to absorption of bone and softening of the posterior and upper ligaments, **real shortening** occurs. If sepsis has been allowed to occur from bursting of the abscesses, hectic fever and amyloid changes come on. Cure, leaving ankylosis, may occur at any stage.

The **Diagnosis** has chiefly to be made from caries of the lumbar spine, but if careful attention is paid to the wasting, deformity, and limitation of movement, no trouble should be found. In **coxa vara** internal rotation and abduction are limited, but there is no wasting. In congenital dislocation all the movements are very free. An X-ray photograph clears any doubts.

Prognosis.—If properly treated and sepsis is prevented, recovery with some ankylosis is to be expected; but general tuberculosis may occur in any case. If sepsis occurs, death may follow from amyloid disease, pyæmia, or septicæmia.

Treatment.—In the early stages the patient must be kept in bed, with a weight extension applied in the line which the thigh takes, and as the flexion disappears the pulley is lowered. When the pain has disappeared and the limb is horizontal, the patient can get about with a Thomas's hip-splint, a patten on the sound leg, and a pair of crutches. These must be worn for at least six months after symptoms have disappeared. The general health must be attended to by good feeding, sunshine, and fresh air. Phelps box is a useful apparatus in this stage. If abscesses form, they should be opened, scraped out with a flushing spoon, and stitched up. Excision of the head of the femur and free scraping out of the joint by the anterior incision is sometimes done in the early stage; but much shortening and a weak movable joint are the results, while complete removal of all the diseased tissues is difficult. However, excision should be done where the disease progresses in spite of treatment, and where the

disease is primarily acetabular. In the **late stages,** where septic sinuses are present, the head of the femur should be excised by the posterior incision, diseased bone removed from the acetabulum, and the tuberculous synovial membrane completely dissected away. Amputation is required if the disease still progresses, if amyloid disease has commenced, or if the patient's general health is too low to stand a prolonged operation.

After recovery by ankylosis the limb may be so adducted and flexed that removal of a wedge from the neck or division below the trochanters is necessary to remedy the deformity.

Disease of the Sacro-Iliac Joint.

Tuberculous disease is commoner in adults than in children, and is usually primarily osseous.

The **Symptoms** consist of pain over the joint, increased by movement or standing. From pressure on the lumbo-sacral cord, pain may be referred to the leg. The leg can be moved without pain or limitation if gentleness is exercised; but pain is produced by compressing or forcibly separating the crests of the iliac bones. There may be apparent lengthening on the diseased side from pushing downwards of the iliac bone on that side. Tenderness and swelling, or even an abscess, may be felt over the joint posteriorly, or the abscess may burrow and point in the lumbar region, groin, or ischio-rectal fossa.

The **Diagnosis** from **sciatica** is made by the absence of pain on compressing the pelvis in sciatica; from **hip disease,** by the fact that there is no pain or limitation of movement at the hip-joint in sacro-iliac disease if gentleness is exercised and the pelvis supported; also that real shortening never occurs in sacro-iliac disease, and that pain on compressing the iliac crests is never present in hip disease.

Prognosis.—If asepsis is maintained and the case is carefully treated, recovery should occur.

Treatment in the early stages consists of absolute rest and a pelvic support. Abscesses should be opened and diseased bone removed.

Excision of Joints.

The chief conditions for which excision is done are: (1) In tuberculous disease and the late stages of acute arthritis, where the disease progresses in spite of treatment; (2) for ankylosis in a faulty position from tubercle, injury, gonorrhœa, or sepsis; (3) for compound dislocation or fracture-dislocations; (4) for comminuted fracture into a joint, where ankylosis will follow and interfere with movement, as in the shoulder or elbow joint; (5) for some cases of osteo-arthritis.

In some regions a firm ankylosis is aimed at; in others a movable joint is obtained.

CHAPTER XXI

INJURIES OF THE SPINE

Sprains.

SPRAINS are produced by violent flexion or rotation of the spine, resulting in rupture of muscles or ligaments. The lumbar and cervical regions are most frequently affected.

The **Symptoms** vary in severity. There is pain, which may be agonizing on movement, so that the spine is maintained in a rigid attitude; tenderness on pressure, and perhaps swelling and bruising. There are no nerve symptoms unless intraspinal hæmorrhage is also present, when paraplegia may appear. Spinal meningitis may follow and lead to compression of the cord, or tuberculous disease of the vertebræ may have its starting-point in a sprain.

Treatment consists in absolute rest, with the application of hot fomentations for a few days, and, when the pain has ceased, massage. In severe cases the patient should be kept in bed for six or eight weeks. If paraplegia develops from the pressure of blood or inflammatory exudation, laminectomy may be necessary. If pain continues from chronic inflammation of the damaged ligaments, counter-irritation with the cautery is necessary.

Penetrating Wounds of the Spine.

Stabs and gunshot wounds are responsible for these lesions.

The **Symptoms** produced are : (1) Those due to the wound in the soft parts, and which may injure the vertebral artery in the neck, the thoracic or abdominal viscera ; (2) fracture of the vertebral arches, with compression of the cord by bone or blood ; (3) loss of cerebro-spinal fluid, which leads to pressure on the base of the brain ; (4) diffuse septic meningitis or myelitis ; (5) wounds of the spinal cord. These may be partial or complete transverse lesions, or division of nerve roots only.

Treatment consists in enlarging the wound, removing foreign bodies or fragments of bone, and rendering the wound **aseptic**. An attempt should be made to unite divided nerve trunks, but it is useless to attempt to unite a divided spinal cord.

Fractures of the Spine.

Causes.—1. **Direct violence**, such as a fall over a railing or a heavy blow on the back. The arches are the parts most susceptible to this form of injury. 2. **Indirect violence** is the more usual cause, by forcible flexion of the spine. The spine breaks at the weakest part, the cervico-dorsal region.

Incomplete Fractures are those in which the continuity of the spine is not destroyed, and are due mainly to direct violence. Fractures of the **spinous processes** occur in the lower cervical and dorsal regions. There are signs of local violence, crepitus, and irregularity in the line of the spines. Great depression will cause paraplegia. Fracture of the **laminæ** produces similar signs, and may cause paraplegia. **Fracture of the transverse processes** and **partial fracture of the bodies** are rare, apart from more serious injuries, and difficult to diagnose. Paraplegic symptoms may arise in any incomplete fracture from concussion immediately, later from hæmorrhage, or still later from inflammatory exudation.

Treatment consists in absolute rest. Laminectomy may be necessary for paraplegia.

Complete Fractures are usually associated with displacement, and are called **fracture-dislocations**. They usually result from indirect violence. The line of fracture runs obliquely from above downwards and forwards, through the body of the vertebra, the upper part of the spine being carried forwards, the posterior edge of the lower portion forming a sharp margin, over which the cord is stretched and bruised, cut through or disintegrated. The bones may go back into position, but the damage to the cord is irremediable. Extradural or intradural hæmorrhage is likely to occur. The gravity of the case depends upon the injury to the cord at the time of the accident, not upon the subsequent pressure by the displaced bones.

Symptoms. — There may or may not be angular deformity, mobility, and crepitus. Paraplegia is usually present below the seat of injury, and there is always some shock. There is generally a zone of hyperæsthesia, due to irritation of nerve roots, just above the fracture. The reflexes below are abolished completely at first; their return indicates that the lesion of the cord is partial. Myelitis, cystitis, and bedsores quickly follow division of the cord.

The *Prognosis* depends on the situation and amount of damage to the cord. The higher the lesion and the more complete the damage, the greater is the danger. In the cervical region death occurs in a few days or weeks.

Treatment.—Absolute rest on a firm horsehair mattress, placed over fracture boards at first, with a water-bed in the later stages. **Operative procedures** may be necessary, and will be discussed under the heading of laminectomy.

Reduction, under an anæsthetic, by extension may be done when the fracture is not in the cervical region and paraplegia is not complete. The skin must be carefully attended to, as **bedsores** may develop very rapidly. The **bladder** must be emptied by a catheter, with strict antiseptic precautions. If septic cystitis occurs, there is rapid extension to the kidneys and death. The penis should be purified and wrapped in antiseptic gauze, and the urethra flushed out before a catheter is passed. If cystitis occurs, the bladder must be washed out with boric acid lotion twice a day and urotropin administered.

The **constipation** must be treated by purgatives or enemata. The patient may gradually recover, partially or completely, or recover some powers of reflex micturition, or die from septic poisoning. If the diaphragm is paralyzed, the patient dies quickly from respiratory troubles.

Dislocations of the Spine.

Dislocation of the spine is practically confined to the cervical region. The articular processes become displaced from one another on one side or both, and the discs and common ligaments are torn. The upper part of the spine is always displaced forwards. The vertical position of the articular processes in the dorsal and lumbar regions prevents dislocation unless accompanied by fracture. Varying degrees of paralysis accompany dislocation, according to the pressure exercised upon the cord. Dislocation of the occiput from the atlas or the atlas from the axis is usually accompanied by fracture of the odontoid process or rupture of the transverse ligament, and death occurs at once from pressure on the cord. Dislocation between the lower five cervical vertebræ usually results from forced flexion combined with rotation. The upper part is displaced forwards, so that the inferior articular processes of the upper vertebra lie in the intervertebral notches of the lower. The dislocation may be unilateral or bilateral.

Unilateral Dislocation.—The head is turned to the opposite side and fixed. Cord symptoms are absent, but there may be tingling and pain along the course of the nerves pressed on in the intervertebral notch. If seen early, the deformity should be reduced under an anæsthetic by flexion and traction. In old-standing cases, the pain from pressure on the nerves may be relieved by excising the articular process.

Bilateral Dislocation, if complete, causes pressure on the cord; if incomplete it probably will not.

Treatment is useless unless paraplegia is incomplete, as the cord is irretrievably damaged. If paraplegia is incomplete, an attempt at reduction by traction should be made, and failing that laminectomy, with excision of portion of the articular processes which are preventing reduction.

Secondary Effects following Spinal Injuries.

The secondary effects which follow spinal injuries are: (1) Direct spinal concussion; (2) spinal hæmorrhage; (3) spinal meningitis; (4) spinal myelitis; (5) spinal neurasthenia.

Direct Concussion is due to severe blows to, without gross damage of, the spinal column. The functions of the cord are disturbed without any considerable visible anatomical change.

The *Symptoms* produced are an immediate and varying degree of paraplegia, general shock, and absence of the reflexes for a time. Death may be produced at once by a blow in the cervical region. Priapism never occurs in simple concussion.

Prognosis.—The patient is likely to recover, more or less perfectly, but it is always difficult to be sure that merely concussion is present.

Treatment consists in absolute rest in the prone position, with the application of an icebag to the spine.

Spinal Hæmorrhage from traumatism may be into the cord or outside it.

Intramedullary Hæmorrhage may result from injury. The substance of the cord is ploughed up, and paraplegia is more or less complete. Some degree of recovery may follow, but the parts supplied from the gray matter at the site of the hæmorrhage remain paralyzed.

The *Diagnosis* depends on the rapid onset of paraplegia, but a crush of the cord might produce exactly the same conditions.

The *Prognosis* depends on the size and situation of the clot.

The *Treatment* is the same as for concussion.

Extramedullary Hæmorrhage may follow sprains, and the bleeding is usually extradural. The symptoms are those of spinal irritation, pain, hyperæsthesia, and spasms, rapidly followed by loss of power and paralysis, which extends from below upwards, causing death by asphyxia. The bleeding may stop at any point and the blood-clot be absorbed in time, so that complete recovery ensues. If a correct diagnosis is made, laminectomy may be done to relieve the pressure.

Spinal Meningitis from injury may be acute or chronic.

Acute Spinal Meningitis is due to bacterial infection.

The *Symptoms* begin with a rigor, followed by fever. There is severe pain in the back and limbs, increased by movement, and causing rigidity and painful muscular spasms ; hyperæsthesia and increased reflex excitability. Myelitis usually follows, causing paraplegia, bedsores, and bladder troubles. Death is usually due to coma, when spreading to the brain has occurred.

Treatment consists of absolute rest, and attention to the bladder and skin.

Chronic Meningitis is localized, and either chronic from the beginning or the sequel of an acute attack. There is localized pain and rigidity in the back, with shooting pains, hyperæsthesia, and muscular spasms. The reflexes are exaggerated, and vesical troubles may ensue.

Treatment consists of absolute rest and counter-irritation by the cautery.

Spinal Myelitis may follow any injury of the spine, meningitis, or pressure on the cord. In acute myelitis the structure of the cord is quickly destroyed ; in chronic cases the nerve structures are compressed by cicatricial tissue.

Acute Myelitis.—Pain, hyperæsthesia, and muscular cramps are quickly followed by paralysis. The reflexes vary according to the completeness of damage. The sphincters of the bladder and rectum are paralyzed, while septic cystitis and bedsores quickly follow and cause death.

Chronic Myelitis causes paresis, gradually followed by paralysis ; hyperæsthesia, gradually followed by anæsthesia, together with bladder and rectal troubles.

Treatment is symptomatic.

Spinal Neurasthenia is usually due to some injury to the spine, such as a sprain from a railway accident ; sometimes to degenerative changes in the spinal cord following small hæmorrhages ; sometimes to hysteria following the general nervous upset. The symptoms are those of pain in the back, inability to undergo mental or physical effort. The bladder and rectum are seldom affected, and

sensation is practically normal, or else hyperæsthesia is present. The patient usually recovers in time, especially after compensation has been obtained.

Treatment consists of complete rest and quiet after the accident. This is difficult to obtain if the patient is worried over trials concerning compensation. After a short time massage and passive movement should be practised, while the patient is being fed up and is taking tonics.

Paraplegia from Spinal Injuries.

1. **Paraplegia arising immediately after the accident**: (1) From direct concussion; (2) from intramedullary hæmorrhage; (3) from crushes or division of the cord.

2. **Paraplegia arising after an interval**: (1) From extramedullary hæmorrhage, if symptoms come on in twenty-four hours without pyrexia; (2) from the pressure of exudation in meningitis: the symptoms are preceded by fever, and develop in two or three days; (3) from the pressure of callus or cicatricial tissue around the cord and membranes.

A **Complete Transverse Lesion** produces—1. Paralysis, with rapid atrophy of the muscles supplied by the destroyed segment. 2. Paralysis of all the muscles supplied by the segments below the lesion; complete and permanent loss of the deep reflexes below the lesion, while the superficial may reappear. If the lesion is incomplete, the reflexes, though absent at first, reappear and become exaggerated. 3. Complete anæsthesia below the lesion, and a zone of hyperæsthesia just above it from irritation near the site of injury. 4. Vasomotor paralysis and trophic disturbance in the paralyzed parts. 5. Visceral changes, especially in the bladder and rectum.

Phenomena of Paraplegia at Different Levels.

1. **At the Upper End of the Sacrum.**—Only the cauda equina is injured, and paralysis of the sacral plexus is produced. There is paralysis of all the muscles and anæsthesia of all the skin of the legs, except those parts supplied by the anterior crural and obturator nerves. The bladder and rectum are paralyzed, and incontinence follows.

2. **In the Dorsi-Lumbar Region.**—There is complete paralysis of the lower limbs, together with anæsthesia. If the centres for the bladder and rectum are destroyed, incontinence and cystitis quickly follow. If the vesical centre escapes destruction, retention with overflow is the result.

3. **In the Mid-Dorsal Region.**—Reflex micturition may occasionally occur after a time. Paralysis of the abdominal muscles prevents proper attempts at coughing; gases accumulate in the intestines and hinder respiration when the abdomen has become distended.

4. **In the Cervico-Dorsal Region.**—The intercostal muscles are paralyzed, and respiration has to be carried on mainly by the diaphragm, so that if bronchitis is present the patient is unable to get rid of the mucus, and dies from asphyxia. Priapism is common.

5. **In the Lower Cervical Region.**—If the lesion is above the fourth cervical vertebra, death occurs instantly from paralysis of the phrenic nerves.

Laminectomy.

Removal of the laminæ and spinous processes of one or more of the vertebræ is done to relieve pressure on the cord from depressed bone, inflammatory material, callus, cicatrices, or tumours. It is useless in cases where the spinal cord has been completely divided or one segment is totally disintegrated. The presence of the deep reflexes, or their return after a little time, indicates that the lesion is not a complete one, and so may justify operation. Other cases suitable for operation are: (1) Injuries which involve the cauda equina; (2) depressed fracture of a neural arch; (3) bilateral dislocation of the cervical spine; (4) paraplegia arising after an interval from the pressure of blood or inflammatory exudation, cicatrices, or callus.

CHAPTER XXII

DISEASES OF THE SPINE

Spina Bifida.

By spina bifida is meant a condition in which there is a cleft, due to imperfect development, in the posterior wall of the spinal canal, and usually accompanied by protrusion of the spinal membranes, and perhaps some of the constituents of the cord, through the gap.

Varieties.—1. **Myelocele** results from non-closure of the primitive medullary groove. The central canal is seen opening on a raw surface, which consists of neural elements. The children are still-born, or only live a day or two.

2. **Syringo-Myelocele** is rare, and consists of a dilatation of the central canal, so that a portion of the spinal cord is spread out over the interior of the sac. Trophic phenomena are prominent.

3. **Meningo-Myelocele** is common. The membranes remain adherent to the skin, fluid collects in them, and the spinal cord and nerves run down the posterior part of the sac.

4. A **Meningocele** is a protrusion of the membranes containing cerebro-spinal fluid, but no portion of the spinal cord or nerves.

Clinical Characters.—A spina bifida forms a tumour in the mid-line of the back, most commonly in the lumbar region. The skin over it may be normal, or thin and translucent. Its size can be diminished by pressure, producing at the same time in infants distension of the anterior fontanelle, and there is an impulse on crying. The cleft between the bones may be felt. Associated deformities are talipes, hydrocephalus, and trophic disturbances. A shadow on transillumination, an umbilicus in the centre of the tumour, or a vertical median furrow, indicate that there are nerve elements present in, or adherent to, the sac.

Prognosis.—If the skin is thin it may give way, causing escape of cerebro-spinal fluid, and death in a few days from septic meningitis. If the tumour is small and

covered with healthy skin, the patient may reach adult life. A meningocele may even undergo spontaneous cure from shutting-off at its neck.

Treatment is palliative or operative. *Palliative* measures consist of protecting the tumour by a shield, and are necessary when operation is refused, when the child is very feeble or the opening extensive, or when ulceration is present but perforation is not imminent. *Operative* measures consist in the injection of Morton's fluid (iodine, 10 grains; iodide of potassium, 30 grains; glycerine, to 1 ounce), or excision of the sac. In the former a small quantity of the cerebro-spinal fluid is withdrawn, with the child recumbent, and then ½ to 1 drachm of Morton's fluid is slowly injected, with the object of promoting adhesion between the walls of the sac. It is only suitable in young children for simple meningocele, where the tumour is rapidly increasing in size or ulcerating, and where excision is out of the question. Excision of the sac is most suitable in cases of meningocele; but in meningo-myelocele the nerve elements may be dissected off the skin, or the strip of skin to which they are adherent may be separated and replaced with them in the spinal canal. The muscles and skin are then stitched over them. Septic meningitis and shock constitute considerable dangers in this operation.

Spina Bifida Occulta means that there is a gap in the neural arch without protrusion of the membranes. An umbilicus, a tuft of hair, or a lipoma over the site, may be the only indications of its presence.

Congenital Sacral Tumours.—These may be spina bifida, dermoids, or even a partially developed fœtus (teratoma). There may be every gradation between a dermoid and attached twins. These always project backwards, and cannot be felt from the rectum.

Congenital Coccygeal Tumours arise from the neurenteric canal, and consist of alveoli lined with cuboidal epithelium, or else are dermoids. Sarcoma and cystic hygroma may also be found. These tumours lie between the sacrum, coccyx, and rectum, but may project into the gluteal region.

Inflammatory Affections of the Spine.

Acute Osteomyelitis is rare, and does not differ from similar affections of other bones. Septic meningitis is likely to follow, so that the prognosis is bad.

Tuberculous Disease of the Spine (Pott's Disease) usually begins in the bodies, and leads to the so-called 'angular curvature.'

Etiology.—The tubercle bacilli develop in a patient predisposed by inherited tendency, or lowered general health, plus some slight injury, which produces the necessary area of lowered vitality. The lower dorsal region is the commonest situation, but any part may be affected.

Pathological Changes.—The disease begins—1. Under the periosteum of the anterior surface of the bodies. The disease spreads to the adjacent vertebræ. The bodies and intervertebral discs are destroyed, so that a gradual curvature is produced. 2. In the interior of the bones, near the intervertebral cartilages, and rarely affecting more than one or two vertebræ. As the bones become destroyed, the weight of the body causes the vertebræ above to sink down, and so more or less acute curvature results. The disease may run its course with or without suppuration.

Cure is effected by the falling together and ankylosis of the bones, new bone being formed in the concavity and acting as a buttress. The disease may spread backwards through the posterior common ligament and cause paraplegia from pressure on the cord. Rarely, lateral curvature is produced from disease mainly affecting one side of the vertebræ.

Symptoms.—There are three typical signs: pain, rigidity, and deformity; and there may be abscess and paraplegia. Rigidity is the most important of these signs.

1. **Pain.**—In the early stages it may be only of an aching character. **Local** pain is that felt in the situation of the diseased bones, and tenderness may be elicited by percussion over the spinous processes. **Referred** pain is produced by pressure on the roots of nerves in the intervertebral foramina, and is felt at their cutaneous terminations. If in the lumbar region, pain may be felt in the

legs; if in the dorsal region, pain may be felt in the abdomen, chest, or arms; if in the upper cervical region, pain may be felt over the upper part of the chest or back of the head.

2. **Rigidity** is invariably present. In the early stages it is due to muscular contractions to steady the painful part. In an adult it can be demonstrated by getting him to go through various movements while a hand is kept over the suspected area. The limitation of movement is better felt than seen. In a child, it is better to lay it on its face and test the flexibility by grasping the ankles, and so raising the legs and pelvis. If rigidity is present, the whole body is raised instead of the back being curved. In the later stages, when repair has taken place, the rigidity is due to bony ankylosis. Secondary curvatures restore the upright position of the body.

3. **Deformity** is due to falling forward of the upper part of the spine as the vertebral bodies become destroyed, so that cases cured in the early stages present none. Where only two bones are involved the deformity is angular; where a larger number are affected the deformity is a curvature. When the curvature is in the dorsal region, the sternum becomes convex anteriorly, and the intercostal spaces are diminished or obliterated.

4. **Abscess** is a serious complication, for the disease is often situated in inaccessible regions, so that a radical cure is impossible; and if sepsis occurs in the abscess cavity, the patient is likely to die from amyloid disease. The pus collects under the anterior common ligament, and finds its way along the sides of the vertebræ to the surface at some distance from the diseased area.

In the **cervical** region a **chronic retropharyngeal abscess** may be found behind the prevertebral fascia. It may project into the back of the pharynx and press upon the glottis, causing difficulty in breathing and swallowing. The abscess may burst into the pharynx and become septic; extend down into the mediastinum or point in the neck behind the sterno-mastoid; or extend down into the axilla behind the vessels. In the **dorsal** region the abscess may follow the course of the posterior branches of the intercostal vessels, and form a swelling close to the spinous processes, with an impulse on coughing; it may

extend along the ribs and point where the lateral branches of the intercostal vessels are given off; or it may make its way under the ligamentum arcuatum internum, and, getting into the psoas sheath, form a psoas abscess.

In the **dorsi-lumbar** or **lumbar** region, a **lumbar** or **psoas abscess** is formed. If the pus tracks backwards along the posterior branches of the lumbar arteries, a lumbar abscess is formed. It the pus gets into the psoas sheath, it passes downwards to the brim of the pelvis, then outwards under the fascia iliaca, forming a swelling in the iliac fossa; then it travels under Poupart's ligament and beneath the femoral vessels. The abscess cavity then expands and comes to the surface, either to the outer or inner side of the vessels. In some cases the cavity extends far down the thigh, or backwards beneath the neck of the femur, to open behind the great trochanter. Rarely the pus travels down inside the pelvis, and comes to the surface in the ischio-rectal fossa or through the sacro-sciatic foramen.

There is little pain with these abscesses till they come to the surface, unless pyogenic organisms have found an entry.

5. **Paraplegia** is rare, and is due to the pressure of tuberculous material on the cord, and not to the acuteness of the curve. Sclerosis is produced by gradual, subacute myelitis by rapid, pressure. The symptoms produced are those of motor weakness. There is loss of power in the legs, weakness of the sphincters, and exaggerated knee-jerks. Later the weakness gives way to paralysis and rigidity, the reflexes diminish, and incontinence of urine comes on.

In the upper cervical region, death may suddenly occur from slipping forward of the occiput, owing to disorganization of the atlanto-occipital or atlanto-axial joints, or detachment of the odontoid process, with consequent compression of the cord.

Course of the Case and Prognosis.—If untreated, the disease progresses steadily; if treated early, repair by ankylosis may be expected. If abscesses occur, they may be opened, scraped out antiseptically, and stitched up; but once septic infection occurs, amyloid disease is almost certain to follow. Paraplegia may disappear under treatment, but septic cystitis or bedsores may be fatal complications. Aute miliary tuberculosis may come on at any time.

The *Diagnosis* of spinal caries is easy when the characteristic deformity is well marked; but in the early stages the most reliable sign is rigidity. Tumours of the spine and aneurismal erosions may simulate caries; but as a rule other signs are present, and the symptoms steadily progress in spite of treatment.

Treatment consists chiefly in immobilizing the spine and taking the weight of the body from above the seat of disease by some form of support. The various methods are:

1. **Rest.**—The patient should be kept on his back on a firm mattress, but never in the prone position, with firm sand-bags on either side to steady the body or neck, according to the seat of disease. If necessary, a plaster, poroplastic, or leather and steel jacket may be applied. Extension applied to the head and legs is of great value in the progressive stages.

2. **Spinal Supports.**—So that patients may get about when the disease is quiescent, a support is necessary; children, however, require an apparatus which allows them, though still recumbent, to be carried out into the fresh air and sunshine. 1. **Phelps' box** is a wooden trough for the body, with two trunks running off it for the legs. The child is strapped into this, and kept there for two or three years, except when being washed. 2. **Double Thomas's splint**: This may be made with a head-rest, to take off the weight of the head. 3. **Jackets** are used when the child is practically well. In adults they may be used after the first few months of rest. The jackets may be of plaster, poroplastic, or leather and steel. If the caries is in the cervical region, a jury-mast should be added, with chin and occiput straps to support the weight of the head. The apparatus should be worn for at least a year after recovery is apparently complete. The general treatment consists of good feeding, tonics, fresh air, and sunshine. Forcible straightening of deformity is not to be recommended.

Treatment of Complications.—**Abscess**: An incision should be made into the cavity, the contents evacuated, the lining membrane scraped out with a flushing spoon, and the opening stitched up. The wound heals, and so any chance of septic infection is prevented. If the wound

becomes infected with tubercle or the cavity fills up again, the process can be repeated, and at the same time the tuberculous edges can be excised. Another method is to tap the abscess, wash out the cavity through the cannula, and leave in an ounce of iodoform emulsion. Occasionally in the lumbar vertebræ it is possible, by an incision alongside the erector spinæ, to get directly at the disease, scrape the bone or remove sequestra. **Paralysis**: Double **extension** should first be tried, and often answers very well. Strict attention must be paid to maintaining an aseptic condition of the bladder and urethra.

Laminectomy is required when pressure on the cord continues in spite of treatment; when septic cystitis threatens life; when the neural arches are mainly affected; and when pressure symptoms come on late, from development of scar-tissue outside the membranes.

Syphilitic Disease of the Spine is rare, consists of gummata, and simulates caries. Lesions elsewhere help in the diagnosis.

Rheumatic Spondylitis and **Gonorrhœal Rheumatism** resemble such diseases in other joints, and are treated in the same way.

Osteo-arthritis may attack the spine and produce ankylosis from interlocking of the osteophytes formed around the intervertebral joints. Kyphosis and pain are produced, and, if the disease spreads to the articulations between the ribs and vertebræ, pulmonary complications follow from impaired movements.

Tumours of the Spine are usually primary sarcoma or secondary sarcomatous and carcinomatous growths. Severe pain unrelieved by rest, deformity, and paraplegia, are the chief symptoms. Treatment is rarely of avail.

Tumours of the Spinal Cord and Membranes belong to the connective-tissue group. They may grow outside the dura mater, from the inner side of the dura, or in the spinal cord itself. Gumma also occurs in these situations. Signs of pressure, viz., referred pain, spasm, or paraplegia, point to the site of the disease. Treatment aimed at syphilis should first be tried, and failing that laminectomy holds out the best prospect.

Infantile Paralysis is due to inflammatory destruction

of the multipolar cells of the anterior cornua, and produces paralysis and atrophy of the corresponding groups of muscles. Various forms of talipes follow, and have to be treated by mechanical supports, tenotomy, tenoplasty, arthrodesis, or amputation.

CHAPTER XXIII

HEAD INJURIES

Injuries of the Scalp.

Wounds of the scalp may be contused or incised. If the loose cellular layer below the occipito-frontalis aponeurosis is opened up, and sepsis is introduced, the pus spreads over its whole extent. The blood-supply of the scalp is good, and is contained in the subcutaneous tissue, so that torn-up flaps retain their vitality.

Treatment consists in purification of the wound, shaving a wide area around and accurate stitching.

Contusions result in the formation of hæmatomata, which may be—(1) **Superficial**, and in the subcutaneous tissue ; (2) **subaponeurotic**, and forming a soft fluctuating swelling, limited only by the attachments of the occipito-frontalis aponeurosis ; (3) **subpericranial**, and limited by the attachment of the pericranium to the sutures surrounding the bone over which the injury has occurred. A fluctuating swelling with a hard edge, due to the deposit of fibrin, usually presents itself, and feels like a depressed fracture ; but the fact that the edge can be made to disappear by pressing hard with the finger serves to distinguish it.

Treatment consists in the application of lotio plumbi.

Traumatic Cephal-hydrocele is a rare condition due to fracture of the cranial vault in children communicating with the subarachnoid space or lateral ventricles. A fluid pulsating swelling under the scalp presents itself. It is better left alone.

Injuries to the Cranial Bones.

Contusions may lead to osteomyelitis and its complications ; to subcranial abscess by auto-infection ; to detach-

ment of the dura mater, and meningeal hæmorrhage ; or to abscess in the brain.

Fractures of the Skull may be—(1) fissured fractures of the vault ; (2) fissured fractures of the base ; (3) depressed or punctured fractures.

1. **Fissured Fractures of the Vault** are due to direct injuries, such as blows, or to indirect injury, such as compression, which bursts the skull. If simple there are no definite signs ; if compound the fissure can be seen and felt. The prevention of sepsis forms the main line of treatment. Callus may form at the site of fracture and produce traumatic epilepsy.

2. **Fractures of the Base** are usually fissured, but may be punctured.

Causes.—(1) **Violence applied to the cranial convexity** produces fracture—(*a*) by *irradiation—i.e.*, a fracture begins in the vault and extends round to the base ; or, what is more common, (*b*) by *bursting—i.e.*, the vault is compressed, and the base bulges beyond its limits of elasticity and gives way.

(2) **Direct injury** to the base is an unusual cause—*e.g.*, when a pointed instrument is pushed through the orbital plate, cribriform plate, or basisphenoid ; or bullet wounds of the base.

(3) **The impact of the vertebral column against the occipital condyles** produces fractures around the foramen magnum in some cases of falls on the feet or nates.

The direction of the fracture may be longitudinal, oblique, or transverse, and limited to one fossa or involving all three. The majority are **compound** fractures, the communication with the air being through the nose, orbit, nasopharynx, or the external auditory meatus after rupture of the tympanum. The dangers of fractured base are extreme, and consist of injury to the base of the brain, hæmorrhage from the venous sinuses or meningeal arteries, and septic meningitis.

The *Signs* are those of (1) injury to the brain, (2) escape of cranial contents, (3) injury of cranial nerves.

(1) **Injury to the brain** may be of the nature of concussion, compression, or laceration.

(2) **Escape of cranial contents**, which may be blood, cerebro-spinal fluid, or rarely brain itself. 1. **Hæmorrhage**

manifests itself in various situations, according to the position of the fracture. In the *anterior fossa* the bleeding may be from the nose or into the orbit, or may pass back into the pharynx, be swallowed, and subsequently vomited. The eye may be pushed forward and pulsate if the cavernous sinus be ruptured. In the *middle fossa* blood usually runs from the ears ; but slight bleeding from the ear may be caused by minor injuries, such as rupture of the membrana tympani, tearing of the lining of the auditory canal, and fracture of the tympanic bone. In the *posterior fossa* a hæmatoma may form behind the mastoid process.

2. The escape of **cerebro-spinal fluid** is a certain sign that a fracture communicates with the subdural space. It may appear in the same situations as hæmorrhage, but is usually found escaping from the ear owing to fracture of the petrous bone. The fluid is limpid, specific gravity 1005, with no albumin, but containing pyrocatechin, which gives the same reaction as sugar with Fehling's solution, The amount which escapes may be small or very large but as a rule it soon ceases.

(3) **Injuries to the cranial nerves** vary according to the site of fracture. That most commonly involved is the facial, in the aqueductus Fallopii, and the paralysis may come on immediately from rupture, or after two or three weeks from the pressure of callus.

The *Prognosis* is grave, but if there is no severe injury to the brain or compression from hæmorrhage the patient should recover, so long as sepsis is prevented.

Treatment.—The chief aim of treatment is to prevent sepsis. The ear must be mopped out with an antiseptic, and then kept covered with an antiseptic dressing, as if it were a wound. The patient must then be kept quiet, the bowels opened with a purge, and an icebag applied to the head. The diet should be low, and a return to active life not permitted for six weeks. If septic meningitis occurs the patient is bound to die.

3. **Depressed** and **Punctured Fractures** are due to direct violence ; usually affect the vault ; may be simple, compound, or comminuted. The outer table may be depressed without the inner being broken, in such places as the frontal sinus. Rarely the inner table is broken

and depressed without fracture of the outer. As a rule both tables are broken. The inner suffers most damage, as it is less supported ; the force of the blow is more diffused by the time it reaches the inner ; also, the momentum of the striking body is less, and the débris of the outer table increases the size of the penetrating body.

Symptoms.—If there is a wound, the fracture and depression may be seen, and blood, cerebro-spinal fluid, or brain, may be escaping. If there is no wound a careful examination is necessary, as a hæmatoma may form and obscure the depression. In cases of doubt an incision should be made.

Gunshot Injuries vary in their effects, according to the velocity and angle at which the bullet strikes. Bullets travelling at a high rate of speed may penetrate both sides of the skull. The momentum of the bullet is transmitted to the molecules of the brain substance, serious pressure is exerted upon the important centres at the base, and respiration may cease at once.

In a **Simple Depressed Fracture** there is usually some concussion, which is followed by compression from hæmorrhage in the neighbourhood. The depressed bone also causes compression later by the **spreading œdema** it sets up in the brain. Death may result quickly, or the patient may recover and then become the subject of traumatic epilepsy from irritation of the cortex. If the depression is over the motor area, convulsions or paralysis are quickly induced.

In a **Compound Depressed Fracture** the blood escapes and does not produce compression. Concussion may or may not be present. The advent of sepsis produces inflammation of the bone, membranes, and brain, which may be limited if the drainage is free ; but if not, death soon follows from compression by the inflammatory exudation. During the stage of compression a hernia cerebri is formed. If the depressed fragments are early removed and asepsis is maintained, the patient has a good chance, unless the brain itself is severely injured.

Treatment.—In all cases, except the saucer-like depressions which occur in young infants, it is necessary to elevate or remove the depressed fragments, stop all bleed-

ing, and disinfect the wound. Symptoms should never be waited for, because, although the patient may recover without operation, the depressed bone may cause traumatic epilepsy or insanity. The skin is shaved and purified, and a large flap is turned down to expose the fractured area, or if a wound is present it is enlarged. Comminuted fragments are removed, and sharp edges which press on the dura mater are clipped away with Hoffmann's forceps. If an elevator cannot be introduced under the depressed bone, a trephine hole is made through the nearest sound bone, the elevator introduced, and the bone prised up. The piece of bone removed with the trephine should be replaced. If the dura mater is torn, it should be stitched up, and then the scalp flap is sutured without a drain, unless oozing is still going on. If the fracture has been compound, it is better to drain it for twenty-four hours. In punctured fractures the hole must be enlarged by trephining, so as to remove the depressed spicules. After operation the patient must be kept quiet in a darkened room on liquid diet for a few days.

Injuries to the Intracranial Bloodvessels.

The hæmorrhage may be intradural or extradural. When it occurs rapidly after an injury and produces compression, it is probably due to rupture of the middle meningeal artery. In other cases it is due to rupture of vessels in the pia mater or to rupture of one of the venous sinuses.

Rupture of the Middle Meningeal Artery.—The anterior branch is the one most usually torn, and it may be ruptured by a fissured or a punctured fracture, or by a blow on the side of the head, which detaches the dura mater without fracture of the bone. In the latter case the artery is torn as it emerges from a canal in the bone. The blood collects between the dura and the bone and causes compression of the brain.

Symptoms.—When not obscured by some other cerebral lesion, the typical symptoms are—(1) temporary concussion; (2) a lucid interval of a few minutes to a few hours; (3) gradually increasing drowsiness ending in coma. If the hæmorrhage is rapid or there is cerebral

laceration as well, there may be no interval of consciousness. In addition there may be, from pressure on the motor area, twitching of the corresponding parts followed by paralysis. The pupil on the injured side becomes first fixed and then dilated, the other following. When the coma is well marked the pulse is slow and full, and the breathing is stertorous. When the brain is lacerated there are alternating tonic contraction and relaxation of the muscles supplied from the injured area.

The *Prognosis* is very grave.

The *Diagnosis* is difficult, unless the symptoms are typical, and they seldom are.

Treatment consists in trephining, removing the blood-clot, and stopping the bleeding. A flap is turned down, and a trephine hole made over a spot 1½ inches above and behind the external angular process exposes the anterior branch. After the blood-clot is removed the bleeding-point is searched for and tied; if it is not seen, more bone must be clipped away. If the bleeding comes from a canal in the bone, it may be stopped with gauze, sponge, or aseptic wax. If the brain then expands, the bone may be replaced and the wound stitched up without drainage; if not, the bone must not be replaced, and the wound should be drained for twenty-four hours. The posterior branch can be reached by a hole made just below the parietal eminence.

Wounds of the Venous Sinuses are due to fracture or puncture. The longitudinal sinus and those at the base of the skull are those most frequently torn. The symptoms produced are the same as those of meningeal hæmorrhage, but are slower in coming on. When the superior longitudinal sinus is torn by a fracture, a hæmatoma of the scalp is associated with symptoms of compression.

Treatment consists in trephining where practicable, removing the blood-clot and plugging the sinus. If one of the basal sinuses is torn treatment is impracticable.

Intradural Hæmorrhage results from wounds of the cortex or membranes in cases of fracture. The bleeding is derived from the vessels of the pia mater, from the middle meningeal artery, or from tearing of the inner wall of a venous sinus. Signs of compression come on after concussion, without an interval of consciousness.

Recovery often follows, though the coma may be prolonged. If adhesions are produced, epilepsy may appear later. Convulsions followed by paralysis point to pressure on the motor area.

Treatment consists in absolute quietness. If focal symptoms or localized injury point to the site of pressure, a trephine opening should be made. The dura mater bulges, the bluish-black blood-clot shows through it, and pulsation is absent. The dura is incised, clot removed, and the bleeding-point tied or stopped by pressure. The wounds in the dura and scalp are then stitched up, without drainage if the brain expands, with drainage if not.

General Condition of the Brain after Head Injuries.

Concussion of the Brain is a condition of shock resulting from a disturbance of the nervous centres by an injury to the head. It varies from a slight giddiness to complete insensibility and death. In fatal cases there is always more or less hæmorrhage into the substance of the brain. The symptoms are due to paralysis of the vasomotor centres in the medulla and inhibition of the heart through the vagus, so that the blood collects in the splanchnic area.

Symptoms.—In bad cases the patient is unconscious, the respirations faint, the pulse weak and rapid, the muscles flaccid, the pupils equal and reacting to light, but may in very bad cases be dilated and insensitive to light. The skin is pale and cold, and the sphincters may be relaxed. In a few minutes to a few hours improvement may be ushered in by vomiting, or signs of compression may come on and terminate in death.

In the stage of **reaction** the pulse, respirations, and mental powers, gradually return to the normal standard. Some headache and irritability may remain for a few days. Permanent defects may be left, such as impairment of vision, hearing, or memory, or neurasthenia.

Treatment.—Absolute rest, with the head low, combined with warmth to the surface. Stimulants, such as alcohol and strychnine, should be avoided, except in bad cases, for fear of increasing the hæmorrhage. In the stage of reaction the diet should be light, and brisk

purgatives are necessary. If the unconsciousness is prolonged, the bladder needs to be emptied by a catheter.

Cerebral Irritation is a condition of great mental irritability which follows superficial laceration of the brain.

Symptoms are manifest after the period of concussion is over. The patient lies curled up on his side, with the eyes shut. He resists attempts to open them both with his muscles and by forcible language. The urine and motions may be passed into the bed. The patient, though not unconscious, pays no regard to his surroundings, but is violently irritable if disturbed. After several days the irritation subsides, and he may become childish, though in time recovery usually follows. Occasionally chronic meningitis is a sequela.

Treatment.—Rest and quietness are essential. The head should be shaved and cold applied. The diet should be light and nourishing, and purgatives are necessary.

Compression of the Brain from trauma, when coming on a few hours after the injury, is probably due to intracranial hæmorrhage. When there is no interval of consciousness, it is probably due to depressed fracture, combined with intracranial hæmorrhage, or it may be due to spreading œdema. If symptoms appear after a few days, they are probably due to cerebral inflammation or abscess.

Compression may also arise from tumours, gummata, or abscesses secondary to otitis media.

Symptoms.—Drowsiness leads on to **coma**. When coma is well marked, unconsciousness is complete, the breathing is slow, and stertor is present from paralysis of the soft palate. The **breathing** is of the Cheyne-Stokes character as death approaches, from paralysis of the respiratory centre. The **pulse** is slow and full at first, rapid and irregular at the end. The **pupils** first contract, then dilate, and become insensitive to light. If the compression is at first one-sided, the pupil on that side goes through these changes in advance of that of the opposite side. **Motor paralysis**, first on one side and then on both, soon becomes complete. If the motor area is first compressed, convulsions precede paralysis. Retention of urine and paralysis of the sphincter ani are usual.

The *Diagnosis* of compression is easy, but its cause may not be clear if the patient is brought in comatose, without any history of accident. 1. It may be due to cerebral hæmorrhage, embolus, or thrombosis; to spreading œdema from cerebral tumour or abscess; or to epileptic coma. 2. Coma may be due to poisons, such as alcohol or opium, or it may be uræmic or diabetic coma. 3. Heatstroke causes unconsciousness, but not coma. 4. Alcoholic poisoning and compression from fracture may co-exist. Therefore all cases should be carefully examined for fracture of the skull; the breath should be smelt for alcohol; the pupils should be examined—in opium-poisoning they are pin-point in size and fixed; in compression they may be unequal and dilated. The state of the reflexes requires examination, any irregularity on the two sides pointing to compression. The urine should be drawn off and examined for albumin and sugar.

Treatment consists in removing the cause. Depressed bone, foreign bodies, blood-clot, and pus, must be removed. The remainder of the treatment is that of head injuries in general—rest, quietness, light feeding, and purgatives.

Intracranial Inflammation.—The different varieties, though separately described, often co-exist.

1. **Subcranial Inflammation** may be either in the nature of an abscess between the dura mater and the bone, or of thickening in the dura mater (pachymeningitis). Suppuration results from compound depressed fracture or auto-infection of blood-clot in cases of simple fracture or contusion. Other cases are due to extension of disease through the bone in chronic otitis media.

The *Symptoms* consist of high temperature; headache, which may go on to coma; an œdematous swelling may form over the site of the abscess. If the fracture is compound the wound is obviously infected. Spasms or paralysis are produced if the pressure is over the motor area. Simple thickening is the same as chronic meningitis.

Treatment consists in freely draining the abscess by removing sufficient bone over it.

2. **Acute Diffuse Meningitis** is always due to pyogenic organisms. The cortex of the brain is always involved as well as the meninges.

The *Symptoms* appear after the first few days. There is constant and increasingly severe headache, vomiting, and optic neuritis, with a frequent full pulse and raised temperature. The patient is very irritable, and there may be convulsive twitching of the muscles. Death occurs from compression by the inflammatory exudation. When the convexity of the brain is chiefly affected, convulsions are more prominent; when the base is most affected, retraction of the head and neck, optic neuritis, and squint, are more in evidence. After death the convolutions are seen to be flattened, the ventricles distended, and the cerebro-spinal fluid is increased in amount and mixed with pus. The membranes and brain are hyperæmic.

