into patients without them. Fortunately only one group of antigens, known as Rh, readily gives rise to antibodies. Thus for practical purposes, such as blood transfusion, it is only necessary to know which of the antigens A, B, and Rh are present in the red cells. (When the red cells contain Rh, we say the patient is Rh-positive ; when they do not, we say he is Rh-negative.)

Incompatibility.—When red cells are transfused into a patient whose serum contains antibodies to any of their antigens, the red cells are first agglutinated and then hæmolysed. (Hæmolysis is always preceded by agglutination, and advantage is taken of this fact in testing for incompatibility.) If there is much hæmolysis, protein shock leads to acute tubular necrosis (see Crush Syndrome, p. 17) and the patient is in grave danger of dying of renal failure. Thus every blood transfusion must be preceded by :

1. *Blood grouping* (A,B,O, Rh) of patient and donor to ensure that the patient's serum does not contain any natural antibodies to the donor's red cells.

2. *Cross-matching* (donor's cells and patient's serum) to confirm the above and to exclude any acquired antibodies to the donor's red cells.

Rh Incompatibility.—Antibodies to Rh are produced when Rh-positive red cells are transfused into an Rh-negative patient. An analogous condition may happen when an Rh-negative woman carries an Rh-positive fœtus ; its red cells may cross the placenta into her circulation so that she forms anti-Rh. These, like all maternal antibodies, pass into the fœtal circulation, the fœtal red cells are destroyed by them, the baby is born with a severe hæmolytic anæmia (icterus gravis) or is even killed *in utero* (hydrops fœtalis).

Rh antibodies and other antibodies artificially acquired to red cells often fail to agglutinate red cells suspended in saline, but will agglutinate red cells suspended in albumin solution. For this reason albumin as well as saline red cell suspensions are used for routine cross-matching. The suspending medium influences the physical consequences of any antigen-antibody union. An anti-bacterial serum, for example, agglutinates bacteria if they are suspended in saline, but not in distilled water.

Coombs' Test.—The antibodies have combined with the red cells even though they have produced no visible effect, and the coating of antibody can be detected by Coombs' test. The cells are treated with a serum made by immunising animals to human globulin, so that it contains antibodies that combine with human globulin molecules to make a precipitate. The antibody coating red cells is, like all antibodies, a globulin ; thus, when the serum binds the globulin molecules together in precipitates, it draws the red cells together into large clumps.

Once antibodies have appeared, every successive stimulus (e.g. pregnancy) increases their amount. Thus one transfusion of Rh-positive blood into an Rh-negative girl may make it impossible for her ever to produce a live child to an Rh-positive husband. *No female under fifty should ever be transfused with Rh-incompatible blood.*

Apart from this danger to the fœtus, any patient, male or female, who has acquired anti-Rh may have a severe, even fatal, reaction if transfused with Rh-positive blood. The anti-Rh will have been produced by a previous transfusion or by an Rh-incompatible pregnancy. To avoid such

R. R. A. Coombs, M.R.C.V.S., Contemporary. Veterinary Surgeon, Department of Pathology, University of Cambridge.

accidents a second rule must be observed: *No patient should be transfused with Rh-incompatible blood unless it is certain he will not need another transfusion.*

Blood Grouping.—Accurate A, B, and Rh blood grouping needs full laboratory facilities. When these are not available the A, B, O groups can be determined with fair accuracy by the following technique (the most usual error will be to mistake Group A for O, and AB for A; this is harmless in grouping a patient but very dangerous in grouping a donor).

Technique of Grouping.—Stock sera from Group A and Group B are placed side by side on a slide. Blood obtained by a prick with a sterile cutting needle is diluted 1 : 20 in saline in order to avoid rouleaux; a drop of this suspension is added to each, and after five minutes is examined microscopically. If clumping of corpuscles is seen in the serum of Group A, then the corpuscles are those of an individual of Group B. If clumping occurs only in the serum of Group B, then the corpuscles are from Group A. If clumping is present in both, then the corpuscles are from Group AB, and if in neither, they belong to Group O (fig. 75).