Treatment.—The head should be shaved, cold applied by Leiter's coil, and the usual rest, quietness, light diet, and purgatives, should be prescribed, as in other head injuries. Operative measures have been found as yet to be of no use.

Acute Meningo-Encephalitis is localized in cases of penetrating wounds if drainage is free, but the cicatrix which follows recovery may cause epilepsy.

3. **Subacute Meningitis** may come on some time after an injury, when the patient is getting about, and is due to mild bacterial infection. The symptoms are a mild edition of those of the acute form. Rest and quietness, with counter-irritation to the scalp, constitute the treatment.

Chronic Meningitis may follow any injury to the meninges. Infiltration of the membranes and adhesion to the cortex result, and constant headache, perhaps tenderness and epilepsy, may be the symptoms.

Treatment consists in rest, quietness, purgatives, and counter-irritation. Trephining may be necessary if traumatic epilepsy is present.

4. **Cerebral Abscess** (see p. 226).

5. **Infective Thrombosis of the Sinuses.**—The sinus most commonly affected is the lateral, from chronic otitis media; but septic thrombosis may spread to the others from cellulitis of the scalp, face, or nose. The clot in the sinus becomes disintegrated, and pyæmic emboli are carried away and set up secondary abscesses in other parts of the body.

The *Symptoms* are those of pyæmia—viz., rigors and high temperature, with sweats accompanying remissions of temperature. Meningitis, pulmonary symptoms, or diarrhœa and typhoidal symptoms, may obscure the diagnosis. Exophthalmos may be produced if the cavernous sinus is involved, while if the longitudinal sinus is affected the veins of the forehead are distended.

Treatment is rarely possible, except when the lateral sinus is affected, and that will be described later (p. 268).

Laceration of the Brain may be due to either non-penetrating or penetrating injuries.

Non-Penetrating Wounds of the Brain may follow blows with or without fracture of the skull. The brain is often most damaged at a point opposite to that on which the blow falls, in cases where there is no depression.

Pathological Changes.—There is always some extravasation, which varies from punctate hæmorrhages to disintegration of part of the brain. Soon afterwards exudation occurs from the neighbouring vessels, and causes swelling. This may subside or go on to **spreading œdema** if the veins in the pia mater are compressed. Spreading œdema soon causes death from central compression. Still later changes, in the absence of spreading œdema, are softening and fatty degeneration of the lacerated areas. The softened tissue is absorbed, and if the motor area is affected paralysis is permanent, and a cicatrix containing hæmatoidin crystals is left.

Symptoms.—Concussion is prolonged, or rapidly followed by cerebral irritation, muscular twitchings, irregular movements, and extreme restlessness. If the motor area is involved, localized convulsions appear first, then become general, and increasing paralysis remains after each fit.

Hæmorrhage into the internal capsule, corpus striatum or ventricle rapidly produces hemiplegia and coma.

In mild cases consciousness returns in a few hours, and slight fever and headache remain for a few days. Inflammatory changes, however, may come on in a few days, and lead to compression or suppuration.

Treatment as a rule is symptomatic—rest, quietness, and cold to the head. Depressed bone, of course, should be removed, and if convulsions continue, and signs of

compression appear, it may be advisable to open the dura mater and remove blood-clot from the injured area.

Penetrating Wounds of the Brain.—As a rule the general disturbance is slight, for concussion is often escaped, while the blood which is poured out has a free exit through the wound, instead of ploughing up the brain. Localized or diffuse septic inflammation is the chief risk. The latter is quickly fatal; both lead to the formation of a hernia cerebri, but recovery may occur in the former. The prognosis is not so grave if the wound is rendered aseptic, as there is less likelihood of compression than in cases where there is no opening.

Symptoms.—Immediate death may occur, or severe concussion may rapidly extend into fatal compression. In other cases inflammation may follow, with focal symptoms if the motor area is damaged.

Treatment.—The hole in the bone must be enlarged, and all depressed pieces, foreign bodies, and blood-clot, removed. In the case of bullets, if not found after a very limited search, they must be left alone. Protruding brain substance is better removed, and an endeavour must be made to sterilize the wound by liberally washing it with antiseptics. The dura mater should be sutured, but with a drain-tube left in for twenty-four hours. If sepsis occurs, a very free opening is necessary to prevent spreading of the inflammation and general meningitis.

Localized Injuries to the Brain.

Upper and Middle Frontal Convolutions.—No motor symptoms are produced, but only cerebral irritation. Mental weakness may follow if the injury is on the same side as the speech centre.

Third Frontal Convolution.—Motor aphasia results from injury to the left in right-handed people; but in young people a speech centre may be subsequently educated on the right side. The reverse applies to left-handed people.

The **Motor Area** consists of the ascending frontal, ascending parietal, superior parietal, and posterior part of the third frontal convolutions. The leg centres occupy

roughly the upper third, the arm centres the middle, and the face and tongue centres the lower third. Lesions of any of these areas produce either spasm or paralysis of the corresponding muscles of the opposite side.

Lesions of the **Occipital Lobe** produce temporary hemianopia. If the **angular gyrus** is destroyed, the loss of half of the visual field is permanent.

Lesions of the **Upper Temporo-Sphenoidal Lobe** produce deafness.

Injury to the **Corona Radiata** cuts off the nerves coming from the overlying cortex, and produces corresponding paralysis. If the corpus striatum or internal capsule is damaged, hemiplegia, and perhaps hemianæsthesia, result.

Injury to the **Cerebellum** produces giddiness and ataxy.

A wound of the **Crus Cerebri** produces more or less hemiplegia of the opposite side and paralysis of the third nerve on the same side.

Injury to the **Pons** is usually at once fatal; if not, hemiplegia of the opposite side and paralysis of the fifth, sixth, seventh, and ninth nerves of the same side make their appearance, and there may be marked contraction of the pupils.

Wounds of the **Medulla** are usually fatal.

Cranio-Cerebral Topography.

The **Fissure of Rolando** begins at a point ½ inch behind the centre of a line extending from the root of the nose to the occipital protuberance, and runs downwards and forwards for 3¾ inches from this at an angle of 67°. This angle can be found by folding a piece of paper to three-quarters of a right angle, or by using Horsley's Rolandometer. Another method consists of using Reid's base-line, drawn from the lower margin of the orbit backwards through the external auditory meatus. Two lines vertical to this are drawn through the depression in front of the meatus and through the posterior border of the mastoid process. The Rolandic fissure extends from the upper limit of the posterior line to where the fissure of Sylvius cuts the anterior one.

The **Fissure of Sylvius** is indicated by a line drawn from a point 1¼ inches behind the external angular process, and above the zygoma to a spot ⅗ inch below the most prominent part of the parietal eminence. The first ¾ inch is the undivided portion, and from here the anterior limb rises vertically for 1 inch.

Hernia Cerebri.

A hernia cerebri is a protrusion of the brain substance through an **acquired** opening in the skull, so differing from an encephalocele, which is a protrusion through a **congenital** defect. It is always due to increased intracranial pressure, either after trephining for a new growth in the brain or when sepsis occurs in a compound or depressed fracture of the skull. The increased pressure causes protrusion of the brain substance, which pulsates synchronously with the heart. Usually the pressure goes on increasing, and the patient dies from coma.

Treatment.—Prevention should be aimed at by strict attention to cleansing the wound, and draining it if necessary in compound fractures. If a protrusion occurs, it must be covered with antiseptic dressings. If the inflammation subsides, granulations spring up on the tumour and produce a cicatrix. Traumatic epilepsy may follow.

Traumatic Epilepsy arises from (1) a slight depression or spicule of bone; (2) excessive callus after a fracture, or thickening from chronic osteitis after a contusion; (3) chronic meningitis with an adherent cicatrix in the brain, especially in syphilitic patients; (4) an osteoma on the inner wall of the cranium.

The *Symptoms* are epileptiform seizures (Jacksonian), with or without an aura. Localization depends on the aura and symptoms, such as localized headache or a cicatrix.

Treatment, which is only of use in those cases where the convulsions remain localized, consists in trephining, if the proper site can be determined. If bone is causing pressure it should be removed, but if a cicatrix is the cause its removal only leads to the formation of a fresh cicatrix. Placing a sheet of gold foil between the brain and membranes may prevent this. If the fits are very

numerous and severe, it is justifiable to remove the cicatrix and surrounding brain substance, but permanent paralysis remains in the muscles supplied by that area. The unsatisfactory results of treatment only emphasize the necessity for exploration in all cases of depressed fracture.

CHAPTER XXIV

DISEASES OF THE SCALP, CRANIUM, AND CRANIAL CONTENTS

Diseases of the Scalp.

Suppuration usually arises from infection from the surface, and may be subcutaneous, subaponeurotic, or subpericranial. Free incisions and fomentations constitute the treatment. Erysipelas and cellulitis do not differ from similar disease elsewhere.

Tumours.—The commonest are **Sebaceous Cysts**, which are often multiple. They are best removed by transfixion, squeezing out the contents, and then pulling out each half of the cyst wall.

Dermoid Cysts are not uncommon about the external angular process, root of the nose, and fontanelles. They may communicate with the dura mater through a congenital opening in the skull, but differ from a meningocele in that their size is not diminished by pressure. Treatment consists in removal by dissection.

Papilloma, fibroma, epithelioma, sarcoma, and lipoma, occur, but do not differ from similar growths elsewhere.

Nævi are common on the scalp. Treatment consists of excision, if the nævus is small; but if large, or the child is very young, electrolysis is better.

Cirsoid Aneurism is that condition in which arteries become elongated, tortuous, and dilated, and is commonest in the auriculo-temporal region. The capillaries and veins are also enlarged. It presents as an irregular tortuous, pulsating swelling, which is diminished by pressure. It may grow rapidly, and as the skin is thinned over it the hair falls out; ulceration may occur, with possibly fatal hæmorrhage.

Treatment is difficult. The best method is extirpation,

after first exposing and ligaturing the main feeding trunks. If much skin has to be taken away, Thiersch grafting is necessary. Electrolysis and caustics are not of much use.

Other Aneurisms are rare. They may be of the true or false variety, and are easily treated by excision.

Other pulsating tumours are some sarcomata of the cranium, secondary nodules of thyroid cancer in the diploe, encephalocele, hernia cerebri, and traumatic cephalhydrocele.

Affections of the Skull.

Congenital Affections are meningocele, encephalocele, and hydrencephalocele. The most frequent situations are the middle line of the skull, root of the nose, occipital region, and fontanelles.

A **Meningocele** consists of a protrusion of the meninges alone, containing cerebro-spinal fluid, through a congenital defect in the skull. It forms a soft fluctuating swelling, which increases in size on expiration, crying, or coughing, and can be diminished in size by pressure. It is translucent if large.

An Encephalocele in addition contains brain substance and pulsates with each heart-beat.

In a **Hydrencephalocele** there is both brain and fluid. The fluid may be as in a meningocele, or may be contained in a cavity in the brain connected with the ventricles. It is usually large and in the occipital region.

The *Prognosis* is grave in all cases. Some are born dead, some are idiots, while in others the swelling increases, bursts, and death occurs from septic meningitis. In some cases the size remains stationary; in meningoceles the growth of the bone may close up the communication with the interior.

Treatment.—In large tumours and those containing brain substance only protection by a shield is possible. Small meningoceles may be excised.

Acquired Affections of the Skull—Atrophy.—1. **Craniotabes** is met with in the first year in congenital syphilitics. 2. **Senile Atrophy** causes no symptoms, but only increased risk from slight injuries. 3. **Gaps in the**

Bone caused by the pressure of tumours or trephining, or by removal of fragments after depressed fracture, render the patient more liable to injuries. The defect after injury or operation may be remedied by chiselling up a portion of the outer table, leaving the pericranium with a pedicle attached to it, and placing it in the gap (autoplasty) ; or by placing a plate of gold or aluminium either under the pericranium or between the dura mater and the bone (heteroplasty). 4. **Hydrocephalus** is associated with atrophy of the cranial bones. It is a chronic condition produced by distension of the ventricles with fluid, either from malformation or from chronic inflammation. There is great enlargement of the head and separation of the bones at the sutures. Death usually occurs from compression. Treatment by tapping or establishing a drain between the ventricles and the subdural space is not encouraging. 5. **Microcephaly** is due to premature ossification of the sutures, and is usually associated with idiocy. Craniectomy has been done in a good many cases, but the results are unsatisfactory.

Hypertrophic Changes are inflammatory in origin, as in congenital syphilis, rickets, osteitis deformans, acromegaly, and leontiasis ossea.

Inflammatory Affections.—Acute Periostitis is due to septic infection, and may lead to necrosis. **Acute Infective Osteomyelitis** of the cranium does not differ from similar disease elsewhere. **Chronic Periostitis** results in the formation of a node, and is due to chronic irritation. If causing any trouble, the node may be chiselled away. **Tuberculous Disease** is rare, and ends in the formation of an abscess, which on being opened is found to lead down to carious bone. Treatment consists of removal of the diseased tissues. **Syphilitic Disease** (gummatous) is common in the frontal and parietal bones.

Tumours of the Cranial Bones are chiefly osteomata and sarcomata.

Osteoma may be either of the cancellous or compact type, and may grow from the outer or inner surface. If external, a round, smooth, hard, painless swelling is felt, attached by a broad base. If internal, signs are produced according to the area of brain irritated, and when they are large compression of the brain follows. Osteoma is

distinguished from syphilitic affections and sarcoma by its very slow growth, painless character, and hardness.

Treatment of the external forms is rarely necessary, but they may be chiselled away. The position of internal osteoma is hard to diagnose, unless over the motor area, so that treatment by trephining is only rarely possible.

Sarcoma may originate in the pericranium, diploe, or dura mater. The pericranial and diploic forms are rapidly-growing tumours, which soon involve the scalp, ulcerate, and produce secondary growths. Sarcoma of the dura mater produces severe localized headache, vomiting, optic neuritis, and epileptic fits, before the tumour makes its appearance. The tumour soon fungates, and septic meningitis and compression lead to a fatal termination.

Treatment consists in free removal, but the cases are rarely diagnosed early enough for this to be satisfactory.

Affections of the Frontal Sinuses.

Fracture of the anterior wall and depression is not uncommon. Surgical emphysema on blowing the nose may follow. Suppuration and necrosis may follow compound fracture. If the posterior wall is also fractured, a cerebral abscess may result.

Inflammation of the frontal sinus is usually caused by extension, in cases of catarrh of the nasal mucous membrane, but may be secondary to penetrating wounds or disease of neighbouring bones.

The cavity drains well unless the infundibulum becomes blocked, when slow distension and thinning of the walls occur. Empyema is due to pyogenic inflammation of the mucous membrane, and produces distension, pain, and tenderness over the sinus. The pus may extend through the posterior wall and produce intracranial abscess.

Treatment is only necessary when distension by pus or mucus is present, and consists in laying open the cavity, through an incision along the inner part of the eyebrow, and trephining. The wall is curetted, the infundibulum enlarged, and a drainage-tube left in it for two or three days. The cavity is then washed out daily through the nose till all discharge has ceased. There is some danger of acute osteo-myelitis following this operation. Unless

treated by prompt laying open and very free drainage there is great risk of extension to the meninges and brain. The only safe operation is entire removal of the anterior wall so as to obliterate the sinus.

Tumours of the frontal sinuses are polypi, ivory osteomata, sarcoma, and carcinoma. Signs are produced by distension of the walls, which usually shows anteriorly. If the inferior wall is depressed the eye is pushed downwards, while if the posterior wall is pushed backwards cerebral compression results. If diagnosed early, treatment by removal is possible.

Cerebral Tumours.

Glioma is the most common; then come sarcomata, tuberculous masses, various cysts, and gummata. The differential diagnosis is not possible beforehand, but other signs of similar disease elsewhere, as of tubercle or syphilis, suggest the nature of the cerebral tumour.

Symptoms.—1. Those due to increased intracranial pressure, such as fixed **headache**, giddiness, loss of memory, epilepsy, and stupor ending in coma. Tenderness on pressure may mark the site of the tumour. 2. **Vomiting**, not preceded by nausea, and bearing no relation to the taking of food. The temperature is often subnormal. 3. **Optic neuritis** is generally present. The edges of the disc are blurred, the vessels are tortuous and seen irregularly, and atrophy follows if life is prolonged. 4. **Focal symptoms** are produced when an area of the brain with definite functions is involved, and are at first irritative, followed by paralysis.

Treatment.—As it is always possible that the tumour is syphilitic, treatment should be begun by pushing iodide of potassium up to doses of 60 grains three times a day, combined with mercury. If no improvement occurs in three or four weeks, the question of operation then arises.

Operation only holds out hope of relief in a few cases, but even though the tumour cannot be removed some good is done by relieving the intracranial tension. It is better to divide this operation into two stages, with an interval of a few days, the first stage ending with the removal of a large area of bone. The scalp is shaved and purified, and the supposed affected area marked on

it, or a bradawl is driven through the scalp into the bone to mark it. A large flap is then turned down to expose this area, and a piece of bone removed with a 2-inch trephine, electric saw, or Gigli's saw. If the intracranial tension is increased, the dura bulges, and pulsation is diminished or absent. The dura is opened at the second stage by a crucial incision, or turned upwards as a flap, and the brain is felt with the finger to detect any abnormally hard or soft area. Superficial or encapsuled growths are shelled out with the finger or Horsley's brain knife. Hæmorrhage is stopped by ligatures and sponge pressure. If the tumour is not seen or felt, the brain is explored with a trocar and cannula or sinus forceps in various directions, or more bone is removed with Hoffmann's forceps. The dura mater is then stitched up, but leaving room for a drainage-tube. If the tumour has been removed, the disc of bone, with a piece cut from the edge to accommodate the drain-tube, may be replaced, and the scalp wound closed in most of its extent. As a rule, the bone should not be replaced, for it is necessary to leave a gap because of the increased intracranial tension, though a hernia cerebri will probably ensue as the growth extends.

Abscess of the Brain.

Causes.—Pyogenic infection is the cause in all cases, and the commonest method is by spreading from chronic otorrhœa. Other cases are traumatic in origin, as in septic compound fractures and penetrating wounds, the frontal and parietal lobes being then chiefly affected. The commonest seat of abscess in the brain, due to middle-ear disease, is the cerebellum. The next most common seat is the temporo-sphenoidal lobe. The suppuration may extend directly through the tegmen tympani, the membranes and brain becoming first adherent to it; but usually there is a healthy area of brain intervening, so that the extension of infection has been along the course of vessels and lymphatic sheaths running between the brain and the middle ear. Similar abscesses rarely follow suppuration in the frontal, sphenoidal, and ethmoidal sinuses, and thrombosis of the cavernous sinus. Pyæmic and chronic tuberculous abscesses also may occur.

An abscess in the brain is usually chronic, but terminates in compression, either from the onset of spreading œdema or rupture into one of the lateral ventricles.

The **Symptoms** in traumatic cases are acute, and, as there is usually diffuse meningitis, there is intense pain, fever, and rigors, coma quickly supervening. In the more common chronic cases the symptoms are often vague in the early stages, but when well marked consist in signs of intracranial pressure. 1. The **headache** and tenderness are severe and localized to the site of the abscess. 2. The **temperature** is subnormal, unless there is associated meningitis. 3. The **pulse** is markedly slowed, even down to 30 or 40. 4. The patient is quite intelligent, but **cerebration** is very slow; vomiting and optic neuritis are usually present. 5. **Motor symptoms** may occur if the abscess is in the anterior part of the temporo-sphenoidal lobe, either irritative or paralytic. If the cerebellum is affected, there is giddiness both while walking and lying down, together with weakness of the hand-grip and increase in the knee-jerk on the side affected. Lateral nystagmus often occurs.

Diagnosis.—From **meningitis**, by the fact that in meningitis there is fever, great restlessness, delirium, photophobia, pain and spasm in the muscles, especially at the back of the neck. An **extradural abscess** is always accompanied by fever. In **lateral sinus thrombosis** there are rigors and profuse sweats, and there may be a hard tender cord in the situation of the internal jugular vein. Chronic abscess and tumour are often indistinguishable in their symptoms, but the presence of chronic otitis media suggests abscess.

Treatment.—The abscess must be opened as soon as possible. Unfortunately, many cases are only diagnosable when it is too late for evacuation to produce a cure. As cerebellar abscess is more common, it is as well to explore the cerebellum first, unless focal symptoms point to the temporo-sphenoidal lobe as the site. A flap is turned down and a piece of bone removed with a trephine. The dura is then incised and the abscess punctured with a trocar and cannula or sinus forceps. These should be passed in various directions till the pus is found, and then the opening must be enlarged, the pus gently washed out, and a drain left in for several days.

For a temporo-sphenoidal abscess the trephine opening should be made ¾ inch above the posterior root of the zygoma, and directly above the posterior border of the bony meatus; for a cerebellar abscess, 1½ inches behind the centre of the external auditory meatus and ¼ inch below Reid's base line. In most cases the mastoid antrum should be first explored; by removing the bone behind it the lateral sinus can be exposed, and by working above or below it the cerebrum and cerebellum can be explored.

CHAPTER XXV

AFFECTIONS OF THE LIPS AND JAWS

Affections of the Lips.

Hare-lip is a cleft of congenital origin left in the lip as the result of want of proper union between its component parts. It is usually unilateral and on the left side, but may be bilateral and accompanied by cleft palate. The cleft varies in size from a mere notch in the red margin to a cleft extending into the nostril and through the alveolus. As a rule, when it is bilateral, the central portion of the lip (prolabium), lying over the premaxillary bone, which is completely separated from the maxillæ on each side, projects forwards as an appendage at the end of the nose. The nostril on the affected side is broad and flattened. Spina bifida and talipes are often associated, and heredity has a marked influence. A double hare-lip, especially if associated with cleft palate, may so interfere with taking of nourishment as to necessitate early treatment; but as a rule it is better to wait till the infant is two to three months old.

Operation for Single Hare-lip.—1. The lip is thoroughly dissected up from the maxillæ and alveoli on each side. 2. The edges of the cleft are then pared, so as to leave a concave surface on each side, taking care to include the apex. When the two cut surfaces are brought together, there is then a projection downwards of the red line, which is afterwards obliterated by the contraction of the

scar. Sutures of silkworm-gut and catgut are used, especial care being taken to accurately approximate the red margin. In **Mirault's** operation, a flap of the red margin from the outer side is stitched to the bevelled-off inner margin of the cleft. The wound is dressed with gauze and collodion. The deep stitches should be removed in a week, the superficial ones at the end of four days. Spoon feeding is necessary during the healing process.

The Treatment of Double Hare-lip.—If the premaxilla retains its natural place, the labial clefts are alone dealt with. If, as is usual, it projects forwards, it must be either removed or replaced, but in any case the prolabium is saved. As a rule, it is better not to remove the premaxilla, for the lip then falls in in an unsightly manner, though, if it is retained, firm union may not occur, and the teeth erupt obliquely backwards.

If it is decided to retain it, the bone is pushed backwards after detaching the prolabium ; if it cannot be pushed back, the septum is divided, and the bone is then forced back. When the gap is too small to receive the premaxilla, its size should be diminished by gouging the teeth out of it. The edges of the premaxilla and alveoli should be pared, and the cut surfaces of mucous membrane then sutured. The lips should then be separated from the alveoli on each side, and the edges pared. The prolabium should be pared on each side, so that a V is formed. The V-shaped portion is then stitched to the pared lip margins on each side without attempting to bring the apex of the V down to the red margin. Below the prolabium the lips come together, so that a Y-shaped cicatrix results. The dressing and after-treatment are the same as in single hare-lip.

Macrostoma, or abnormal width of the mouth, is a developmental defect, and is remedied by paring the outer portion on each side and stitching the raw surfaces together.

Microstoma, or congenital contraction of the mouth, is due to defective development of the lower jaw. If it causes trouble, it may be remedied by making a cut from each corner of the mouth and stitching the skin to the mucous membrane both above and below.

Macrocheilia, or hypertrophy of the lip, is—(1) Congenital, and due to lymphangiectasis. Treatment consists in removing a V-shaped portion. (2) An acquired form in children is due to chronic irritation from cracks or fissures in the lip. Attention to the general health usually effects a cure. (3) In some cases in adults the cause is tertiary syphilis, and the treatment is that of syphilis in general.

Syphilitic Affections are common. A **primary** sore is produced by contact with syphilitic infective material, and presents a smooth ulcerated surface resting on an indurated base with somewhat extensive infiltration. The submaxillary glands are early enlarged. The appearance may suggest epithelioma, but its development is very rapid. The age of the patient is usually younger than in epithelioma, and secondary symptoms soon make their appearance. In the **secondary** stages mucous patches are common on the mucous membrane of the lip. In the **tertiary** stages gummata and serpiginous ulcers occur. In **inherited syphilis** mucous patches are common, and may leave radiating cicatrices at the corners of the mouth. The treatment is that usual in syphilis.

Herpes Labialis is a condition in which vesicles situated on a hyperæmic base appear, and in a few days become pustular. No treatment is necessary, as the cases get well in about a week.

Nævi should be dissected out if small, treated by electrolysis if large.

Warty Growths may occur on the lower lip. They are distinguished from epithelioma by the absence of infiltration of the base. Treatment consists in removal.

Epithelioma is common in the lower lip, especially in smokers of clay pipes. It is very rare in women. The disease begins as an indurated crack, which gradually extends and ulcerates; as a wart-like growth which ulcerates; or as an indurated nodule. The ulcer slowly and steadily extends, and eventually involves the jaw. The submental and submaxillary lymphatic glands are early enlarged, and later the glandulæ concatenatæ. Visceral deposits are rare. When death occurs, it is due to fungation of the secondary growths in the neck

and exhaustion from sepsis and pain, or secondary hæmorrhage from erosion of bloodvessels.

The *Diagnosis* rests upon the **infiltration** of the base and its slower growth than that of a primary sore. If there is any doubt, a piece should be removed and examined microscopically.

Treatment.—The growth can usually be removed by a V-shaped incision, keeping ½ inch away from the growth in every direction. The cut margins are easily stitched together. If the whole lip has to be removed, incisions are carried out on each side under the body of the jaw; the lateral flaps are then detached from the jaw and brought together in the mid-line to form a new lip. The glands in the submaxillary triangle should be completely removed at the same time.

Affections of the Gums and Alveolar Processes.

Alveolar Abscess arises from suppuration around the fang of a carious tooth. The pus finds its way over the edge of, or perforates, the alveolus, and points through the mucous membrane. Occasionally the pus strips up the periosteum and leads to necrosis of the jaw. The pain of an alveolar abscess is severe. Complications which may follow are extension upwards into the antrum, producing empyema, or in the lower jaw the abscess may point externally and cause a persisting sinus.

Treatment necessarily consists in removing the tooth, and this usually effects a cure. An abscess under the periosteum needs incision. If necrosed bone is present it must be removed.

Pyorrhœa Alveolaris is a condition in which the gums are inflamed and there is a discharge of thin pus from the tooth-sockets. In consequence the gums atrophy, the teeth become loosened, and after a time fall out. The cause is bacterial infection, and several or many teeth may be affected.

Treatment consists in the removal of tartar, which is always present. A small piece of cotton-wool soaked in 1 in 500 perchloride of mercury must then be pushed up between the tooth and the gum with a fine probe twice a day. This treatment must be prolonged till a cure is

effected; if not the teeth will be lost, or even various toxæmic affections may occur, such as osteo-arthritis.

Dental Cysts are single cysts which develop at the roots of carious teeth. They are due to proliferation of embryonic remains of the enamel organ. The cyst is lined with columnar epithelium and contains mucoid fluid. A regular painless expansion of the bone occurs usually in the upper jaw, and as the bony wall becomes absorbed eggshell crackling is felt. The tooth at fault is always a dead one.

Treatment consists in removal of the tooth or stump, freely laying open the cyst and scraping out its epithelial lining. Healing occurs by granulation.

An **Epulis** is a tumour growing from the periosteum of the gum. A **Simple Epulis** is fibromatous, and may be due to carious teeth. A smooth red, perhaps lobulated, swelling is formed. It is elastic and firm, and may be pedunculated or sessile.

Treatment consists in cutting away the growth, scraping the underlying bone, and removing any carious teeth. If it recurs, a small piece of the jaw to which it is attached must also be removed.

A **Malignant Epulis** is a myeloid sarcoma growing from the medulla of the alveolar process. It forms a soft, rapidly-growing, dark-red swelling, which goes on to ulceration.

Treatment consists in freely removing the growth and the portion of alveolus from which it arises, without injuring the continuity of the jaw.

Epithelioma and **Sarcoma** may occur, and necessitate free excision of the growth together with the part of the jaw affected.

Necrosis of the Jaw.—*Causes.*—(1) Alveolar subperiosteal abscess from carious teeth; (2) fracture of the jaw when septic osteomyelitis supervenes; (3) tertiary syphilis rarely; (4) mercurial poisoning; (5) phosphorus-poisoning is met with in workers in ordinary phosphorus, the fumes getting in through carious teeth; (6) acute infective osteomyelitis, usually of the lower jaw, may follow one of the specific fevers, and nearly the whole jaw may necrose; (7) tuberculous disease.

Symptoms.—There is severe pain, and the face is red,

swollen, shiny, and hot. An abscess forms and points in the mouth, face, or neck. A sinus discharging offensive pus is left. In the lower jaw an involucrum encloses the sequestrum, but this rarely occurs in the upper.

Treatment.—The abscess should be freely opened, and the cavity frequently irrigated till the sequestrum is loose; it is then removed from within the mouth if possible.

Affections of the Antrum.

Suppuration within the Antrum usually extends from disease of the middle turbinate bones, but may be secondary to caries of the bicuspid, first, or second molar teeth. It also may be secondary to frontal sinus suppuration. In chronic cases the opening is often blocked by polypi.

Acute cases are usually associated with acute rhinitis. The *symptoms* produced are a feeling of tension and pain over the antrum, and perhaps shooting pain along the trigeminal nerve. Similar symptoms are present when acute suppuration is due to penetrating wounds. Cases secondary to acute rhinitis usually recover under treatment by washing out the nose frequently with a weak alkaline lotion.

In **chronic** cases the only *symptom* in most cases is the purulent nasal discharge. When the outlet becomes temporarily blocked, pain, swelling, redness, and œdema, may make their appearance over the antrum. Pus may be seen coming from under the anterior end of the middle turbinate bone, especially after the head has been held forward and tilted towards the opposite side. There may be signs of distension of the cavity, either upwards, downwards, inwards, or outwards; or there may be infra-orbital neuralgia.

Diagnosis.—The presence of a purulent discharge coming from under the middle turbinate bone, together with the other symptoms, lead to the suspicion that there is pus in the antrum; but confirmation is only obtained by puncturing the antrum through the inferior meatus with Lichtwitz's trocar and cannula, and washing out pus through it. Transillumination should also be tried. If one side only is non-translucent, pus should be suspected.

Treatment consists in frequent irrigation of the cavity through a hole made into it. The hole may be made through the socket of either of the bicuspids or first two molars—the first molar for preference, but whichever is carious should be extracted. A metal tube should be kept in the opening till discharge has ceased. If none of these teeth are carious, a hole should be made through the inferior meatus ½ inch behind the anterior end of the inferior turbinate bone, and irrigation performed through this. Cases which persist in spite of this are treated by opening the cavity through the canine fossa, scraping the walls thoroughly and draining it through a large opening into the inferior meatus of the nose. All polypi or diseased bone must, in addition, be removed from the nose.

Hydrops Antri is a condition of distension of the antrum with glairy fluid. It is due to a cystic tumour of the mucous lining or to a dentigerous cyst which has encroached on the antrum. The bone is expanded, and there may be eggshell crackling over it. Treatment consists in opening the cavity through the canine fossa and scraping out the contents.

Simple Tumours, such as polypi, fibromata, and odontomes, lead to expansion of the antrum, and may be removed through an anterior opening. Sarcomata and carcinomata necessitate removal of the whole bone.

Tumours of the Upper Jaw.

A localized **Osteoma** may occur in the antrum, or there may be a diffuse symmetrical overgrowth of bone, called **Leontiasis Ossea**. It is a rare disease in which new bone is formed over the forehead, jaws, and cranial bones, leading to great disfigurement. In time pressure upon the cranial nerves, eyes, and brain may occur, and cause death by cerebral compression. No curative treatment is known, but in some cases the bony masses may be chiselled away.

Malignant Diseases of the Upper Jaw.—Sarcoma may originate in the alveolus, antrum, spheno-maxillary fossa, or may secondarily involve the jaw by extension from naso-pharyngeal sarcomatous polypus.

Carcinoma is squamous when starting in the gums,

columnar when beginning in the nose, acinous if originating in the antrum.

Symptoms in malignant cases consist in—1. If on the **anterior surface**, the presence of an infiltrating tumour. 2. If in the **antrum**, signs of distension, a foul, blood-stained discharge from the nose, with perhaps epiphora and blockage of the nose. The growth may project into the nasal cavity. 3. If the growth commences **behind the maxilla**, the whole bone may be pushed forward, or the growth may extend outwards and form a swelling in the pterygoid and temporal fossæ, or upwards into the orbit, or downwards into the palate. Signs of pressure on the superior maxillary division of the fifth nerve may be present. Glands soon become enlarged, both in sarcoma and carcinoma, in the submaxillary region, and visceral deposits follow. The growth rapidly goes on to fungation.

The *Diagnosis* from simple tumours rests upon the rapidity of the growth, the blood-stained discharge from the nose, the greater age of the patient, the tendency to infiltrate, and the involvement of lymphatic glands. In any case of doubt an exploratory operation and microscopic examination of portion of the tumour are advisable.

Treatment consists in free removal where the whole growth is eradicable, but in many cases the infiltration has spread too far.

Excision of the Superior Maxilla.

The head and shoulders are raised, and chloroform is administered by Junker's apparatus. Sometimes a preliminary laryngotomy is done and the pharynx plugged, to prevent blood entering the air-passages. The central incisor of the affected side is removed, the upper lip is split in the mid-line, and an incision is carried around the border of the nose to a point ½ inch below the inner canthus, then outwards from this along the orbital margin to its outer border. This flap is then turned outwards from the bone. A narrow saw is now passed into the nose, and its floor and the alveolus are sawn through. The periosteal floor of the orbit is then stripped up, and,

while the orbital contents are protected by a spatula, the nasal process of the maxilla is sawn through, then the malar bone into the spheno-maxillary fissure. The final division is completed with bone forceps. The bone is then grasped with lion forceps and twisted out; at the same time the soft palate should be separated from the hard. Hæmorrhage from the branches of the internal maxillary artery is profuse at this stage, but is easily controlled by plugging. Bleeding-points are ligatured, the cavity is packed with gauze, and, finally, the wound in the cheek is accurately closed. The gauze must be removed in twenty-four hours, and frequent irrigation then practised. Rectal feeding is necessary for twenty-four hours, but after that the patient may be fed by a tube passed into the pharynx.

Many **partial operations** are done in which the purpose is to leave the orbital plate, and, where possible, this is good practice.

Tumours of the Lower Jaw.

Chondroma, fibroma, and osteoma, are simple tumours, and are the same as in the upper jaw.

Dentigerous Cysts are commoner in the lower than the upper jaw, and form around teeth so misplaced that they cannot erupt.

A slowly-growing tumour forms and expands the jaw, so that eggshell crackling may be felt, and, when the bone is absorbed, fluctuation. Absence of a permanent tooth or a persisting milk-tooth is suggestive. Suppuration may occur in the cyst.

Treatment consists in freely opening the cavity, removing the tooth, scraping out the walls, and allowing it to heal by granulation.

Epithelial Odontome, or Fibrocystic Disease of the Jaw.—A tumour composed of spaces lined with cuboidal epithelium derived from the enamel organ expands the jaw.

Treatment consists in freely opening and scraping out the cavity.

Myeloid Sarcoma may be periosteal or endosteal. When endosteal it causes expansion of the bone.

Treatment consists in freely scraping out the growth. If it recurs, portion of the jaw must be removed.

Round- or Spindle-celled Sarcoma necessitates free removal of the jaw. **Epithelioma** may involve the jaw by spreading from the gums, lip, or tongue, and free removal of bone is necessary.

Excision of the Lower Jaw.—If the whole of one side is to be removed, the lower lip is split and the incision carried along the lower border of the jaw and behind the ramus as high as the lobule of the ear. This flap is then turned back, the central incisor is removed, and the bone sawn through at its socket. The internal connections are divided as far as the angle, and then the bone is firmly depressed while the masseter and internal pterygoid muscles are detached. The tendon of the temporal and external pterygoid are detached, but here the knife must be kept close to the bone, so as not to wound the internal maxillary artery. The condyle is then freed by dividing the temporo-maxillary ligaments, and the bone is now separated. After hæmorrhage has been stopped the soft parts are stitched back in place. Considerable deformity is left, as the remaining half is pulled across the middle line.

Diseases of the Temporo-Maxillary Articulation.

Acute Synovitis may occur in a case of rheumatic fever.

Acute Arthritis arises from pyæmia or gonorrhœa, or in children by extension from otitis media. Abscesses form and ankylosis remains. The abscesses should be opened, and excision of the condyle may be necessary subsequently.

Osteo-Arthritis.—The condyle is enlarged, the joint grates, and there is a good deal of pain, especially in damp weather. The interarticular cartilage becomes worn away and the articular cavity enlarged, so that the condyle is more easily displaced forwards. Stiffness, and even ankylosis, may follow. If medical treatment fails, the condyle should be excised.

Tuberculous Disease is rare, and if ankylosis is left the condyle must be removed.

Immobility of the Jaw may be due to—1. Ankylosis as a result of disease of the joint. 2. The contraction

of cicatrices after burns, lupus, or operations. 3. Reflex spasm of muscles from the irritation of carious teeth, an impacted wisdom-tooth, or spasm due to tetanus. 4. Inflammatory conditions, such as mumps, parotid abscess, alveolar abscess, or new growths, either from their size or from extensive infiltration. In cases of ankylosis, where the muscles are not secondarily contracted and there are no cicatrices, excision of the condyle may suffice ; but in bad cases ankylosis quickly recurs, so that it is necessary to remove a wedge of bone, with its apex forwards from the region of the angle, leaving a false joint in this situation.

Excision of the Condyle.—A flap of skin and subcutaneous tissue is turned down over the condyle. A transverse incision is then made over the neck, so as not to injure the facial nerve, and the structures are separated with a raspatory from the bone. The neck is then divided by bone forceps and the condyle twisted out.

CHAPTER XXVI

AFFECTIONS OF THE NOSE AND NASO-PHARYNX

Depression of the Bridge of the Nose results from fracture, defective growth as a result of congenital syphilis, or destruction of bone caused by tertiary syphilis. The condition is best remedied by injecting paraffin with a melting-point of 115° F. under the skin and moulding it to the required shape.

Expansion of the Bridge of the Nose is due to intranasal pressure produced by the growth of fibrous and sarcomatous polypi. Various affections of the skin of the nose occur, such as acne, acne rosacea, and rhinophyma or sebaceous adenoma. Acne is treated by remedying the dyspepsia and applying lotio plumbi ; dilated capillaries are destroyed with the galvano-cautery. The protuberant masses of overgrown sebaceous glands are dissected away, and the raw surface is Thiersch-grafted.

Partial or Total Destruction of the Nose may be due to injury, but is usually a result of tertiary syphilitic ulceration, lupus, or rodent ulcer. Various plastic operations are done to remedy this unsightly defect, or an artificial nose attached to spectacle frames can be worn.

1. The **Indian method** of rhinoplasty consists in turning down a flap from the forehead whose pedicle contains the frontal artery of one side, and stitching the flap to a raw surface prepared on the remains of the nose.

2. The **Italian method** consists in dissecting up a flap of skin from the arm, leaving its pedicle attached, and using it to form an artificial nose. The arm must be fixed to the head so that there is no tension on the pedicle for ten days ; then the pedicle is detached.

3. **The French method** consists in dissecting up flaps from the cheeks and stitching them in the mid-line.

Examination of the Nose and Naso-Pharynx.—1. **Anterior Rhinoscopy.**—A good light, a head mirror, and a Lennox Browne nasal speculum are required. The septum, anterior ends of the inferior and middle turbinate bones, can be seen and examined with a probe.

2. **Posterior Rhinoscopy.**—The tongue is depressed, and a small mirror is placed behind the uvula and soft palate. Adenoid growths are easily seen. If these are not present, the posterior nares and posterior ends of the turbinate bones, as well as the openings of the Eustachian tubes, may be seen.

3. **Palpation of the Posterior Nares** with a finger passed up behind the uvula and soft palate. The presence of adenoids or tumours in the naso-pharynx can be determined.

Foreign Bodies commonly become impacted in the nose in children, and their presence is suggested by a purulent nasal discharge. An attempt should be made to wash out the foreign body by syringing through the other nostril. If this fails, an anæsthetic should be given and forceps or a scoop used.

Acute Rhinitis.—1. **Catarrhal** — commonly called 'cold in the head.' The inflammation may spread to the accessory sinuses and Eustachian tube. Some relief may be obtained by washing out the nasal cavities three

times a day with a weak alkaline lotion or by using Ferrier's snuff.

2. **Suppurative Rhinitis** may be secondary to acute suppuration in one of the sinuses, when treatment should be directed to the sinus. Gonorrhœal rhinitis should be treated by frequent irrigation.

3. True **Diphtheria** occurs sometimes in the nasal passages, and is treated by frequent irrigation and the injection of antitoxin.

Chronic Rhinitis.—The common form is characterized by swelling and engorgement of the soft tissues covering the inferior turbinate bone, especially in people with long, thin noses. Obstruction to respiration and abundant discharge of muco-pus are the results. The anterior end is the part most affected. Chronic pharyngitis and laryngitis often follow.

Treatment.—In the early stages irrigation with a weak alkaline lotion is sufficient; but if there is permanent hypertrophy of the inferior turbinate, it should be touched with the galvano-cautery.

Another form is **Atrophic Rhinitis**, in which the mucous membrane shrinks and the scanty exudation dries in crusts. Atrophic pharyngitis and laryngitis are often associated with this form.

Treatment consists in improving the general health, keeping the nose irrigated with an alkaline lotion, and using boric acid snuff.

Ozæna is a general term applied to cases in which there is an offensive muco-purulent discharge from the nose. It may be due to syphilitic, tuberculous or malignant disease in the nose, suppuration in the accessory sinuses, or to the later stages of atrophic rhinitis. In atrophic rhinitis the fœtor is due to decomposition in the retained mucus, and the treatment consists in keeping the nose free from this by frequent irrigation, and then spraying the nasal cavity with menthol and almond-oil (10 grains to 1 ounce). The general health must also be improved.

Disease of the Middle Turbinate Bone and Ethmoid occurs as a result of syphilis, tuberculous disease, and septic infection from without. The inflammation spreads to the periosteum and the bone itself, causing caries or necrosis, and frequently suppuration in the accessory

sinuses. In bad cases the cavernous sinus may be thrombosed, or intracranial abscess may be caused. On examining the nose, a polypoid mass of granulations is seen covering the middle turbinate, and if pressed on by a probe pus is seen to ooze out, and carious bone may be felt. Definite sequestra are found in syphilis.

Treatment consists in removing all diseased bone. The polypoid mass is first snared off; then the diseased middle turbinate is removed with a spokeshave or a ring knife. Suppurating accessory sinuses are opened and freely drained. Care must be taken not to perforate the cribriform plate.

Nasal Polypi are either simple mucous polypi, fibrous, or fibro-sarcomatous in nature.

The Mucous Polypus resembles a myoma in structure, but this is due to the hypertrophic tissue, of which it is composed being œdematous. The cause is either osteitis of the bone from which it grows, usually the middle turbinate, or suppuration in one of the accessory sinuses; but the superior turbinate and other parts of the ethmoid, especially at the openings of accessory sinuses, may be affected. The growths are usually multiple, and may project either from the anterior or posterior nares.

The *Symptoms* produced are those of gradually increasing obstruction, especially in damp weather, and a watery discharge, which rarely may be blood-stained. The voice often becomes nasal in quality. On examination, the polypus appears as a grayish semi-translucent mass, around the neck of which a probe can be passed.

Treatment consists in removal by a wire snare, with or without cocaine. The snare is passed between the septum and the polypus, and then up to the neck of the polypus, so as to grasp a small portion of the bone. The wire is then tightened, but not sufficiently to cut, and the growth is dragged away rather than cut off. If bleeding is free, the nasal cavity is packed with gauze for twenty-four hours. If polypi recur, they must again be snared off and the underlying bone curetted.

A **Fibrous Polypus** may be a pure fibroma or a fibro-sarcoma, and springs from the basi-sphenoid or basi-occipital. It may be either predunculated or sessile, and if large is often lobulated. Obstruction to respiration,

and epistaxis, are the chief *symptoms* in the early stages, but ulceration and fœtid blood-stained discharge come on later. Expansion of the nose, pushing forward of the eyes or depression of the palate, are signs of the pressure of the growth, and even the base of the skull may be eroded. Young people mostly are affected, and the chief danger is hæmorrhage from the large blood spaces in the growth.

Treatment.—When the growth is small and pedunculated, it must be removed by scraping it away from its attachment by Roughton's instrument passed up behind the soft palate. Recurrence, if pure fibroma, is due to part of the growth having been left. Severe hæmorrhage always occurs during removal, and it is advisable to do a preliminary laryngotomy and plug the pharynx. In sarcomatous cases it is better to split the soft palate and chisel away the posterior part of the hard palate to get a free exposure. It may even be necessary to remove the whole superior maxilla to get a free exposure.

Epithelioma and **Sarcoma** may occur in the nose, and, if recognised sufficiently early, can be treated by free removal of the growth.

Adenoids are very common in children, and consist of a hyperplasia of the lymphoid tissue, which is abundant in the mucous membrane of the naso-pharynx, especially in the vault, where it is known as Luschka's tonsil.

Symptoms.—The growths cause obstruction to nasal respiration, so that the mouth is held open for breathing, and so during sleep snoring occurs. There is a great susceptibility to nasal catarrhs, Eustachian obstruction, intermittent deafness, and in severe cases suppurative otitis. The cervical glands may be enlarged from the entrance of organisms through the adenoids. The palate is often high and arched, and the expression dull and stupid. The growths can be seen with the posterior rhinoscope or felt by the finger.

Treatment consists in most cases in operation. Palliative treatment consists in sending the child to the seaside, giving tonics, and insisting on nasal breathing exercises. Mild cases may thus get quite well, but in all severe cases operation is necessary. In children over ten and in adults nitrous oxide produces sufficient anæsthesia, but those

under ten require chloroform or ethyl chloride. The growths are removed by Gottstein's curette or Lowenberg's forceps, finishing off with the finger-nail. The bleeding is free, and the child should be turned over at the end of the operation, so that the blood runs out of the mouth. After-treatment consists in washing the mouth out with weak Sanitas and giving fluid food for a day or two. The risks are slight, but they are those of the anæsthetic, hæmorrhage, asphyxia from inhaling blood, and acute otitis media.

Epistaxis, or bleeding from the nose, has a variety of causes. Traumatism, ulceration, tumours, and foreign bodies, are local causes. A small abrasion on the anterior part of the septum is commonly found. General causes are increased arterial tension, as in chronic nephritis; blood changes, as in hæmophilia, purpura, and scurvy; mitral obstruction.

Treatment.—A local cause should always be looked for, and if a bleeding-point be found, it can be stopped with the galvano-cautery or a solution of chromic acid on a swab. Cold applied to the root of the nose stops many cases. Occasionally the injection of adrenalin hydrochloride solution will stop the bleeding. If these measures fail, the nose must be plugged with gauze after placing a pad over the posterior nares. For this purpose Bellocq's sound is often used to get the piece of silk which holds the plug into place.

CHAPTER XXVII

AFFECTIONS OF THE MOUTH, THROAT, AND ŒSOPHAGUS

Stomatitis may be of several varieties.

1. **Catarrhal Stomatitis** results from the irritation of roughened teeth, operations in the mouth, dyspepsia, improper feeding in infants; and it occurs in measles and scarlatina. The mucous membrane becomes hyperæmic and swollen, the secretion is increased, and painful erosions and ulcers soon make their appearance. *Treat-*

ment consists in removing the cause and frequent washing out of the mouth with a solution of chlorate of potash or Sanitas.

2. **Aphthous Stomatitis** is due to bad feeding in infants, and is marked by the presence of whitish spots, which become ulcers. *Treatment* consists in proper feeding and keeping the mouth clean.

3. **Thrush** is similar in appearance, and due to the growth of *Oidium albicans*.

4. **Gangrenous Stomatitis** (cancrum oris) occurs in children after measles or scarlatina, or in old people who suffer from albuminuria or diabetes. Spreading gangrene and toxæmia rapidly produce death, unless vigorous measures of scraping are done and antiseptics applied.

5. **Mercurial Stomatitis** arises usually from an overdose of mercury, but in a susceptible patient may be due to a single dose. The gums are swollen, tender, and spongy, and there is pain when the teeth are clenched. In severe cases the teeth may come out and the jaw necrose. Fœtor of the breath and salivation are marked. *Treatment* consists in stopping the mercury, giving magnesium sulphate, and washing the mouth out frequently with chlorate of potash.

6. **Syphilitic Stomatitis** has been already described (Chapter VI.).

Affections of the Tongue.

Congenital Abnormalities. — The tongue may be absent, or there may be hemiatrophy. **Tongue-tie** is due to excessive shortness of the frænum, so that protrusion is prevented. *Treatment* is only needed in the severe forms, and consists in snipping the frænum. **Ankyloglossia** is a condition in which the tongue is bound to the floor of the mouth either congenitally or as a result of ulceration or new growths. **Macroglossia** is usually congenital, and due to overgrowth of connective tissue secondary to lymphatic obstruction. The tongue protrudes from the mouth, and the mucous membrane becomes dry, and indented or ulcerated by the teeth. *Treatment* consists in excision of a V-shaped portion, and suturing together the raw surfaces.

Wounds of the Tongue are often caused by the teeth during fits or falls. If bleeding is free, the artery must be tied and the wound stitched, but most cases only require an antiseptic mouth-wash.

Acute Parenchymatous Glossitis may arise from septic wounds, stings of insects, mercury, and the acute exanthemata. The tongue becomes painful, rapidly swells up, and protrudes from the mouth. Salivation is marked, and speech, deglutition, and respiration, are interfered with; even urgent dyspnœa may occur from the size of the tongue or extension of œdema to the glottis. Resolution generally occurs, but suppuration may ensue.

Treatment consists in removing the cause, giving purgatives and a mouth-wash. In bad cases a free incision gives rapid relief. If asphyxia is threatening, laryngotomy should be done.

Abscess of the Tongue may be a result of the above, or may be chronic, and should be treated by free incision.

Chronic Superficial Glossitis is often associated with a similar condition on the inner surface of the cheeks or lips. Its most common cause is tertiary syphilis, but gout and chronic irritation from smoking may also be causes. It is very liable to be followed by epithelioma, especially when on the sides of the tongue. Five stages are described, but several of these may be present together: 1. **Enlargement of the papillæ.** 2. Overgrowth of epithelium, so that white horny patches, or **leukoplakia**, appear. 3. Shedding of the epithelium and atrophy of the papillæ, so that the **smooth shiny tongue** now makes its appearance. 4. **Cracks** or **fissures** occur, as the result of contraction in the deeper structures. Ulceration may also occur on the surface. 5. **Epithelioma** forms the final stage. The symptoms produced during these stages are tenderness of the tongue and pain on taking hot fluids, condiments, stimulants, or smoking. The affection is very chronic, unless epithelioma follows.

Treatment consists in removing sources of irritation, such as rough teeth, tobacco, alcohol, and condiments. The mouth must be washed out with a solution of sodium bicarbonate after meals, and antisyphilitic remedies

administered. As a rule, the disease cannot be cured, and treatment only arrests the progress or allays the symptoms.

Ulceration of the Tongue. — 1. **Dental** ulcers are due to rough teeth. 2. **Dyspeptic** ulcers are found on the dorsum in alcoholics. 3. **Tuberculous** ulcers are seen rarely in consumptives, on the dorsum, near the tip. They have nodular undermined edges. Treatment consists in scraping and applying pure carbolic acid, or the pain may be relieved by applying cocaine. 4. **Lupus** is rarely found on the tongue. Scraping and nitric acid applications form the treatment. 5. **Syphilitic** and **cancerous** ulceration are common.

Syphilitic Disease of the Tongue may be—(1) A primary sore ; (2) secondary mucous patches, fissures, or condylomata ; (3) gummatous ulceration or chronic superficial glossitis.

Gumma is fairly common, and usually begins as a submucous or intramuscular infiltration, near the mid-line and rather far back. The swelling, firm at first, soon softens and breaks down, leaving a sore with deep, sharply-cut edges and a wash-leather slough on the base. The edges are not indurated, and there is no infiltration fixing the tongue to the floor of the mouth; so the tongue can be protruded, and swallowing and speech are not interfered with. There is little pain, and the submaxillary glands may or may not be enlarged.

Treatment consists in giving iodide of potash and mercury. The sore soon heals, leaving a contracted cicatrix.

Innocent Tumours, such as papilloma, nævi, lipoma, cysts, and dermoid cysts, are rare.

Cancer of the Tongue, in the form of squamous epithelioma, is very common. Its cause is not known, but chronic irritation from a rough tooth or smoking is supposed to contribute to its onset. It may begin as an ulcer on the margin, or as an indurated crack on the dorsum following chronic superficial glossitis or a gumma. It may begin as a warty growth, which has an indurated base, or as a submucous infiltration. Epithelioma may spread to the tongue from the floor of the mouth or the larynx. Whatever the mode of origin, the growth soon becomes indurated, ulcerated, with a raised, hard edge

and an irregular base with a sloughy surface. There may or may not be pain with it, but soon the breath becomes fœtid, and as the tongue becomes fixed salivation is increased; protrusion and swallowing are more and more interfered with. The pain then becomes severe, and radiates to all the branches of the fifth nerve. The submaxillary lymphatic glands are first enlarged, then the glandulæ concatenatæ; in the late stages these glands may undergo cystic degeneration and fungation. The lower jaw may be invaded by extension of the growth. The patient in the late stages gets into the stage of cachexia from the pain, toxæmia, and inability to get sufficient nourishment and sleep. Death usually occurs in an untreated case in twelve months, as a result of septic pneumonia or hæmorrhage.

Diagnosis.—There can be no doubt in the late stages, where there is a crateriform indurated ulcer, fixity, fœtor of the breath, and enlarged glands; but in the early stages, when there is doubtful induration about a fissure, wart, or small ulcer, a small piece should be removed and examined microscopically. Iodide of potassium should be given in a case of doubt, but it should be combined with a microscopic examination, for cancer sometimes improves for a few weeks with iodide.

Treatment.—Thorough and early removal is the only treatment which holds out any hope of cure. In any case, if we can insure removing the growth from the mouth, death from glandular disease is less painful. In hopeless cases, division of the lingual branch of the fifth nerve relieves the pain, and antiseptic mouth-washes help to allay the fœtor. The operations for removal of the tongue are either intrabuccal or extrabuccal.

The **Intrabuccal Operation** (Whitehead's) is adopted when the disease is limited to one portion of the tongue and the muscles are not much infiltrated. The glands are removed by a separate incision, both in the submaxillary region and along the carotid sheath, and after this is done the lingual artery is tied where it lies under the hyoglossus. The mouth is then opened, two strong silk ligatures are passed, one through each half of the tongue, so as to pull it forwards. Then, if one half of the tongue is to be removed, the organ is split along the mid-

line, and its lateral attachment divided; a transverse cut is made across the base, and finally the muscles are cut through below. The lingual artery can be picked up before it is snipped, even if it has not been tied previously. If the tip only is affected, a V-shaped piece can be removed. If the whole tongue is removed, the stump must be prevented from falling back over the glottis and causing asphyxia by passing a strong piece of silk through it and fixing it to the dressings. If the tongue has to be removed far back, a preliminary laryngotomy and plugging the pharynx prevents inhalation of blood, and the anæsthetic is more easily administered. If tracheotomy is done, Hahn's or Trendelenburg's tubes may be used.

The **Extrabuccal Operation** is done when the jaw or floor of the mouth is involved, or when the tongue substance is deeply infiltrated. Kocher's or Langenbeck's incisions may be used. Kocher's incision extends from the tip of the mastoid to the great cornu of the hyoid and up to the symphysis. The flap is turned up, and the submaxillary salivary and lymphatic glands removed; the mylohyoid muscle is then divided, and the mucous membrane detached from the alveolus. If the jaw is affected, that portion is also sawn through in front and behind. Half or the whole of the tongue is then freed, as in the intrabuccal operation, and drawn down through the wound, so that the muscles can be cut close to the hyoid bone. Langenbeck's incision begins at the angle of the mouth, and runs to the anterior border of the masseter, down over the angle of the jaw to the great cornu of the hyoid, then up to the symphysis. The bone is then sawn through in this line, and the jaw displaced forwards, so that a clear view is obtained of the field of operation.

The raw surface in the mouth is diminished by drawing it together, when possible, with catgut. Whitehead's varnish may be painted over it. The external wound is stitched up with drainage for a few days. The mouth must be frequently irrigated with Sanitas solution, and the patient is better sitting up. Feeding by the rectum is necessary for twenty-four hours; after that a feeding-cup with an œsophageal tube suffices.

The greatest danger is from septic pneumonia; but this can be prevented by having the teeth properly

cleansed before the operation, keeping the mouth frequently irrigated afterwards, and by getting the patient up on the second day. Secondary hæmorrhage may occur if the wound in the neck becomes septic.

It is surprising how well patients talk after removal of portion or the whole of the tongue. Unfortunately, unless a free and early clearance of the glands in the neck is done, recurrence soon appears there.

Affections of the Floor of the Mouth.

Sublingual Abscess starts from septic infection of a puncture or abrasion, and must be opened early.

Actinomycosis of the floor of the mouth occurs as a brawny chronic inflammatory swelling, which points in several places, and discharges yellowish granules of the fungus. It is best treated by giving large doses of iodide of potassium.

Cystic Swellings of the Floor of the Mouth.—1. **Mucous Cysts** form small translucent swellings which require excision. 2. A **Ranula** is a cyst due to the dilatation of one of the sublingual ducts, and containing a glairy fluid. The tumour may be as big as a walnut. It should be incised, emptied, and as much of the wall removed as possible, the cavity being left to heal by granulation. 3. **Dermoid Cysts** occupy the mid-line, and project below the chin. They arise from the thyroglossal tract. Lateral ones arise from the cervical clefts. The contents consist of sebaceous material or clear fluid. Such tumours must be completely dissected out from below the chin. If portion is left the tumour recurs.

Affections of the Salivary Glands.

Inflammation of the Parotid Gland.—1. **Epidemic Parotitis**, or mumps, is highly infectious, and is marked by fever, swelling of the parotid and socia parotidis. Eating is very painful. One or both parotids may be affected, and occasionally the testis, breast or ovaries are metastatically inflamed.

Treatment consists in keeping the patient at rest and isolated, and giving food which does not require mastication.

2. **Simple Parotitis** may be due to injury or calculus in the duct, and is marked by pain and swelling. Occasionally in abdominal diseases, when the patient is being fed by the rectum, a mild septic parotitis occurs by spread of infection from the teeth. Fomentations relieve the condition.

3. **Suppurative Parotitis** may occur in pyæmia, and in scarlet or typhoid fever by extension along Stenson's duct. The gland becomes swollen and tender, the skin over it tense and œdematous, and the pain severe. The pus is apt to burrow deeply in the neck owing to the density of the overlying fascia, so that, unless opened early, toxæmia, and even pyæmia, may ensue. The fact that the whole gland, including the socia, is enlarged, distinguishes it from inflammation of the lymphatic glands lying over it.

Treatment consists in applying fomentations in the early stage, but as soon as the presence of pus is indicated an incision into the gland should be made parallel to the facial nerve and the abscess drained.

Obstruction of Salivary Ducts results from cicatricial contraction or the presence of salivary calculi.

Symptoms.—The gland rapidly enlarges when stimulated by eating ; the swelling subsides afterwards as the saliva slowly gets past the obstruction. When a calculus is present there may be an offensive discharge. Complete blockage may produce a cyst, which bursts and causes a salivary fistula. Calculi are commonest in the submaxillary and sublingual ducts.

Treatment.—Calculi should be removed ; a strictured orifice should be dilated or a new one made.

Tumours of the Parotid Gland.

The **Mixed Parotid Tumour** is an **endothelioma**, and contains colloid tissue which looks like cartilage, fibrous tissue, myxomatous tissue, and structures resembling glandular tissue. The tumour is firm and nodular, and, though usually beginning in the superficial part, may extend to the deepest part of the gland beneath the ramus of the jaw and to the styloid process. It is at first freely movable, but later becomes fixed and obstructs the move-

ments of the jaw. The growth is slow and painless so long as it is simple and the facial nerve is not paralyzed; but often these growths take on a malignant character.

The **Malignant Tumours** are sarcoma, carcinoma, and endothelioma, and often occur in what has been a simple mixed tumour. The growth then rapidly increases, becomes fixed, and the nerves and vessels are pressed upon, leading to facial paralysis. The skin soon becomes infiltrated and attached, fungation following. Secondary deposits occur in the glands and viscera.

The *Diagnosis* of simple from malignant growths is important, as the simple can be shelled out. The simple tumours grow slowly, the skin is free over them, and the facial nerve is not pressed upon. Enlarged lymphatic glands lying over the parotid have a more superficial position than a real parotid tumour.

Treatment.—Simple tumours are removed by making a vertical incision down to the capsule of the gland; then a horizontal one is made through the gland to the tumour, so as to avoid the facial nerve. The tumour is then enucleated easily, unless it is of long standing, when its deep processes may render this extremely difficult.

Malignant tumours should not be touched unless seen early. The whole gland and its capsule must be removed through a vertical incision over it. The lower part should be first dealt with, so that the external carotid artery and temporo-facial veins may be tied early. The gland is then drawn up and its deep connections carefully severed. The facial nerve must necessarily be sacrificed.

Tumours of the Submaxillary Gland are similar to those in the parotid.

Salivary Fistula arises from injuries dividing Stenson's duct. Much inconvenience is caused by saliva running over the cheek. If the buccal portion is involved, the duct should be slit up within the mouth; but if the fistula is in the masseteric portion, a tube must be passed from the buccal opening to the opening on the cheek, and retained there for some time, gradually shortening it as the canal becomes re-established.

Affections of the Palate.

Cleft Palate is a congenital defect in the roof of the mouth, due to failure of union of the palatal segments. The last part to unite normally is the uvula, so that cleft palate varies from a bifid uvula to a complete cleft through the hard palate and alveolus. In the extreme cases, single or double hare-lip is associated. The ethmo-vomerine septum may project either between the two palatal segments or be attached to one. The wider the cleft, the more difficult it is to unite the soft structures by operation; but a highly arched palate is a more favourable one to operate upon than one only slightly arched, as the flaps meet more easily.

Nutrition is impaired by the presence of a cleft palate, as the power of suction is lost, and the child has to be fed with a spoon, with the head thrown back. As this requires careful attention, many children do not get it, and succumb from starvation or intercurrent disease.

If the children grow up, **articulation** is much impaired by the inability to shut off the nasal cavity from the buccal in trying to produce sounds which require such, as the letters *b*, *d*, *f*, *g*, *p*, *t*.

The time for operation usually chosen is two to three years. The child is then able to stand the operation, but if left much longer the habit of faulty speech is difficult to get rid of. Some surgeons repair the palate at a very early age, leaving the hare-lip to be united later. It is necessary that the child should be in a good state of health, and that the mouth and throat be free from inflammation.

Operation.—Chloroform is given with Junker's apparatus, and the mouth is kept open with Smith's gag. When the cleft involves the hard palate, Langenbeck's operation, or **uranoplasty**, is that usually adopted. 1. **Incision and detachment of muco-periosteal flaps:** Lateral incisions from $\frac{1}{4}$ inch internal to the last molar tooth forwards for $\frac{1}{2}$ inch, and parallel to the alveolus, are made. The muco-periosteal flap is stripped up to the margin of the cleft till the instrument protrudes; then the soft palate must be carefully detached from the posterior margin of the hard palate and hamular process.

2. **Paring the edges of the cleft**: The edges are seized with forceps and pared, so that a straight raw edge is left. 3. **Passage and tightening of sutures**: One wire stitch is passed about ½ inch from the edge with Smith's needle. The rest of the palate and uvula are stitched with interrupted silkworm-gut sutures passed with an ordinary palate needle. These sutures are then tightened in turn. 4. The **tension** on the flaps is relieved by prolonging back the lateral incisions sufficiently. After the operation the child is fed upon liquid food for five days, and after that with soft food for a fortnight. The mouth should be frequently washed out with Sanitas. The stitches are removed in a fortnight.

When the soft palate is alone affected, the operation is called staphylorrhaphy. The edges are pared, lateral tension cuts made, and the margins then sutured.

Results.—The articulation is never perfect, as the velum is far from being a perfectly acting one; but the nose is shut off from the mouth, and careful education by a voice-trainer will improve the speech a great deal.

Mechanical Treatment.—Instead of operations, a plate may be worn to block up the cleft, and a movable velum may be attached to take the place of the soft palate. These are not so satisfactory as operations.

Ulceration of the Palate is most commonly **syphilitic**, and either secondary or tertiary; in the latter the ulcers are deep, and may be associated with necrosis of the bone. Simple, lupoid, tuberculous, and epitheliomatous ulceration may also occur.

Acquired Perforations of the Palate are practically always due to tertiary syphilis. If the soft palate is involved, adhesions to the posterior pharyngeal wall are common. The voice is nasal and resembles that of cleft palate. Antisyphilitic treatment is necessary, and the opening may be closed by wearing an obturator. Operations are unsatisfactory in these cases.

Necrosis of the Palate is due to syphilis usually, but may result from the extension of an alveolar abscess.

Tumours which occur on the hard palate are fibroma and adenoma, each of which is slow in growth and does not infiltrate or ulcerate. Sarcoma and epithelioma also occur, and if seen early require free removal.

Elongation of the Uvula, due to chronic inflammation, causes a tickling cough. Cocaine should be applied, and about two-thirds should be snipped off with scissors.

Affections of the Tonsils.

Acute Tonsillitis probably arises from infection with micro-organisms, but cold is a predisposing cause. The inflammation may be superficial, and only portion of a general catarrhal inflammation of the velum and pharynx. Treatment consists in using a gargle of chlorate of potash.

Acute Follicular Tonsillitis is marked by general enlargement of the tonsils, with consequent obstruction to breathing and swallowing. Patches of exudation are seen at the mouths of the follicles, the temperature is raised, the bowels are confined, and the submaxillary glands are enlarged and tender.

Acute Parenchymatous Tonsillitis is inflammation of the tonsil, soft palate, and fauces, and often results in a peritonsillar abscess. The palate and anterior pillar are dusky and swollen, and the tonsil is pushed across to the mid-line. These conditions are distinguished from scarlet fever by the absence of the characteristic rash.

Follicular tonsillitis is treated by giving calomel (5 grains), salicylate of soda, and an antiseptic throat spray.

Peritonsillar abscesses must be opened by puncturing the most prominent part of the swelling and enlarging the opening with forceps.

Chronic Tonsillitis results in hypertrophy, and is usually associated with adenoids. The tonsils are large and pale, and show the large orifices of the crypts. Recurrent attacks of inflammation are common. The patients are usually mouth-breathers and snore at night. Deafness may occur from associated swelling of the orifice of the Eustachian tube.

Treatment.—Fresh air and good food, together with painting the tonsils daily with glycerine of tannic acid, will cure some cases; but most resist this treatment, and so tonsillotomy is required. This may be done with cocaine or gas, and the tonsil is best removed with the

spade guillotine. Forceps and a tonsil bistoury may also be used. Hæmorrhage soon ceases in children. If it continues, iced lotion should be applied; if that fails, the galvano-cautery. The tonsil may also be shelled out with the finger after snipping the mucous membrane in front of it.

Syphilitic Disease of the Tonsil may be primary, secondary, or tertiary.

Tumours of the Tonsil are almost always malignant. **Epithelioma** may begin in the tonsil or spread to it from other parts.

Lympho-Sarcoma begins as a smooth, rapidly-growing tumour, which soon infiltrates the surrounding structures and affects the lymphatic glands. **Round-celled Sarcoma** may also occur. These growths all tend to block up the pharynx and to ulcerate. Hæmorrhage is likely to occur and produce a fatal termination.

Treatment.—If seen in the early stages, the growth may be removed by shelling out the tonsil from the mouth and dissecting out the glands by a separate incision in the neck. If the growth extends beyond the tonsil, it must be removed from the neck through an incision along the anterior border of the sterno-mastoid, deepened till the pharyngeal wall is reached, removing at the same time the glands and tying the external carotid artery.

Affections of the Pharynx.

Acute Pharyngitis is usually catarrhal and part of a general inflammation of the nose, pharynx, and tonsils. The throat is reddened, and swallowing is painful.

Treatment consists in using an astringent gargle or inhaling steam to which tinct. benzoin. co. has been added.

Chronic Pharyngitis is often met with in people who have to exert their voices—*e.g.*, clergymen, costers, etc.—and in people who drink or smoke excessively. The mucous membrane is red and thickened, the lymphoid nodules and bloodvessels are enlarged, and there is a thick muco-purulent discharge, which tends to dry on the back of the throat. If allowed to persist, this form, which is often associated with similar trouble in the nose, goes on

to atrophic pharyngitis, when the mucous membrane becomes dry and glazed and the breath is very offensive. Chronic laryngitis is also often associated with it.

Treatment consists in removing all sources of irritation —smoking, alcohol, and vocal exertion. Astringents should be sprayed or painted on the pharynx. Enlarged lymphoid nodules should be touched with the galvano-cautery. In the atrophic form the general health must be attended to, boric acid snuff used, and menthol dissolved in oleum amygdalæ (10 grains to 1 ounce) painted on the throat.

Syphilitic Affections of the Pharynx are met with in the secondary stage as mucous patches and snail-track ulcers; in the tertiary stage as gummatous infiltration, which soon breaks down and forms typical ulceration. The ulcers soon heal under treatment by mercury and iodide of potassium, but the cicatrization may lead to adhesion of the velum to the posterior pharyngeal wall; or pharyngeal stenosis, which may require division and regular dilatation with bougies.

Tumours of the Pharynx are rare. Naso-pharyngeal polypi may extend to the pharynx.

Epithelioma is uncommon primarily, but may extend to the pharynx from the tonsil or tongue. Death results from hæmorrhage, obstruction to breathing and swallowing, or dissemination.

Treatment by operation is often fatal, but in very limited cases the growth may be removed by attacking it from an incision along the anterior border of the sterno-mastoid, after a preliminary laryngotomy so that the pharynx can be plugged.

Retropharyngeal Abscess is either acute or chronic. **Acute** abscess occurs usually in children from septic infection of the submucous tissue. Urgent dyspnœa and regurgitation of fluids through the nose are the symptoms. It is distinguished from the dyspnœa of diphtheritic laryngeal obstruction by the presence of a soft fluctuating swelling felt by the finger in the pharynx. The **Chronic** form is due to spinal caries in the neck, and the pus is behind the prevertebral fascia. In the acute cases the pus may burst into the pharynx or point in the neck. Chronic cases point in the neck or travel down to the mediastinum or axillæ.

Treatment.—The abscess should be opened by an incision in front of the sterno-mastoid if pointing there; if not, behind that muscle. An opening should not be made in the mouth, for the pus may enter the glottis; and also further infection of the cavity will follow.

Affections of the Œsophagus.

Malformations.—A congenital opening may exist between the œsophagus and trachea, or the upper end may be blind. Congenital stricture may also occur. Acquired malformations take the form of **Diverticula.**

1. **Pressure Diverticula** are due to pouching of the wall from weakness of the muscles posteriorly in the first inch or two of the œsophagus or lower end of the pharynx. The cavity extends downwards between the œsophagus and spine, and only makes itself evident in adults.

The *Symptoms* are due to distension of the pouch with food, which decomposes and regurgitates undigested. Gas may be squeezed out by pressing on the swelling in the neck. The swelling causes difficulty in swallowing. A bougie can be passed into the pouch, but also can be manipulated to pass into the stomach, or one can be passed into each at the same time.

Treatment consists in excision of the pouch.

Traction Diverticula are rare, and due to contraction of cicatricial tissue in the mediastinum pulling on the œsophagus. They are of no importance.

Foreign Bodies such as coins, fish-bones, tooth-plates, may lodge in the œsophagus. Impaction of a large body in the pharynx may lead to immediate death from asphyxia. Foreign bodies when impacted lead to ulceration and perforation, causing either severe hæmorrhage, mediastinal or cervical cellulitis.

Treatment.—Fish-bones are best removed with the expanding probang; coins with the coin-catcher or œsophageal forceps. If the foreign body cannot be pulled up with forceps, it should be pushed on into the stomach. Röntgen rays can be used to locate metal substances. Impaction in the upper part of the œsophagus can be relieved by making an incision in the neck in front of the sterno-mastoid and working down between

the carotid sheath on the outer side, and the larynx and trachea on the inner, till the œsophagus is opened. The wound is drained, although the mucous membrane has been sutured. If the impaction is near the cardiac orifice, the foreign body may be removed sometimes by opening the stomach and withdrawing it by the fingers. When once the foreign body has passed into the stomach it should be left alone, and will soon reach the anus. Purgatives should be avoided in this stage.

Inflammation of the Œsophagus is caused by swallowing corrosives or irritants. Rectal feeding is necessary at first. If ulceration is produced the subsequent cicatrization causes a fibrous stricture.

Hysterical 'Stricture' occurs in neurotic young women. It differs from genuine stricture in that greater difficulty is experienced in swallowing liquids than solids, in the fact that it gets completely well from time to time instead of progressively worse, and in that an œsophageal bougie passes easily.

Treatment should be of the usual antihysteric variety.

Organic Stricture of the Œsophagus is either fibrous or malignant.

1. **Fibrous Stricture** is usually due to swallowing corrosives, but may be syphilitic. The commencement of the œsophagus is the common site. Increasing difficulty in swallowing first solids and then fluids characterizes the disease. If the stricture is high up food returns immediately; if it is low down the œsophagus becomes dilated above the stricture, the food collects for some time, and is then returned undigested and in a large quantity. Death occurs from starvation.

2. **Malignant Stricture** is epitheliomatous. The commonest sites in order are: Behind the cricoid; where the bronchus crosses the œsophagus; at the cardiac orifice. Perforation of the ulcer into the trachea causes death from septic pneumonia; into a large vessel, hæmorrhage; into the mediastinum, septic cellulitis. The glands at the base of the neck are often enlarged. The symptoms are the same as in fibrous stricture, but in addition blood is vomited sometimes and a growth can occasionally be felt in the neck. The growth frequently spreads to the back of the larynx and causes hoarseness or aphonia.

Pressure on the recurrent laryngeal nerve causes paralysis of one or both cords.

The *Diagnosis* of stricture of the œsophagus is made by excluding such causes of pressure on the tube as aneurysm, mediastinal tumours or growths in the neck. Then an œsophageal bougie is passed, till the stricture prevents its further progress. The stomach is 16 inches from the teeth, the œsophagus being 9 inches in length, and its upper end 7 inches from the teeth. Gentleness must be used in passing a bougie, for perforation is easily produced. A fibrous stricture can only be diagnosed by a clear history of swallowing a corrosive some time before.

Treatment of Fibrous Stricture.—1. **Dilatation** with bougies of increasing sizes at intervals of several days. 2. If dilatation is impossible or contraction quickly recurs, **Symonds' tube** may be used. 3. If the stricture is at the cardiac orifice it may be dilated with the fingers through an opening in the stomach. 4. **Gastrostomy** is the final resort, and sometimes the rest thus obtained brings about yielding of the stricture sufficiently to allow dilatation by bougies, so that the gastrostomy wound may be allowed to close.

Treatment of Malignant Stricture.—This consists in using Symonds' tube if the growth is not behind the cricoid or bronchus, where it causes too much irritation to be tolerated. Its chief advantage is that the patient has the satisfaction of tasting his food. In the other cases gastrostomy is necessary as soon as the patient shows signs of getting insufficient nourishment. Tracheotomy may be required when the glottis is affected.

CHAPTER XXVIII

AFFECTIONS OF THE EAR

THE **External Ear** may be congenitally absent, or there may be accessory auricles. Large and prominent ears can be improved in appearance by excising a V-shaped portion.

Hæmatoma Auris results from injury, especially in

the insane. No treatment is necessary, but deformity from contraction often remains. Eczema and boils affect the auricle.

Cerumen often collects in and blocks the meatus, causing deafness. If the wax presses on the membrana tympani noises in the ear, giddiness, and vomiting may be caused. The wax can be seen with a speculum. Treatment consists in syringing it out with warm water. It may be necessary to first soften the wax with glycerine.

Foreign Bodies may be removed by syringing, fine forceps, or a sharp hook. If this fails the auricle must be detached by an incision behind, so as to get more directly at the deepest part of the meatus.

Exostoses may grow from the wall of the auditory canal, and if causing deafness must be removed with the electric burr.

Otitis Media.—The cause of acute inflammation of the middle ear is extension along the Eustachian tube of a preceding inflammatory condition in the throat. It commonly follows scarlatina and measles, but a common cold or the presence of adenoids may be sufficient as a starting-point. There is severe pain in the ear, deafness or tinnitus, and a raised temperature. As pus collects in the middle ear, the drum is reddened and bulges. Later on, if not incised by the surgeon, a perforation occurs, and the pain is relieved as the pus is discharged. Under careful treatment, by frequent irrigation of the ear and keeping it covered with antiseptic dressings, the perforation may heal ; if not, the case becomes one of chronic otorrhœa.

In **Chronic Otorrhœa** the general health should be improved, adenoids should be removed, and the middle ear should be kept free from discharge by syringing it frequently with boric acid lotion or by pouring in peroxide of hydrogen. The cavity is then dried, and a few drops of boracic alcohol (gr. xxx. ad ℥i.) are instilled. Inflation of the tympanic cavity by Politzer's bag or by Valsalva's method may also be of use. It is important to see if the perforation is large enough to allow of efficient drainage; if not, it should be enlarged. If in spite of this the discharge persists, one of the following complications is present :

The **Surgical Complications of Chronic Otitis Media** are very important, owing to the great risk to life some of them involve.

The **Extracranial Complications** are unimportant, viz.: **eczema** of the meatus, **boils**, and, rarely, **extension of an abscess** through the tympanic plate to the temporo-maxillary articulation.

The **Cranial Complications** are often grave. 1. **Necrosis** or **ankylosis** of the ossicles causes impairment of hearing. 2. The inflammation may extend to the temporal bone and cause **caries** or **necrosis**. The skull may be opened through the thin roof of the tympanum in this manner, and so intracranial complications may occur. 3. **Polypi** protruding through the membrane are an evidence of caries of the bone, and prevent the escape of discharges. 4. **Facial paralysis** may arise from chronic inflammatory thickening around the aqueductus Fallopii. 5. **Mastoiditis** frequently occurs from spread of the inflammation to the mastoid antrum and cells. The antrum is present at birth, but the cells are only developed at puberty. Extension of inflammation to the bone around the antrum causes severe pain and tenderness over the mastoid and a raised temperature. In children suppuration extends along a communicating vein, which runs through the squamoso-mastoidal suture and leads to the formation of a subperiosteal abscess, which, besides having the ordinary feature of an abscess, *displaces the auricle outwards and downwards*. The same condition occurs in adults from caries of the bone covering the antrum. Intracranial complications may follow. **Cholesteatoma** is a name given to a chronic form of mastoiditis in which the antrum is distended with a mass of epithelial cells and cholesterine. Occasionally tubercle is the cause of otitis media and mastoiditis.

Treatment.—In the early stages of mastoiditis, hot fomentations should be applied. If this does not relieve the pain quickly, or if an abscess be present, a curved incision must be made over the mastoid process, and followed by an opening into the antrum either with the gouge or electric drill.

The position of the antrum is marked by the supra-meatal dimple in most cases, but if this is absent the

position for opening this cavity can be found by taking the point of junction of two lines drawn as tangents to the upper and posterior walls of the bony meatus. The adult antrum is about $\frac{3}{5}$ inch from the surface. A free opening is made and all diseased bone is scraped away. The cavity is then packed with gauze and dressed daily.

This operation is suited for acute cases, but where the disease is old-standing and the hearing much impaired the bone lying between the antrum and middle-ear, the ossicles, and the outer wall of the attic must be removed, thus converting the two cavities into one large one. Care must be taken not to divide the facial nerve, as it lies to the inner side of the iter ad antrum. The external auditory meatus is then enlarged by splitting it posteriorly and stitching the upper part out of the way, so that a big opening is left through which the cavity can be dressed. The posterior wound is then closed. Ten days later the wound is opened up again and the bony cavity covered with a Thiersch graft. Permanent cure results from this operation.

The **Intracranial Complications.** — 1. **Subcranial Abscess**, or suppuration between the skull and dura mater, is usually caused by necrosis of the roof of the tympanic cavity or antrum. When the abscess is of any size, cerebral irritation and compression occur. Pain and headache are followed by drowsiness and coma. The temperature is raised, but rigors are not present; the pulse is rapid, vomiting is frequent, and optic neuritis and pain in the back of the neck are present if basal meningitis follows. The pus may discharge itself along the course of the mastoid emissary vein.

The *Diagnosis* from **cerebral abscess** is often difficult, but the rapid pulse, raised temperature, irritability, and retracted neck are unlike the typical slow pulse, subnormal temperature, and slow cerebration of a cerebral abscess.

Treatment consists in first opening the mastoid antrum and then enlarging the opening upwards to expose the dura mater and evacuate the abscess.

2. **Meningitis** may be localized or diffuse. Raised temperature, great irritability, and retraction of the neck going on to drowsiness and coma form the symptoms.

Diffuse cases are fatal. Localized meningitis may get better when the complete mastoidectomy has been performed.

3. **Thrombosis of the Lateral Sinus** arises from direct extension backwards from the antrum either through the bone itself or a mastoid emissary vein which leads direct to the sinus. The sinus becomes blocked by septic clot, which softens, and pyæmia follows from infective emboli being carried into the blood-stream. The jugular vein may be felt in the neck sometimes as a hard cord.

Symptoms.—Very high remittent temperatures associated with rigors and sweats, together with pain over the mastoid, are the characteristic symptoms. The pyæmia may take on either a pneumonic or a typhoidal form.

The *Diagnosis* is easy in a typical case, but in the early stages it may be very difficult.

Treatment, to be successful, must be undertaken early. The antrum is opened, the opening is then enlarged backwards to expose the lateral sinus. A hypodermic needle thrust in demonstrates whether the blood is fluid or not. If a thrombus is present, then the internal jugular vein is exposed at the level of the upper border of the thyroid cartilage—or lower if the thrombus is more extensive—and tied to prevent further escape of septic emboli into the circulation. The vein is then opened here and in the lateral sinus, and the clot washed away. The openings above and below are then packed with gauze, and allowed to heal by granulation.

4. **Abscess in the cerebrum or cerebellum** is not uncommon, and has already been described (p. 231).

CHAPTER XXIX

SURGERY OF THE NECK

Affections of the Neck.

Branchial Fistulæ are due to imperfect closure of the branchial clefts. Their openings are along the anterior border of the sterno-mastoid, and discharge a glairy fluid. If inconvenience is caused, the epithelial lining should be completely dissected out.

Branchial Cysts arise from distension by secretion of incompletely obliterated branchial clefts. Slowly-growing, soft, painless, fluctuating swellings are formed. Sebaceous matter or glairy mucous fluid forms the contents. They may extend very deeply, even to the wall of the pharynx or tonsil. Treatment consists in complete extirpation. Carcinoma is said to arise sometimes in the remains of a branchial cleft.

Congenital Induration of the Sterno-mastoid arises from injury during parturition, and may lead to torticollis.

Congenital torticollis, cysts of thyroglossal origin, and cystic hygroma, also occur.

Cysts of the Neck.

Cysts of Congenital Origin.—1. **Dermoids** may arise in the mid-line, from branchial clefts or the thyroglossal duct. 2. A **Thyroglossal Cyst** may originate in any part of the duct if a portion remains unobliterated. Its course runs from the foramen cæcum of the tongue to the isthmus of the thyroid, between the geniohyoglossi and behind the hyoid bone. If the cyst bursts on the surface, a **median cervical fistula** is formed. Complete excision is necessary. Thyroid adenomata may grow from any portion of the duct. 3. **Cystic Hygroma** is usually congenital, but may grow later. It consists of a swelling composed of dilated lymphatic spaces. The tumour is soft and diffuse, and its size is lessened by pressure. If not extending to inaccessible parts, or if increasing rapidly, it should be completely removed.

Acquired Cysts of the Neck.—1. **Sebaceous Cysts.** 2. **Bursal Cysts** occur between the hyoid bone and thyro-hyoid membrane. Complete excision is the best treatment. 3. **Unilocular Serous Cysts** are uncommon, and are probably due to dilatation of lymph spaces. Excision is the best treatment. 4. **Hydatid Cysts** are rare. 5. **Blood Cysts** are rare, and are usually in communication with a vein, and should be excised. 6. Cysts are found in connection with the salivary and thyroid glands. 7. **Malignant Cysts** are due to degeneration of epitheliomatous lymphatic glands.

Cut Throat.

In the case of attempted suicide a right-handed man begins on the left side, and the cut is deepest there. If the wound is deep only in the middle, the air-passages are opened ; but if deep also at the sides, the big vessels are divided, and the patient rapidly bleeds to death.

Wounds involving the Air-passages may be above the hyoid, through the thyro-hyoid space, through the larynx, or into the trachea.

The **Immediate Effects** are due to hæmorrhage, asphyxia, or the entry of air into veins. When **above the hyoid** the root of the tongue, and perhaps the lingual or facial arteries, are divided. Asphyxia may occur from the base of the tongue falling back over the glottis. When **through the thyro-hyoid space** the epiglottis is cut through ; blood may enter the larynx and cause asphyxia. **Wounds of the larynx** itself are usually slight, but blood may trickle down into the lungs. When the **trachea** is wounded, the carotid arteries are usually cut, and fatal bleeding quickly follows. The inferior thyroid artery and recurrent laryngeal nerve may also be cut.

The **Secondary Effects** are usually inflammatory: (1) Septic cellulitis in the neck, œdema of the glottis, secondary hæmorrhage and pyæmia, or (2) septic broncho-pneumonia from inhaling septic blood-clot, discharges or food. (3) Surgical emphysema may occur.

Treatment.—All bleeding points must be secured and strict measures taken to render the wound aseptic. If the air-passages have not been opened, the wound can then be stitched up, leaving in a drainage-tube. If the trachea is wounded, a tracheotomy tube should be inserted for two or three days. If the larynx is wounded a tube is unnecessary, but the wound should be left open. If the thyro-hyoid space is opened, tracheotomy should be done, and the epiglottis stitched accurately without perforating the mucous membrane. The wound should then be closed, layer by layer, and drained. The patient must be fed for several days by an œsophageal tube.

Sequelæ. — An **aerial fistula** may follow from per-

sistence of an opening. It is repaired by separating the skin from the mucous membrane and stitching them separately.

Laryngeal or tracheal stenosis may necessitate the retention of a tracheotomy tube permanently. **Aphonia** may arise from division of the recurrent laryngeal nerve.

Diseases of the Thyroid Gland.

Goitre, or enlargement of the thyroid gland, is fairly common.

Causes.—The only clearly proven cause of parenchymatous goitre is the drinking of water from special sources. What is the particular constituent present, or what is absent that should be there, is not known, but the absence of iodine is suggested.

Varieties. — (1) Parenchymatous; (2) adenomatous, which may also be cystic; (3) malignant; (4) exophthalmic. Acute inflammation is sometimes seen.

General Features.—In all cases there is a swelling of part or whole of the thyroid, which moves on deglutition. Pressure on surrounding parts leads to dyspnœa, either from bilateral or unilateral pressure, or pressure on the recurrent laryngeal nerve.

Parenchymatous Goitre consists of a diffuse overgrowth of the whole thyroid body. It is soft, painless, and only gives rise to symptoms if it causes bilateral pressure on the trachea. Adenomata are common in a parenchymatous goitre. Fibroid degeneration may also occur.

Adenomatous Goitre.—Encapsuled adenomata grow in the substance of the lateral lobes, but never in the isthmus. These adenomata may resemble either the fœtal or adult thyroid in structure. Many adenomata are converted into cysts, containing a thin brownish fluid, probably due to admixture with blood. Old adenomata may become calcified. Obstruction to respiration in these cases arises from bending of the trachea to one side or the other, or from a substernal adenoma causing pressure from before backwards.

Treatment. — **Parenchymatous Goitre** very often lessens in size under the administration of tonics, iodine,

iodide of potassium and thyroid extract. If the tumour persists, or increases, or gives rise to difficulty in breathing, removal of one half of the gland is necessary. Total removal gives rise to myxœdema.

A transverse or curved incision should be made across the most prominent portion of the tumour through the platysma and infrahyoid muscles to the capsule. The superior thyroid vessels and all big veins belonging to the tumour are ligatured close to the mass. A finger is then slipped behind the lobe, and it is dislocated from its bed, thus exposing the inferior thyroid vessels, which are ligatured close to the gland so as not to injure the recurrent laryngeal nerve. The gland is then carefully peeled off the trachea and isthmus, taking care not to injure the tracheal rings, which may be very thin. The infrahyoid muscles are then stitched together, and finally the skin ; but a drainage-tube should be left in for twenty-four hours. The patient should be kept in the nearly sitting-up position and with a special nurse, as great restlessness often follows.

Adenomata are removed by exposing the gland, and incising the gland substance down to the bluish-white capsule of the adenoma, which is then shelled out. The bleeding-points must be carefully tied and the gland stitched up. If oozing persists a drainage-tube must be left in. If multiple adenomata are present, that part of the lobe which is affected should be removed.

Exophthalmic Goitre, or **Graves' Disease**.—The thyroid is enlarged and pulsates. The patient is anæmic and tremulous, the heart's action is rapid, and the eyeballs protrude. The two theories as to its causation are : (1) that it is solely a nervous derangement, and (2) that it is solely due to excessive absorption of thyroid secretion. Weak females are those usually affected. Owing to the protrusion of the eyeball, the sclerotic can be seen above the cornea as the patient follows a finger downwards (Von Graefe's sign). Fine tremors, diarrhœa, pigmentation of the skin, and marked wasting are present in severe cases.

The *Prognosis* is bad when the mental symptoms are in excess of the physical, and when there is marked emaciation or diarrhœa.

Treatment consists in rest, attention to the general health, and tonics. Phosphate of soda is said to do good in

some cases. If the disease causes much distress, and the patient is willing to undergo the great risk, operative treatment may be undertaken. Half the gland may be removed or three of the thyroid arteries tied. It is better to operate with local anæsthesia, as general anæsthetics are badly borne. Striking improvement slowly follows in some cases, but in others an acute maniacal condition develops, followed by death in twenty-four hours, and for which no explanation can be found. A large thymus is always found in fatal cases.

Malignant Goitre is usually carcinomatous, but may be sarcomatous. A few cases of endothelioma have been lately described. It is hard, and infiltrates the surrounding tissues. The carotid vessels run through the mass instead of being pushed backwards and outwards. The recurrent laryngeal is early compressed and paralyzes the cord on that side. The growth may protrude into the larynx.

Treatment consists in free removal, but few cases can be diagnosed sufficiently early to justify an attempt.

Acute Inflammation of the Thyroid Gland results from pyogenic infection, and usually goes on to suppuration. Free incisions are necessary.

Accessory Thyroids are sometimes found attached to the isthmus or lateral lobes, or in connection with the thyroglossal duct. They should be removed if causing any trouble.

CHAPTER XXX

SURGERY OF THE AIR-PASSAGES, LUNGS, AND CHEST

Foreign Bodies in the Air-Passages.

The Pharynx and Glottis may be blocked by attempting to swallow too large a mass of food, and cause fatal asphyxia. Smaller bodies may become impacted and cause œdema of the glottis; or a mass of food may be vomited and then block the entrance to the larynx.

Treatment.—The obstruction must be rapidly removed with a finger, and, if this is unsuccessful, a rapid laryngotomy must be done, followed up by artificial

respiration. If the dyspnœa is not urgent, an examination can be made with the laryngoscope.

Foreign Bodies in the Larynx.—Partial or complete obstruction may be caused by such bodies as coins, buttons, or tooth-plates. Violent coughing, hoarseness, respiratory stridor mark incomplete obstruction, but œdema of the glottis may soon follow and render it complete. Ulceration and necrosis of the cartilages may also follow.

Treatment consists in finding the body by laryngoscopic examination, and removing it either with laryngeal forceps or through a laryngotomy opening; failing that, by thyrotomy.

Foreign Bodies in the Trachea.—The foreign body must be small enough to enter the glottis, and not too heavy, or it drops into one of the bronchi. It becomes impacted in mucus or may be free.

Symptoms.—A severe attack of coughing occurs at the time of entry. Later, similar spasmodic attacks are produced by the body being coughed up against the vocal cords. Death may occur from impaction there. Catarrhal tracheitis soon comes on.

Treatment consists in performing a low tracheotomy and removing the body by inverting the patient and concussing the back. If this does not cause expulsion the trachea must be left widely open, when coughing may remove the body.

Foreign Bodies in a Bronchus.—Buttons, pebbles, O'Dwyer's tubes, etc., are the kind of articles which may get into a bronchus, especially the right. Immediate spasmodic **obstruction** marks its entry through the larynx. Later, signs of obstructed entry of air into the lung appear, and still later signs of complete obstruction and collapse of the lung. **Inflammation** soon follows, and bronchitis, bronchiectasis, and suppuration are the results. The body may be expelled with a quantity of pus; the suppuration may extend to the pleura and form a localized empyema; or the lung may become riddled with abscesses, and the patient dies from toxæmia.

Treatment.—The position of the body must be determined by examination of the chest and by skiagraphy, and an attempt made at removing it through a low

tracheotomy wound. Abscess or empyema must be opened, and then usually the body comes out with the pus.

Injuries of the Larynx.

Fracture of the hyoid bone, incised wounds, and fracture of the thyroid cartilage may occur. Rest is the only treatment necessary unless dyspnœa arises, when tracheotomy is necessary.

Diseases of the Larynx.

Laryngeal Diphtheria usually extends from the fauces, but may be primary. Intubation or tracheotomy is necessary if the obstruction is severe and does not yield to antitoxin.

Œdema of the Glottis.—*Causes.*—(1) Severe laryngitis or perichondritis; (2) submaxillary cellulitis or retropharyngeal abscess; (3) scalds from inhaling steam or drinking corrosives; (4) the presence of foreign bodies. The mucous membrane covering the epiglottis, aryteno-epiglottidean folds, false vocal cords and interarytenoid space is swollen and œdematous, and either partially or completely obstructs inspiration.

Treatment consists in scarifying the swollen tissues and inhaling steam impregnated with Tinct. Benzoin. Co. If dyspnœa is urgent, laryngotomy or tracheotomy is necessary.

Syphilitic Disease of the Larynx.—Mucous patches may be seen in the secondary stage, but soon disappear under treatment. Gummatous ulceration of the epiglottis and aryteno-epiglottidean folds causes great destruction; extension to the cartilages may lead to necrosis Hoarseness and dyspnœa are the symptoms, while subsequent cicatrization may lead to stenosis.

The *Treatment* consists in giving mercury and iodide of potassium. Tracheotomy is necessary for urgent dyspnœa.

Tuberculous Laryngitis is nearly always secondary to phthisis. Ulcers form on the arytenoids. The epiglottis and aryteno-epiglottidean folds are swollen and œdematous. The mucous membranes are usually very pale. Hoarseness, cough, and pain are the usual symptoms.

Treatment.—Local applications of orthoform or iodoformigen powder or lactic acid are often useful, but the prognosis is bad.

Paralysis of the Larynx may occur from injury or division of the recurrent laryngeal nerve; from the pressure of aneurysms of the aorta, malignant goitre, and carcinoma of the œsophagus. The cord on the affected side, if completely paralyzed, lies midway between abduction and adduction; if incompletely, it lies in the mid-line. Symptoms may be slight in unilateral cases, but in bilateral cases aphonia alone results, unless the paralysis affects the abductors only, when phonation is possible, but the dyspnœa may be severe enough to necessitate tracheotomy.

Papilloma of the Vocal Cords gives rise to hoarseness and perhaps dyspnœa, and should be removed with laryngeal forceps.

Epithelioma may occur in the epiglottis, true or false vocal cords. The growth infiltrates, and may spread beyond the larynx. Hoarseness, aphonia, cough, and blood-stained expectoration are the symptoms. The glands only become enlarged when the growth spreads beyond the larynx.

Treatment by local removal after thyrotomy is possible in the early stages. Complete removal of the larynx is rarely a successful operation in preventing recurrence.

Operations upon the Air-Passages.

Sub-Hyoid Pharyngotomy consists in opening the pharynx by a transverse incision across the thyro-hyoid space cutting through the base of the epiglottis. By this means, or by a vertical median incision dividing the hyoid bone, a good exposure of the glottis is obtained for the purpose of treating growths.

Thyrotomy is done for removing foreign bodies or treating intra-laryngeal growths. Tracheotomy is first done and a Hahn's cannula used, or gauze is packed around an ordinary tube. A vertical incision is made over the thyroid cartilage in the mid-line, and the cartilage cut or sawn through. Cocaine should be swabbed over the interior of the larynx to prevent coughing. The carti-

lage must afterwards be very accurately stitched in apposition, so as not to impair phonation.

Extirpation of the Larynx is done for epithelioma. Removal of one half only may be necessary.

Complete Extirpation.—A low tracheotomy is done and Hahn's tube introduced. An incision is made from the centre of the hyoid bone to the cricoid cartilage, and a transverse one across the hyoid bone to the sterno-mastoid on either side. Flaps are turned back baring the thyroid cartilage. The superior and inferior laryngeal arteries are tied. The crico-tracheal membrane is divided and the larynx pulled forward, so that its posterior attachments to the pharyngeal wall can be severed. The thyro-hyoid membrane and the base of the epiglottis are cut through, and the larynx is then free. The transverse incision is sutured, but the vertical is allowed to heal by granulation. The upper end of the trachea is stitched to the wound, and the tube transferred to it at the end of a week. The opening into the pharynx is sometimes closed completely at the time of operation.

Laryngotomy is done for sudden, urgent dyspnœa or for convenience in mouth operations. A transverse incision is made over the crico-thyroid membrane, which is then opened transversely and a flattened tube inserted. In children there is insufficient space, so that the cricoid must also be divided or a tracheotomy done.

Tracheotomy.—The isthmus of the thyroid lies over the third and fourth rings. A high tracheotomy is performed above the isthmus, a low one below. Tracheotomy is required for obstruction to the respiration due to diphtheria, œdema of the glottis, foreign bodies, stenosis, tumours, laryngeal paralysis, compression of the larynx or trachea by tumours, and as a preliminary measure in operations where it is necessary to prevent blood entering the air-passages. The high operation is less risky, but the low one is necessary for the removal of foreign bodies from the trachea or bronchus, and in extirpation of the larynx.

The High Operation.—The patient is placed on the back, with a narrow pillow under the neck. Chloroform or cocaine can be used as anæsthetics. An incision, 1½ inches long, is made downwards from the cricoid carti-

lage, keeping strictly in the mid-line. The incision is deepened till the tracheal rings and isthmus are exposed. Enlarged veins give trouble during this stage if there is dyspnœa. A director-hook is thrust into the trachea, and the point of a knife is slid along the groove to open the trachea from below upwards. The patient is allowed to cough for a few minutes, while the wound is kept open with dilating forceps; then the tube is inserted and tied in.

Low Tracheotomy is performed in the same way, but the incision reaches nearly to the episternal notch. Care must be taken not to wound the left innominate vein, which reaches a finger's breadth above the level of the sternum. The muscles are retracted to either side, the inferior thyroid veins clamped, and the fascia over the trachea is then divided.

There are many forms of **tracheotomy tube**, but the best have an inner tube which can be taken out and cleaned, and an introducer. **Durham's lobster-tailed tube** and **Parker's tubes** are the best. The **bivalve-tube** is also useful.

The tubes which also plug the trachea for mouth or laryngeal operations are **Hahn's**, which is covered with compressed sponge, and **Trendelenburg's**, which has a pneumatic jacket.

Difficulties and Dangers of the Operation.—The short, fat neck of infants, the extreme movements of the larynx and trachea, and the engorgement of the inferior thyroid veins in cases of laryngeal diphtheritic obstruction, constitute great difficulties. If the incision wanders from the mid-line, the large vessels or œsophagus may be wounded; or the œsophagus may be punctured by plunging the knife too boldly through the trachea. Air may rarely enter the veins. Some trouble may be found in introducing the tube if dilating forceps are not kept in during the introduction. The trachea may be blocked with membrane below the end of the tube.

After-Treatment.—The room should be warm and the air kept moistened with steam from a bronchitis kettle. No gauze should be kept *over* the tube, but the mucus or membrane should be wiped away as it is coughed up. The inner tube is taken out and cleaned by the nurse every four hours; the outer tube once a day by the

surgeon. If the tube or trachea is blocked with mucus, the tube must be taken out and the dilating forceps introduced. The coughing set up by this expels the mucus. A special suction apparatus has also been devised for this purpose. An early attempt should be made to make the patient do without the tube. If the patient can breathe with a windowed tube with a finger placed over the ordinary opening, the tube may be left out.

After-Complications of Tracheotomy.—(1) Ulceration of the trachea from the pressure of a badly-shaped tube; (2) cellulitis spreading from the wound; (3) septic pneumonia; (4) difficulty in leaving off the tube from granulations obstructing the lumen, or from laryngeal stenosis by adhesions of the vocal cords or paralysis of the abductors. A laryngoscopic examination should be made and granulations scraped away, or the glottis dilated with O'Dwyer's tube; and failing this, thyrotomy and dealing with the causes found.

Intubation of the Larynx.—O'Dwyer's tube is passed through the glottis by means of the introducer. Its expanded upper end prevents it slipping further down. It requires some practice to introduce, and it acts very well in many cases of œdema of the glottis and diphtheria.

Surgical Affections of the Lungs.

Wounds of the Lungs are due to violence applied to the chest either with or without fracture of the ribs, or to penetrating injuries.

Non-Penetrating Wounds.—1. **Contusion** without fracture of the ribs produces pain, and perhaps slight hæmoptysis. The pain is soon relieved by keeping the patient quiet and strapping that side of the chest.

2. **Laceration** of the lung is produced by fractured ribs, and only rarely occurs without. Direct violence is always the cause. Severe shock, pain, and dyspnœa with hæmoptysis or hæmothorax, are the usual symptoms. The hæmoptysis is slight in small injuries, severe and quickly fatal where the laceration is deep and big vessels are torn. Air may escape freely into the pleural cavity and produce pneumothorax and collapse of the lung. Severe dyspnœa, a tympanitic note on percussion, amphoric

breathing, and metallic tinkling on auscultation, are the signs of pneumothorax. If the patient lives, the air is absorbed in a few days. Blood is absorbed also in a few days, and suppuration does not occur in the pleural cavity unless there was preceding bronchitis or bronchiectasis.

Surgical Emphysema indicates a wound of both parietal and visceral layers of the pleura. Air enters the pleural cavity on inspiration, and is forced into the subcutaneous tissues on expiration. The fine crackling felt by pressure with the hand is quite characteristic. The emphysema may be very extensive, but never does any harm, and disappears in a few days.

The later effects consist of a localized traumatic pleuropneumonia which lasts a few days.

Penetrating Wounds of the Lung are similar to the above, except that the wound allows some of the blood to escape, and permits the entry of pyogenic organisms, so that empyema is not infrequent. Intercostal arteries may also be wounded.

Treatment.—When the rupture of the lung is due to a subcutaneous injury, the patient should be kept at rest in bed. The chest should be strapped if the ribs are not fractured. Opium is the best drug to give for hæmoptysis. Ergotin is also recommended. Hæmothorax seldom gives trouble, either from its amount or from decomposition of the blood-clot ; but if compression of the lung occurs or suppuration, the pleural cavity must be opened and drained. The air in a pneumothorax becomes absorbed in five or six days.

If a patient is cyanosed, with dyspnœa and a full pulse, venesection produces immediate relief.

The treatment of **penetrating wounds** consists in purifying the skin in the neighbourhood, enlarging the wound if necessary, exploring it with a finger, and removing any fragments of bone or foreign bodies. The wound should then be packed with gauze and allowed to heal by granulation.

Hæmorrhage from an intercostal artery is treated by exposing and tying the bleeding-points ; **pulmonary hæmorrhage** by absolute rest, opium, and applying ice to the chest. If the patient is in danger from loss of blood, 2 pints of saline solution should be given intravenously.

Hernia of the Lung is very rare, and may occur suddenly from rupture of the intercostal muscles and pleura, or slowly from yielding of a cicatrix. A soft crepitant swelling with an impulse on coughing, and over which a vesicular murmur can be heard, constitute the signs. No treatment is necessary.

Prolapse of the Lung may occur through a penetrating wound. It should always be purified and returned, or it will become gangrenous.

Empyema, or suppuration in the pleural cavity, though occasionally due to traumatism, usually follows pleurisy or pneumonia. The organisms causing it are pneumococci, streptococci, staphylococci, tubercle bacilli, *Bacillus coli*, and actinomycosis.

The physical signs are those of fluid in the pleural cavity ; that side does not move well, the percussion note is dull, there is absence of breath sounds, vocal fremitus and resonance are diminished. Left alone, an empyema may burst through an intercostal space, usually the fifth. The lung is collapsed in extent according to the amount of pus. The pleura, at first covered with lymph, soon becomes covered with layers of granulation tissue, the deeper part of which is converted into fibro-cicatricial tissue, and the lung itself also undergoes some fibroid change. If the pus is let out early, the lung and pleura soon expand, but if allowed to remain the infiltration of the lung and the density of the scar tissue covering it hinder expansion. Nature attempts to remedy this in various ways. (1) The other lung expands and pushes the heart over to the opposite side; (2) the chest wall falls in, the intercostal spaces are obliterated, and the spine is curved, with its concavity towards that side ; (3) the abdominal viscera are pushed up ; and (4) exuberant granulations form on the pleura. If a cavity still remains an operation is necessary.

The *Diagnosis* of empyema is only made by exploration of the pleural cavity with a syringe. In all cases where fluid is diagnosed, an exploration should be made when it does not commence to clear up in a few days, or irreparable damage may be done to the lung, for upon early drainage depends whether immediate expansion will occur. The most favourable cases are the pneumococcic ones ; the least favourable are the tuberculous.

Treatment should be undertaken without delay. **Aspiration** seldom cures, but may be undertaken where the dyspnœa is great, and an anæsthetic given afterwards for the excision of a piece of rib. **Drainage** is always necessary, and is best done by excising a portion of the fifth or sixth rib in the mid-axillary line. The patient should be allowed to come round quickly from the anæsthetic, so that the coughing which occurs will expel the masses of coagulated lymph and help to expand the lung. A big drainage-tube is then inserted. Daily dressings are necessary, but irrigation of the cavity is seldom needed. If, because of delay in treatment, the cavity does not soon close, **Estlander's operation**, or some modification, must be performed. The wound must be enlarged and a number of ribs exposed, and sufficient of them removed to convert the cavity into a pyramidal one, the base of which is the open wound. This is packed with gauze and allowed to heal from the bottom. If the operation has to be extensive, the flaps are allowed to fall back upon the granulating surface of the lung, and in these cases marked scoliosis and weakness of that side of the chest follow.

Pneumotomy, or incision of the lung, is done for abscess or gangrene of the lung, bronchiectasis, hydatid of the lung, and tuberculous cavities, if they are primary at the base. The area to be operated upon is decided by the physical signs and exploring syringe (except in hydatid cases). Portion of one or more ribs is then excised. If the lung is adherent, the operation is proceeded with ; if not, the two layers of pleura are stitched together or shut off by packing with gauze. The lung is then explored with a needle and syringe, and, when the cavity is found, the opening is enlarged and a drainage-tube inserted.

Wounds of the Heart.

Wounds of the heart and the big vessels are usually quickly fatal. A few cases of suture of the heart wall have been successful.

Pericardial Effusions, either serous or purulent, may require evacuation if excessive by **aspiration** through the fifth interspace, close to the left border of the sternum, or

1½ inches from the sternum in the fourth or fifth interspaces. Drainage in purulent cases is done by excising a piece of the fifth left costal cartilage.

CHAPTER XXXI

DISEASES OF THE BREAST

Affections of the Nipple.

Fissure of the Nipple only occurs during lactation and as a result of not drying the nipple after nursing. The nipple becomes painful, and is likely to be infected with pyogenic organisms, so that inflammation may spread along the lymphatics into the substance of the breast or to the axillary glands.

Treatment.—The nipples should be hardened by bathing them with spirit during the last few weeks of pregnancy as a preventative. After nursing, the nipples should be washed with boracic lotion and then carefully dried. When a fissure has formed, the nipple should be rested and covered with an antiseptic dressing, the milk being drawn off with a breast-pump.

Eczema of the Nipple may be simple or of the kind known as **Paget's Disease**, which is really malignant in nature. A smooth, red, raw surface with an abundant yellow discharge is presented, and the nipple gradually melts away. Ordinary scirrhus, or duct cancer, is found beneath this. Treatment consists in removal of the whole breast and the axillary glands.

Abscess of the areola, chancre of the nipple, and sebaceous cysts, are occasionally seen.

Inflammatory Affections of the Breast.

Acute Mastitis is often seen in the puerperal period. Infection enters through a crack in the nipple, and spreads either along the lymphatics or the ducts. Mastitis is uncommon apart from lactation, but may result from injury, or as a metastasis in mumps.

Symptoms.—The breast is swollen, painful, and tender,

and, owing to the soreness of the nipple, the breast is not relieved of its secretion, so that it is distended. If suppuration follows, redness, œdema, and fluctuation occur over the site of the abscess. The abscess may be—(1) supramammary, the pus lying between the skin and breast; (2) intramammary, or the common form, in which the pus is in the substance of the breast; (3) submammary, which is beneath the breast, and may spread from the deep lobules, but more frequently is due to disease of the underlying ribs.

Treatment, before suppuration occurs, consists in supporting the breast with a bandage, emptying the gland regularly with a breast-pump, and applying a belladonna plaster over the gland to stop the secretion and allay the pain. When pus is present an incision should be made at once, or the abscess may burrow extensively and riddle the breast. The incision should be made in a line radiating from the nipple, so as not to cut the ducts; it should be free, and all pockets opened up with the finger. Then a large drainage-tube is inserted and shortened daily, as the wound heals by granulation. If necessary, several incisions are made.

Chronic Mastitis may be of two kinds—lobar and interstitial.

1. **Chronic Lobar Mastitis** consists of enlargement of one or more lobes, which are tender and painful, resulting from imperfect involution at the end of lactation or following acute mastitis. Treatment consists in supporting the breast and applying a belladonna plaster.

2. **Chronic Interstitial Mastitis** occurs usually in patients at or past the menopause. There is infiltration and overgrowth of the connective tissue, and proliferation of the epithelium, so that the acini are filled. Cysts may form owing to the pressure of the interstitial growth preventing the escape of secretion. These are known as **involution cysts**, and the fluid may be clear or turbid and brown. As a rule these cysts are multiple, scattered and tiny, but one may become large and resemble a tumour.

Symptoms.—There may or may not be pain in the breast, but a number of small scattered lumps are usually found. Both breasts are usually affected. The skin is seldom attached over the lumps, but the lymphatic glands

may be slightly enlarged. Distinct cysts may be felt in some cases. The disease slowly progresses, and ends in atrophy of the breast or general cystic formation. It is said that cancer is likely to follow interstitial mastitis.

The *Diagnosis* from scirrhus rest on the facts—(1) that the whole breast, and probably the other breast, are affected with scattered nodules; (2) that the nodules are free from skin and pectoral fascia; (3) that the lumps are less distinctly felt with the flat of the hand than those of scirrhus; (4) that the glands are not commonly enlarged, and if they are, not so stony hard as are those of scirrhus. The two diseases are occasionally present together, and in any case of doubt an exploratory incision and microscopic examination should be made.

Treatment consists in supporting the breast and applying a belladonna plaster. Single cysts should be removed, but if the whole gland is cystic complete removal is better.

Chronic Abscess is rare, and may simulate a tumour. An indurated mass forms in the breast, and may give rise to retraction of the nipple, attachment of the skin, and enlarged axillary glands. If fluctuation can be detected, this distinguishes it from scirrhus, which it otherwise resembles. An incision settles the diagnosis and cures the disease. Tubercle is sometimes the cause of this condition.

Diffuse Tuberculous Disease is occasionally seen. Scattered caseous nodules are found, which break down and form sinuses, the axillary glands being frequently affected secondarily.

Treatment.—Incision and free scraping is sufficient in limited disease, but it is usually necessary to remove the whole breast.

Syphilis of the Breast occurs in the form of a primary sore, condylomata, and rarely as a gumma.

Cysts of the Breast.

Acinous or Retention Cysts arise from inflammatory obstruction to the ducts during or after lactation, so that distension with milk occurs, the tumour formed being called a **Galactocele**. Treatment consists in opening and draining the cyst.

Involution Cysts occurring in chronic interstitial mastitis have been described. **Cystic** dilatation of the ducts occurs in connection with duct papilloma, duct cancer, and cysto-adenoma. Discharge from the nipple on squeezing occurs in these cases usually.

Interacinous Cysts.—Serous Cysts arise from dilatation of lymph spaces. They are lined by smooth endothelium, are usually multilocular, contain serum, but never intracystic growths. Fluctuation can be felt unless the wall is very dense, when the cyst can only be diagnosed from a scirrhus by an exploratory incision. Treatment consists in excision.

Hydatid and **Dermoid Cysts** are rare. Cystic degeneration of malignant tumours is sometimes found.

Tumours of the Breast.

In examining a case of tumour in the breast, attention should be paid to the history as to duration and pain. This should be followed by inspection of the breast as to swelling or shrinking, difference in the level of the two breasts, dimpling of the skin, and retraction of the nipple. The breast should be palpated with the flat of the hand while the patient is recumbent. The consistency of the tumour, its mobility in the surrounding parts and whether fluctuating or not, should be determined. The arm is then raised above the head and the lump moved along the course of the fibres of the pectoralis major. If the tumour is adherent to the pectoral fascia, this cannot be done. The axillary and supraclavicular glands and the opposite breast and axilla must be examined. Finally, the liver should always be examined to detect the presence of secondary growths. The common tumours in the breast are fibro-adenoma and scirrhus. Sarcoma occasionally occurs, while lipoma, fibroma, chondroma, and osteoma, are rare.

Adenoid Tumours of the Breast are innocent and encapsuled, and characterized by—(1) spaces lined with cuboidal epithelium, which may be slit-like or distended into cysts; (2) epithelium which shows no tendency to spread beyond the basement membrane; (3) intracystic growths occasionally; (4) an interstitial structure of fibrous connective tissue.

Pure Adenoma is rare, but **Fibro-Adenoma** is common. It occurs in young adults as a rounded, well-defined, movable tumour, which may or may not be painful. The axillary glands are not enlarged, the skin over it does not dimple, and the nipple is not retracted. On section after removal it is encapsuled, pinkish, and foliated, and does not infiltrate the surrounding tissues. Microscopically there is more fibrous tissue than is met with in normal breast.

The *Diagnosis* from scirrhus is made by the facts of (1) slow growth; (2) absence of infiltration of skin or pectoral fascia; (3) exact definition and free mobility; (4) an incision where there is the least doubt.

Treatment consists in enucleation.

Diffuse Hypertrophy of the Breast is usually fibro-adenomatous, occurs in adolescents, and is more often bilateral. Treatment consists in removing the adenomatous mass, which usually can be shelled out. A soft rapidly-growing form of fibro-adenoma has been called adeno-sarcoma, but this is a wrong title, as it is quite innocent, can be shelled out, and does not recur.

Cysto-Adenoma.—There is a marked development of intracystic growths into the epithelial-lined spaces of the tumour. The cysts may be multiple and of great size. The intracystic growths are due to proliferation of the interacinous tissue, which pushes the epithelial wall before it. The tumour is irregular and painless, and the axillary glands are not enlarged. When the tumour is of great size the capsule and skin may become adherent, and the skin may give way over it; but the fact that the skin is not infiltrated with new growth, but only distended, distinguishes it from a malignant tumours.

Treatment consists in removing the tumour, which is encapsuled and does not recur.

Duct Papilloma is an ordinary papillomatous growth occurring in a terminal galactophorous duct, which is dilated. A blood-stained discharge comes from the nipple. A tumour may or may not be felt, and the diagnosis from duct cancer is difficult. Local removal is necessary, but a microscopic examination should be made to be sure it is not malignant.

Sarcoma of the Breast is not common. It may be either round- or spindle-celled. It usually occurs in

young women. A rounded, rapidly-growing tumour forms, which may lead to ulceration of the skin and fungation. In the early stage it can only be distinguished from fibro-adenoma by the rapidity of its growth. Secondary growths may occur in the axillary glands, or general dissemination may occur. A spurious capsule may be found in the early stage. Secondary changes may occur in the tumour, such as hæmorrhages and myxomatous degeneration.

The proper *Treatment* is removal of the whole breast and axillary glands.

Carcinoma of the Breast.

The breast is the commonest seat of cancer next to that of the uterus. Two principal forms are found—acinous carcinoma and duct carcinoma.

Acinous Carcinoma is the common form, and usually there is much fibrous stroma present, and so it is called **Scirrhus**; where little is present it is called **Encephaloid**.

Scirrhus commences in a lobule of the breast. The epithelial cells proliferate, and spread along the lymphatic spaces into the surrounding tissues. There is a tumour, which is usually small, stony-hard, ill-defined in outline, and incorporated in the breast substance. In the early stages the skin moves over it, but soon the suspensory ligaments which connect the breast with the skin are infiltrated and contracted, so that the skin dimples when moved over the tumour. The whole breast may be contracted, so that the nipple on that side is at a higher level than the other. If the galactophorous ducts are involved in the growth, the nipple becomes retracted as the fibrous portion contracts. In time the growth invades the skin and pectoral fascia. The skin may become the seat of a typical scirrhus ulcer, with an excavated, smooth, clean, or, if not kept clean, a sloughy base, and a raised, rampart-like edge. Or the skin may be affected with numbers of separate nodules of growth.

Cancer *en cuirasse* is a name given to the condition in which the skin over the whole gland and side of the chest is infiltrated. The skin then has a 'pig-skin' or 'orange-skin' appearance.

When the tumour is adherent to the pectoral fascia, it

cannot be moved freely in the direction of the fibres of the pectoralis major with the arm outstretched.

The lymphatic glands of the axilla are early enlarged, first the set running along the border of the pectoralis minor, then the subscapular and remaining axillary sets, and next the supraclavicular glands. The disease may also spread to the mediastinal glands, or to the opposite breast and axilla by lymphatic communications. Handley has shown that the peritoneum and liver may be infected by direct downward lymphatic extension of the growth.

In the later stages secondary growths appear in the liver and other internal organs and in the bones, so that spontaneous fractures may occur. The tumour may become fixed to the ribs, and the arm much swollen from pressure obstruction of the veins and lymphatics. Death follows from exhaustion.

Encephaloid Cancer is much less common, but is more rapid in growth and more quickly fatal. The tumour contains little fibrous stroma, so that it is softer, and the signs due to contraction are absent. It quickly ulcerates and disseminates.

Atrophic Scirrhus is a slowly-growing form, which may last as long as fifteen years, dissemination only occurring at the end. The excessive shrinking of the stroma destroys the cancer cells. The nipple is deeply retracted, and the tumour and breast converted into a scarlike mass.

Duct Carcinoma is rare, and appears in the form of an infiltrating papilloma in a dilated galactophorous duct not far from the nipple, from which comes a blood-stained discharge.

The diagnosis from simple duct papilloma can only be made by microscopic examination.

Duration.—The duration of cancer varies. The encephaloid type is fatal in less than a year. The atrophic form may last twenty years. Duct cancer is the least malignant. Scirrhus varies from two to five or six years.

Diagnosis.—The question of scirrhus arises in the consideration of all breast tumours. The chief points in favour of cancer are the stony hardness, union with the breast tissue, limited mobility, dimpling of the skin, perhaps retraction of the nipple and enlargement of the

axillary glands. Sarcoma, as a rule, can only be distinguished from encephaloid cancer microscopically.

Every case of tumour of the breast should be examined by an incision, and if there is then any doubt a microscopic examination should be made.

Treatment should be early and thorough. However small the tumour may be, the entire breast and its corresponding lymphatic area, as high as the apex of the axilla, should be removed; for, once infection of the lymphatic spaces has occurred, the whole lymphatic area must be looked upon as infected.

Successful operations depend upon a knowledge of the **lymphatics** and **extent** of the breast. The lymphatics begin in plexuses around the acini, which converge to vessels running along with the ducts and end in a subareolar plexus. From this three or four main lymphatic trunks run to the axillary glands. In addition, lymphatics run along the suspensory ligaments to the skin all over the prominence of the breast from the interacinous plexuses. Also vessels leave the deep part of the breast to join lymphatic plexuses in the pectoral fascia. The plexuses in the fascia run to the axilla, and also communicate with those in the pectoralis major. Lymphatic vessels pass into the mediastinum, and also communicate with those of the opposite breast and axilla.

The extent of the breast is much greater than the prominence would lead one to believe. It extends almost to the clavicle, just to the edge of the sternum, down to the seventh rib, and out to the mid-axillary line.

The points, then, in operating are that the whole breast, the skin over the prominence, the pectoralis major muscle (except the clavicular portion), the fat, fascia, lymphatic vessels and glands of the axilla, must be removed, and in one piece, for if cut across at any part there is danger of strewing cancer cells on the wound and so infecting it with growth. Removal or division of the pectoralis minor facilitates the cleaning of the axilla.

The skin incisions should not be planned with a view of afterwards being able to stitch the margins together, but solely with the object of eradicating the disease. By undercutting the skin it can be made to slide, so that a big gap can be covered over; besides, any raw surface

can easily be Thiersch-grafted. The wound should be drained with a large tube brought out through the posterior axillary wall for twenty-four hours. The arm should be kept at right angles to the side to facilitate drainage and prevent subsequent limitation of movement.

Palliative Treatment in inoperable cases consists in doing oöphorectomy and giving thyroid extract; but the results are not promising. Röntgen rays have caused shrinkage in some inoperable growths.

Cases which are beyond operation are cancer *en cuirasse;* where there is much enlargement of supra-clavicular glands or secondary growths in the liver; where the growth is attached to the ribs; where there is evidence of pressure on the axillary nerves.

CHAPTER XXXII

INJURIES OF THE ABDOMINAL WALLS

1. **Contusions** vary in their results according to the amount of injury to the viscera. A slight blow only causes bruising of the abdominal wall, unless a viscus, such as the bladder or stomach, is distended, when rupture of the organ and extravasation of its contents followed by peritonitis may occur. Any sudden blow on the epigastrium produces shock from stimulation of the solar plexus, and this may even be fatal.

Hæmatoma of the abdominal wall may suppurate, from infection spreading to it from a bruised coil of intestine.

The *Treatment* of an abdominal contusion is always a matter of anxiety, for it is impossible at first to be sure if any visceral injury exists. The patient is put to bed, and warmth is applied to combat shock. The first point to clear up is whether the patient has a ruptured bladder; then whether there is free fluid, such as blood, in the peritoneal cavity; next, whether there is free gas, as shown by obliteration of the liver dulness; and, lastly, whether there is blood-stained vomiting, which may show that the stomach is lacerated. A steadily rising pulse is a

strong indication of visceral injury. In cases of doubt it is safer to explore the peritoneal cavity than to wait for more definite symptoms, unless very severe shock is present, when it is better to wait a few hours, giving 2 pints of saline intravenously in the meantime. Opium should never be given, as it masks the symptoms. Injuries of the special viscera will be described later.

2. **Non-Penetrating Wounds of the Abdominal Wall** only need strict purification and suturing.

3. **Penetrating Wounds of the Abdominal Wall** cause hæmorrhage and shock, especially when viscera are wounded. There may or may not be injury to or protrusion of the viscera. The viscera usually protruded are omentum and small intestine, and strangulation may occur if the opening is small. The danger of septic peritonitis is great.

Treatment.—The external wound and protruded viscera must be carefully cleansed and replaced, except omentum, which should be ligatured and cut off. Wounds in the gut must be sutured, unless the gut is much damaged, when enterectomy should be done if the patient's condition is good; if not, the piece of gut should be fixed in the wound as in colotomy. Where there is any doubt about penetration, the wound must be enlarged, and if the peritoneum is then found to be opened, the viscera must be examined. The wound is then sutured in three layers, but it is safer to leave a drainage-tube down to the peritoneum for several days.

Affections of the Umbilicus.

Umbilical Hernia is described at p. ~~319~~ 331.

An **Adenoma** may grow from the remains of the umbilical vesicle. Unless it has a fistulous communication with a Meckel's diverticulum, it should be ligatured and cut off.

Umbilical Fistulæ.—1. A **Fæcal Fistula** of congenital origin arises from non-closure of the vitello-intestinal duct. An acquired one is due to perforation of the bowel, either from strangulated hernia or tuberculous peritonitis. 2. A **Congenital Urinary Fistula** is due to non-closure of the urachus. Excision is the best treatment. 3. A **Biliary Fistula** at the umbilicus results from an abscess connected

with the gall-bladder pointing there. In extroversion of the bladder the umbilicus is absent.

Affections of the Peritoneum.

Peritonitis may be divided into suppurative and non-suppurative classes, both of which may be either localized or diffuse.

Etiology.—The cause is always microbic, and the constitutional symptoms are due to the absorption of toxins. The organisms commonly found are: (1) *Bacillus coli communis*, which gains entrance from the intestine through a perforating wound or ulcer, or passes through the intestinal wall when its vitality is lowered by inflammation or paralytic distension; (2) *streptococci*, introduced through a penetrating injury or operation, or through the Fallopian tube after parturition; (3) *gonococci*, spreading beyond the Fallopian tube; (4) *tubercle bacilli*. Rheumatism is said to cause peritonitis occasionally.

Acute Diffuse Peritonitis usually arises from rupture of the stomach, intestine, appendix, or a localized collection of pus. It may also follow operations, and rupture of a septic gall-bladder or a urinary bladder.

Symptoms.—**Vomiting** is persistent and without effort on the part of the patient. **Pain and tenderness** are always present, but vary greatly in severity. **Distension and constipation** are constant features. The **temperature** is raised unless the toxæmia is profound, when it is subnormal. The **pulse** becomes steadily increased in rapidity. The **respirations** soon become entirely thoracic, and the **abdominal muscles are rigid** till overcome by the distension. The patient lies with his knees drawn up, and the face soon becomes sunken and anxious, and the lips are cold and bluish.

When due to sudden perforation, the onset is marked by profound shock, which is usually recovered from in two or three hours. In the later stages there is often evidence of free fluid in the abdominal cavity. Death occurs from exhaustion.

Post-mortem the local evidence of peritonitis consists of the presence of turbid serum or pus and lymph. The adjacent coils of intestine and omentum are usually matted together by lymph.

Treatment by operation is not very favourable, but it gives the patient the only chance. The objects of operation are to get rid of the toxic fluid and to deal with the cause. If the effusion is limited it should be mopped up with sterilized swabs, but if the whole cavity is infected, the abdomen should be freely irrigated with saline through several incisions, one in the mid-line and one in each flank, and drained with glass or rubber tubes, one going down to Douglas's pouch. If the patient's condition is good, the intestines should all be protruded (evisceration) and washed ; but, as the shock from this is severe, it is not suitable for most cases. Advanced cases never recover.

Acute Localized Peritonitis is due to lesions in which the peritoneal cavity becomes shut off by adhesions between the intestines, omentum, and abdominal walls. It may be non-suppurative or suppurative.

1. **Non-Suppurative** occurs in connection with gastric ulcer and appendicitis. The adhesions may cause subsequent troubles, such as internal strangulation.

Treatment consists in absolute rest and hot fomentations.

2. **Suppurative** usually occurs in connection with the appendix, but may be connected with the stomach or gall-bladder. The pus may burst through the barriers of adhesions and cause diffuse suppurative peritonitis.

Symptoms.—Pain usually begins at the umbilicus, but afterwards settles in the area affected, which is tender and covered by rigid abdominal muscles. There is usually some fever, vomiting, and constipation, and the pulse is rapid. As the swelling increases a tumour is felt, which is dull on percussion. and is due to matted omentum and intestines more than to effusion. If the pus travels towards the surface, the abdominal wall becomes œdematous and red, then fluctuation appears, and the abscess discharges foul-smelling pus. The abscess may burst into the rectum, bladder, or pleural cavity.

Treatment consists in keeping the patient at rest, applying hot fomentations to relieve the pain, and draining the abscess cavity as soon as it is evident that suppuration is going on. A steadily-increasing leucocytosis is a valuable aid in the diagnosis of the presence of an abscess.

Tuberculous Peritonitis is more common in the young than in old people, and is usually secondary to tuberculous ulceration of the intestine or tuberculous lesions elsewhere. Three main varieties occur: 1. The **ascitic** variety, in which the peritoneum is studded with tubercles, some of which are caseating, and there is an abundant exudation of straw-coloured fluid, which may be free or encysted by adhesions. 2. The **fibrous** variety, in which adhesions of the intestines and omentum are a marked feature. The omentum is often curled up into a sausage-like tumour, which lies transversely above the umbilicus. The adhesions may lead to obstruction by constricting or kinking the intestine. 3. The **ulcerous** variety, in which perforations occur between neighbouring coils of intestine (fistula bimucosa), or a fæcal fistula forms at the umbilicus.

Symptoms.—The general health becomes depressed, and constipation alternates with diarrhœa. There is some abdominal pain, and wasting soon becomes marked. The abdomen is tender, and may or may not contain free fluid.

Treatment is by hygiene and good feeding at first. If this fails, simple laparotomy often cures the ascitic variety, sometimes the fibrous, but seldom the ulcerous. It is not necessary to wash out the abdominal cavity, but only to drain away the fluid and stitch up the opening. Laparotomy may also be required to relieve intestinal obstruction, fæcal fistula, or localized abscesses.

A **Subphrenic Abscess** is a localized suppurative peritonitis in the neighbourhood of the lower surface of the diaphragm, due to ulceration of the stomach or duodenum. If the ulcer is on the anterior wall, the pus is limited behind by the gastro-hepatic omentum, above by the diaphragm, and below and in front by the stomach, abdominal wall, and adhesions. If the ulcer is on the posterior surface, the pus may occupy the lesser omental sac, or be entirely retroperitoneal, adhesion of the two layers of the lesser sac having occurred previously. The abscess, if left, points to the left of the ensiform cartilage. Another cause is appendicitis, the pus finding its way up behind the colon.

Suppuration about the kidney, gall-bladder, ribs, ver-

tebræ, and empyema, are occasionally causes, but suppuration in the liver itself usually extends directly into the pleural cavity or lung.

Pus alone or pus and gas from the intestine are contained in the abscess. The pleural cavity may become affected by direct extension.

The *Symptoms* are variable. They may come on abruptly, as in perforation, or insidiously. The temperature is raised ; there is pain and tenderness over the lower ribs, and a swelling, which may be either dull or tympanitic. The liver is pushed down, except in anterior ulcer cases. The heart is pushed directly upwards by the diaphragm, and not to one side, as in empyema or pneumothorax, which are the conditions for which it may be mistaken. The abscess may burst into the general peritoneal cavity, one of the hollow viscera, or upon the surface.

Treatment.—Open the abscess at once at the upper part of the swelling, and put in a drainage-tube. If the cavity extends into the lumbar region, a counter-opening should be made through the ninth intercostal space, removing a piece of rib if necessary. If the pleural cavity is not already shut off, the two layers should be stitched together.

Affections of the Mesentery.

Wounds may arise from penetrating or non-penetrating injuries. Hæmorrhage is the immediate result, and if it is found that the blood-supply of a portion of the intestine is cut off, that piece must be resected.

Thrombosis of the Mesenteric Vessels, unless from strangulation in a hernia or a volvulus, is either due to an embolus in the artery or to thrombosis in the vein spreading from a septic focus. The bowel becomes engorged, and dark, blood-stained stools are passed, while the symptoms are indistinguishable from those of acute intestinal obstruction.

The only hope of successful treatment lies in immediate laparotomy, with removal of the gangrenous bowel, leaving a temporary enterostomy, which may be closed later if the patient lives.

Cysts and Tumours of the mesentery may have to be enucleated during an operation.

Tuberculous Glands are common in children, but rarely need removal.

Affections of the Stomach.

Rupture of the Stomach from falls occurs only when this organ is distended. Penetrating injuries may open the stomach.

Symptoms.—Severe pain, rigidity, vomiting of blood, and prolonged shock, are the early symptoms; later ones are those of septic peritonitis, with free gas in the peritoneal cavity. If the opening is very small and the stomach empty, adhesions may occur, and close the opening or limit the peritonitis, and lead to the formation of a subphrenic abscess.

Treatment.—The abdomen should be opened in the mid-line, high up, and the peritoneum in the neighbourhood swabbed clean. The perforation is then stitched with a double row of continuous sutures. It is wise to use a drainage-tube leading down to the site of rupture for a few days.

Foreign Bodies in the stomach are either those swallowed or concretions (hair-balls). If causing trouble they must be removed by gastrotomy.

Ulcer of the Stomach.—1. **Acute Ulcers** occur in any part of the stomach, and may give rise to perforation, but rarely to fatal hæmorrhage. 2. **Chronic Ulcers** are more common in women than men. Only 5 per cent. occur on the anterior surface, but 80 per cent. of the fatal perforations occur there. The ulcer is rounded, but may be irregular, clean cut, and may extend to any depth through the coats. When of long standing, there is extensive surrounding induration. The ulcer may be horseshoe-shaped, and involving both anterior and posterior walls. The common age in women is twenty to forty; in men, thirty to fifty. The treatment of gastric ulcer is medical, but that of the complications is surgical.

Complications of Gastric Ulcer.—1. **Excessive and Persistent Hæmorrhage** is usually capillary in origin,

and not fatal. If bleeding recurs in spite of treatment, the abdomen should be opened and the stomach examined for an indurated area; failing this, the stomach should be opened and searched carefully. The ulcer should then be excised. Equally good results are obtained by doing gastro-jejunostomy after tying the bleeding-point.

2. **Perforation of the Ulcer** is a grave complication. The common situation is near the lesser curvature, on the anterior wall and near the cardiac end. The patient is seized with severe epigastric pain and shock. The muscles are **rigid** over the upper part of the abdomen, and the pulse is rapid. Signs of free fluid, free gas, and septic peritonitis, become evident in a few hours. If the perforation is small and the leakage gradual, the onset is less acute.

The *Prognosis* is very grave, and depends upon how soon an operation is done and the quantity of stomach contents extravasated.

Treatment.—The abdomen must be opened and the escaped gastric contents swabbed out. The perforation is then closed with a double row of Lembert's sutures or a purse-string stitch. If this is impossible owing to the induration, a piece of omentum should be stitched over it. A drainage-tube should be left in, and packed around with gauze. Liquid food may be given by the mouth as soon as the patient is able to take it.

3. **Perigastric Inflammation** is either adhesive or suppurative. **Adhesions** are protective, to limit extension of inflammation. They usually occur between the pylorus and the liver, gall-bladder, or bile-duct, but occasionally the omentum, colon, diaphragm, and anterior abdominal wall. Adhesions in the lesser sac and to the pancreas occur, and this fixity is one of the factors which prevents healing. Internal strangulation may be produced by such bands.

Suppurative Perigastritis may be due to limited perforation, or simply invasion of the tissues by organisms through the damaged wall. A subphrenic abscess is formed.

4. **Stenosis** is due to cicatricial contraction, usually occurs near the pylorus, and leads to pyloric obstruction. A horseshoe ulcer leads to *hour-glass contraction*, with

similar symptoms, except that when the stomach is filled with a measured quantity of water a smaller quantity is recovered with a tube, portion remaining in the pyloric pouch. If the abdomen is observed while the stomach is being filled, the dilated cardiac pouch may seem to disappear, its place being taken by a new swelling at the pyloric end. Contraction at the cardiac orifice produces symptoms like those of stricture of the œsophagus.

Treatment.—At the cardiac end, gastrostomy; at the pyloric end, gastro-jejunostomy. Hour-glass stomach is best treated by a double gastro-enterostomy to drain both pouches. Any case of gastric ulcer which persists or recurs in spite of careful medical treatment should have the ulcer excised or gastro-jejunostomy performed.

Cancer of the Stomach in the form of columnar carcinoma is very common, especially at the pylorus. A hard, ulcerated growth with an everted margin is the usual type, but occasionally it appears as a diffuse infiltration of the whole stomach. If the growth occurs at the pylorus, marked obstruction is caused. The glands along the lesser curvature and pyloric end of the greater curvature are soon involved, then the glands in the transverse fissure and the liver itself. Adhesions may form by infiltration extending to the liver, pancreas, colon, or anterior abdominal wall. The case often terminates by dissemination through the peritoneum. Gastric ulcer is said to be a predisposing cause.

Symptoms.—Pain in the epigastrium, which gradually increases in severity, and discomfort after food, which later leads to vomiting, are the early symptoms. Blood is vomited in the later stages. The steady wasting of the patient, the presence of blood, and the absence of free hydrochloric acid in the vomit, are signs which point to malignancy as against gastric ulcer. Sometimes a tumour can be felt through the anterior abdominal wall. The stomach should be inflated to find out its exact size; the vomit should be examined for hydrochloric and lactic acids, sarcinæ and cancer cells.

If the **cardiac end** is involved, the symptoms are similar to those of œsophageal stricture.

If the **pylorus** is affected, a tumour moving with respiration may possibly be felt, but the typical signs of pyloric

obstruction are present—viz., the stomach becomes dilated; splashing occurs when the patient is moved, owing to the accumulation of fluid; a large amount of frothy fluid and decomposing food is vomited about every two days; and marked wasting occurs.

In the later stages ascites occurs from pressure on the portal vein, jaundice from pressure on the bile-duct, and œdema of the legs from pressure on the vena cava.

Treatment.—When symptoms of chronic gastritis persist in spite of medical treatment, an exploratory operation is justifiable. When a tumour is felt, the case is usually beyond radical treatment; but if signs of pyloric obstruction are present a palliative operation is necessary; otherwise the case is better left alone.

Gastrostomy may be performed for cancer at the cardiac end. Partial gastrectomy for cancer of the body is only possible in early cases.

If there are few adhesions in cancer of the pylorus, pylorectomy should be done if it is thought the patient can stand such a severe operation. If the adhesions are extensive, gastro-jejunostomy should be done to relieve the starvation.

Simple Stenosis of the Pylorus usually results from the cicatrization of a gastric ulcer near the pylorus, but may be due to adhesions around an inflamed gall-bladder or to *congenital hypertrophy* of the pyloric sphincter muscle. The stomach is hypertrophied and dilated. Splashing, vomiting of a large quantity of frothy fluid every two days, and wasting mark the progress. A peristaltic wave may be seen passing across the region of the stomach.

Treatment consists in first trying to relieve the condition by regular washing out of the stomach. If this fails, **gastro-jejunostomy** should be done. Other operations are **Loreta's**, which consists of opening the stomach and dilating the pylorus with a finger, **excision of the pylorus**, and **pyloroplasty**.

Acute Dilatation of the Stomach is a rare sequel to an operation. Enormous distension, accompanied by the vomiting of large quantities of fluid, leads to a fatal result in a few days. It is believed to be due to constriction of the third piece of the duodenum by the root of the mesentery.

Treatment consists in regular washing out of the stomach.

Operations upon the Stomach.

Gastrotomy is required to remove foreign bodies, to dilate the orifices, or to examine ulcers. A vertical incision through the upper part of the left rectus is the best one, but it may be made parallel to the costal margin. The stomach is picked up, and two strong sutures are passed through the serous and muscular coats to hold it. The rest of the abdominal cavity is then protected by packing around with gauze. An incision is made in the long axis, and a finger inserted to explore. The wound is closed by two rows of continuous stitches, the first going through all the coats, the last through serous and muscular coats only.

Gastrostomy, or the formation of a permanent artificial opening into the stomach by which the patient can be fed, is needed in stricture of the œsophagus. It must be so done that regurgitation of gastric juice, and consequent ulceration of the skin, are prevented. A modification of **Franck's** operation best supplies this. A vertical incision about an inch to the left of the mid-line, and 4 inches in length, running downwards from the xiphoid cartilage, is made through the abdominal wall; a cone of stomach is pulled up and a silk ligature is passed through it. The base of the cone is stitched to the right side of the wound by three sutures, which pass through the posterior sheath of the rectus. A second incision is made 1 inch long, 1½ inches to the left of the first and parallel to its upper part, and a channel made from it through the fibres of the rectus. The apex of the cone is drawn through to this opening. The rectus sheath and skin are then stitched up in the first wound; the apex of the cone is opened, a No. 10 rubber catheter is passed, and 4 ounces of peptonized milk poured into the stomach. The tube is stitched in and the mucous membrane fixed to the second opening by two sutures. The bend of the tube of stomach and its passage through the fibres of the rectus, which act as a sphincter, prevent regurgitation. Opening the stomach at once is not found to increase the danger,

and it has the advantage that the patient can be fed at once, and there is no danger of the mucous membrane falling back. The patient receives 4 ounces of milk every four hours in addition to rectal feeds. The amount is gradually increased till the rectal feeds can be left off.

Witzel's operation consists in stitching a tube into a hole in the stomach, folding and stitching the serous and muscular coats over the tube, and fixing the stomach to the abdominal wall.

Gastrectomy may be partial or complete. The cardiac end is then stitched to the jejunum or duodenum.

Pyloroplasty.—A longitudinal incision is made through the stricture, and stitches are then put in, so that the wound is converted into a transverse one.

Pylorectomy is done for malignant stricture. The pylorus is exposed by a median incision in the upper part of the abdomen. The greater and lesser omenta are separated, including the glands along the whole of the lesser curvature and those along the pyloric portion of the greater curvature, clamps are applied to the stomach and duodenum. The growth is then cut away widely, and the divided ends are sutured and gastro-jejunostomy performed.

Gastro-jejunostomy is done either by direct stitching, or by the use of Murphy's button, or of one of the various bone bobbins. The upper part of the jejunum is united to either the anterior or posterior surface of the stomach. The anterior operation is quicker, easier, and there is less risk of soiling the peritoneum ; but it has the disadvantage that it may cause pressure on the transverse colon, over which it is dragged. In the posterior operation the upper part of the jejunum is selected, an opening is made through the transverse mesocolon, and the jejunum is stitched to the posterior wall of the stomach. The stomach may be previously washed out with boric acid lotion. A double row of continuous stitches should be used, the inner going through all the coats of the intestine and stomach, the outer through peritoneum and muscular coats only. The opening should be at least 1½ inches long. Rectal feeding should be adopted for two days ; then peptonized milk may be given cautiously by the mouth, and in a week other milk foods. Murphy's button

saves time if the patient is very weak. The occurrence of persistent biliary vomiting afterwards, known as the **Vicious Circle**, has been the bugbear of the operation. It is due to kinking of the site of junction, so that the opening gets blocked by a spur of the wall of the jejunum. The stomach gets filled with the fluids swallowed, and the bile, after distending the duodenum, regurgitates into the stomach, as it cannot get past the block. Vomiting then goes on, and the patient will die of exhaustion.

This complication can be prevented by making a large opening ; by not leaving a loop of jejunum hanging down between the duodeno-jejunal flexure and the anastomosis ; and by fixing the jejunum to the stomach by an extra suture beyond either end of the new opening, so that it lies as a wide arch.

If this complication has come on, the abdomen must be opened, and an anastomosis made between the afferent and efferent loops.

An operation designed to prevent this is the **Y** anastomosis of Roux. The jejunum is severed, the distal end being used to drain the stomach, while the proximal end is implanted lower down into the side of the distal portion. It involves a double anastomosis, and ought not to be needed if the principles of the production of the **Vicious Circle** are understood.

Duodenal Ulcer may arise in the same way as gastric ulcer, or may follow burns. The symptoms caused are pain several hours after food, which is relieved by taking food, vomiting and the passage of blood in the motions. Perforation may produce acute general peritonitis or a chronic localized (subphrenic) abscess. Stricture may follow cicatrization of a duodenal ulcer.

Treatment should be the same as for gastric ulcer.

Affections of the Intestines.

Congenital conditions are, **Persistence of Meckel's Diverticulum** and **Congenital Stenosis of the Duodenum.**

Injuries of the Intestine.

Contusion results from blows on the abdomen. Slight bruising is followed by quick recovery; but in severe cases the injured intestinal wall is invaded by the *Bacillus coli*, and sloughing follows, especially if the circulation is interfered with by damage to the mesentery. If the damaged area is quickly shut off by adhesions, a localized abscess occurs, and the patient may recover with a fæcal fistula; but if sufficient adhesions are not formed, general peritonitis quickly follows, and with a fatal termination.

The *Symptoms* consist of shock, localized pain, and rigidity of the abdominal muscles. Vomiting is not a marked feature, and the pulse does not steadily increase in rapidity, as it does if the intestine is ruptured.

Treatment.—Keep the patient at rest, and should signs of rupture, free fluid in the abdomen, or localized peritonitis, appear, the abdomen must be opened and the lesion dealt with.

Rupture of the Intestine follows kicks in the abdomen or 'run-over' accidents. The duodeno-jejunal junction and the lower ileum are frequent sites of rupture. Acute general peritonitis practically always follows, unless treatment is very prompt. A localized abscess has been known to occur.

The *Symptoms* begin with severe shock, rigidity, and intense localized pain in the abdomen. Free gas shows its presence by obliteration of the liver dulness. The **pulse is a steadily increasing one**, and a valuable indicator as to the advisability of interference. Vomiting may or may not be present. Blood in the vomit indicates rupture of the stomach or duodenum.

The *Diagnosis* is easily made if there is free gas in the abdominal cavity; but in the earlier stages the presence of severe localized pain, rigidity, a steadily increasing pulse, and the history of the accident, should lead to an exploratory laparotomy.

Treatment.—Until it is decided to open the abdomen, shock should be treated by warmth and stimulants; but on no account should morphia be given, as it masks the symptoms and causes fatal delay. After a laparotomy the incision is stitched up, unless a portion of the intestine

is much damaged, when it is excised, the cut ends joined, and the abdominal cavity cleansed and drained.

Punctures or Stabs of the Intestine usually cause escape of fæcal matter and peritonitis.

The *Symptoms*, unless there is immediate escape of gas or fæces from the abdominal wound, are like those of rupture of the intestine, but there is less shock.

Treatment.—All stab wounds about the abdomen should be enlarged and explored. If the peritoneum has been opened, the viscera should be examined, and if an opening is found in the intestine it should be stitched up with a double row of continuous sutures.

Perforation of the Intestine arises from intestinal ulcers, whether tuberculous or typhoidal, from enteritis following strangulated hernia, and sometimes from the impaction of a foreign body. In acute cases general peritonitis follows ; but in some chronic ulcers, especially tuberculous, localized peritonitis occurs and an abscess is formed, which, if it opens on the surfaces, is followed by a fæcal fistula. The usual situation for perforation of a typhoid ulcer is in the lower 2 feet of the ileum, and the usual time is the third week. The symptoms are those of collapse, a sudden fall to a subnormal temperature, and a great increase in the frequency of the pulse. The abdominal pain is severe, and there are usually signs of free gas in the abdomen.

Treatment consists in opening the abdomen and stitching up the perforation; though few cases recover, all except the moribund should have this, their only chance.

In the colon perforation is due to chronic obstruction from impaction of fæces, to perforation of a malignant ulcer, or to distension of the colon above a complete obstruction.

Foreign Bodies in the intestine may be gall-stones which have gained entrance to the duodenum through ulceration of the gall-bladder. They increase in size as they obtain a fæcal coating, and they may become impacted at the narrowest part of the intestine, the lower ileum. These, with **enteroliths** and **foreign bodies** accidentally or purposely swallowed, may give rise to symptoms either of obstruction or perforation.

Colitis, when of the simpler or mucous variety, is due

to constipation. Lavage of the colon and abdominal massage generally relieve it.

Graver cases of the ulcerative type may need appendicostomy, so that the irrigation of the intestine may be more efficient.

Tuberculous Disease of the Intestine is most common in the ileo-cæcal region, and gives rise to diarrhœa in the early stages, and symptoms of obstruction in the later cicatrizing period. Sometimes a definite **Tuberculous Cæcal Tumour** is formed, and may resemble either an appendicitic mass or a carcinoma. The best form of treatment consists in excision of the mass.

Stenosis of the Intestine.

Cicatricial contraction and cancer are the usual causes.

Simple Stricture results from the healing of tuberculous ulcers. These are usually transverse, whereas typhoid ulcers, which rarely produce stricture, are longitudinal. Stricture may follow syphilitic ulceration, injury, or intussusception, but this is rare. In the large intestine, dysenteric ulceration is the most common cause, but syphilis of the rectum and pelvic cellulitis may also produce constriction.

In the **small** intestine, as the contents are fluid, the stricture only makes itself evident when the lumen has become much narrowed. It may then be blocked by a fold of mucous membrane, or a portion of undigested food so that obstruction occurs. This may continue, or be relieved for a time, but sooner or later it becomes complete and is fatal unless treated by operation.

In the **large** intestine similar attacks occur, but there is less pain and vomiting, and aperients aggravate the attacks. The abdomen becomes more distended than in obstruction of the small intestine.

Treatment in the early stages consists in giving fluid food and large enemata, but as soon as a serious attack of obstruction is threatened the abdomen must be opened, and the condition dealt with by enteroplasty, enterectomy, or intestinal anastomosis. Failing these, an artificial anus must be made, but it must be remembered that a

permanent opening more than a foot above the ileo-cæcal valve leads to a fatal termination, as too much absorbing surface is thereby cut off.

Cancer of the Bowel is usually in the form of columnar carcinoma, and appears as a circular growth around the bowel. Secondary deposits occur in the mesenteric glands and in the liver.

The *Symptoms* are those of intermittent chronic obstruction, which sooner or later ends in an acute attack. A tumour may be felt in some cases; in others a localized abscess due to invasion by the *Bacillus coli* may occur, and if it bursts on the surface, or is opened, a fæcal fistula follows.

Treatment.—An exploratory laparotomy should be made when there is reasonable ground to suspect the presence of cancer of the bowel. The growth can then be excised with a V-shaped portion of the mesentery, and the two ends united by direct stitching. If, owing to the fixity or secondary growths in the liver, it is decided not to remove the growth, the impending acute obstruction can be avoided by anastomosing a portion of the intestine above the growth to a portion below, or by making an artificial anus above the growth.

Idiopathic Dilatation of the Colon is rare, and met with in infancy. The colon is enormously dilated and hypertrophied. Congenital contraction of the rectum is found in some cases, no cause in others. Obstinate constipation is always present, and death may ensue from complete obstruction. Excision of the rectum, sigmoid flexure, and descending colon may be necessary.

Enteroptosis, or Glénard's disease, is a condition in which the stomach, intestines, transverse colon, kidneys, or other viscera, are displaced downwards. A relaxed abdominal wall is usually present as a causative factor, and the patients are often neurasthenic. There may be very little in the way of symptoms, or there may be marked constipation and spasmodic pains.

Treatment consists in improving the general health, abdominal massage, and wearing a belt to support the lax walls. If this fails, it may be necessary to fix the viscera in place by an abdominal operation.

Operations on the Intestines.

Enterotomy, or incision of the bowel, is done for the removal of foreign bodies or to examine the interior of the bowel. The opening should be longitudinal and along the antimesenteric aspect, and is closed by a double row of continuous stitches, the first going through all the coats, and the second through the peritoneal and muscular coats only.

Enterostomy is the formation of an artificial opening into the intestine to relieve intestinal obstruction, when the patient's condition is too bad to permit a prolonged operation. A distended coil of intestine is opened, a Paul's glass tube is tied in, and the intestine is stitched to the wound.

Enteroplasty is done in the same way as pyloroplasty for cicatricial contraction.

Enterectomy, or excision of portion of the bowel, is done—(1) to remove simple or malignant strictures; (2) to remove gangrenous gut due to strangulation; (3) to remove a portion damaged by gunshot wounds; (4) and in some cases of intussusception. The operation is often fatal, as the condition of the patient is already very bad.

If possible, the bowel should be emptied beforehand. The abdomen is opened, and the portion to be removed is isolated from the peritoneal cavity by gauze packing.

The bowel is clamped on either side to prevent escape of fæces. The affected portion of bowel and a V-shaped piece of mesentery are cut away with scissors. The bleeding-points are secured, and the bowel united with one of the various bobbins or by direct stitching. The cut edges of mesentery are then sewn together.

Enterorrhaphy, or closure in cases of openings into the bowel. The method of closing longitudinal openings has been described. End-to-end union and lateral approximation will now be discussed.

End-to-End Union may be brought about by—

1. **Simple Suturing.**—A double row of continuous sutures is the best method of insuring speed and freedom from leakage when no bobbin is used. The inner row goes through all coats, the outer through peritoneum and muscular coats only.

2. **Maunsell's Operation.**—Two stitches are passed to fasten the mesenteric and antimesenteric edges together. These are left lying in the lumen of the bowel, and are grasped through a new longitudinal incision 1 inch away and used to invaginate the surfaces to be united through this opening. The edges are then rapidly stitched, the invagination reduced, and the longitudinal opening closed.

3. **Murphy's Button** consists of two portions, one of which fits into the other. Each half is fixed into the open end of the bowel by a purse-string stitch. The two portions are then pressed together, when they are secured by a catch. There is a spring so arranged that the peritoneal surfaces covering each portion are kept in apposition till union by adhesions has occurred. By this time the portion under pressure has atrophied, and the button passes along the alimentary canal and out through the anus. The button usually appears about the tenth day, but rarely it has been known to become impacted and cause ulceration and fatal peritonitis. It is of great value in cases where speed is necessary.

4. Various forms of **Decalcified Bone Bobbins**, such as Mayo Robson's, Allingham's, and Bailey's, are used. They are hollow tubes used for the purpose of facilitating the suturing of the cut margins with a double row of continuous sutures. They become soft in a few days, and so cause no mechanical injury.

Lateral Anastomosis is used to short-circuit a malignant growth or stricture, which cannot otherwise be dealt with, or in place of end-to-end union after closing the divided ends. The openings should be at least 1½ inches long, and the two pieces of bowel should be fixed with a double row of continuous sutures, as in gastro-jejunostomy. Murphy's button or Robson's bobbin may also be employed.

An **Artificial Anus** is established in some cases of intestinal obstruction, intussusception, or wounds of the bowel. When the small intestine is opened, a Paul's tube is tied in for several days; but if the opening is more than a foot above the ileo-cæcal valve, some form of short-circuiting is necessary subsequently, to prevent death from interference with nutrition. An opening into the colon has not this effect upon nutrition. If the open-

ing is to be a temporary one, only a portion of the lumen is brought out; but if it is to be permanent, a loop of intestine is withdrawn and subsequently cut away, so that the upper and lower openings are completely separated.

Colotomy is the establishment of an artificial anus in the colon. The termination of the descending colon is usually chosen, and the incision is made in the left iliac region. Lumbar colotomy is now only done in operative surgery classes.

Uses of Colotomy.—The most common cases requiring colotomy are those of—(1) carcinoma of the rectum or sigmoid flexure, where a radical operation is impossible, or as a preliminary to this operation; (2) chronic obstruction of the large intestine from simple stricture or pressure from without, if the obstruction cannot otherwise be relieved; (3) congenital absence of the rectum, when a perinæal incision fails to reach intestine; (4) some cases of syphilis of the rectum, recto-vesical and recto-vaginal fistulæ; (5) volvulus of the sigmoid flexure, if the volvulus cannot be reduced or will not remain reduced.

Lumbar Colotomy.—An opening is made into the posterior aspect of the descending colon from the loin, but as this operation has been given up it will not be described here.

Iliac Colotomy.—An incision 3 inches in length is made at right angles to a line running from the umbilicus to the anterior superior spine, the centre of the incision being at the junction of its outer and middle thirds. The abdomen is opened, and the upper part of the sigmoid flexure is pulled out together with its mesentery. A hole is made in the mesentery, and the whole thickness of the abdominal wall is brought together at the middle of the incision through this by a mattress stitch. A few stitches are then passed to join the peritoneum of the gut and the skin here and there. Another plan is to pull out the gut and slip a glass rod through the mesentery, allowing the rod to rest upon the skin on either side of the incision. The bowel is covered with protective and an antiseptic dressing. After three or four days the bowel is opened, and at the end of a week the whole lumen can be removed, leaving a separate upper and lower opening. No anæsthetic is needed, as the bowel is insensitive. If

it is necessary to open the bowel at once, the wound is carefully protected with gauze, and the bowel is tapped with a large trocar and cannula, a Paul's tube being subsequently tied in so as to carry the fæces away from the wound. A special cup truss has to be worn when the patient walks about subsequently.

Appendicitis.

By appendicitis is meant inflammation of the walls of the appendix, which spreads to its peritoneal coverings, and it is due to invasion by micro-organisms, usually the *Bacillus coli.*

Etiology.—The anatomical structure of the appendix is such that any inflammatory attack is liable to produce serious consequences. 1. The mesentery extends only for two-thirds of its length, so that a slight amount of swelling interferes seriously with the blood-supply of the terminal third. 2. The large amount of lymphoid tissue present lends itself readily to inflammatory processes. 3. Fæcal concretions may form within the appendix, and by setting up ulceration allow invasion of the walls by the *Bacillus coli.* Foreign bodies, such as pins, fruit-stones, etc., rarely act in the same way. 4. Tubercle and actinomycosis are rare causes. In all cases the actual cause of the attack is invasion of the walls of the appendix by organisms, usually the *Bacillus coli*, but streptococci occasionally. 5. There is no doubt that chronic constipation is an important factor, as the catarrhal inflammation set up by this condition, or the purgatives taken for its relief, spreads to the appendix, and may be the starting-point of the first attack.

Pathology.—The organisms find an entrance through an ulcer or abrasion of the mucous membrane, and at once cause inflammatory swelling in the submucous tissue. The swelling causes obstruction in the blood-vessels, and the organisms then spread through the muscular coat to the peritoneal covering. The changes in the peritoneum vary in severity. 1. Simple exudation of lymph may occur, and produce adhesions around the appendix. 2. A localized intraperitoneal abscess may be

formed, shut in by adhesions between the omentum, intestines, and abdominal wall. 3. General septic peritonitis may occur. In other cases perforation or gangrene of the tip may result from the inflammation, and be associated either with a localized abscess or general peritonitis. Thrombosis of the veins of the appendix may lead to pylephlebitis and hepatic abscess. An attack may leave some stenosis of the lumen, and cause subsequent distension by mucus, so that there is a liability to recurrent attacks.

The **clinical varieties** of appendicitis are: (1) Catarrhal appendicitis, associated with plastic peritonitis; (2) appendicitis with a localized abscess, with or without perforation or gangrene; (3) appendicitis with general peritonitis, due to perforation or gangrene of part of the appendix; (4) relapsing appendicitis, in which the attacks recur with very short intervals.

Catarrhal Appendicitis with Localized Plastic Peritonitis begins suddenly with pain about the umbilicus or right iliac fossa, vomiting, constipation, and slight fever. There is some tenderness at or about McBurney's point, a spot at the junction of the outer and middle thirds of a line joining the umbilicus and anterior superior iliac spine. A swelling, due to matted coils of intestine and omentum, may be felt, and there is always rigidity of the muscles in the right iliac fossa. There may be pain at the end of micturition, due to stretching of inflamed peritoneum as the bladder is emptied. The attack usually subsides in three or four days, leaving adhesions.

Appendicitis with a Localized Abscess begins in the same way, but one or more of the signs—pain, vomiting, tenderness, and temperature—is more severe. A well-marked swelling is usually present, and the pulse steadily increases in frequency. There is also a steadily-increasing leucocytosis. A persistently high temperature, or a subnormal temperature with an increasing pulse-rate, are strong indications as to the presence of pus. Three terminations may occur: 1. The attack may subside, leaving the pus shut up. 2. The abscess may point and discharge itself into the bowel or on the surface, or it may track upwards along or behind the colon, and form a subphrenic abscess. 3. The localized abscess may burst

and cause general peritonitis. The rectum should always be examined, as a collection of pus may be felt in Douglas's pouch.

Appendicitis with General Peritonitis is preceded by the symptoms as above when due to rupture of a localized abscess, more often it is present from the beginning in the 'fulminating' cases due to perforation or gangrene. The ordinary signs of acute peritonitis follow sudden acute pain, and the case resembles that of perforated gastric ulcer.

Relapsing Appendicitis occurs in frequent attacks of more or less severity. Adhesions or stenosis are usually present. The attacks may be only those of colicky pain, lasting a few hours, without fever, in cases of stenosis, and may disappear after a time, owing to complete obliteration of the lumen; or there may be frequent attacks of acute appendicitis, each leaving peritoneal adhesions.

Diagnosis.—The cardinal signs are pain and tenderness in the right iliac fossa, vomiting and constipation, with some rise of temperature. If a swelling and localized rigidity are present, there can be no doubt.

The *Prognosis* is always uncertain. However mildly a case may begin, it is never certain what course the disease may take, and constant observation by an experienced surgeon is necessary in order that prompt treatment may combat complications.

Treatment.—The cases, as regards treatment during an attack, fall into two groups: (1) Where there is only plastic peritonitis; (2) where there is suppuration. In the first group the patient should be kept at rest, with hot fomentations to relieve the pain. Fluid diet should be given, and the patient not disturbed for several days by purgatives or enemata. On no account should morphia be given, as it masks the symptoms of the onset of suppuration.

Where pus is present or suspected, the abdomen should be opened over the swelling, and in most cases it will be found that there are adhesions to the anterior abdominal wall, shutting off the abscess cavity from the rest of the abdomen. A finger should be gently inserted to feel for and remove a concretion or the appendix; but

no prolonged search should be made for the appendix for fear of breaking down the adhesions. A large rubber drainage-tube should be inserted, and the cavity will soon become clean and heal by granulation. If, when the abdomen is opened, no adhesions to the anterior abdominal wall are found, the cavity should be protected with gauze packing. The abscess will then be found amongst a mass of matted omentum and intestine, and can be opened by gently separating them. A drainage-tube is inserted, and the gauze packing is left in for three days. By that time firm adhesions have formed and the peritoneal cavity is safe from infection.

In the 'fulminating' cases, where there is gangrene or perforation, and there has been no preliminary isolation of the part by adhesions, fatal general peritonitis will supervene unless the condition is dealt with in the first twelve to twenty-four hours. As mentioned before, the symptoms exactly resemble those of perforated gastric ulcer. The abdomen should be opened over the region of the appendix, and the healthy portion isolated at once with gauze pads. The appendix is then sought for and removed. The turbid serum in the neighbourhood should be mopped out, and the regions in which it has been found freely drained. The abdominal wound is left open, and the protective pads are not removed for two or three days. Many cases can be saved if operated on thus early.

In any case in which the symptoms are excessive, especially with a rapidly increasing pulse-rate, an operation should be done, as this gives the only chance in cases where there is suppuration without adhesions, especially in those cases due to perforation or gangrene.

Operation for Removal of the Appendix.—An incision is made at right angles to a line (at the junction of the outer and middle thirds) joining the umbilicus and anterior superior iliac spine, one-third being above and two-thirds below it. The muscle and aponeurotic fibres are split along their course instead of being divided to prevent a hernia ensuing.

A better incision is that through the middle of the rectus sheath, then pulling the uninjured rectus inwards.

The cæcum is found, and the anterior longitudinal band is traced down to the appendix, which usually

comes off from the inner side and runs inwards and downwards. If not found there, it should be looked for in the retrocæcal pouch or on the outer side of the cæcum. The meso-appendix should be ligatured and cut through, a collar of peritoneum turned back, and the mucous and muscular coat ligatured near the base and cut off. The peritoneum should be stitched over the stump, and then the stump should be invaginated into the wall of the cæcum by running a purse-string stitch around it.

This operation should be done in all relapsing cases during a free period, especially if the first attack has been a severe one. In acute cases the abdominal wall is divided freely in the line of the incision; in relapsing cases the muscles are separated in the direction of the fibres to minimize the risk of subsequent ventral hernia.

Sequelæ.—A **fæcal fistula** sometimes follows, but often closes spontaneously. If it does not do so, the cæcum must be exposed and the opening sutured. A **ventral hernia** often follows after an abscess has been drained. It is better to open the abdomen to repair the hernia and at the same time remove the remains of the appendix, as sometimes further attacks occur in spite of the fact that usually the appendix is completely destroyed when an abscess has formed.

Affections of the Liver.

Rupture of the Liver is produced by blows or crushes affecting the chest or abdomen, stabs, and gunshot wounds.

Symptoms.—Shock and signs of internal hæmorrhage are the chief symptoms, and upon the latter depends the great danger. The patient is cold, pale, very restless, and there are signs of free fluid in the abdominal cavity. There is usually pain and tenderness over the liver. In the mild cases the blood is absorbed and the wound cicatrizes, and in the severe cases hæmorrhage is rapidly fatal.

The *Diagnosis* depends on the history of the injury and signs of internal hæmorrhage. Shock alone is insufficient evidence.

Treatment.—The patient is kept quiet in bed, with hot

bottles and fluid diet. Where there is reasonable evidence to suspect rupture, the abdomen is opened in the mid-line high up. An attempt may be made to close a tear by stitches; and failing this, the bleeding is stopped by plugging tightly with gauze. The cautery may also be used to stop hæmorrhage from shallow tears.

Abscess of the Liver has several causes.

1. **Tropical Abscess** occurs in patients who have had dysentery. The abscess is usually single, loculated and situated in the posterior part of the right lobe. Streptococci, *Bacillus coli* and the *Amœba coli* are found in different cases. The pus is thick and reddish-brown in colour, and has a foul smell.

Symptoms.—There is usually pain and tenderness over the whole hepatic region. The temperature is usually raised, and in acute cases is high and accompanied by rigors. Loss of appetite and wasting are present, while slight jaundice may come on. The liver is usually found to be enlarged upwards, but if the abscess projects below the costal margin a fluctuating swelling may possibly be felt. If left alone, the abscess may point through the abdominal wall in the epigastrium, may burst into the general peritoneal cavity, some part of the intestine, the lung, or the pleural cavity. In some cases it may remain encysted, the abscess walls becoming much thickened.

Treatment.—If the abscess is pointing through the abdominal wall, it only needs incision and drainage. If a swelling is attacked from the abdomen, and there are no adhesions to the abdominal wall, gauze packing should be inserted till adhesions have been formed. The abscess is then incised and a large drainage-tube inserted, or, in urgent cases, the abscess is opened at once, and the packing is trusted to prevent soiling of the peritoneal cavity.

When the abscess is in the posterior part of the right lobe, a piece of the ninth or tenth rib is removed behind the mid-axillary line, the costal and diaphragmatic pleura are stitched together, and the diaphragm is incised over that portion of the liver which is not covered by peritoneum. The abscess is opened and a large drainage-tube is inserted.

The diagnosis is confirmed during the operation by

exploring the liver with an aspirating needle before incising it.

2. **Multiple Abscesses** occur in pyæmia, either of systemic or portal origin. Treatment is useless.

3 **Suppurative Cholangitis** causes multiple abscess in the liver from suppuration spreading along the bile-ducts. The organisms spread from the intestine or from the gall-bladder after operation. Pain over the liver, pyrexia, and rigors are usually present. The gall-bladder should be opened and drained, but the cases are usually fatal.

4. **Hydatid Cysts** in the liver may suppurate, and are treated in the same way as tropical abscess.

Hydatid Cysts occur most frequently in the liver. A localized smooth, painless enlargement of the liver is felt or can be percussed. The cyst contains fluid and daughter-cysts, and is contained in an adventitious cyst consisting of condensed liver tissue. Fluctuation may be felt if the cyst is large and superficial, but the much-talked-of 'thrill' is rarely felt. The diagnosis of hydatid is suggested by the evidence of a smooth localized enlargement of the liver without any affection of the general health, but it can only be confirmed by an exploratory laparotomy. Aspiration through the abdominal wall should never be done.

The cyst may go on growing and burst into the abdomen or lung, but rarely into the pleural cavity, and this may occur with or without suppuration. In many cases the cyst degenerates and shrinks into a pultaceous mass, which does no harm and is only found post-mortem.

Treatment.—Hydatid cysts in the liver should never be dissected out. The abdomen is opened and protected with gauze packing. The cyst is brought up to the wound and tapped. The opening is enlarged and the daughter-cysts, mother cyst, and fluid are removed.* The cavity is then dried out and the opening in it sutured. Two or three stitches are then passed through the adventitious cyst and the abdominal wall to anchor it against the

* Confusion often exists as to the terms 'ectocyst' and 'endocyst.' These are properly applied to the two layers of the wall of the parasitic cyst. The adventitious cyst in which it lies, but with which it has no anatomical connection, is formed of the condensed fibrous tissue of the host.

wound, which is then stitched up in three layers. If by any chance infection is introduced at the time of the operation or travels through the bile-ducts to the wall of the sac, the pus is easily evacuated by opening the wound, and it will be found that protective adhesions have formed which safeguard the abdominal cavity.

If the cyst is a suppurating one, gauze packing should be left around the sac for three or four days and the sac drained, or the case may be treated as described for abscess in the liver.

Tumours of the Liver are seldom primary, but secondary carcinoma and sarcoma are common.

Affections of the Gall-Bladder and Biliary Passages.

Rupture of the Gall-Bladder results from blows, crushes, and penetrating wounds. Bile escapes into the peritoneal cavity, and peritonitis follows usually. Pure bile is sterile, but if there is any inflammation of the biliary passages the bile contains pyogenic organisms. A large amount of pure bile escaping suddenly into the peritoneal cavity produces peritonitis, probably from its irritating action allowing invasion of the intestinal wall by the *Bacillus coli*. Jaundice usually follows from absorption of bile. In a penetrating wound bile escapes on the surface, and septic peritonitis may follow.

Symptoms.—Shock and pain come on at once, and are followed by signs of free fluid or a localized swelling and jaundice. Signs of peritonitis follow later.

Treatment consists in opening the abdomen if a rupture is suspected. The bile should be swabbed out and the tear stitched up if possible. A drainage-tube should be left in for a few days, reaching down to the lesion. If it is not possible to stitch up the opening, the margins should be stitched to the wound (cholecystostomy), or the gall-bladder excised (cholecystectomy). If the common duct is wounded, the opening should be sutured; if it is divided, the ends should be closed and cholecystenterostomy performed.

Cholelithiasis.—Gall-stones are rare in young subjects, but are commonly met with after middle age, especially in women. They consist of cholesterine crystals, bile pig-

ment, and bile salts, with a nucleus of inspissated mucus. When multiple stones are present they are faceted.

Causes.—Retardation of the bile flow from the pressure of corsets, a sedentary life or irregular meals, and especially constipation, are the predisposing causes; then follows infection from the intestine, by the colon or typhoid bacillus setting up catarrh of the gall-bladder. Cholesterine and pigment are now deposited, and give rise to stones. Gall-stones are commonly found in cases of carcinoma of the gall-bladder.

Course.—Gall-stones only give rise to symptoms—(1) when they try to escape; (2) when they hinder the escape of bile; and (3) when they cause cholecystitis.

Symptoms are entirely absent in many cases. Pain in the right hypochondrium is a common symptom, and is more often due to attacks of cholecystitis than to biliary colic. If the patient is examined during an attack, a distended gall-bladder projecting below the costal margin at the tip of the eighth or ninth costal cartilage may be felt. It forms an elastic tumour, moving with the liver on inspiration and dull to percussion.

The complications which may occur are biliary colic, cholecystitis, suppurative cholangitis, and impaction of a stone in one of the ducts.

Biliary Colic is due to the passage of a stone along the bile-passages. It varies from slight pains, usually ascribed to stomach-ache, to the most agonizing colic, beginning in the right hypochondrium and accompanied by vomiting. The pain continues till the stone reaches the intestine or passes back into the gall-bladder. Some tenderness and slight jaundice usually follow for a few days, but jaundice is not present if the stone does not reach the common duct. These attacks recur at varying intervals, and should be treated by hot fomentations and the hypodermic injection of $\frac{1}{4}$ to $\frac{1}{3}$ grain of morphia.

Impaction of a Stone.—When the stone lies in the cystic duct, the gall-bladder is usually distended with mucus and some bile; there is a varying amount of pain, but no jaundice. When the stone lies in the common duct, the pain and tenderness are more marked, and there is always jaundice, which, however, varies in intensity from time to time. In these cases the gall-bladder is not

usually distended, though in obstruction to the common duct by malignant disease distension is a frequent symptom. A stone impacted in the lower end of the duct may ulcerate into the duodenum or colon; more rarely into the peritoneal cavity, producing peritonitis, or into the retroperitoneal tissues, producing an abscess.

Cholecystitis.—A catarrhal form usually precedes the formation of gall-stones. The more severe degrees of cholecystitis are usually associated with the presence of gall-stones and the *Bacillus coli*. Infection spreads through the wall of the gall-bladder, and localized peritonitis occurs. This may result in the formation of adhesions only, or a localized abscess, which makes its way to the surface or into some part of the intestine. A fistula may form between the gall-bladder and the colon, through which stones may escape.

The *Symptoms* produced are those of a localized peritonitis—viz., pain, tenderness, and rigidity in the right hypochondrium; slight fever, vomiting, and constipation from inflammatory obstruction of the neighbouring coils of intestine. Perforation of the gall-bladder sometimes occurs, and then the symptoms are those of an acute general perforative peritonitis. A gangrenous form of cholecystitis may rarely complicate gall-stones, but more commonly follows specific fevers. The symptoms are those of perforative peritonitis.

Suppurative Cholangitis is usually due to stones impacted in the common duct, the organisms finding their way up from the bowel and producing suppuration in the bile-ducts in the liver. High fever, with deep and persistent jaundice, is the symptom which leads to the diagnosis of this condition. If untreated, it usually ends fatally by producing multiple abscesses in the liver.

Prognosis in Cholelithiasis.—It is impossible to predict the course. Mild attacks of colic may be followed by severe complications, while severe attacks may end in cure by ulceration of the stone into the alimentary canal, though the tendency to spontaneous cure is very slight. The prognosis is much improved by an early operation, which carries very slight risk, while, if left till there are extensive adhesions or septic complications, the risks are much increased. Chronic pancreatitis is a frequent complication of stones impacted in the common duct.

Treatment—Palliative.—If the attacks of pain or jaundice are mild and infrequent, and the patient's health returns to normal in the intervals, medical treatment suffices. This consists in regulating the patient's diet, prescribing regular exercise, with the use of saline aperients and a mixture of urotropin, 5 grains, iridin, 1 grain t.d.s.

Operative Treatment is advisable—(1) when there is persistent or frequent pain or swelling in the region of the gall-bladder, even though the patient has never had either colic or jaundice; (2) when attacks of colic are frequent; (3) when signs of impaction are present, either in the common or cystic duct, and resist treatment more than two or three weeks. If fever occurs in an attack of this kind, it indicates septic cholangitis, and is a reason for operating without delay. (4) When there is doubt as to whether persistent jaundice is due to impaction of a stone in the common duct or to its occlusion by malignant disease, a delay of a few weeks will clear up the doubt. In the malignant case the patient goes rapidly down hill, and probably a tumour or secondary deposits may be felt.

Cholecystotomy.—The gall-bladder may be exposed either through a vertical incision from the tip of the ninth rib, or through an incision parallel to and 1½ inches below the right costal margin. The liver is drawn up and the intestines packed away with gauze. If the gall-bladder is distended, the fluid is removed by tapping it with a trocar and cannula. The opening is then enlarged, and the stones are removed with a scoop. The bile-ducts are examined along their whole course by a finger externally, and by a long probe internally if it can be passed. If the interior is fairly healthy, the opening in the gall-bladder may be closed by two layers of continuous sutures, followed by closure of the abdominal wound, but usually it is much safer to drain the gall-bladder for a time by **cholecystostomy**. The margins of the opening in the gall-bladder are stitched to the parietal peritoneum and transversalis fascia at the upper part of the wound, and the rest of the incision is closed. A drainage-tube is left in till the discharge is clear mucus and then removed. If there is no obstruction to the passage of bile into the intestine, the fistula usually closes quickly; if not, it must be remedied by performing cholecystectomy or cholecystenterostomy.

A stone impacted in the common duct may be difficult to remove with the scoop. If it cannot be pushed forwards or backwards, the duct should be opened to remove the stone, the opening being afterwards sutured, and a drainage-tube left in for a few days down to the site of the opening. To remove a stone impacted behind the second piece of the duodenum it is necessary to incise both anterior and posterior walls of that part of the intestine.

Cholecystectomy is the best method of ensuring the non-recurrence of gall-stones, and is necessary for malignant disease of the gall-bladder, for acute gangrenous cholecystitis, for traumatic lesions when the gall-bladder cannot be repaired, and for biliary fistula due to stricture of, or impaction of a stone in, the cystic duct. The fundus of the gall-bladder is separated from the liver down to the cystic duct, which is then clamped and divided. The stump and the raw surface of the liver are covered by flaps of peritoneum, and a drainage-tube is left in for a few days. In very fat people, or with inadequate assistance, cholecystostomy is safer.

Cholecystenterostomy, or the formation of an artificial opening betweeen the gall-bladder and the intestine, is required in cases of stenosis of the common duct or impaction of a stone low down, when it is not advisable to attempt removal. The junction is effected either by direct stitching or by Murphy's button. It must be remembered that infection from the intestine may set up a fatal suppurative cholangitis after cholecystenterostomy. In some cases of persistent jaundice there is a great tendency to bleed. This is due to an accompanying chronic pancreatitis which has caused the removal of the calcium chloride from the blood. Such cases should be given calcium chloride 20 grains every four hours by mouth, or 1 drachm t.d.s. per rectum, for two or three days before the operation, and it will then be found that no excessive bleeding occurs.

Affections of the Pancreas.

Injuries of the Pancreas.—These are due to crushes, blows, and penetrating injuries, and the pancreas is

seldom the only organ wounded. The exact nature of the injury is only discovered during an operation for internal hæmorrhage. The bleeding-points must be tied, if possible; if not, the hæmorrhage must be stopped by leaving on artery forceps and packing with gauze.

Inflammatory Affections of the Pancreas.—The micro-organisms which cause inflammation enter usually by the pancreatic duct, especially in cases in which a stone is impacted at the lower end of the common bile-duct. In other cases they may enter directly when the base of a gastric or duodenal ulcer is adherent to the pancreas.

Disseminated Fat Necrosis is occasionally found in the form of scattered yellow spots in the fat of the mesentery and omentum in the neighbourhood of the pancreas. These are due to the breaking up of the fat cells by the fat-splitting ferment which has escaped from the pancreas, the fatty acids then combining with lime salts.

Acute Hæmorrhagic Pancreatitis is the most severe type, and has an acute onset. There is violent epigastric pain, vomiting, constipation, with a small, rapid pulse, and collapse, followed by distension of the abdomen—in fact, symptoms indistinguishable from perforative peritonitis or internal strangulation.

The correct diagnosis is only made by opening the abdomen, when it is found that the pancreas is swollen and infiltrated with blood, and that there is a considerable quantity of bloody serum free in the abdominal cavity. The discovery of little patches of fat necrosis may give a hint as to the nature of the trouble. The abdomen should be drained in the neighbourhood of the pancreas, but many of these cases are fatal.

Suppurative Pancreatitis is due to the entrance of germs from the intestine or biliary tract. A diffuse suppurative infiltration or a number of disconnected abscesses may occur. The pus spreads beyond the pancreas in one of several directions—either into the lesser peritoneal sac, the left subphrenic space, the general peritoneal cavity, or into some part of the intestine. Septic thrombosis with hepatic abscess may follow. The onset is that of a circumscribed inflammation in the epigastrium, in many cases of which the

inflammatory mass can be felt. The abdomen should be opened and guarded with gauze pads while the abscess is explored. A counter-opening behind is necessary, as well as anterior drainage.

Chronic Pancreatitis is not uncommonly associated with the impaction of a gall-stone in the common duct, or inflammation of the biliary passages. The pancreas is sclerosed, and may be shrunken, though sometimes it may form a palpable tumour. Pain, tenderness, and dyspeptic symptoms may be present, while diabetes, wasting, and the presence of undigested fat in the stools may be observed. Removal of the obstructing gall-stone or drainage of the biliary passages is urgently called for in these cases.

Cysts of the Pancreas are due, not to obstruction of the duct, but to some previous inflammatory attack or traumatic lesion. The fluid is brown, turbid, of an alkaline or neutral reaction, and is capable of peptonizing albumin, converting starch into sugar, and emulsifying fat. The cyst may be felt as a rounded elastic or fluctuating swelling, and it may project either between the stomach and the liver, or between the stomach and transverse colon. The patient has usually, before his condition is recognized, passed through a period of ill-health, attributed to dyspepsia, and has undergone considerable emaciation from loss of fats in the stools.

Treatment consists in exposing the cyst and draining it from the front or from the back. The cases usually heal, though slowly, and the skin is liable to be irritated by the digestive action of the discharge.

Carcinoma of the Pancreas is either primary or secondary to carcinoma of the pylorus. It leads to pyloric obstruction, jaundice, and ascites, and rarely lends itself to operative procedures.

Affections of the Spleen.

Rupture of the Spleen results from blows or crushes. Shock, localized pain, and signs of intra-abdominal hæmorrhage, are the symptoms. The abdomen should be opened and the spleen excised. Sometimes plugging with gauze stops the bleeding.

Abscess of the Spleen is usually pyæmic and fatal. Sometimes it occurs by spread of infection from a coil of intestine. Incision and drainage is then necessary.

A **Floating Spleen** should be stitched to the extra-peritoneal tissues through a hole made in the parietal peritoneum covering the diaphragm.

Tumours of the Spleen.—General enlargement is met with in lymphadenoma, malaria, lardaceous disease, and rickets. New growths are hydatid cysts, sarcoma, and secondary carcinoma.

An enlarged spleen can be felt extending below the costal margin downwards and to the umbilicus, with a notch in the anterior edge. It moves with respiration, and the note over it is always dull, as the intestine is never in front of it. Hydatid cysts are treated like those in the liver.

Splenectomy is undertaken for rupture, for the so-called idiopathic hypertrophy where there are no leukæmic changes, and where malignant disease is diagnosed sufficiently early. The abdomen is opened by an incision running vertically downwards from the ninth left rib. The pedicle is transfixed and ligatured, and the spleen is removed.

CHAPTER XXXIII

HERNIA

A **Hernia** is the protrusion of a viscus or portion of a viscus through an opening in the walls of the cavity in which it is contained. Here only hernia in connection with the abdomen will be described.

The common situations are the inguinal canal, crural canal, and umbilicus ; but hernia may occur through the sciatic notch, obturator foramen, and diaphragm.

Etiology.—*Congenital Causes.*—1. The most important is non-obliteration of the funicular process, and all cases of congenital hernia are due to this. The intestine or omentum may come down at any period of life into a patent funicular process. 2. Late descent of the testis is often associated with hernia. 3. Inherited weakness of

the abdominal muscles is common as a factor. 4. Congenital phimosis may produce hernia through the straining efforts at micturition. 5. Congenital defects in the umbilicus, linea alba, and diaphragm, allow the production of hernia.

Acquired Causes are those which weaken the abdominal muscles or increase the intra-abdominal pressure. Pregnancy, chronic bronchitis, violent efforts, chronic constipation, urethral obstruction from stricture or enlarged prostate, are causes of increase in pressure. In Glénard's disease the lower part of the abdominal wall is weakened and bulged, and at the same time the attachment of the mesentery slips down, owing to degeneration of the muscle of Treitz, so that the intestines occupy an abnormally low plane in the abdomen.

Structure.—A hernia consists of a sac, its contents, and its coverings.

The **sac** consists of peritoneum, and, apart from a congenital sac, is derived from the peritoneum originally covering the hernial orifice. The sac consists of a body and a neck. The neck may be wide, or narrow and thickened from the irritation of a truss. The sac is irreducible except in its earliest stages. Inflammation in the sac from pressure or blows causes thickening and the formation of adhesions between the sac and its contents, or between different parts of the sac itself. Natural cure may come about by adhesions at the neck shutting off the abdominal cavity, a subsequent effusion into such a sac being known as **hydrocele of a hernial sac.**

The **coverings** are so matted in old cases as to be indistinguishable from one another. They are derived from the structures lying over the protrusion.

The **contents** may be any abdominal organ, but usually only intestine and omentum are found. Small intestine is more often found than large. Omentum when reducible is little altered in structure, but when irreducible becomes thickened and adherent to the sac. **Enterocele** and **epiplocele** are terms applied to hernia of intestine and omentum respectively. The cæcum sometimes comes down into a hernial sac, and in rare cases its posterior surface has only a partial serous covering. A pouch of bladder may be dragged down in a very big hernia, but it then lies to the inner side of the sac, not in it.

Symptoms —A rounded swelling is present, which has an expansile impulse on coughing. It cannot be separated from the abdominal cavity, and is reducible into it except when irreducible or strangulated. Intestine gurgles when reduced, while omentum feels soft and doughy and does not gurgle.

Special Forms of Hernia.

An **Inguinal Hernia** protrudes into or through the inguinal canal. If it extends into the scrotum it is called **complete**; if not beyond the external ring it is called **incomplete** (bubonocele). The neck of the sac lies to the inner side of the pubic spine and above the level of Poupart's ligament. Two varieties occur—the oblique and the direct.

An **Oblique Inguinal Hernia** occupies the whole length of the inguinal canal, so that the deep epigastric artery is to the inner side of the neck. Its coverings are: (1) Skin and subcutaneous tissue, (2) intercolumnar fascia, (3) cremasteric muscle and fascia, (4) infundibuliform fascia, and (5) extraperitoneal fat. There are three forms of oblique inguinal hernia—congenital, infantile, and acquired.

1. In **Congenital Inguinal Hernia** the funicular process is unobliterated, and in infancy or at puberty, or even later, intestine or omentum is pushed down into it. The hernia becomes complete at once, and may be immediately strangulated. If the tunica vaginalis has not been shut off, the hernia surrounds the testis, and it is called **Congenital Vaginal Hernia**. If the tunica vaginalis is closed, the hernia comes down to the top of the epididymis, and is called a **Congenital Funicular Hernia**. The structures of the cord are always spread out over the sac in congenital hernia.

2. In **Infantile Hernia** the funicular process is shut off from the abdominal cavity, but remains patent below the internal ring. An acquired hernia may then come down behind the process or may invaginate it. It is only recognisable during operation.

3. In an **Acquired Inguinal Hernia** the sac consists of peritoneum protruded from the abdomen. It increases

in size slowly, and extends usually to the head of the epididymis, but if very large may overlap the front of the testis. In old-standing cases the internal ring is pulled inwards behind the external ring, so that it is indistinguishable from a direct hernia.

A **Direct Inguinal Hernia** is always acquired, and only passes through portion of the inguinal canal. It passes through, or pushes before it, either the transversalis fascia or the conjoined tendon. The deep epigastric artery and spermatic cord lie on the outer side of the neck. The hernia protrudes through Hesselbach's triangle, and, according as the neck lies to the inner or outer side of the obliterated hypogastric artery, it is known as internal or external direct hernia. It occurs only in old people.

An **Interstitial Hernia** is an inguinal hernia which has a sac occupying some portion of the abdominal wall.

1. The **intraparietal** form has a sac between the peritoneum and transversalis fascia, and with it there may or may not be an ordinary sac. An ordinary hernia may be reduced into this abnormal sac (hernia *en bissac*), and if it has been strangulated the symptoms continue although the swelling has been reduced.

2. The **interparietal** form is situated between the internal and external oblique muscles, and spreads outwards and upwards above Poupart's ligament.

3. The **extraparietal** form has a sac which comes through the external ring and then spreads out along Poupart's ligament superficial to the external oblique. It is generally associated with a partially descended or undescended testis.

The *Signs* of an inguinal hernia are : A swelling in the inguinal canal, which may extend into the scrotum, with an impulse on coughing. The testis can be felt below and behind, and the swelling is not translucent.

Inguinal hernia is commoner in males, but in women it is not uncommon up to the age of twenty-five, and is then of the congenital variety, extending along the canal of Nuck.

The *Diagnosis* of inguinal hernia is usually easy, but there are some conditions from which it has to be distinguished.

An incomplete hernia has to be distinguished from—

1. **Encysted hydrocele of the cord**, which has an impulse on coughing, but cannot be reduced into the abdomen, and also it can be fixed by traction on the testis. If the upper end can be reached this distinguishes it from hernia. 2. A **testis retained in the inguinal canal** is recognised by the fact that the scrotum is empty on that side and testicular sensation is felt. 3. A **chronic abscess**, pointing through the external ring, has an impulse on coughing and may be reducible, but it does not feel like a hernia, and usually swelling and fluctuation can be felt in the iliac fossa. There are also signs of the original cause. 4. A **lipoma of the cord** can only be distinguished from a bubonocele if the upper limits of the swelling can be felt. 5. **Hæmatocele of the cord** shows signs of, and has a history of, injury.

When the hernia is complete, it differs from purely scrotal swellings by the fact that you cannot feel its upper limits. A varicocele does not feel in the least like an omental hernia.

Treatment is either palliative by trusses or operation.

Trusses are of numerous varieties, but the essentials are that there must be a pad over the hernial aperture, kept in place by a spring which passes transversely around the body, midway between the great trochanter and the crest of the ilium, and joined in front by straps. Various forms of pad are used, consisting of steel covered by cork and leather, wood, vulcanite, indiarubber cushions filled with air, water, or glycerine. In oblique hernia the pad must rest over the inguinal canal; in direct hernia it should rest over the opening. If a truss is worn continuously for a year or two, especially in congenital hernia, a cure may be effected, but not if the hernia has been down many months.

In infants the skein of wool or flannel truss acts efficiently. It is changed night and morning, the hernia being kept back while it is being readjusted. An india-rubber truss is also well borne by infants.

Operative Treatment affords good results in properly selected cases. Those specially suitable are cases of congenital hernia, where the muscles are strong and the inguinal canal is not much stretched. The operation will be followed by recurrence in cases—(1) where there is inherited weakness of the abdominal muscles; (2) where

there is general bulging of the lower part of the abdomen and enteroptosis. Where very large irreducible herniæ are operated upon, there will be recurrence unless a truss is worn. Children should be treated by truss till the age of three. If the hernia is then uncured, it should be operated upon. In other cases, after a truss has been tried for a year, operation is advisable.

Many operations are practised, but **Bassini's** is the most useful. An incision $2\frac{1}{2}$ inches long is made over the inguinal canal, exposing the structures of the cord and the external oblique. The external oblique fibres are split from the apex of the external ring to expose the canal. The sac is found, opened, emptied of its contents, and isolated from the structures of the cord up to the internal ring. If the hernia is irreducible, the intestine is freed and returned to the abdomen, omentum being ligatured and removed. The neck of the sac is then transfixed and tied with silk, and the fundus removed. The stump returns to the abdomen, three or four stitches are then passed through the conjoined tendon and arched fibres of the internal oblique and transversalis muscles above, and the deep part of Poupart's ligament below. These are tied behind the cord. The external oblique is then sutured in front of the cord, leaving just sufficient opening for it to pass through without pressure. The skin is then closed by a continuous stitch. The patient should be kept in bed for three weeks, and should not exert himself for at least six weeks. If the wound has suppurated, or if the case is one in which the abdominal muscles are weak, it is advisable that a light truss should be worn afterwards for six months.

In congenital vaginal hernia the sac must be divided below, and left as a tunica vaginalis. Recurrence after operation is due to suppuration, faulty selection of cases, or the restoration of a large mass of omentum which has been down for a long time.

Femoral Hernia.—A femoral hernia protrudes through the crural canal, and presents through the saphenous opening. It is more common in women, especially in those who have borne children. The coverings are: (1) Skin and subcutaneous tissue, (2) cribriform fascia, (3) anterior layer of the femoral sheath, (4) septum

crurale and extraperitoneal fat covering the peritoneal sac. The femoral vein lies immediately to the outer, and Gimbernat's ligament to the inner, side of the neck of the sac. An irregular obturator artery may pass between the neck and the femoral vein, or along the free border of Gimbernat's ligament. A femoral hernia, after leaving the saphenous opening, projects upwards and outwards along Poupart's ligament, and may even project above it, but the neck is always below Poupart's ligament and outside the pubic spine.

The *Signs* are usually characteristic: viz., a more or less reducible swelling, with an impulse on coughing, and a neck which runs into the abdomen by way of the saphenous opening. From **inguinal hernia** it is distinguished by the neck being below Poupart's ligament and external to the pubic spine. An **enlarged lymphatic gland** lying over the saphenous opening may be mistaken for an irreducible omental femoral hernia; so may a **lipoma** in the crural canal. A **psoas abscess** pointing through the saphenous opening is reducible, and has an impulse on coughing; but fluctuation can be felt between the swelling at the saphenous opening and the swelling always present in the iliac fossa in these cases. Signs of spinal caries are always present. A **pouch in a varicose saphenous vein** close to the saphenous opening has an impulse on coughing, and disappears when the patient lies down; but it has a characteristic thrill on coughing which should prevent mistakes.

Treatment.—A **truss** will keep up most femoral herniæ, but there is little prospect of cure by this means.

Operative Treatment is used either in strangulation or for radical cure; but the latter is not so certain in its results as in chosen cases of inguinal hernia. The sac is exposed by a vertical incision over the crural canal, opened, emptied of its contents, transfixed, and cut off. Two or three stitches are then passed between Cowper's ligament and Poupart's ligament to close the crural ring. Other methods used are to fasten Poupart's ligament down to the pubic ramus by a staple driven into the bone, or to drill the bone and fix it by a wire suture. The patient is kept in bed three weeks.

Umbilical Hernia.—1. **Congenital Umbilical Hernia**

is rare, and due to imperfect withdrawal of the intestine into the abdomen at birth. If overlooked, it is tied with the cord and strangulated. The abdomen should be opened, the gut reduced, and the umbilicus closed by sutures.

2. The **Umbilical Hernia of Infants** is due to yielding of the umbilical cicatrix. Constipation or phimosis may cause the straining which starts it. Most cases are cured by removing all causes of straining, and supporting the umbilicus with strapping.

3. The **Umbilical Hernia of Adults** usually protrudes through the linea alba, just above or below the umbilicus. It is most frequent in women who have borne children. In old cases the sac is thin and the contents are matted together, so that obstruction is liable to ensue. Inflammation and strangulation are not uncommon. Ulceration of the skin covering it may occur and lead to perforation.

Treatment.—Favourable cases for operation are those where the ring is small. Large umbilical herniæ are best treated by trusses. Operation consists in exposing the sac by a vertical incision, opening it, and reducing the intestine. Omentum should be ligatured and cut away. The sac should be dissected up to expose the opening in the abdominal wall. The sac is then ligatured and cut off, and the edges of the ring are brought together by a layer of buried sutures. It is advisable to expose the edges of the recti, and stitch them in apposition. In very bad cases it may be necessary to use a wide prepared silver filigree to give strength to the abdominal wall.

A **Ventral Hernia** is a protrusion occurring through the anterior abdominal wall elsewhere than at the usual hernial orifices. A 'fatty hernia of the linea alba' is a protrusion of extraperitoneal fat through an opening in the linea alba. A small sac of peritoneum may be drawn through the opening, and so produce a true hernia.

Treatment consists in removing the mass, taking care that, if a sac is present, no viscera are included in the ligature.

Ventral hernia may occur from yielding of a cicatrix after abdominal operations, especially if the wound has suppurated, or has been used to drain an appendicitic abscess. Treatment consists in excising the scar, then

uniting the peritoneum, muscles, and skin, in separate layers.

Sometimes in women who have had children the linea alba is much stretched and the recti separated. An abdominal belt is necessary.

A **Lumbar Hernia** through Petit's triangle is rare, and is treated in the same way as a ventral hernia.

A **Diaphragmatic Hernia** protrudes through a congenital aperture or an opening due to injury. It is only found after death.

An **Obturator Hernia** protrudes through the upper part of the thyroid foramen. It is usually only recognised during an exploratory laparotomy for internal strangulation. It may, however, be indicated, when there are symptoms of strangulation, by a sense of resistance and fulness close to the origin of the adductor muscles, and pain in the distribution of the obturator nerve.

Treatment for strangulation is usually through an abdominal wound, but the sac may be reached through an incision over the inner part of Scarpa's triangle. The constriction should be divided directly upwards.

Abnormal Conditions of Herniæ

Irreducible Hernia is due to adhesions between the contents and the sac, or between the contents themselves. This may be associated with contraction of the neck of the sac.

Treatment.—1. By keeping the patient in bed and applying taxis at intervals, an irreducible hernia often becomes reducible. 2. By using a **hinged-cup truss** reduction may often be accomplished in six to twelve weeks. 3. In very large herniæ of old people it is better to merely support it with a bag truss. 4. In healthy people and in small herniæ it is better to do an operation for radical cure. A patient cannot keep a hernia up with a truss if there is a piece of irreducible omentum in the sac.

Inflamed Hernia arises from injury. There is localized peritonitis in the sac. The part is red, hot, swollen, and tender, and there is usually some fever, malaise, vomiting, and constipation. The condition differs from

strangulation by the presence of fever instead of shock, and the absence of tension in the sac. The hernia is irreducible in the acute stage. Adhesions are left, and if the hernia is purely omental the result may be that the sac becomes permanently shut off.

Treatment consists in putting the patient to bed and applying hot fomentations.

Obstructed Hernia.—The onward passage of fæces is prevented. Nausea, vomiting, and constipation are produced, but the lower bowel may empty itself and flatus may be passed. The tumour, though distended, does not become tense, and usually a doughy mass can be felt, Colicky pains are felt. This condition may go on to strangulation. It occurs most commonly in umbilical hernia.

Treatment consists in the use of copious enemata.

Strangulated Hernia.

A hernia is strangulated when its contents are so constricted that the circulation of the blood is at first obstructed and finally arrested. The contents affected may be either intestine or omentum, or only a portion of the lumen may be strangulated (**Richter's Hernia**), or Meckel's diverticulum (**Littre's Hernia**).

A hernia may become strangulated at its first appearance in a congenital sac, but more usually it occurs in old-standing herniæ from the extrusion of an additional amount of the abdominal contents. In these cases the neck of the sac is often thickened from irritation, and in inguinal hernia this is the usual site of constriction. In femoral hernia Gimbernat's ligament, and in umbilical hernia the linea alba, are the sites of greatest constriction.

Pathology.—The pressure first affects the veins in the intestine or omentum, so that it becomes congested and œdematous, and exudation on the surface causes fluid to appear in the sac—hence the tenseness of the sac, which is one of the most reliable signs. If allowed to proceed, the arteries soon become obstructed, and gangrene follows. A strangulated piece of intestine becomes dark red from congestion, stiff from exudation, and distended from the

collection of gas within it. The peritoneal covering is shiny, unless gangrene has occurred, when it becomes dull black or gray. The most important point is at **the site of strangulation**, where the gut is liable to ulceration and perforation. The fluid in the sac is at first clear, but later becomes blood-stained and infected with the *Bacillus coli*, which migrates through the damaged walls.

Omentum, when strangulated, is at first congested and red, and later becomes black and gangrenous. A natural cure may occasionally result from adhesions to the sac maintaining the vitality of the piece of omentum.

If a strangulated hernia is left, the sac and surrounding tissues become inflamed and slough, so that an artificial anus is formed; but few patients survive long enough for this to effect a natural cure.

After the relief of strangulation, even if gangrene has not occurred, paralysis of the intestine may be temporary or may persist, or the paralyzed vessels may allow so much exudation as to cause gangrene. In some cases thrombosis of the veins occurs and leads to gangrene of the strangulated portion, which may even extend to and involve neighbouring parts of the intestine.

Symptoms—*General.*—Severe pain comes on suddenly after some effort, at first referred to the umbilicus, and subsequently to the site of the hernia. This is accompanied by some shock. The pulse is weak, and, though slow at first, becomes rapid; the skin is cold and clammy; vomiting occurs, and soon becomes frequent and fæcal-smelling. Constipation is complete, though both fæces and flatus may be passed at first from the lower bowel. The patient gradually becomes exhausted from the vomiting and inability to take food. When gangrene occurs, the temperature becomes subnormal, the pulse very rapid and weak, and the patient dies of toxæmia from the general peritonitis which follows gangrene.

Local.—A tumour forms at one of the hernial sites; or more often the patient has been the subject of a hernia, which he now finds to be *irreducible*, *tense*, tender, and *without impulse on coughing*. If allowed to persist, the sac and coverings become gangrenous.

Strangulation of omentum only is rare. In a Richter's hernia there may at first be passage of fæces and flatus, but all the other signs are present.

Treatment consists in reduction by taxis or operation. **Taxis**, or reduction, must be very gentle. The fundus must be grasped with one hand and compressed, to diminish the size of the hernia. The neck is steadied with the fingers of the other hand. An inguinal hernia is pressed upwards and outwards. A femoral hernia is pressed downwards and inwards towards the saphenous opening, and then backwards and upwards along the crural canal, the leg being kept flexed and adducted to relax the saphenous opening. An umbilical hernia is pressed backwards, but steady compression to reduce the œdema is more important in all cases than the direction of the pressure. No prolonged attempt should be made without an anæsthetic. When an anæsthetic is given, all preparations should be made for operation, though gentle taxis is again attempted.

The objections to taxis are that the gut may be easily bruised or ruptured; that gangrenous gut may be returned to the abdomen; that strangulated gut may be reduced into a second sac, whose presence is not suspected; that contents and sac may be reduced *en masse*, and therefore still strangulated; that infected fluid may be returned into the abdomen; and, finally, that radical cure cannot be done at the time, and the patient is therefore liable to recurrence. Taxis should never be employed in femoral hernia, nor in any hernia which has lasted more than twenty-four hours.

Persistence of Symptoms after apparently Successful Taxis.—1. Vomiting may be due to the anæsthetic, but it does not persist or remain fæcal. 2. The gut may be paralyzed or become gangrenous. 3. The gut may have been strangulated through a slit in the omentum and is therefore unrelieved. 4. The hernia may have been reduced into a second sac. 5. The hernia may have been reduced *en masse*, either with the whole sac around it or with the neck only, the fundus and the neck having been forcibly separated. In such a case a swelling may be felt at the top of the inguinal canal by inserting a finger, this examination being suggested by the persistence of the symptoms. 6. The hernia reduced may not be the one which caused the symptoms.

If symptoms persist and progress, the hernial orifices

must be carefully searched, and, if no tumour can be discovered, the abdomen must be opened and a strangulation sought.

Operative Treatment should be undertaken **at once** when gentle taxis has failed. An incision is made over the sac, which is then opened. There is usually fluid in the sac, so there is no danger of wounding the gut. The fluid is washed away, then the cause of strangulation is made out, and a hernia knife guided up to it by a finger or broad hernia director. The constriction is nicked in one or two places and the gut is **drawn down**, so that the site of strangulation may be examined. Omentum is ligatured and removed. According to the condition of the intestine the further treatment differs.

1. If the gut, though black, has not lost its polish, it is reduced by gently compressing it to remove the œdema.

2. If gangrene is suspected, the strangulated portion must be resected, and end-to-end union established.

3. If the gut is undoubtedly gangrenous, one of two methods must be adopted : (1) If the patient is profoundly collapsed and will not bear a prolonged operation, an artificial anus is established by dividing the constriction outside the sac, so as not to open the peritoneal cavity. The loop of bowel is then opened to give free exit to the fæces. Most of the cases which have to be treated in this way are so bad before treatment is commenced that a fatal termination must be expected. (2) If the patient can possibly stand it, immediate resection gives the best chance, and with Murphy's button or a bobbin much time can be saved.

A radical cure is advisable after the strangulation has been relieved, unless the patient's condition contra-indicates it. Liquid food is given at the end of twenty-four hours, and the bowels need not be disturbed for five or six days, when castor-oil may be given.

Complications—Acute Enteritis may arise in the strangulated portion of gut. This is indicated by vomiting, localized pain, and the passage of mucus, which may be blood-stained. Ulceration and perforation may follow and cause fatal peritonitis. Fluid diet and large doses of bismuth constitute the treatment.

Peritonitis may follow, when the wall is so damaged

that the *Bacillus coli* can pass through ; or it may occur from infection of the wound by the operator. The abdomen should be opened and drained as soon as peritonitis is evident.

A localized intraperitoneal abscess may occur from a small perforation. When opened, a fæcal fistula is likely to follow.

In strangulated inguinal hernia the constriction is divided directly upwards, in femoral hernia directly inwards. In the latter case, if an abnormal obturator artery is wounded, the incision must be enlarged, so that the bleeding-points may be tied. If enterectomy has to be performed in a femoral hernia, it must be done through a second wound above Poupart's ligament, owing to the shortness of the mesentery.

CHAPTER XXXIV

INTESTINAL OBSTRUCTION

Intestinal Obstruction is a condition characterized by interference with the passage of the intestinal contents. In acute cases it is, in addition, often associated with strangulation.

The best classification is a clinical one—acute obstruction, chronic obstruction, and intussusception.

Acute Intestinal Obstruction.

Causes.—(1) Strangulation by bands or adhesions or through apertures ; (2) volvulus ; (3) acute intussusception ; (4) the termination of chronic obstruction ; (5) the impaction of foreign bodies ; (6) strangulation over a band, or acute kinking (rare). These are mechanical causes ; another common cause is peritonitis, which is an inflammatory cause.

Symptoms.—Sudden severe pain referred to the umbilicus comes on, perhaps, after an effort. Shock, evidenced by a weak pulse, a cold, clammy skin, and a subnormal temperature, accompanies the pain. The pain, inter-

mittent at first, becomes continuous. Vomiting is persistent, and soon becomes fæcal-smelling. The patient becomes exhausted by the vomiting and inability to take food. The abdomen becomes distended, and if the obstruction is not relieved, perforative peritonitis follows, so that the patient dies in about seven to ten days from the onset. Constipation is usually absolute, though the lower bowel may empty itself at first.

Pathology.—Strangulation by bands or adhesions, or through apertures: Bands and adhesions are due to old **plastic peritonitis**, from appendicitis, tuberculous peritonitis, pelvic peritonitis, etc. The intestine may be strangulated by being caught under a band, or in a band which has formed a loop. Bands may be formed from **omental adhesions.** A **Meckel's diverticulum** may become adherent to some part of the abdominal contents or wall, and form an obstructing band. The **appendix, Fallopian tubes**, or **appendices epiploicæ**, may contract abnormal adhesions, under which the bowel may be caught and strangled. **Slits** in the mesentery and **peritoneal pouches** may cause obstruction if the intestine passes into or through them. The ordinary strangulated hernia is a similar form of intestinal obstruction.

A **Volvulus** consists of rotation of the gut upon its own mesenteric axis, so as to obstruct the passage of the intestinal contents, and sooner or later produce strangulation. The sigmoid flexure is the part most commonly affected, though the cæcum or small intestine may be affected. A long, narrow mesosigmoid and dragging, due to chronic constipation, are the predisposing causes. Some irregular movement then produces rotation of the sigmoid. Plastic peritonitis may fix the coil in its new position, but the obstruction of its blood-supply and its distension with gas soon lead to peritonitis and death.

Volvulus is rare before forty, and usually occurs in males. It is preceded by chronic constipation, but the symptoms begin with sudden pain. The pain, vomiting, and collapse, are not so great as in strangulation or obstruction of the small intestine, but the distension is greater. Death usually occurs from peritonitis if it is unrelieved.

Impacted Foreign Bodies.—These may be gall-stones,

enteroliths, or foreign bodies swallowed. Gall-stones big enough to cause obstruction have reached the intestine by ulcerating through from the gall-bladder to the duodenum. They are increased in size by a fæcal coating, and become impacted in the lower part of the ileum. There is a history of inflammatory attacks about the gall-bladder, but not of biliary colic. The acute obstruction is preceded by attacks of incomplete obstruction, as is also the case when foreign bodies swallowed are the cause.

Enteroliths are rare, and are formed of phosphate of lime, carbonate of magnesia (taken as medicine), or of indigestible vegetable materials.

Obstruction **across a band** causes also arrest of the circulation, but it may become relieved spontaneously.

Kinking may be due to the dragging of adhesions.

Acute Intussusception will be described later.

Acute obstruction following chronic is marked by the pain becoming constant, and vomiting starting and becoming persistent and fæcal-smelling.

Diagnosis.—This is not difficult, but the cause can usually be made out only by opening the abdomen. The mechanical form of obstruction must be distinguished from the inflammatory form, especially that of appendicitis associated with peritonitis. The temperature, localized tenderness, and rigidity, of appendicitis serve to distinguish it.

Treatment.—The only thing that can give the patient the chance he ought to have is immediate operation. It is advisable to wash out the stomach before the operation, so that intestinal contents may not be vomited and inhaled during the operation.

Three objects are aimed at: (1) To empty the distended bowel above the obstruction; (2) to relieve the obstruction; (3) to treat the strangulated intestine. In cases that are almost moribund, the abdomen should be opened with cocaine or eucaine anæsthesia; a distended coil is pulled out and tapped, a Paul's tube being subsequently tied in. The peritoneal cavity is protected with gauze packing during these manipulations. The bowel is stitched to the abdominal wound after the fæces and flatus have drained away. No attempt at relief of

the obstruction can be made in these cases till a later date, and, of course, a high death-rate must be expected.

In less severe cases the abdomen should be opened in the mid-line below the umbilicus, and a systematic search made for the cause of the obstruction. The hernial orifices are first examined, then the cæcum. If the cæcum is distended, the obstruction lies below it; if collapsed, above it. In the former case the sigmoid should next be examined. If collapsed, the colon must then be traced backwards till the obstruction is found. If the cæcum is collapsed, the intestine must be pulled out a foot at a time and examined, beginning with the ileum, and replacing it as each part is done with. If the intestine is much distended, several coils may be tapped and emptied, to facilitate the search.

Bands and adhesions should be divided between ligatures. A volvulus should be untwisted if possible. If it tends to rewind, the mesosigmoid must be stitched to the abdominal wall. If it cannot be untwisted owing to adhesions, or if the mass is gangrenous, it must be resected if the patient can stand so severe an operation. If not, an artificial anus must be made both in the drawn-out loop and in the colon above it.

Foreign bodies should be pushed back to a healthy part of the intestine, and removed through an incision at the antimesenteric border, which is afterwards stitched up.

Chronic Intestinal Obstruction.

Causes.—(1) Intra-intestinal conditions—impaction of fæces and foreign bodies; (2) affections of the intestinal wall, such as stricture, new growths, adhesions of coils of intestine; (3) compression of the bowel from without by tumours or adhesions.

Symptoms.—The patient suffers from gradually increasing constipation and colicky pains, perhaps alternating with diarrhœa, due to enteritis. Attacks of temporary complete obstruction may occur, and finally acute obstruction comes on. The abdomen then becomes distended, severe griping pains occur, and vomiting, which ultimately becomes fæcal-smelling. Coils of intestine can be seen moving during the pains in a thin

patient. If the condition is allowed to go on, the patient dies of peritonitis from perforation above the stricture, or migration of the *Bacillus coli* through the paralyzed wall, or from poisoning by absorption of the intestinal contents.

Treatment.—Unless the case has become one of acute obstruction, it should be treated temporarily by fluid diet, copious enemata, and small doses of calomel combined with belladonna. An early operation should, however, be advised in all cases but those of fæcal impaction.

If the obstruction has become complete, the abdomen must be opened. If the small intestine is obstructed, a coil above must be drained with a Paul's tube, leaving the cause to be dealt with later. If the obstruction is in the large intestine, the colon must be opened and drained with a Paul's tube, either in the usual situation for colotomy, or, if the stricture is above the sigmoid, a piece of the ileum a foot away from the cæcum is opened and stitched to a median wound.

In chronic peritonitis diet, enemata, and abdominal massage, must be trusted to unless the obstruction is acute.

Intussusception.

A portion of the bowel becomes invaginated into the part below. The invaginated portion is called the **intussusceptum**; the portion into which it is protruded, the **intussuscipiens**. There are, therefore, three layers—the outer or **ensheathing** layer, the inner or **entering** layer, and the middle or **returning** layer. Not only does the intestine enter, but also the mesentery; so that, in addition to the obstruction due to traction, strangulation from pressure on the bloodvessels is added. Peritonitis usually follows from migration of the *Bacillus coli*. This may be limited, and merely cause adhesions between the entering and returning layers, or may be diffuse and fatal from perforation or gangrene.

Causes.—It is due to irregular peristalsis, a contracted portion of the intestine being forced into the lumen of the bowel immediately below. Irritating ingesta, polypoid tumours, and malignant growths, may be the cause of the irregular peristalsis.

Situations.—1. The commonest is the **ileo-cæcal**, the apex of the intussusceptum being the ileo-cæcal valve, which may travel so far as even to protrude from the anus. 2. The **enteric** form involves the small intestine. 3. The **colic** form involves the colon. 4. The **ileo-colic** form is rare. The ileum passes through the ileo-cæcal valve into the colon, but after it has passed a certain distance the ileo-cæcal valve and cæcum follow. In each variety, except the last, the intussusception grows at the expense of the ensheathing layer, the apex remaining always the same portion of gut.

Symptoms.—**Acute Intussusception** is most common in children. It begins suddenly with severe abdominal pain and vomiting. Blood-stained mucus is passed, perhaps with tenesmus. Collapse soon comes on, and may be fatal in twenty-four hours; otherwise death occurs in a few days from peritonitis. In most cases a 'sausage-shaped' tumour can be felt, usually along the course of the colon, but lower down, or just above the pubis. The right iliac fossa feels empty ('signe de Dance'). A natural cure may follow, but rarely, from sloughing of the intussusceptum, whilst the peritoneal cavity is protected by adhesions uniting the entering and ensheathing layers.

Chronic Intussusception usually occurs in adults, and is only diagnosed as a case of chronic intestinal obstruction with a tumour, the intussusception being found at the operation.

Treatment.—The reduction of the intussusception at the earliest possible moment is the only treatment admissible, and this can only be done with certainty by operation. The abdomen should be opened over the tumour if it can be felt; if not, in the mid-line below the umbilicus. The intussusception is then reduced by squeezing out the entering portion, beginning at the lowest part. The intestine should never be pulled out, for fear of tearing it. If there is any difficulty, the wound must be enlarged and the lump brought out. If, owing to adhesions, reduction cannot be done, the intussuscepted portion must be excised through an incision in the ensheathing layer, but the outlook is bad in these cases. If the bowel is gangrenous, the condition is so bad that

nothing more can be done than to bring out the coil and establish an artificial anus.

If, owing to any reason, an operation is not possible, non-operative procedures must be tried. These consist of attempting to reduce the invagination by inflation with air, or better still by fluid. A catheter is passed into the rectum, and fluid poured in from a funnel raised not more than 2 feet. A hand is placed over the tumour to feel when the lump disappears. The objections to this are, that after twelve hours reduction cannot be obtained by this method; that valuable time is wasted if it fails; that you cannot tell if the last inch has been reduced (and if it has not, recurrence is certain); that it is no use in the enteric or ileo-colic forms; and that the bowel may be ruptured.

Chronic intussusception has usually to be treated by excision.

Investigation of a Case of Intestinal Obstruction.

The points to be examined are:

1. The **Previous History**, with special reference to chronic or localized peritonitis, dysentery, syphilis, biliary colic, and chronic constipation.

2. The **History of the Present Attack**—whether the onset is acute or gradual, and whether previous subacute attacks have occurred.

3. The special **Symptoms** must then be considered.

(*a*) **Vomiting** is always present when obstruction is complete. It is more marked, and comes on earlier, when the small intestine is involved.

(*b*) **Constipation** is usually present, though the bowel below the obstruction may be emptied.

(*c*) **Pain** is very marked when the small intestine is involved, less so when the colon is obstructed. It is intermittent when the obstruction is incomplete, continuous when complete, and the pain is at first referred to the umbilicus.

(*d*) **Collapse** is due to reflex nervous disturbance and persistent vomiting. At the end of the case toxæmia is added. Collapse comes on early in acute cases, late in chronic ones. The higher the obstruction, the greater the shock.

(*e*) **Abdominal tenderness** only comes on with the onset of peritonitis.

(*f*) **Distension** is situated in the middle of the abdomen when the lesion is in the small intestine; in the flanks when the rectum or sigmoid is involved, unless there is great distension, when the whole abdomen is blown up. Visible peristalsis is frequently seen in chronic cases.

4. All the **hernial apertures** should be investigated, also the **rectum and vagina**. The abdomen should be palpated to ascertain the existence of a tumour or free fluid.

CHAPTER XXXV

AFFECTIONS OF THE RECTUM AND ANUS

THE rectum is examined by the digital and visual methods. For the latter, a short tube or proctoscope and a head-light are necessary. With the electric inflating sigmoidoscope the whole of the interior of the rectum and the bowel above, as far as the middle of the sigmoid, can be carefully inspected, and this should be a routine examination in cases where there are symptoms of colicky pain, persistent diarrhœa, or alternations of diarrhœa and constipation, or the passage of mucus and blood.

Congenital Malformations.—The rectum is developed in two portions, the upper from the hinder end of the primitive gut, and the lower from an involution from the perinæum—the proctodeum. At an earlier stage the hind-gut and bladder have a common opening, the cloaca. Congenital malformations are due to absence of or stenosis of the proctodeum; absence of the rectum, or persistence of the communication with the bladder, urethra, vagina, or vulva.

1. The anus is absent, with or without the development of the rectum. The latter may open in some abnormal situation, or may end blindly low down or at the pelvic brim.

2. A septum may exist 1 inch from the anus at the junction of the two parts.

3. The anus may be present, while the intestine ends at the pelvic brim or opens elsewhere.

4. The anus may be of the pinhole variety.

Treatment must be prompt. A septum should be punctured with a tenotome, the opening being afterwards dilated with forceps and kept dilated by passing a finger daily. When there is no indication as to the position of the lower end of the rectum, from absence of bulging on crying, a median incision must be made not deeper than 2 inches. When the bowel is found, it is brought down and stitched to the skin margins of the incision after being opened. If the rectum cannot be found colotomy must be done.

Abnormal openings into the vagina, etc., will close once a proper passage for the fæces is established.

A pinhole anus must be dilated with bougies. A communication with the bladder or urethra will probably cause suppurative nephritis, but the child is too young to stand an operation to prevent this.

Inflammation of the Rectum (Proctitis) causes pain, tenesmus, and the passage of mucus, or pus, and blood. The causes may be piles, a polypus, foreign bodies, and occasionally the gonococcus.

Treatment consists of rest in bed with the bowels kept relaxed, and the use of injections of lotio plumbi.

Bilharzia Hæmatobia gives rise to polypoid growths in the rectum. The ova found in these have a lateral spinous projection. Tenesmus, diarrhœa, and the passage of blood, are caused.

Ischio-Rectal Abscess.

1. **Acute Ischio-Rectal Abscess** is due to infection of the fat of the ischio-rectal fossa with pyogenic organisms. It occasionally results from skin infection, but usually spreads from the rectum. The mucous membrane is abraded by a constipated motion, and the *Bacillus coli* then invades the wall and spreads to the fossa. A fish-bone or pin occasionally causes the wound in the rectum. An abscess forms alongside the rectum, and may burst into the rectum, on the surface, or both, a fistula being likely to follow.

Treatment.—A free incision should be made at once,

opening up ev. ry part of the abscess, including the communication with the bowel if it can be found. Cellulitis of a gangrenous type may also occur, and must be promptly treated by free incisions and stimulants.

2. **Chronic Ischio-Rectal Abscess** is met with in phthisical patients. A caseating focus is found in the fossa, which breaks down and discharges by several sinuses, which may be at a distance from the anus.

. *Treatment* consists of a free incision, scraping out the tuberculous area, and applying pure carbolic acid.

3. **Suppuration in the Ischio-Rectal Fossa** may come from a distance, as in disease of the sacro-iliac or hip joints, caries of the spine or pelvis, abscess, or stone in the prostate.

Anal Abscess occurs under the anal integument, and must be freely opened.

Fistula-in-Ano.

Causes.—Usually a fistula results from an ischio-rectal abscess, but it may come from just above a stricture of the rectum.

Varieties.—The **Complete Fistula**, which opens both externally and into the bowel. When following an anal abscess the track lies under the skin ; when following an ischio-rectal abscess the inner opening is within an inch of the lower end of the bowel, and there are usually tracks burrowing in various directions from it into the perinæum, buttock, or in a horseshoe form to the other side.

2. The **Blind Internal Fistula** has an opening into the rectum only. The symptoms are attacks of pain, increased on defæcation, and followed by the passage of pus in the motions, with relief from the pain. The orifice may be felt as a small dimple, or seen with a rectal speculum.

3. The **Blind External Fistula** is one in which there is said to be no communication with the bowel. This is only because the opening which is always present has not been found.

There is no tendency for a fistula to heal, owing to the constant movement of the external sphincter, hence this

muscle must always be divided. In the late stage of phthisis a patient is better left alone.

Operation.—The bowels should be emptied by a purgative and enemata. A probe-pointed director is passed along the fistula into the rectum and out through the anus, and the intervening structures are cut. All secondary tracks are completely opened up; the wound is packed with gauze and allowed to granulate up from the bottom, so that a sinus does not re-form. A morphia suppository should be left in the rectum to prevent action of the bowels. If the fistula opens so high that both sphincters must be divided, incontinence will follow unless the fistula is completely excised, and the edges of the wound are stitched so as to get primary union.

A Fissure of the Anus is a small crack through the mucous membrane, usually at the posterior part, and its position is indicated often by an external pile. It is caused by a constipated motion tearing down either one of the little valves between the columns of Morgagni or an internal pile. In time the motions cause the tear to extend till it reaches the margin of the anus.

The *Symptoms* consist chiefly in severe pain, which comes on with defæcation and lasts several hours. The pain may be so severe that patients refrain from defæcation for many days. The fæces may be streaked with blood.

Treatment.—The base of the fissure must be divided, including the external sphincter; the wound then heals by granulation. The bowels must be kept relaxed. Paralyzing the sphincter by stretching often brings about a cure. Palliative treatment consists in giving confectio sennæ and applying ung. hydrarg. nit. dil.

Fibrous Stricture of the Rectum.

Stenosis of the rectum is the most important result of chronic inflammation, whether the cause is chronic dysenteric, syphilitic or tuberculous ulceration. The rectum may be compressed by bands due to pelvic cellulitis. A stricture may result from operations involving the whole circumference of the rectum. A fistula may

be associated, the inner opening being just above the stricture.

Symptoms.—Constipation, alternating with a spurious diarrhœa due to enteritis, is the early symptom. The motions become flattened or pipe-stem-like. Some pain and the passage of mucus are usually present.

The patient may die from complete obstruction, or septic absorption from ulceration above the stricture causing fistula and burrowing abscesses.

A simple stricture is bandlike, fibrous, and without the definite induration of carcinoma. The long history is also of great importance. Syphilitic proctitis leads to the conversion of the rectum into a long, narrow, tortuous, and rigid canal. When the stricture is high, the gut below may be ballooned, partly from paralysis of its wall and partly from invagination of the mass above.

Treatment.—In the early stages the motions must be kept soft by giving castor-oil, and the stricture must be dilated with bougies. If the stricture is low down, treatment may be begun by notching it in several places. Bougies must be passed at intervals for a long time to prevent recurrence.

Colotomy may be necessary in cases where the whole wall is rigid, to relieve obstruction; or as a temporary measure in other cases, to allow ulcers above the stricture to heal.

Syphilitic Disease of the Rectum and Anus.

1. A primary sore may occur at the anus.

2. Mucous tubercles or condylomata are common secondary manifestations, and should be dusted with calomel and boric acid.

3. Tertiary diffuse syphilitic disease of the rectum occurs commonly in young women. It begins as a gummatous infiltration of the mucous membrane and submucous tissue, ulceration following. Part or the whole of the rectum may be involved, and even the genitals and anus may be an infiltrated mass riddled with fistulæ. The cicatrization resulting from this condition causes syphilitic stricture.

Treatment.—Mercury and iodide of potassium combined with dilatation by bougies will cure the early cases,

but where there is much contraction and ulceration a temporary, or even permanent, colotomy is necessary.

Tumours of the Rectum.

Polypus. — An adenoma occurs most frequently in children. It forms a round, red, mobile swelling with a long pedicle. The symptoms are the passage of blood and mucus without signs of obstruction. Prolapse of the rectum or of the polypus may occur. Treatment: The pedicle should be tied or divided with the cautery, and the polypus removed.

Papilloma is rare, and causes hæmorrhage and a watery discharge. Treatment consists in removal by ligature or a wire snare.

Sarcoma is rare, and grows from the submucous tissue as a large fleshy tumour projecting into the rectum. Treatment consists in extirpation.

Epithelioma of the Anus is of the squamous type. It should be treated by excision, including the inguinal glands.

Cancer of the Rectum appears as a columnar epithelioma, which forms a nodular, ulcerated outgrowth, as well as infiltrating the muscles. The mass gradually encircles the bowel, and in time blocks up the lumen. The infiltration extends to the sacrum, uterus, bladder, and vagina; and the iliac vessels and sacral nerves may be pressed upon. Secondary growths appear in the lumbar and mesorectal glands and liver. If the anus is involved, the inguinal glands may also be enlarged.

The *Symptoms* are so slight at first that the disease may be advanced before it is discovered. Attacks of constipation, alternating with diarrhœa and the passage of mucus, are the early signs. The rectum seems to the patient not to be emptied by defæcation, and this may end in tenesmus and constant pain. The motions may become flattened or pipe-stem-like, and streaked with blood. An ulcerated nodular growth may be felt, limited to one segment or surrounding the bowel. Micturition is painful if the bladder is infiltrated, and a rectovesical fistula may form and cause death from suppurative nephritis.

The cases run a rapid course, some dying from obstruction, some from exhaustion, while others die from suppurative nephritis, or peritonitis from perforation of ulcers above the stricture.

Treatment consists either in excision of the rectum or colotomy.

Excision of the Rectum can be done from the perinæum, through the sacrum or vagina, from the abdomen, and by a combination of the abdominal and perinæal methods. The height of the growth, therefore, does not matter, the important question being whether it is freely movable. Loss of mobility is due to infiltration of surrounding structures, and contra-indicates excision. Secondary growths in the lumbar glands or liver, and marked debility, also contra-indicate excision.

A preliminary colotomy has the advantages of enabling the lumbar glands and growth to be felt from above, of preventing fæces pouring over the wound, and of being more convenient than a sacral anus. Its disadvantages are that it increases the number of operations, and fixes the bowel somewhat, and so hinders manipulation during excision.

1. **The Perinæal Operation.** — The rectum is thoroughly emptied, and the patient is placed in the lithotomy position. An incision is made all round the anus beyond the growth and backwards to the tip of the coccyx, and the separation is carried up around the rectum by scissors. The bowel is divided above the growth, bleeding-points are ligatured, and the wound is packed with gauze. The mucous membrane and skin margin become approximated in time. If only one side is affected, partial excision is done. The perinæal method should only be adopted for growths at or in the immediate proximity of the anal orifice.

2. **Excision by the Sacral Route (Kraske's Operation).**—With the patient lying on the right side, a median incision is made from the anus to the middle of the sacrum. The coccyx is excised. The ligaments and muscles are detached from the sides of the sacrum as high as a point just below the third sacral foramina, at which point the sacrum is sawn across and the lower piece removed. The rectum is exposed, and cut through

above and below the growth. The peritoneum may have to be opened to get above the tumour. If the sphincter and anus are unaffected, they are left, and the bowel is brought down, and an end-to-end anastomosis is made. If the whole rectum has to be removed, the upper end is either brought down and stitched to the skin around the original anus, or, if this is not possible, an anus is made just below the divided sacrum. During the operation the sacral glands must be searched for and removed if enlarged. Incontinence usually remains, and is less easy to manage with a truss than is a colotomy.

3. **The Abdominal Route.**—It is only rarely that an end-to-end anastomosis can be effected after excision of a high rectal growth through the abdomen ; but by—

4. **The Combined Abdominal and Perinæal Operation,** the mesosigmoid and mesorectum can be divided, the sacral glands removed, and the peritoneal reflections freed from the abdomen, which is then closed, and the operation continued from the perinæum. The freed rectum can now be drawn down unopened, excised, and the upper end stitched to the anal margin.

Colotomy should be done for obstruction at the earliest possible moment. It should also be done in the absence of early signs of obstruction if there is much pain on defæcation. If colotomy is refused, the diet must be fluid, so that there are little fæcal remains. Morphia is necessary for the pain.

Hæmorrhoids.

By **Piles** is meant a varicose condition of the veins surrounding the anus and lower inch or two of the rectum.

Causes — Predisposing.—The hæmorrhoidal veins are very little supported, have no valves, and are at the lowest part of the portal circulation, hence they become dilated during any portal congestion.

Exciting. — Constipation, by producing prolonged straining at stool, leads to varicosity, and even phlebitis. Pregnancy, pelvic and abdominal tumours, stricture of the rectum, cirrhosis of the liver, may cause piles by obstructing the venous return.

The veins may be varicose and cause no symptoms till an attack of thrombosis is induced by exposure to cold, alcoholic excess, the use of strong purgatives, or congestion of the liver.

Piles are either external, internal, or both.

External Piles are situated below the external sphincter and covered with skin, **Internal Piles** above it and covered with mucous membrane. External piles appear as folds of skin radiating from the anus, each containing a central varicose vein. They cause no symptoms unless inflamed, when the pile becomes distended with blood-clot. The inflammation subsides in a few days, leaving the pile larger and firmer than before.

The *Treatment* of external piles when uninflamed consists in preventing constipation, keeping the parts clean, and applying hamamelis ointment. They seldom need removal, except when associated with internal piles. Inflamed piles should be treated by rest, a large warm enema, and fomentations. If there is much pain, the pile should be incised and the blood-clot turned out.

Internal Piles are at first soft, but if existing long become harder. The mucous membrane covering them is deep red and thickened, and the piles may protrude during defæcation. There may be discharge of mucus and blood with the motions. The mucous membrane is smooth and shiny in the piles which do not bleed readily, roughened and granular from dilated capillaries in those that bleed.

The *Symptoms* consist of a feeling of fulness and bleeding, which if persistent leads to anæmia. The piles may become prolapsed, and even strangulated by the sphincter. The bleeding is beneficial in some cases of cirrhosis of the liver and heart disease.

Complications.—**Phlebitis** in a pile, known as 'an attack of piles,' causes it to become blue, swollen, and tender. The attack may subside and lead to natural cure, or suppuration may come on, and perhaps cause pyæmia. **Strangulation** may follow prolapse, and lead to sloughing, with the danger of pyæmia. **Prolapse** may become chronic, and **fissure of the anus** may be associated.

Treatment—General.—Constipation must be prevented by taking confectio sennæ daily, and avoiding excess in eating or drinking.

Local.—In the early stages the parts should be washed gently and regularly with cotton wool, and hamamelis ointment applied.

Radical Treatment is advisable when there is much pain and bleeding. It must be ascertained first that the piles are not due to disease elsewhere, as cirrhosis or stricture, or to pregnancy. The bowels are emptied, and the patient is placed in the lithotomy position. The sphincter is then dilated with two thumbs, to expose the piles, which are caught up with ring forceps. A clamp is applied to the piles in turn, and they are removed by the cautery. The bowels are kept confined for five or six days, when castor-oil is given. Very little pain and no bleeding follow this operation. Removal can be done by snipping the mucous membrane around the pile and ligaturing its base. Crushing is also done.

Whitehead's Operation consists in excising the pile-bearing area, and stitching the divided mucous membrane to the margin of the anus.

Rectal Prolapse.

The **Incomplete** form consists in protrusion of the mucous membrane only; the **Complete** form in protrusion of the muscular coats also.

Causes.—Feebleness of the sphincter, combined with straining from chronic constipation, diarrhœa, worms, stone in the bladder, stricture, and enlarged prostate, produces prolapse.

Symptoms.—There is frequent desire to defæcate, and some protrusion, which may return spontaneously or may have to be reduced. There are no projecting masses, as are seen in prolapsed piles. When the whole thickness is protruded, the peritoneal pouch in front of the rectum may also come down, and small intestine may accompany it and become strangulated. The prolapsed portion may become strangulated and slough, exposing the patient to the risk of peritonitis. In an intussusception, the only condition which can be mistaken for a prolapse, the finger can be inserted between the anal mucous membrane and the intussusception.

Treatment.—In the early stages removal of the cause

will bring about a cure. In children the prolapse must be reduced, and retained by strapping the nates together and applying a pad and T bandage.

When palliative measures fail, *Operative Treatment* is called for. In slight cases cicatricial narrowing is obtained by snipping away or cauterizing longitudinal strips of the lower inch of the rectum. Failing this, the prolapse must be excised, remembering that the peritoneal cavity may be opened and that small intestine may be prolapsed as well.

In children palliative treatment is sufficient, but in adults operative treatment is often necessary.

If prolapse still recurs, the abdomen must be opened, and the mesosigmoid anchored by sutures to the abdominal wall (colopexy).

CHAPTER XXXVI

SURGICAL AFFECTIONS OF THE KIDNEYS

If disease of one kidney is suspected, either from the presence of enlargement or from the fact of the urine containing pus or blood, it is important to make sure that there are two kidneys, and, if so, the functional value of each. The same examination will reveal which kidney is at fault if there are no other determining factors. *Luys' segregator* is passed into the empty bladder after a thorough irrigation. The indiarubber septum is then screwed up so as to divide the bladder into two compartments, each of which receives the efflux from a ureter. Each lateral catheter empties this into its own test-tube, and the contents are examined and compared as to the presence of pathological products and percentage of urea.

The same result can be obtained by catheterizing each ureter, but it requires much more skill, and infection may be carried from the bladder into the ureter.

A cystoscopic examination may throw some light upon which kidney is diseased and the nature of such disease; for instance, there may be a few tubercles around the ureteric orifice when the corresponding kidney is tuber-

culous, and, still more, the orifice may be drawn up and 'funnelled' from infiltration and shortening of the ureter. Again, it has been found that a hydronephrosis was solely dependent upon a villous papilloma at the ureteric orifice in the bladder. In cases of hæmaturia of obscure origin blood may be seen flowing from one ureter.

Congenital Malformations are—(1) Absence of one kidney; (2) horseshoe kidney; (3) lobulated kidney; (4) double ureter and pelvis; (5) multiple renal arteries.

Congenital Displacement occurs occasionally, the kidney lying over the sacro-iliac synchondrosis.

Congenital sarcoma, cystic disease, and hydronephrosis also occur.

Floating and Movable Kidney.—A true **Floating Kidney** attached to the abdominal wall by a mesonephron is very rare.

A **Movable Kidney** is an acquired condition in which the kidney moves freely in the perinephric fat. It is most common in women, and on the right side.

Causes. — It often follows parturition owing to the violent efforts and the subsequent laxity of the abdominal walls. It may also follow rapid emaciation or injury. Many cases are associated with enteroptosis (Glénard's disease).

The *Symptoms* may be entirely absent in some cases. They consist of aching pain in the loin, nausea, vomiting, and constipation. Attacks of renal colic and intermittent hydronephrosis may occur from kinking of the ureter. A movable tumour can be felt in the region of the kidney.

Treatment consists in improving the general health, abdominal massage, and wearing an abdominal belt with a pad. When this fails, or there are attacks of colic or hydronephrosis, nephrorraphy should be done.

Injuries of the Kidney are due to crushes, blows, and stabs. Hæmorrhage into the kidney, its pelvis, and the perinephric tissues, follows. The peritoneum over the anterior surface may be torn, intraperitoneal hæmorrhage following. Rupture of the posterior surface causes infiltration of the retroperitoneal tissues with urine and blood, and subsequent suppuration.

The *Symptoms* consist in severe shock, pain in the loins, and hæmaturia. The passage of clots down the

ureter may give rise to renal colic, or may obstruct the duct and bring about suppression on that side. A swelling may form in the loin from bleeding into the perinephric tissues. Intraperitoneal bleeding is indicated by signs of free fluid, a rapid pulse, and restlessness.

Treatment.—In many cases absolute rest alone is necessary. The side should be fixed by strapping, and an ice-bag applied over the kidney. When the signs of bleeding are excessive, it is necessary to expose the kidney and suture the rupture, or excise the kidney. This is done from behind, unless fluid is present in the abdominal cavity, when an opening is made from the front. Peritonitis or a perinephric abscess need similar treatment.

Rupture of the Ureter is rare. Extravasation of urine occurs and causes a perinephric abscess. After this has been incised, a urinary fistula is left, which may close after a time. If it persists, nephrectomy must be done. In a few cases the ureter may be repaired.

Hydronephrosis.—The pelvis and calyces are distended with urine owing to some obstruction.

Causes.—**Congenital stenosis** at the junction of the ureter and pelvis may cause unilateral hydronephrosis; a congenital impervious condition of the urethra causes bilateral hydronephrosis. **Acquired** forms are due to (1) blockage of the urinary passages by stones, parasites, stricture; (2) kinking of the ureter due to a movable kidney; (3) pressure of tumours or cicatrices on the ureter; (4) a villous papilloma at the ureteric orifice.

A sudden and absolute block leads to suppression of urine. Hydronephrosis results from intermittent or incomplete obstruction, whether the urethra or the ureter is affected.

Pathology.—The pelvis and calyces become dilated, and later the cortex and pyramids become thinned and expanded. Interstitial inflammation accompanies this, and at first the urine is abundant and of low specific gravity. In the later stages the secreting substance is entirely atrophied. At any stage septic processes may convert the condition into pyonephrosis.

The *Symptoms* may be entirely absent, only a painless enlargement of the kidney being noticed. If both are affected, there is at first an abundance of low specific

gravity urine, which later becomes scanty, uræmia following. If one kidney only is affected, the urine remains normal. Pain, vomiting, and increased frequency of micturition, may be present. The size of the tumour varies from time to time, diminution being accompanied by an increased flow of urine. Sepsis may produce pyonephrosis at any time.

Treatment.—The cause should be removed, if possible. Unilateral hydronephrosis usually needs an exploratory incision, and if the block cannot be removed nephrectomy is necessary.

Inflammation of the Kidney and its Surroundings.

1. **Pyelitis**, or inflammation of the pelvis, is due to—(1) calculi; (2) tuberculous disease; (3) extension of sepsis from the bladder and urethra; (4) sometimes movable kidney; (5) the ingestion of cantharides or turpentine; (6) a pyæmic embolus.

The lining membrane is red and swollen, and exudes muco-pus or pus. A certain amount of hydronephrosis occurs from the blockage produced by the swelling. When pyogenic organisms are present, the kidney substance may be invaded (pyelonephritis). Perinephric suppuration may follow from extension.

The *Symptoms* are pain and tenderness over the kidney, frequency of micturition, and pus in *acid* urine, unless there is cystitis as well, when the urine is alkaline. The pyuria is intermittent when the ureter is occasionally blocked.

Treatment.—The cause is removed if possible. When pyelitis is due to extension from the bladder, the latter must be attended to.

2. **Pyelonephritis**, or suppurative inflammation of the kidney substance as well as of the pelvis, is more common, and is usually due to extension of sepsis from the bladder in cases of stricture, stone, enlarged prostate, new growths, and spinal injuries. It may be due to calculus in the kidney or ureter, or stricture of the ureter. Organisms spread upwards along the mucous membrane or lymphatics of the ureter, or along strings of mucus, and cause pyelitis. The bacteria further invade the lymphatics

around the renal tubules and give rise to abscesses. Acute inflammation causes death from uræmia, but if the process is chronic pyonephrosis is the result.

Symptoms.—In **acute** cases a rigor follows an operation on the urinary passages, associated with fever and vomiting. The patient gets into a typhoid condition, and dies in two or three weeks from uræmia. In **chronic** cases the onset is insidious. There is some pain in the loin and an irregular intermittent temperature. The urine is alkaline and contains pus and casts. The case terminates in death from toxæmia.

Treatment.—The cause must be attended to and the bladder regularly washed out, while a large quantity of fluids should be drunk. Hot fomentations and cupping over the loins relieve the pain, and urotropin is the best internal antiseptic.

3. **Pyonephrosis** —The pelvis becomes distended with pus from pyelitis, pyelonephritis, or hydronephrosis, especially when due to renal calculus, tuberculous disease, or vesical affections.

Symptoms.—The kidney is enlarged and tender. The temperature is raised at night, and the patient wastes. The urine is scanty, and pyuria is either constant or intermittent. If both kidneys are affected, death occurs from uræmia or pyæmia.

Treatment.—When both kidneys are involved, from some urethral or prostatic affection, no operation on the kidneys is feasible. If unilateral, nephrotomy must be done and the cause removed if possible. Failing this, the cavity is drained or the kidney excised.

4. **Abscess in the Kidney** occurs in pyelonephritis and pyæmia. Symptoms are produced when the abscess is large enough to be felt.

Treatment consists in nephrotomy and drainage, or nephrectomy if the kidney is much destroyed. Chronic abscess is usually tuberculous in nature.

5. **Perinephric Suppuration** is caused by invasion of the surrounding tissues by organisms from the pelvis or substance of the kidney, either from ulceration or without a breach of the surface. Suppuration may also spread to the region of the kidney from the appendix, intestine, pleura, ribs, or spine.

Symptoms.—An indurated painful swelling occurs in the region of the kidney. The temperature is raised, and there may be rigors. The abscess may point on the surface or burst into the intestine or pleural cavity, but rarely into the peritoneal.

Treatment consists in evacuating the pus by a free incision and dealing with the cause.

Tuberculous Disease of the Kidney occurs in three forms: 1. As part of general tuberculosis, and giving rise to no special symptoms. 2. It may extend upwards from tuberculous disease of the bladder and affect both kidneys. The mucous membrane of the ureters, pelvis, and calyces, and finally the kidney itself, become converted into tuberculous granulation tissue. The kidneys become enlarged owing to hydronephrosis or pyonephrosis, and a perinephric abscess may follow. Death occurs from chronic toxæmia or uræmia. Treatment is of little use. 3. **Primary tuberculosis** of the kidney is unilateral. A focus of tubercle begins in the cortex, caseates, and spreads to the pelvis, infecting it. Pyonephrosis follows, and infection of the bladder may succeed it. Perinephric suppuration may also occur.

The *Symptoms* at first consist of aching pain in the loin and frequent micturition, not improved by rest. Hæmaturia comes on early and without apparent cause, is not increased by movement or improved by rest. Pus is usually present in acid urine, and the *Bacillus tuberculosis* may in some cases be detected. In the late stages the kidneys may be felt much enlarged.

The *Diagnosis* is doubtful in the early stages, unless bacilli can be demonstrated by the microscope or inoculation of a guinea-pig. The hæmaturia is much slighter than in cases of renal calculus, and is not influenced by rest. The hæmorrhage is not so profuse as in cases of new growth. Slight attacks of renal colic may occur from the passage of caseous matter, but not severe attacks like those due to calculus. If the ureter is involved it may be felt as a thick cord on rectal or vaginal examination. As mentioned previously, an expert cystoscopic examination may be of great value. An exploratory incision settles the diagnosis in doubtful cases.

Treatment.—If on exposure of the kidney a limited portion is found to be diseased, a wedge-shaped portion is excised. If, as is more usual, the kidney is extensively affected, two methods may be adopted: 1. If the other kidney is healthy, nephrectomy with removal of as much of the ureter as possible is done. 2. Nephrotomy, followed by drainage, is done when the patient's condition is too bad to stand the bigger operation, or when the other kidney is also affected.

Renal Calculus.—Renal calculi are formed in the renal tubules, and may find their way into the pelvis, ureter, or bladder. They may lodge and increase in size in the substance of the kidney or calyces. Though usually small in size, a calculus may occupy the whole pelvis, with branches running into the calyces. The commonest stones are formed of uric acid, next being those of oxalate of lime, then urates, phosphates, and cystine.

A stone lodged in the parenchyma may give rise to no symptoms. Pyelitis soon follows lodgment in the pelvis, and the ureter may be blocked more or less, so causing hydronephrosis or pyonephrosis. Complete blockage produces suppression. Perinephric suppuration and discharge of the calculus through a fistula in the loin may occur. The calculus may pass into the ureter, causing renal colic. It then either slips back into the pelvis or reaches the bladder, where it may remain as a vesical calculus or be passed *per urethram*.

The *Symptoms* consist of pain in the loin, markedly increased by exercise, especially on jolting. The pain may be referred to the thigh, groin, or testicle. The colic is associated with hæmaturia, and often pyuria exists with frequency of micturition. The kidney may be enlarged, and tender on pressure. A large stone may exist without any symptoms whatever.

Renal Colic.—The most typical symptom consists in a sudden attack of excruciating and paroxysmal pain shooting down the loin to the bladder and testis. The attack is accompanied by vomiting, faintness, and collapse. Frequent efforts to pass urine are made, but only a scanty amount of blood-stained urine is passed (strangury). The pain ceases suddenly when the calculus slips back into the pelvis or reaches the bladder.

Impaction in the Ureter may occur in any part of its course, but the upper and lower ends, and the brim of the pelvis, are common sites. Pain and hæmaturia persisting after an attack of renal colic suggest impaction, and a skiagram may show a shadow in the course of the ureter. The kidney above may undergo marked changes, which destroy its functional value, or the stone may cause an abscess around the ureter and be discharged in that way.

Calculous Anuria is the term applied to suppression of urine from blockage by stone in the ureter of both kidneys, or of a solitary effective kidney. It usually begins with some pain, and at first a few ounces of urine are passed. The patient dies of uræmia, though no symptoms of poisoning appear for seven or eight days. Vomiting, a slow, full pulse, and contracted pupils, going on to convulsions and coma, are the signs of uræmia.

The *Diagnosis* is often difficult. The colic has to be diagnosed from biliary colic and the pain of appendicitis by the associated symptoms. From renal tuberculosis it is distinguished with difficulty. X rays have improved so much in technique that it can almost be relied upon that if no shadow is shown there is no stone, given that the patient is not too fat, the colon is empty, and the skiagram is a good one.

Treatment—Palliative.—The patient's diet must be regulated so that there is no excess; plenty of fluid should be taken as well as proper exercise. Alkaline purgatives and urotropin should be ordered. Sometimes under this treatment a small stone becomes encysted, but it is unlikely that a stone once formed will be dissolved. Renal colic is treated by hot baths, ½ grain of morphia, or chloroform, to relieve the pain.

Operative Treatment is adopted if the above means fail, if a perinephric abscess forms, or a stone is impacted in the ureter. Nephrolithotomy is the ideal operation, but if the kidney is converted into a mere abscess cavity nephrectomy is necessary. Mr. A. D. Reid has introduced an ingenious tube, with an X-ray screen at one end, which is sterilizable. By this means the kidney can be searched directly when it is on the loin during the operation, and tiny stones which might otherwise be

missed are easily seen. This is very important, as a second operation upon a kidney which has already been the subject of incision for stone is by no means as easy as a primary operation. Nephrectomy should not be done if it is suspected that the other kidney is also affected.

In calculous anuria the only means of saving life is an exploration of the kidney, pelvis, or ureter, the latter being followed to its lower end by prolonging the incision and pushing forward the peritoneum. The lower end of the female ureter can only be got at *per vaginam*. An impacted stone is removed through an incision in the ureter, which is subsequently stitched up.

Tumours of the Kidney.

General Characters.—A swelling, retaining roughly the shape of the kidney, is felt in the loin, over which the percussion note is dull, though there is a band of colon resonance over the front of it, unless the tumour is very big. The tumour moves with respiration, and there is no pedicle going down to the pelvis.

Innocent Tumours.—1. **Cystic Disease** is either congenital or acquired, and usually bilateral, though one side is more advanced than the other. The cysts are lined with epithelium and filled with fluid containing urea. The cysts may be numerous and the tumour of great size. The symptoms are those of interstitial nephritis, and death is due to uræmia. The cause is unknown. As both kidneys are affected, an operation is useless.

2. **Papilloma** of the pelvis is a rare condition causing profuse hæmaturia, and is only diagnosed by an exploratory operation.

3. **Adenomata** resembling the structure of the **adrenals** may grow in the substance of the kidney and necessitate nephrectomy.

Malignant Tumours.—1. The **Sarcomata of Infants**, which are congenital or come on in infancy. Round or spindle cells or striated cells (myosarcoma) are found. Dissemination soon occurs. Treatment is unsatisfactory, but nephrectomy is worth trying if only one kidney is affected and the case is seen early.

2. The **Sarcomata of Adults** are spindle-celled, and cause a rapidly-growing swelling, associated with profuse hæmaturia and pain. Nephrectomy is seldom satisfactory in preventing dissemination.

3. **Carcinoma** is uncommon, and resembles sarcoma in symptoms.

Hydatid Cysts may grow in the kidney. No symptoms are caused till a large tumour appears, unless the cyst has burst into the pelvis and daughter-cysts have been passed. The kidney should be exposed and the cyst opened. The hydatid cyst and its contents are removed, and the kidney is then stitched up, unless the cyst is a suppurating one, in which case it should be drained.

Dermoid Cysts may occur. **Serous Cysts** may arise from obstruction of tubules, and seldom cause symptoms, unless large. They are best treated by excision, though incision and drainage are also practised.

Operations on the Kidney.

The three chief incisions to expose the kidney are the lumbar, abdominal, and lumbo-abdominal.

The **Lumbar Incision** commences at the outer border of the erector spinæ, ½ inch below the last rib, and runs downwards and forwards for 4 or 5 inches in the direction of the anterior superior iliac spine. The posterior attachment of the abdominal muscles and transversalis fascia are divided, and the perinephric tissue is then torn through till the kidney is exposed.

The **Abdominal Incision** opens the peritoneal cavity through the linea semilunaris. The colon is displaced inwards, and the kidney is exposed by dividing the peritoneum over it.

The **Lumbo-Abdominal Incision** extends vertically from the tip of the last rib to the iliac crest. The peritoneum is pushed forward till the kidney is exposed. The lumbar incision is that most used, unless a tumour is very big, when the abdominal is chosen.

1. **Nephrotomy** consists in incising the kidney for exploration or removal of some abnormal condition. The lumbar incision is made, and the kidney is drawn up into the wound and examined. It may be then explored

with a round needle for stone. If there is still doubt, an incision must be made through the cortex into the pelvis. The pelvis and calyces are then carefully examined for stone by the finger and probe. The ureter can be examined by introducing a probe through a hole made in the pelvis. A stone or papilloma should be removed. If the operation has been for suppuration, the cavity is then drained by a large rubber tube. If for stone, the wound in the cortex is stitched up, unless there has been severe suppuration.

2. **Nephrectomy** is done for—(1) extensive tuberculous disease ; (2) calculous pyonephrosis ; (3) hydronephrosis when other measures have failed ; (4) bad cases of ruptured kidney ; (5) some cases of ruptured ureter.

Before excising a kidney, it must be ascertained that there is another and an efficient kidney. By means of an exploratory laparotomy it can be determined that there is another kidney, and a rough estimate made of its value. By the cystoscope gushes of urine from each ureter prove the presence of two kidneys, and with the segregator a specimen may be obtained from each.

The lumbar method is used when the tumour is not too big, and where pus is present in the swelling. Whichever method is adopted, the organ is freed from the surrounding tissues, taking especial care on the right side not to tear the inferior vena cava. The renal vessels and ureter in the pedicle are then tied separately and divided, and the kidney is removed. When the ureter itself is suppurating it must be stitched in the lower angle of the wound. The cavity should be drained from behind when the lumbar incision has been made ; through the loin by a separate drainage-hole when the abdominal route has been used.

3. **Nephrorrhaphy** is done to fix a movable kidney. The kidney is exposed by the lumbar incision, and two or three silk stitches are passed through the substance of the kidney and then through the divided muscles above and below the wound. When tied they fix the kidney. Another method is to strip off the capsule of the kidney over a large area by a crucial incision, and stitch the four flaps of capsule to the abdominal wall.

CHAPTER XXXVII

AFFECTIONS OF THE BLADDER AND PROSTATE

Congenital Abnormalities.

Ectopia Vesicæ, or Extroversion of the Bladder.—The anterior wall of the bladder and the abdominal wall in front of it are absent, so that the posterior mucous membrane protrudes and the ureters are seen emitting urine by intermittent gushes. There is a wide separation of the pubic bones, and the penis is cleft along the dorsum (epispadias) and drawn upwards over the trigone. The testes are imperfectly descended, and congenital hernia is not uncommon. The urine is always ammoniacal, and the skin around may ulcerate and become covered with phosphates. Death often occurs from sepsis spreading up the ureter.

The condition is caused by imperfect development of the anterior wall of the allantois and lower part of the anterior abdominal wall. At birth the lower part of the umbilical cord is spread over the raw surface, the posterior vesical wall being exposed when it separates. The umbilical cicatrix is always absent.

Treatment.—The wearing of a urinal is unsatisfactory. Plastic operations: A flap of skin is turned down and stitched to the margins of the mucous membrane, to form an anterior wall. The raw surface of this flap is covered by sliding the skin from either side. Other flap methods are also used.

Trendelenburg's operation consists in dividing the posterior sacro-iliac ligaments, and pushing the innominate bones forwards till the pubic bones meet. This causes the bladder to recede and lie in a deep furrow, so that its edges can then be pared and stitched anteriorly. The epispadias is subsequently cured, but, as there is no sphincter, incontinence persists.

Transplantation of the ureters to the rectum usually ends in sepsis, spreading to the kidney; though this is said not to happen, in more recently reported cases, where the ureteric orifice has been transplanted as well.

An **Umbilical Urinary Fistula** results from imperfect closure of the urachus.

Traumatic Affections of the Bladder.

Rupture of the Bladder is caused—(1) by a blow on the abdomen when the bladder is full ; (2) as a complication of fracture of the pelvis ; (3) by a penetrating wound ; (4) from overdistension, especially if the wall is ulcerated.

Intraperitoneal Rupture involves the superior or posterior surface. The symptoms consist of shock and local pain. There is constant desire to micturate, nothing being passed except, perhaps, a little blood. Fatal peritonitis follows unless early treatment be adopted. A little blood-stained urine is usually withdrawn by passing a metal catheter, and the rent may be felt. A measured quantity of boracic lotion should be injected ; if a rupture exists, the amount returned is considerably less than that injected.

Treatment consists in immediate laparotomy, sponging out the fluid, and suturing the rent with a double row of stitches, through the serous and muscular coats, but avoiding the mucous coat. Trendelenburg's position is useful after the fluid has been removed. A catheter is tied in for the first three days, or the urine is drawn off at frequent intervals by catheter.

Extraperitoneal Rupture involves the anterior wall or base. The urine infiltrates the pelvic cellular tissues, and, if there has been previous cystitis, sets up severe and often fatal septic cellulitis. Abscesses point over the pelvic brim and in the perinæum. Free incisions are necessary. If the urine is healthy, the prognosis is better.

Methods of examining the Bladder.

The history, symptoms, and character of the urine are considered. Inspection, palpation, and percussion, come next. Instrumental examination : The patient passes his water, after which a catheter is introduced, and the residual urine measured. A sound is then passed, and a stone, tumour, or roughness of the wall felt for. A finger inserted into the rectum or vagina before the sound is withdrawn enables one to examine the base of the bladder, prostate, and vesiculæ seminales. Bigelow's evacuator sometimes displays the presence of a small

stone by the click which is given. By the cystoscope the inside of the bladder can be looked at. The patient must be anæsthetized, the bladder washed out, and 6 ounces of boracic lotion introduced. The instrument must be lubricated with glycerine, not oil.

A suprapubic cystotomy is the final resort.

Cystitis.

All forms of true cystitis are due to bacterial infection, of which the *Bacillus coli* and *staphylococci* are the commonest. The organisms are introduced on instruments, travel along the mucous membrane of the urethra, as in gonorrhœa, or grow along mucus lying in the urethra, or travel downwards from the kidney.

Acute Cystitis is due to—(1) gonorrhœa spreading to the bladder ; (2) the presence of foreign bodies or after operations ; (3) the introduction of sepsis on instruments or mucus, as in paralysis of the bladder from spinal injuries. Cantharides and cold in gouty subjects are said to produce cystitis.

Symptoms.—(1) Pain and tenderness over the hypogastrium ; (2) frequent and painful micturition, only small amounts being passed (strangury) ; (3) pyuria. The temperature is raised, and there is tenesmus. The case usually terminates by resolution, though irritability of the bladder may remain. Sepsis may spread to the kidney, and cause fatal toxæmia. In some cases retention, distension, and atony occur if the neck of the bladder is chiefly affected. The wall of the bladder may slough in very severe cases.

Treatment.—The patient must be kept in bed with hot fomentations over the hypogastrium. A fluid diet, with plenty of barley-water, must be given. Alkalies and hyoscyamus, with morphia suppositories, relieve the pain. Urotropin (gr. x. t.d.s.) is the best internal antiseptic. If the urine is very foul, the bladder may be washed out. In sloughing cystitis median perinæal drainage is necessary, but these cases are usually fatal.

Chronic Cystitis is due to the entry of organisms, but there is always a predisposing cause, such as stricture of the urethra or enlarged prostate, causing retention ; cal-

culus ; tumour ; foreign body or tuberculous disease in the bladder. It may follow acute cystitis and spinal injuries.

The *Symptoms* are frequency of micturition, by night as well as by day, with some pain, and there is mucus and pus in the urine. The urine is alkaline, foul-smelling, and contains crystals of triple phosphate ; but if the cystitis is due to a pure infection with *Bacillus coli*, the reaction remains acid. There is little pain, unless a calculus or ulceration is the cause. The loss of sleep from the frequency of micturition impairs the health. The septic condition may spread and cause pyelonephritis.

Pathology.—The mucous membrane is thickened and congested, and often ulcerated. Often the results of stricture of the urethra are present, viz., hypertrophy and sacculation. Perforative ulceration is rare, and leads to peritonitis or pelvic cellulitis.

The *Diagnosis* of the cause is most important. The urethra and prostate must be carefully examined as being the common causes. Tuberculosis comes on insidiously, and bacilli may be found in the urine. Hæmaturia is also a frequent sign. Pyelitis causes no pain on micturition, though there is frequency. The cystoscope may help.

Treatment.—Remove the cause if possible. The bladder should also be washed out with boracic lotion, 1 in 2,000 perchloride or quinine (gr. ii. ad ℥i.), twice a day. The diet should be light, and alcohol avoided. Urotropin and salol are the best drugs to give. Buchu, copaiba, and sandal-wood-oil are also useful. If these measures fail, continuous drainage should be tried. If tying in a catheter fails or cannot be borne, the bladder should be opened suprapubically. This enables the surgeon to inspect the bladder and deal with any condition found. Drainage for about three weeks is usually sufficient. Perineal cystotomy is not so efficacious for exploratory purposes.

Tuberculosis of the Bladder is usually secondary to similar disease of the kidney, prostate, or testis, but rarely may be primary. It is commonest in young men, and is predisposed to by gonorrhœa. Tubercles are deposited in the mucous membrane about the trigone, and ulcerate early. The ulcers may spread to the prostate.

The *Symptoms* begin with apparently causeless and painless frequency of micturition. As the frequency increases, micturition becomes painful, and blood and pus are passed. Bacilli are found with the microscope, or demonstrated by inoculating a guinea-pig. Death results from exhaustion, extension to the kidney, phthisis, or general tuberculosis.

Treatment.—The general health must be treated by fresh air, good diet, and tonics. Irrigation with boracic lotion or weak iodoform emulsion relieves the symptoms. Morphia suppositories relieve the pain. Failing this, suprapubic drainage is necessary, and allows of local applications to the ulcers through a 'caisson' speculum. The ulcers may be scraped and painted with iodoform, or cauterized. As a rule, the best that can be hoped for in these cases is to relieve the pain and delay the course of the disease. Mr. John Pardoe has recently reported a large series of cases treated with Tuberculin R., in which the results are much more favourable than with any other method of treatment.

Simple Ulcer of the Bladder is rare, and causes great irritability and hæmaturia. It is situated near the neck or trigone, and is diagnosed with the cystoscope. If not relieved by washing out with ·5 to 3 per cent. lactic acid solution, it must be scraped and cauterized through a suprapubic incision.

Tumours of the Bladder.

Simple tumours are—(1) **Myxomatous Polypi** in children; but the common one is (2) the **Papillomatous or Villous Tumour**, seen mostly in adults. It is usually situated near the trigone, and close to the ureteral orifices. The villous processes are delicate tufts of connective tissue covered with transitional epithelium. The growth may be pedunculated or sessile. The growth is apparently locally infective, for if left the bladder becomes studded with growths.

The only *Symptom* in the early stage is hæmaturia, which lasts from a few hours to weeks. After an interval the bleeding recurs. No other symptoms occur till later, when pain and frequency of micturition, due to cystitis,

make their appearance, while interference with the outflow may arise from blockage of the neck of the bladder by the growth. Portions of the tumour may be passed. On rectal examination or with the sound, nothing abnormal can be felt. With the cystoscope the tumours may be distinctly seen. If the ureteral orifice is affected, pain may occur early and be referred to the loin. Recurrence after removal is common.

Sarcoma of the Bladder is rare and grows rapidly.

Cancer of the Bladder may be primary or spread from the rectum or uterus. Primary growths usually begin near the trigone, infiltrate the muscular wall, and ulcerate. Dissemination does not occur till late.

Symptoms.—Hæmorrhage appears later than in simple tumours, but is more persistent. Pain is a constant early symptom, accompanied by frequency of micturition, chiefly due to the quick onset of cystitis. In the harder forms of growth irritability of the bladder precedes the hæmaturia. Shreds of growth may be found in the urine. Interference with the flow of the urine is caused by involvement of the neck of the bladder, hydronephrosis by affection of the orifices of the ureters. With a sound, a tumour may be felt projecting into the bladder ; *per rectum* a hard mass may be felt in the base of the bladder ; while with the cystoscope the ulcerated surface may be seen. The vesical wall may become perforated, causing extravasation, cellulitis, or a recto-vesical fistula. Death occurs from exhaustion or spread of sepsis to the kidneys.

The **Diagnosis** of a tumour is made certain by the cystoscope or by finding shreds of growth in the urine. In the female the bladder may be explored by a finger. In simple tumours hæmorrhage precedes the irritability of the bladder, and there are long intermissions between the attacks, while the hæmaturia of malignancy is usually constant, though it may be only slight at times. A villous tumour cannot be felt, while a malignant one usually can. Cystitis occurs early in cancer.

Treatment of Tumours of the Bladder.—Removal by suprapubic cystotomy is the best treatment for villous tumours. The bladder is sponged dry, and a 'caisson' is passed, through which the growth and the mucous membrane from which it grows are cut away. Bleeding is

stopped with the cautery. The bladder should be drained for a few days. Only those malignant growths at the apex of the bladder are suitable for removal. When growths are irremovable, the bladder should be regularly washed out, and morphia given for the pain. As a palliative measure, the villous processes of a malignant growth may be shrivelled by the injection of the bladder with a 1 per cent. solution of resorcin after cocainization. This relieves the spasmodic pain for a time. Suprapubic drainage must be established if hæmorrhage and cystitis persist in spite of irrigation, but it is well to postpone it as long as possible.

Functional Derangements of the Bladder.

Incontinence, or involuntary escape of urine, may be active, passive or false.

1. **Active Incontinence** occurs in young children from increased excitability of the reflex act, or weakness of the sphincter vesicæ. When incontinence occurs only at night, the condition is nervous in origin; when there is in addition imperfect control in the day, some peripheral irritation exists, such as phimosis, worms in the rectum, adenoids, calculus, or uric acid crystals in the urine. When incontinence occurs both by day as well as night, weakness of the sphincter is the cause, and the cases are incurable.

Treatment consists in removing all sources of irritation and waking the child at regular intervals to micturate. Belladonna and urotropin are the most useful drugs.

2. **Passive Incontinence**, or dribbling of the urine from the urethra as soon as it enters the bladder, is due to—1. **Paralysis** of the sphincter vesicæ from injury or disease of the spinal cord. If the detrusor centre is damaged without injury to the sphincter centre, retention followed by overflow occurs. Overdilatation of the female urethra is followed by paralytic incontinence. These cases are incurable. 2. **Mechanical Incontinence** may result from impaction of a stone in the internal meatus.

3. **False Incontinence**, or distension with overflow, is due to 'residual' urine gradually increasing till the

bladder is distended. Then the urine dribbles away involuntarily. Stricture and enlarged prostate are the common causes.

Treatment consists in keeping the bladder regularly emptied by catheter, but atony often remains.

Atony of the Bladder is a condition in which the patient cannot empty the bladder, although there is no true paralysis of its walls.

Causes.—(1) Chronic overdistension; (2) a single prolonged voluntary or involuntary overdistension; (3) gonorrhœal cystitis sometimes; (4) old age.

Treatment consists in removing any obstruction and keeping the bladder emptied by regular catheterism. Strychnine and other tonics and electricity may improve the expulsive powers of the bladder.

Retention of Urine, or distension of the bladder, with inability to pass urine, is due to—(1) penile and urethral causes—*e.g.*, phimosis, stricture, a ligature around the penis, impacted calculus, perinæal abscess, ruptured urethra; (2) prostatic inflammation, tumour, calculus, or abscess; (3) vesical causes—*e.g.*, atony, paralysis, calculus, or tumours; (4) reflex retention after operations about the genitals and anus; (5) pressure from neighbouring organs, such as a retroverted gravid uterus; (6) hysteria. The common cause in infants is phimosis; in children, impacted calculus; in men, gonorrhœa or, commonest of all, stricture; in old men, enlarged prostate.

When the bladder is much distended great pain is felt. In cases due to stricture the urethra gives way behind the obstruction, and extravasation of urine follows. Rarely a sacculated bladder gives way and causes pelvic cellulitis. In cases due to atony or paralysis, the urine constantly dribbles away after distension has occurred.

Abnormal Conditions of the Urine.

1. **Urinary Deposits.**—**Uric acid** is found in acid urine as brown lozenge-shaped plates or whetstone crystals. **Urates** appear as a reddish sediment in acid urine if the urine is of high specific gravity. The deposit is soluble on boiling. The appearance of uric acid and urates is due to great tissue changes going on, as in fevers; or to

excessive ingestion of nitrogenous food and too little exercise; or is a temporary occurrence owing to digestive disturbance. Gouty people eliminate part of their waste nitrogen as uric acid or urates, and so are more liable to suffer from stone.

The *Treatment* of this condition (lithæmia) consists in limiting the diet so that sweets and alcohol are avoided. Outdoor exercise should be taken, and saline purgatives, with an occasional dose of blue pill.

Oxalate of lime appears in the urine of dyspeptics as 'envelope' crystals. The digestion should be treated, tonics given, and especially change of air.

Phosphates occur as—(1) triple phosphates in alkaline decomposing urine, in the form of 'coffin-lid' or 'knife-rest' crystals and feathery stars; (2) amorphous phosphate of lime in chronic cystitis or during the 'alkaline tide' a few hours after meals; (3) a mixture of the above varieties. The deposit becomes more evident on boiling, but dissolves on addition of a few drops of acetic acid. The vesical or constitutional condition must be treated.

2. **Hæmaturia.**—1. **Renal Hæmaturia** is due to acute nephritis, calculus, tumours or injury of the kidneys. Blood-casts may be found. 2. **Vesical Hæmaturia** is due to calculus, tumours, injury, cystitis, or the presence of the *Bilharzia hæmatobia.* In the last the ova cause papillomatous tumours in the bladder. 3. **Prostatic Hæmaturia** is due to congestion, calculus, ulceration, or malignant disease. 4. **Urethral Hæmaturia** is due to catheterism, laceration or gonorrhœa. The blood flows independently of micturition. 5. **Constitutional Causes** are—purpura, scurvy, hæmophilia. Hæmoglobin is present, but not corpuscles, in paroxysmal hæmoglobinuria. The spectrum and hæmin tests are the most certain, but the guaiacum-ozonic ether test is reliable for urine.

3. **Pyuria** may be renal, vesical, prostatic, or urethral, in origin. The pus is recognised microscopically and by becoming ropy on the addition of liquor potassæ.

4. **Chyluria** is due to rupture of lymphatic vessels in the vesical mucous membrane in cases affected by the *Filaria sanguinis hominis.* The urine is milky from the presence of fat-emulsion.

5. **Albuminuria** is such an important condition that, before operation, the urine should always be tested for it.

Tests.—1. A deposit not soluble in acetic acid forms on boiling. 2. A precipitate is formed by adding nitric acid. 3. With picric acid albumin is precipitated. A microscopic examination may show renal casts or pus cells.

Albuminuria may arise from—1. **Chronic Bright's Disease**, with thickened arteries and high-tension pulse. These patients tolerate operations so badly that only operations which are absolutely necessary should be done. 2. **Lardaceous Disease** arising in long-standing bone disease. This indicates that a radical operation, such as amputation, should be done. 3. Albuminuria may be intermittent and functional. 4. Extension of inflammation from the bladder (pyelonephritis). 5. Cardiac disease.

6. **Diabetes.**—The presence of sugar in the urine is of great importance. 1. With Fehling's solution a reddish precipitate of reduced copper comes down on boiling. 2. With picric acid and liquor potassæ the solution becomes dark red and opaque on boiling. Diabetics are very susceptible to the attack of pyogenic organisms. The associated endarteritis and peripheral neuritis may induce gangrene of the extremities in chronic cases.

Stone in the Bladder.

Varieties.—1. The **uric acid** calculus is usually oval, smooth, brown, and laminated on section. It may have a crust of phosphates. 2. The **urate of ammonium** calculus is similar. 3. The **oxalate of lime** or mulberry calculus is nodular, dense, laminated, and dark red-brown in colour, from admixture of blood. 4. The **phosphatic** calculus is rare, but concretions may form in a saccule of the bladder. Phosphatic coatings are common on other stones or foreign bodies in the kidney and bladder when there is cystitis or pyelitis. Phosphates give a white, chalky appearance to stones. 5. **Cystine** stones are yellowish-green in colour and very rare.

Structure of a Calculus.—1. The **nucleus** may be blood-clot, mucus, a renal calculus, or a foreign body. 2. The **body** consists of layers of uric acid, oxalates, phosphates, etc., the crystals being held together by

mucus. 5. The **crust** consists of phosphates, and is formed only when cystitis is produced.

Calculi may be single or multiple, in the latter case being faceted.

Causes.—In children bad feeding is the cause, as stone is almost unknown except amongst the poor. In adults stone is rare in women, as small calculi are readily passed. The character of the drinking-water has a direct bearing, and probably hot countries, by inducing much sweating, tend to produce stone.

Symptoms.—The classical symptoms are pain, frequent micturition, and hæmaturia. The **pain** occurs at the end of micturition, as the bladder contracts on the stone, and is referred to the glans penis. Exercise increases the pain. **Hæmaturia** occurs towards the end of micturition, the quantity of blood being slight. **Frequency of micturition** is increased by exercise, so it does not occur at night unless cystitis is also present. Sudden **interruption in the flow of urine**, with pain in the glans penis, occurs when a small stone suddenly rolls over the orifice of the urethra.

A history of previous renal colic or passage of gravel should be inquired for. Even a small stone causes marked symptoms in a child or young adult, while old men may tolerate a large stone easily. An oxalate of lime stone is rougher, and therefore less tolerable than other stones. In children the symptoms may resemble those due to phimosis.

The actual **Diagnosis** can only be made by the sound and cystoscope. With an anæsthetic a large stone may be felt by bimanual rectal or vaginal examination. To examine with the sound, the buttocks should be raised and the bladder should contain a few ounces of fluid. A careful and systematic search should be made, a metallic click being felt or heard when the sound touches the stone. If there is still doubt, a Bigelow's evacuator should be used, and calculi may be washed out of saccules and rattle against the tube when the bulb is relaxed. A phosphatic concretion may resemble an encysted stone, as it is only felt in one situation and does not move.

The **Complications** of stone are cystitis, pyelitis, and pyelonephritis. Prolapse of the rectum and hæmorrhoids may be caused by the straining in passing water.

Treatment consists in removing the stone by lithotrity, suprapubic cystotomy, or lateral lithotomy.

Lithotrity is the operation of choice. The bladder should be washed out, and 6 ounces of boracic lotion left in to obliterate folds in the mucous membrane and to prevent injury to the walls. The lithotrite is introduced closed. The blades are then opened, the stone grasped, and the blades screwed up, so that it is crushed. The fragments are then picked up, and crushed till they are sufficiently small. Then a large evacuating-tube is passed, and with the Bigelow evacuator the fragments are washed out and caught in the glass receptacle of the apparatus. It is necessary to reintroduce the lithotrite if fragments rattle against the tube, but do not become washed out. When no more fragments are felt rattling against the tube, the stone is completely removed. There is always some bleeding in this operation. The patient should be kept in bed for a week.

Sequelæ.—Cystitis may occur from the introduction of sepsis, and must be treated by washing out the bladder twice a day. **Atony** of the bladder may occur in old people. The condition called **urinary fever** may follow if there is any preceding affection of the kidneys.

Suprapubic Cystotomy is the operation to be done when a crushing operation is not advisable. The bladder is washed out, and 8 or 10 ounces of boracic lotion left in it. The pelvis is raised, so that the intestines fall out of the way. A median incision, 3 inches long, from the symphysis pubis upwards is made, the muscles are separated, and the cellular tissue is divided till the bladder wall is exposed. Two silk threads are passed, to hold each side of the incision in the bladder wall which is now made. A finger is passed to examine the stone, which is then removed with lithotomy forceps. When there is no cystitis, the bladder is sutured, leaving out the mucous coat ; when there is cystitis, the bladder is drained with a rubber tube.

Lateral Lithotomy is rarely done now, as the two preceding operations are far superior. With the patient in the lithotomy position, an incision is made down to a staff with a lateral groove, previously placed in the urethra. The incision begins just to the left of the mid-line.

1½ inches in front of the anus, and extends to a spot midway between the tuber ischii and the anus. The knife is then carried along the groove into the bladder, dividing the membranous portion of the urethra and part of the prostate. A finger is then passed to dilate the opening and feel the calculus. The staff is then withdrawn, and the stone is removed with lithotomy forceps or between a finger and a scoop. The bladder is then washed out, and drained by a tube for three or four days. The urine escapes for a time, but as the wound heals the urine is passed by the urethra.

The dangers of the operation are hæmorrhage, wound of the rectum, pelvic cellulitis, and septic cystitis.

Choice of Operation.—**Lithotrity** is the operation of choice in all cases in which the stone is not too large and the urinary organs are fairly healthy.

Lithotomy is advisable—(1) for stones over 3 inches in diameter which are beyond the power of a lithotrite; (2) if there are two or three oxalate stones, as they are very hard; (3) when the bladder is much contracted; (4) when the prostate is enlarged, so that the prostate may be removed at the same time to prevent recurrence of the stone; (5) when the kidneys are affected, necessitating drainage of the bladder; (6) when a stricture cannot be dilated sufficiently to allow the introduction of a lithotrite; (7) when the stone is encysted.

Calculus in the Female.—If the stone is no bigger than ½ to ¾ inch in diameter, it may be removed by dilating the urethra. If larger, lithotrity is better, while for very large stones suprapubic cystotomy is the only good operation. Vesico-vaginal cystotomy is undesirable, as a fistula may be left.

Affections of the Prostate.

Acute Prostatitis is an infective condition often due to gonorrhœa, but may arise from the passage of dirty catheters, from the presence of urethral stricture, vesical or prostatic calculi. Some cases subside without suppuration, but in others **follicular** abscesses form and burst into the urethra. In the worst cases the pus spreads through the prostate to the ischio-rectal fossa or rectum, leaving a urinary fistula.

Symptoms.—Micturition is very frequent, with pain at the end of the act; there is a feeling of weight about the rectum, and pain on defæcation. There is marked pyrexia, and even rigors. The prostate is felt to be enlarged and tender, with soft spots when suppuration is established. Retention of urine accompanies suppuration.

Treatment.—Absolute rest is necessary. The bowels must be kept well open. The pain is relieved by hot baths or hot fomentations and morphia suppositories; failing this, half a dozen leeches are applied to the perinæum. If a catheter is needed, a soft rubber one should be used. If this treatment fails, it is because an abscess is forming, and should be treated by a median perinæal incision.

Chronic Prostatitis commonly follows gonorrhœa, and is a sequel to an acute attack. The prostate is enlarged from interstitial exudation.

Symptoms.—There is a feeling of weight in the perinæum, with frequent and sometimes painful micturition. Threads of mucus are found in the urine, and in addition there is a glairy discharge from the urethra. The prostate is enlarged and tender.

Treatment.—Abstinence from alcohol and sexual excitement are necessary. Counter-irritation by blisters to the perinæum may do good. Chronic gonorrhœa should be treated by applications of silver nitrate (gr. v. ad ℥i.) to the prostatic urethra by means of the urethroscope. In very long-standing cases tonics and a change of air are necessary, and in addition dilatation of the urethra with a large metal bougie.

Tuberculous Disease of the Prostate is rarely primary, but secondary to disease elsewhere in the genito-urinary tract. There is an irregular enlargement of the lateral lobes, caseation, and abscess formation. The disease soon spreads to the bladder.

The *Symptoms* consist of frequent and painful micturition, the last drops being often blood-stained. Pus is found in the urine, and tubercle bacilli may be detected. The disease is readily recognised from the rectum, as the prostate contains nodules of varying consistency. Abscesses may burst into the urethra, rectum, or perinæum.

Treatment consists in improving the general health. Abscesses may be opened and scraped out through a transverse perinæal incision.

Prostatic Calculi are small concretions formed in the follicles, usually multiple and consisting of carbonate of lime. Symptoms are rarely produced unless the stones protrude into the urethra and cause some obstruction simulating enlarged prostate. The stone is felt with a sound, and with a finger in the rectum the stone can be felt between it and the sound.

Treatment consists in removal of the stones by median perinæal section.

Enlargement of the Prostate is a condition commonly found in patients over fifty years of age, which interferes with the act of micturition, and may destroy life by setting up secondary changes in the bladder and kidneys, like those produced by urethral stricture. Little is known as to the causation. There may be general enlargement of all the tissues of the prostate, or it may consist of a number of masses which look like adenomata. Fibromyomata are said occasionally to be present. The changes induced are—(1) the prostatic sheath of pelvic fascia is thickened ; (2) the close connection between the capsule and the sheath is loosened, so that it is easy to enucleate the gland ; (3) as the gland enlarges it projects upwards between the mucous membrane and the sphincter vesicæ, so that an intravesical enlargement is seen. This may be a collar-like projection, looking like the cervix uteri, or, if one lateral lobe only projects into the bladder, it takes the form of what used to be called the 'middle lobe.' (4) The prostatic urethra is lengthened, and may be laterally compressed or distorted, and the intravesical prominence may be a hindrance to the passage of an ordinary catheter ; (5) the bladder is hypertrophied from the excessive work thrown upon it, and may become fasciculated and pouched. In the pouch, which lies behind an intravesical enlargement, residual urine collects, and, if cystitis comes on, phosphatic stones may be formed there.

Symptoms begin with frequency of micturition, then some difficulty in the act of micturition, with diminution in the power of projection. Some pain and tenesmus occur later. Secondary changes in the bladder depend on the amount of obstruction. Hypertrophy and saccula-

tion come on, and are followed by atrophy and dilatation. Dilatation of the ureters and hydronephrosis are produced still later. As atrophy of the bladder comes on, a certain amount of residual urine remains after each act of micturition. As this increases, distension and atony are found with overflow incontinence. Cystitis soon comes on, and may be followed by septic changes in the kidney. The early changes may be unnoticed till overflow incontinence appears. Priapism may occur in the early stages.

The *Diagnosis* is made by a consideration of the symptoms and physical examination. The gland may be felt to be enlarged from the rectum, but there may be marked prostatic obstruction with little posterior enlargement. The length and direction of the urethra are measured by a coudé catheter, and the amount of residual urine is noted.

The *Complications* which occur are—retention, cystitis, calculi, hæmaturia, urethritis, and prostatic abscess.

Treatment is palliative or operative. *Palliative* measures consist in attention to the general health and avoidance of alcohol, exposure to cold, and excessive exercise. If there is any residual urine, the bladder must be emptied regularly by a catheter, either coudé, bicoudé, or silver prostatic, taking great care that the instrument is always aseptic.

Catheter Fever may occur in any patient who uses catheters. It is probably due to absorption of toxins lying in the urethra through an abrasion produced by the instrument. A rigor followed by a high temperature, which lasts a few hours and then passes off, is the usual course; but fatal suppression of urine follows in a few cases. By some it is supposed to be a reflex nervous phenomenon. The patient must be kept in bed during the attack. Urotropin (10 grains) given a few hours before the instrument is passed may prevent a rigor.

When the patient suffers from pain and restlessness in spite of palliative measures, operative treatment is necessary, but the longer a patient postpones it, the more likely is it that septic changes have been induced which increase the risk of the operation.

Prostatectomy may be carried out through a suprapubic or a perineal incision. The former is the method usually adopted in England. The bladder is opened by the usual suprapubic incision. The index and middle

fingers of the left hand, which is covered by a rubber glove, are then introduced into the rectum to steady and push up the prostate. With the finger-nail of the right index finger the mucous membrane at the internal urethral meatus is torn through, and the finger is slipped between it and the prostate. By working all round in this plane the whole prostate can be shelled out, or what, for practical purposes, amounts to the whole prostate. The small fibrous prostate is more difficult to remove than the large one. The cavity is then irrigated with hot lotion to stop the bleeding, and the bladder is drained with a large tube for four or five days. After a period of from seven days to several weeks, the power of voluntary micturition returns and the wound closes. The risks of the operation are dependent upon the preceding condition of the patient. If the amount of urea he is excreting is much below the normal, the danger is very great. Similarly, if the bladder is very septic, there is great risk of fatal toxæmia or uræmia following. If it is decided to operate upon such patients, a vigorous endeavour should be made to improve the conditions by keeping the patient upon a mixture of urotropin and acid phosphate of soda, and irrigating the bladder for a fortnight. It may even be advisable to drain the bladder for a period before removing the prostate.

If symptoms of toxæmia come on after the operation, frequent intravenous injections of saline solution, 2 pints at a time, may save the patient. Another danger in patients with chronic bronchitis and dilated hearts is that of hypostatic pneumonia. Such should be propped up in bed as soon as they come round from the anæsthetic, and got out of bed sitting in a chair as soon as possible. If the patient is unable to get along with catheter life, and refuses prostatectomy, a permanent vesical fistula may be established. Such operations as castration, vasectomy, and ligation of the internal iliac, have been given up.

Cancer of the Prostate (scirrhus) occurs in old men, and soon infiltrates the capsule. Obstruction to the flow of urine, pain, and hæmorrhage, come on rapidly, and a hard nodular mass is felt from the rectum. Secondary deposits occur in the lumbar glands, and pressure symptoms are produced by infiltration of pelvic vessels and nerves. Palliative treatment only can be adopted.

CHAPTER XXXVIII

AFFECTIONS OF THE URETHRA AND PENIS

Affections of the Urethra.

Congenital Malformations.—**Occlusion** is fatal, the bladder, ureters, and kidney being found dilated.

Epispadias is rare. It is always found as a complication of ectopia vesicæ. In other cases the cleft varies in extent, but most commonly the urethra opens just in front of the symphysis, and the floor of the urethra is exposed along the dorsum of the penis. Various plastic operations are used to repair this.

Hypospadias is commoner, and is due to imperfect development of the floor of the urethra. The portion belonging to the glans may be cleft, or the whole penile portion, even back to the perinæum, in the latter case combined with cleft scrotum.

Two troubles occur: (1) The meatus is always small, and produces some obstruction; (2) the penis is curved and bound downwards when the cleft extends far back, and so prevents sexual intercourse. When the fissure is limited to the glans, only dilatation of the meatus is necessary. In the other cases a plastic operation must be done, the best of which seems to be Hamilton Russell's.

Traumatic Laceration of the Urethra commonly results from falls astride a rail or beam, blows in the perinæum, or as a complication of fracture of the pelvis, the membranous portion then being torn. In the former cases the urethra is torn near the junction of the bulbous and membranous portions. The urethra may be partially or completely torn across.

Symptoms.—The pain varies in severity, and a hæmatoma forms. Blood escapes from the urethra independently of micturition. If the patient attempts to pass water, he is unable to do so, but urine extravasates into the tissues. An organic stricture always follows.

Treatment.—The patient must be warned not to attempt micturition, so as to avoid extravasation. If a catheter can be passed easily, it may be tied in for a few

days, and antiseptic dressings applied to prevent infection spreading to the blood-clot. Or a catheter may be passed every four hours. If an instrument cannot be passed, or extravasation has occurred, a perinæal incision must be made to expose the rupture and stitch the separated ends together around a catheter, which is tied in for four or five days. The rest of the wound should be left open. If sepsis has followed extravasation in cases not treated till late, free incisions must be made, the rupture exposed, and a catheter passed into the bladder. It is no use attempting then to repair the urethra.

Foreign Bodies, such as pipe-stems, calculus, pencils, pins, etc., may be found in the urethra. Partial or complete obstruction occurs, and may be followed by ulceration, peri-urethral abscess, and extravasation. If the body cannot be withdrawn by forceps, the urethra must be opened, but a fistula may follow.

Simple Urethritis may be due to the *Bacillus coli*, the passage of uric acid crystals, calculus, or the introduction of an instrument. The symptoms resemble, but are milder than, those of gonorrhœa, and no gonococci are found. Alkalies, urotropin, and purgatives, should be given, and alcohol forbidden.

By **Stricture of the Urethra** is meant all forms of obstruction to micturition due to alterations in the walls of the urethra. Three forms are described: spasmodic, congestive, and organic.

Spasmodic Stricture is induced in many cases by operation about the anus or genitals, and the retention is relieved by passing a catheter.

Congestive Stricture is due to inflammatory swelling of the urethral mucous membrane, associated with some amount of spasm, and is usually due to gonorrhœa. The retention is usually relieved by placing the patient in a hot bath. If this fails, a catheter must be passed. By some the danger of carrying gonococci into the bladder is considered very serious, and suprapubic aspiration is substituted for catheterism.

Organic Stricture is due to the contraction of cicatricial tissue in the walls of the urethra.

Causes.—1. Long-continued inflammation from gonorrhœa is the commonest cause. 2. Traumatic stricture

results from contraction of the cicatrix after rupture of the urethra. 3. Stricture follows the healing of a urethral chancre. The commonest situation is in the bulb, but the orifice and membranous or penile portion may be narrowed.

Various terms are applied—annular, bridled, tortuous, resilient—according to the physical conditions.

The **Symptoms** consist of steadily-increasing difficulty in micturition, and urine may trickle away after the act is completed. Irritability of the bladder and frequent micturition follow. The urine becomes alkaline and foul, and as residual urine collects the bladder becomes distended and retention occurs. There is usually a gleety discharge.

Results.—1. The **urethra** is dilated behind the stricture and may be ulcerated. Forcible attempts at micturition may lead to rupture and extravasation, or inflammation may extend without rupture and cause a peri-urethral abscess. 2. The **bladder** hypertrophies, owing to its increased work, and becomes fasciculated. As the pressure increases, the mucous membrane becomes pouched out between the fasciculi (sacculation), and when cystitis comes on phosphatic concretions may form in the saccules. Perforation owing to ulceration, followed by extravasation, is rare. In the later stages hypertrophy gives way to dilatation and atony. 3. **Hydronephrosis, pyonephrosis and pyelonephritis**, develop partly as the result of back pressure, and partly from the extension of sepsis to the ureter and kidney.

Physical Examination.—The actual diagnosis is only made by examination with bougies. It is better to begin with a No. 12 graduated Lister's metal bougie, keeping the point along the floor till the lacuna magna is passed, and then along the roof. The bougie may be obstructed by spasm, but gentle pressure overcomes this. If, however, the bougie will not pass with gentle pressure, an organic stricture is present, and smaller instruments must be tried. Flexible catheters and bougies may also be used. The distance at which the stricture begins should be measured off on the bougie. The length of a stricture is measured by passing an acorn-tipped bougie and noting at what distance the shoulder catches on withdrawal.

The *Dangers* of catheterism are shock; hæmorrhage; false passages from not keeping the catheter in the urethra, and using undue force; epididymitis from extension of sepsis; and urinary or 'catheter' fever. Occasionally the temperature remains up for a few days. In patients who have secondary septic kidney troubles, suppression of urine may occur and prove fatal. The *treatment* of urinary fever consists in keeping the patient warm in bed, keeping the bowels freely open, and giving quinine. If suppression occurs, cupping over the loins may relieve renal congestion; the bowels must be freely opened with purgatives, and sweating must be induced by pilocarpine or vapour baths. Uræmic symptoms may sometimes be relieved by copious and repeated intravenous injections of saline solution to encourage diuresis and diarrhœa.

The Treatment of Passable Strictures.—Dilatation may be *gradual*, the size of the instrument being increased at intervals of a few days till No. 12 is reached; or *rapid*, in which the dilatation is carried up to No. 12 at one sitting. When only a small instrument can be introduced, it may be tied in for forty-eight hours to produce *continuous* dilatation, and it is then found that an instrument several sizes larger can be passed. The patient must be kept in bed and put up with a good deal of irritation of the urethra. *Forcible* dilatation should not be done. After the stricture is dilated, the patient must pass a bougie himself at regular intervals for the rest of his life to prevent recurrence.

Urethrotomy, the alternative to dilatation, may be either internal or external, or the stricture may be excised.

Internal Urethrotomy is suitable for resilient penile strictures. These dilate easily, but contract to their former size quickly. Old cartilaginous strictures and irritable strictures are suited to this method. The stricture must be dilated to No. 5 size, so that the urethrotome can be passed through it. The hidden blade is then projected, and by withdrawing the instrument the stricture is cut through along the floor of the urethra from behind forwards. The urethra should be flushed out before and afterwards with a Guyon's syringe. A full-sized metal bougie is passed then and daily afterwards for some weeks, the intervals gradually being increased.

External Urethrotomy is required when no instrument can be passed; for dense tortuous strictures in the bulb which do not yield to dilatation; for cases where there is extravasation of urine, or where there are perinæal fistulæ. Syme's operation is done when the stricture can be dilated to No. 3 or 4 size, Wheelhouse's when no instrument can be passed.

Syme's Operation.—Syme's shouldered staff is passed, the narrowed portion lying in the stricture, and the shoulder resting against the face of it. A perinæal incision is made in the mid-line down to the groove in the staff, so that the stricture is completely divided. A gum-elastic or railroad catheter is then passed into the bladder and tied in for three days, after which it is removed, and a metal catheter is passed daily till the wound is healed. If the stricture has been properly divided, tying in a catheter is unnecessary, for it is sufficient to pass a silver instrument daily. After the wound is healed, it is necessary to pass a bougie at gradually increasing intervals to prevent relapse.

Wheelhouse's Operation.—Wheelhouse's straight staff is passed down to the face of the stricture, and a perinæal incision is made down to the groove in it, so that the urethra is opened just in front of the stricture. The staff is turned so that the anterior end of the incision is drawn up by the hook on it. The sides of the opening are held apart with forceps, and the orifice of the stricture is thus exposed. A fine probe-pointed director is passed through the stricture, which is divided along the floor. A probe-pointed gorget is then passed into the bladder, and by its help a catheter is introduced and tied in. The subsequent treatment is the same as in Syme's operation. **If retention of urine is present**, an attempt should be made to pass a catheter. If not successful, the patient is put into a hot bath, and a dose of opium given. If urine is not then passed, the bladder must be aspirated suprapubically, or Wheelhouse's operation done, the latter being the better course.

Cock's Operation, or opening the urethra behind the stricture to relieve acute retention, is sometimes done. A finger is passed into the rectum to the apex of the prostate. A knife is plunged in the mid-line to the apex

of the prostate, so that the distended urethra is opened and urine gushes out. A catheter is passed into the bladder to drain it through the perinæal wound. In a few days it may be found that an instrument can be passed through the stricture ; if not, Wheelhouse's operation must be done.

The Complications of Stricture are periurethral abscess, fistula, and extravasation of urine.

A **Periurethral Abscess** begins around the urethra from slight extravasation or absorption through an ulcerated surface. A brawny, tender swelling appears in the perinæum and points, giving rise to a **Fistula** discharging urine and pus. The fistulæ may be multiple, opening in the perinæum, scrotum, and buttocks.

Treatment consists in freely incising the abscess and dilating the stricture. Perinæal fistulæ sometimes heal after dilatation of the urethra, but Syme's or Wheelhouse's operation is often necessary.

Extravasation of Urine is due to rupture of the dilated urethra behind a stricture during a violent effort at micturition ; or by attempting to pass water after traumatic laceration of the urethra ; or it may succeed the rupture of a peri-urethral abscess into the urethra. The rupture is usually just in front of or just behind the triangular ligament. In each case the urine passes forwards between the triangular ligament and Colles's fascia to the scrotum and penis, and along the spermatic cords to the anterior abdominal wall. The attachments of fasciæ prevent its spread backwards in the perinæum or on to the thighs.

Symptoms.—There is burning pain at the time of rupture, though the distended bladder may feel relieved temporarily. A swelling soon forms in the scrotum and perinæum, and, as the urine is septic in these cases, sloughing cellulitis is soon set up, even gas being formed in some. The pulse is rapid and the temperature high at first, but subnormal in the later stages of exhaustion.

Treatment consists in free incisions into every part where urine is extravasated. The urethra and stricture must be laid open, and a catheter tied in. The parts must be dressed frequently with fomentations till healing occurs by granulation.

Affections of the Penis.

Phimosis, or inability to retract the prepuce over the corona glandis, may be congenital or acquired. **Congenital** cases may have an opening so narrow as to make micturition impossible, or 'pinhole' in size, and causing irritability of the bladder. The prepuce is always more or less adherent to the glans ; smegma accumulates, and may cause balanitis. Distension of the bladder and hydronephrosis follow obstruction, and the straining may induce hernia or prolapse of the rectum. In adult life venereal disease is more serious if phimosis is present, and epithelioma of the penis is more frequent in subjects with phimosis. **Acquired** cases are due to the cicatrization of venereal sores.

Treatment consists in circumcision, which is best done by splitting the prepuce along the dorsum, separating the lateral halves from the glans, and then trimming off the redundant prepuce on each side. Hæmorrhage is then stopped, and the edges are united with catgut. Wet gauze dressings are the simplest and most satisfactory.

When a tight prepuce has been kept retracted for a short time, the constriction causes swelling and œdema in front of it, which prevents its return, the condition known as **Paraphimosis**. If untreated, ulceration of the mucous membrane follows.

Treatment consists in grasping the penis between the fore and middle fingers of each hand, and by pressing with the thumbs on the glans the œdema is diminished and the prepuce is drawn forwards over it. The œdema may be diminished by multiple punctures, but if this does not succeed the constricting band should be divided, and circumcision proceeded with at once, unless balanitis is present, in which case it is better to delay circumcision for a few days.

Balanoposthitis, or inflammation of the mucous membrane of the prepuce and glans, is due to ordinary pyogenic organisms, gonorrhœa, or soft chancre. When phimosis exists, considerable ulceration may occur, with sloughing of the prepuce in neglected cases.

Treatment consists in cleansing the parts and applying

lead lotion. If, in spite of syringing between the glans and prepuce, trouble persists, the prepuce must be slit up.

A **Soft Chancre** is a local infection with a specific organism. A papule forms in twenty-four hours, and becomes a vesicle in two or three days. At the end of four or five days it has passed through a pustular stage and become an ulcer with a sharp outline. Any part of the penis may be affected. The sore is highly infective, but no constitutional symptoms follow. Multiple sores are often present. The sore may be modified by phimosis, extensive ulceration occurring then; or, if much inflammation accompanies it, the induration may resemble that of a syphilitic or hard chancre; or, syphilitic infection may occur at the same time, so that instead of healing in three weeks the sore persists and constitutional symptoms follow. The lymphatic glands are always enlarged, and may suppurate (bubo). If only pyogenic cocci are absorbed, the suppuration is confined to the glands; but if the specific virus is absorbed, ulceration occurs around the glands as well.

Treatment consists in keeping the sore clean and dressing it with lotio nigra. The prepuce must be slit up if there is retention of the discharges. Healing occurs in two to three weeks. Buboes must be opened as soon as pus is present, and a vertical incision gives the best drainage.

Herpes on the penis and prepuce is often associated with gout. A crop of vesicles, preceded and accompanied by itching, run together and produce a pustule. The parts must be kept clean, and treated with lotio plumbi or dusted with zinc oxide.

Warts around the corona are most frequently a sequela of gonorrhœa. They should be snipped away and their bases cauterized.

Epithelioma of the Penis usually commences in the sulcus behind the corona, and rarely unless phimosis is present. A warty growth appears, and soon ulcerates. It is distinguished from papilloma by its indurated base. A blood-stained discharge from beneath the prepuce is suspicious in an old man. The progress is rapid, the corpora cavernosa and inguinal and lumbar glands soon becoming affected.

Treatment.—Amputation must be early, as the course is rapid. **Amputation of the penile portion** is suited to cases in which the corpora cavernosa are not affected. A dorsal skin flap is made, and the urethra is brought out and stitched through a hole in this after the upper wall has been split. **Amputation of the whole penis** is more often necessary. With the patient in the lithotomy position, the scrotum is split in the mid-line, and the urethra and corpus spongiosum are divided 1½ inches in front of the triangular ligament. The incision is carried around the root of the penis, and the corpora cavernosa are separated from the pubic arch. The suspensory ligament is divided, and the organ is then separated. The urethra is stitched to the posterior angle of the incision, and the two halves of the scrotum are then sutured. The enlarged glands in the groins are removed at the same time or two weeks later.

CHAPTER XXXIX

AFFECTIONS OF THE TESTIS, CORD, SCROTUM, AND SEMINAL VESICLES

Congenital Affections of the Testis.

Incomplete Descent.—The testis may remain in the abdomen, but more usually lies in the inguinal canal just above the external ring. The scrotum is empty on that side, and frequently an interstitial hernia is associated.

Malposition of the Testis.—The testis may be found in the perinæum or in the region of the saphenous opening, and is said to be guided to these regions by accessory bands of gubernacular tissue. Testes in an abnormal position are usually imperfectly developed, and liable to undergo torsion and gangrene.

Treatment.—Excision of the testis is the best form of treatment if there is any discomfort. Few of the operations for placing the testis in the scrotum are successful, owing to the shortness of the cord.

Torsion of the Testis produces local signs like those of strangulated hernia, but there is fever and absence of abdominal distension and fæcal vomiting. The inflamed or gangrenous testis and cord generally need removal.

Injuries of the Testis and Cord.

Contusions of the Testis.—Hæmorrhage occurs beneath the tunica albuginea, and if extensive, atrophy of the testis may follow. There is intense pain, collapse, and rapid swelling.

Treatment consists in keeping the patient in bed and applying an ice-bag. If there is much extravasation, the tunica must be punctured to prevent atrophy of the testis.

Penetrating Wounds cause hæmorrhage. If the wound is septic, hernia testis follows; if not, the wound soon heals.

Hæmatocele of the Tunica Vaginalis arises from an injury, such as a blow or tapping a hydrocele, or as a result of malignant disease of the testis. The tunica vaginalis becomes rapidly distended with blood in traumatic cases, and with a good deal of pain. The swelling is smooth, fluctuating, and tense, resembling a hydrocele except that it is not translucent. After a time the wall becomes hard from deposit of fibrin. In old cases of hydrocele bleeding may occur from time to time, and calcareous deposits may occur in the organized blood-clot on the walls of the tunica, so that the swelling resembles a solid tumour.

The *Diagnosis* is easy in recent cases, but in old ones it may be suspected from the history and confirmed by an exploratory incision.

Treatment.—In recent cases rest and the application of cold may induce absorption; if not, the blood must be evacuated by an incision. In old cases the sac must be opened, the clot removed, and the parietal portion of the tunica excised. If the testis is atrophied, castration is advisable.

Hæmatocele of the Cord is rare, and due to injury. A swelling occupying the inguinal canal and cord down to the testis appears rapidly. It is distinguished from a hernia by its freedom from impulse on coughing and irreducibility. The history and some signs of bruising distinguish it.

Treatment consists in rest and the application of lotio plumbi.

Inflammatory Affections of the Testis.

Acute Orchitis, or inflammation of the body of the testis, usually results from injury, but may be gouty in origin or follow mumps or typhoid. The testis becomes enlarged, very painful, and tender. The pain may be felt in the groin or back. The scrotal tissues become red and infiltrated, and there is not the same tendency to acute hydrocele as in epididymitis. Suppuration sometimes occurs, and after incision a hernia testis follows. Atrophy is a common sequela in all cases.

Acute Epididymitis is almost always due to extension of gonorrhœa along the vas, but any other form of urethritis may cause it. It begins with pain in the region of the internal ring, which soon extends to the testis. The epididymis is felt as a crescentic swelling, embracing the testis. There is often acute hydrocele, and the scrotum is red and œdematous. Suppuration is rare. Some orchitis is often present in addition, but atrophy rarely follows, though obstruction to the passage of semen may be absolute, sterility following double epididymitis.

The *Treatment* of both conditions consists of rest in bed, with the scrotum supported. Cold is the best application in the early stages, hot fomentations in the later. Blood may be abstracted locally in severe cases by opening two or three scrotal veins (leeches are inadvisable). A ½-grain suppository of morphia may be necessary to relieve the pain. Light diet and purgation are advisable. After the acute stage is passed, enlargement persists for some time, and is best treated by applying pressure either with strapping or a Julien's suspensory bandage and a mass of cotton-wool.

Tuberculous Disease of the Testis.—In most cases the epididymis is affected first, and in some cases solely. It may be primary or secondary to disease elsewhere. Tubercles are deposited, run together, and form caseous masses. Whether it begins in the globus minor or major, the whole epididymis is soon affected, and the disease spreads to the testis and vas deferens. An abscess may form in the testis and spread through the tunica albuginea

to the surface of the scrotum. The vas soon becomes thickened, and, if the disease has lasted for some time, the vesiculæ seminales also. Finally the disease attacks the prostate and base of the bladder, and spreads to the ureters and kidneys, and general dissemination may occur.

Symptoms.—The onset may be **acute**, simulating or following a gonorrhœal epididymitis, but the swelling, instead of diminishing at the end of a week, persists or increases, and goes on rapidly to abscess formation and extension to the bladder. The ordinary **subacute** case begins with some pain and tenderness in the testicle, and the epididymis is found to be generally enlarged. Sometimes it is nodular and contains softer areas. The vas is thickened early, and testicular sensation persists as long as any normal gland remains. An abscess in connection with the epididymis may point, but does not give rise to a hernia testis.

When the bladder and prostate are affected, pain and frequency of micturition come on.

Treatment.—The only treatment which will prevent certain spread to the bladder in **acute** cases is early castration. In the **subacute** cases constitutional treatment, with residence at the seaside, may be tried with success in early cases. In most, however, operative treatment is necessary. Partial operations, such as scraping, are useless. If the body of the testis is not diseased, it is sufficient to excise the epididymis and vas as high up as the internal ring, thus leaving the testis to produce its internal secretion. If the testis is much affected, however, castration is necessary.

Syphilitic Disease of the Testicle.—A nodular thickening of the globus major may occur in secondary syphilis, but is of little importance. **Tertiary Syphilis** of the testis is a late affection, and may be bilateral. There is a diffuse infiltration of the whole organ, beginning in the body of the testis. In some cases gummata may be present as well. The testis becomes evenly enlarged and stony hard, often accompanied by a hydrocele and early loss of testicular sensation. The gland structure may become entirely replaced by connective tissue. If gummata are present as well, breaking down occurs, and the usual syphilitic ulcer presents itself.

Under treatment the swelling may disappear entirely, but the testis remains impaired in function or useless.

Hernia Testis is the term applied to protrusion of the gland substance through an opening in the tunica albuginea and scrotum. It is always preceded by increased pressure from inflammation inside the tunica albuginea, so that as soon as an opening is made elasticity forces out the gland structure, which appears as a mass of granulation tissue.

Treatment consists in castration for tuberculous disease. Simple cases heal if dressed antiseptically. If not, the gland substance may be freed and the skin brought together over it.

Tumours of the Testis.—Malignant tumours are more common than innocent.

Malignant Tumours are either sarcoma or carcinoma. They are impossible to distinguish clinically, though in the young only sarcoma occurs. A rapidly-growing tumour, retaining the shape of the testis at first, is found, but soon irregular bosses of unequal consistence, and fluctuating in parts, appear. The disease spreads along the cord, and the lumbar glands are early affected in both. The chance of cure by operation is slight. When the skin of the scrotum becomes infiltrated the inguinal glands also become enlarged. Death usually occurs in a year from the time the tumour is noticed.

Treatment consists in early castration.

Innocent Tumours.—Fibro-cystic Disease : A tumour forms in the testis, containing numerous cysts lined with cuboidal or stratified epithelium. There is a varying amount of intercystic connective tissue. Cartilage and myxomatous tissue may be found, as in mixed parotid tumours. The testis is spread out over the tumour substance. This condition is found in young adults, and is believed to arise in the remains of the Wolffian body. The testis steadily enlarges, without pain, the cord remaining unaffected and the skin not ulcerating, except when the tumour is large. The diagnosis is confirmed after an exploratory incision, and the testis is then removed.

Chondroma, fibroma, osteoma, and myxoma, are tumours which are rarely found.

Hydrocele.

A hydrocele is a collection of fluid, other than pus or blood, in the neighbourhood of the testis or cord.

1. **Vaginal Hydrocele** is one in which there is an accumulation of fluid in the tunica vaginalis.

(*a*) **Acute Hydrocele** follows injury, or is secondary to acute epididymitis or orchitis. The effusion is small and readily coagulates. Absorption soon occurs, but the sac may become obliterated by adhesions.

(*b*) A **Congenital Hydrocele** occurs in cases where the funicular process remains patent. It shows the general signs of hydrocele, but the fluid is returned to the abdominal cavity on lying down or by pressure. The application of evaporating lotions and a woollen truss cures most cases ; if not, the sac should be excised, as a hernia may follow.

(*c*) An **Infantile Hydrocele** is distension of a sac in which the funicular process has been obliterated only at the internal ring. Treatment is the same as for acquired hydrocele.

(*d*) **Acquired Vaginal Hydrocele** is very common, and is probably due to some inflammatory affection of the epididymis. A hydrocele usually accompanies gumma of the testis, but not tuberculous or malignant disease. In old cases the tunica vaginalis becomes thickened.

Signs.—A pyriform swelling appears in the scrotum, which is elastic if tense, but otherwise fluctuating. The testis is situated posteriorly, and the swelling is translucent, except in old cases with thickened walls. There is no impulse on coughing, and the fingers can be placed above the limits of the swelling by grasping the cord just below the external ring. The fluid is yellowish, and may contain cholesterine.

Treatment.—(1) *Palliative.*—The fluid may be removed at intervals by tapping, but it soon recurs.

(2) *Radical.*—**Injection**, after tapping, of fluids which induce an inflammatory reaction, so that the cavity may become obliterated ; 1 to 2 drachms of tincture of iodine may be injected, but 20 to 40 minims of liquefied carbolic acid is more certain and not nearly so painful. The patient should be kept in bed till all the swelling is gone.

Excision of the wall of the sac is by far the best method. The parietal portion is removed close to the testis, and the surface of the testis is scraped with the knife or touched with pure carbolic acid. Drainage is unnecessary if all the bleeding has been stopped.

2. **Encysted Hydrocele of the Epididymis** appears as a globular, elastic, translucent swelling, which seldom becomes bigger than the testis. The fluid is usually opalescent from the presence of spermatozoa. This condition is probably due to distension of the fœtal relics, Kobelt's tubes, or to dilatation of one of the vasa efferentia testis.

Treatment consists of tapping, injection, or excision.

Encysted hydrocele of the testis is unimportant, and due to dilatation of lymph spaces in the tunica albuginea.

3. **Hydrocele of the Cord** — (*a*) **Encysted.** — The funicular process is imperfectly obliterated, and, if distended with fluid, a rounded elastic swelling is found in the inguinal canal. The swelling is movable unless the testis is fixed by traction. The upper border is sharply limited. In the female the same condition is called a hydrocele of the round ligament. Treatment consists in tapping, injection, or excision. (*b*) **Diffuse Hydrocele of the Cord** is a name given to œdema of the structures of the cord.

A **Chylous Hydrocele** contains a milky, fatty emulsion, the mode of origin of which is uncertain.

Varicocele.

A varicocele is a varicose condition of the pampiniform plexus. It is common in young men, especially if the scrotum is lax and pendulous. That it is nearly always on the left side is supposed to be accounted for by the fact that the left spermatic vein lies behind the sigmoid flexure, and so may be pressed upon, and also that the vein opens at right angles into the left renal vein, instead of obliquely. Probably there is a congenital overdevelopment of the veins, which is only brought to notice when the blood-supply and growth of the testis increase at puberty.

A soft mass of dilated and tortuous veins can be felt in

the scrotum behind and above and overlapping the testis. There is an impulse on coughing, and the swelling disappears on lying down. It fills from below if a finger is applied over the external ring while the patient stands up again. A varicocele has a perfectly characteristic feel, and cannot be mistaken for a hernia. Some patients have no pain, others much aching, while in some a neurotic element is marked.

Treatment.—In slight cases a suspensory bandage relieves the symptoms. No atrophy of the testis will occur. Radical treatment is necessary, if the varicocele is large, for entry into the services, or if the patient is going to live in a tropical climate. Neurotic cases are best left alone. An incision is made in the direction of the cord, 1½ inches long, with its centre just below the external ring. The coverings of the cord are divided, and the spermatic veins isolated and stripped right down to the epididymis. The veins are ligatured above and below and removed. If the scrotum is very lax, the upper and lower ligatures should be tied together to raise the testis, or a portion of the scrotum may be excised.

General Diagnosis of Scrotal Tumours.

The first point to decide is whether the swelling is purely scrotal, or whether something descends into it from the inguinal canal and abdomen. By grasping the cord immediately below the external ring this may be decided, the condition of the cord being also noted at the same time. Thus hernia and encysted hydrocele of the cord are distinguished from vaginal hydrocele, tumours of the testis, etc.

When the swelling is purely scrotal, inspection and manipulation are the next steps. A varicocele has a characteristic feel. If the swelling is rounded, it must be determined whether it is solid or fluid. If fluid, it is a hydrocele or an early hæmatocele, the former being translucent, the latter not. If the swelling is solid, it may be an old hæmatocele, syphilitic or tuberculous disease, or a new growth. A **hæmatocele** may be recognised by its history. **Syphilitic enlargement** is hard

and smooth, testicular sensation is lost, and a hydrocele is often associated with it. **Tuberculous disease** occurs in younger people, the epididymis being first attacked, and not the testis; the cord is early implicated, hydrocele is rare and suppuration frequent. Testicular sensation remains till late in the disease. **Tumours**: Simple ones are rounded, slow in growth, and do not affect the cord; malignant growths are rapid, infiltrate quickly, and affect the glands. When there is any doubt, it must be cleared up by an exploratory incision. Enlargement of both testes is much more likely to be tuberculous or syphilitic than malignant. A rectal examination must never be omitted, as tuberculous disease of the vesiculæ may be a very early complication of similar disease in the epididymis.

Castration is required in many conditions: for simple and malignant tumours, tuberculous disease, old hæmatoceles, and malposition. It has been done for enlarged prostate, but this is now given up. Unless the scrotum is infiltrated, the incision for removal is made over the cord, as in operation for varicocele. The organ is then pulled up into the wound, and the cord is ligatured and divided as high as possible. If the scrotum is infiltrated or the tumour is large, the incision necessarily involves the scrotum.

Affections of the Vesiculæ Seminales.

Acute Vesiculitis is a complication of gonorrhœa characterized by pain in the perinæum, increased during defæcation. An abscess may form and burst into the rectum, bladder, or peritoneal cavity. The semen is often blood-stained. If an abscess forms, it must be evacuated by the transverse perinæal incision.

Tuberculous Disease results from extension from the testis. The vesiculæ can be felt as hardened masses from the rectum. Suppuration may lead to a rectovesical fistula. Complete excision is sometimes possible by the transverse perinæal incision.

Affections of the Scrotum.

Injuries may give rise to a hæmatoma. Cellulitis is usually due to extravasation of urine. Œdema is part of general anasarca, or is local and due to erysipelas. Scrotal fistulæ are due to stricture of the urethra.

Eczema of the scrotum is due to chronic irritation from pediculi or from working in tar, paraffin, or soot. After a time epithelioma may develop (chimney-sweep's cancer). Complete removal is necessary.

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