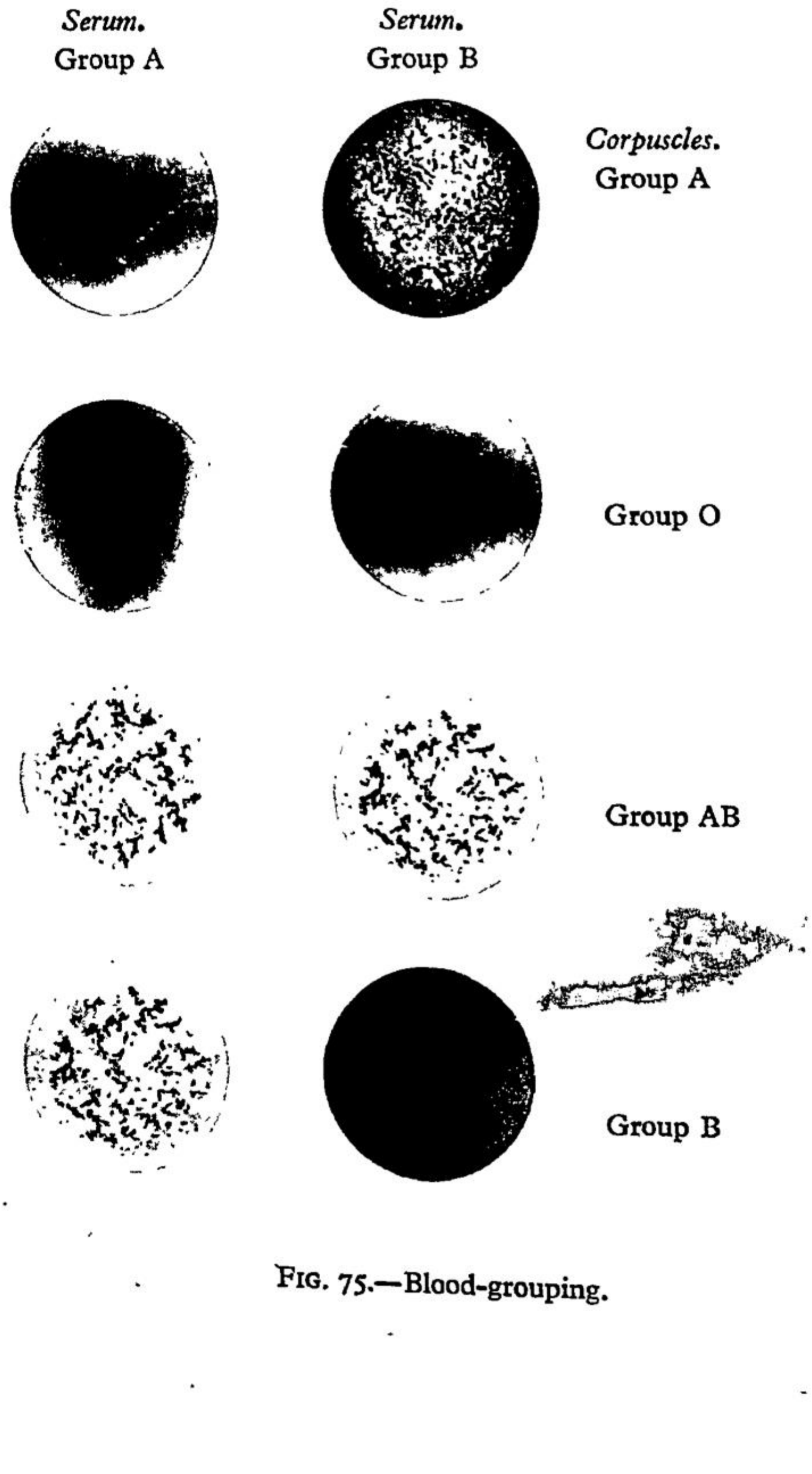


FIG. 75.—Blood-grouping.

Cross-matching.—It is always advisable to ensure that the patient's serum does not agglutinate the donor's red cells suspended in albumin as well as saline. Safe cross-matching demands laboratory facilities, but in emergency the following technique will prevent dangerous reactions :

Mix on a slide one drop of patient's serum and one drop of a 1 : 20 saline suspension of donor's red cells and rock for five minutes. Clumping indicates incompatibility.

METHODS OF TRANSFUSION

Drip transfusion is utilised as a means of combating loss of blood or shock, as after a severe accident or during a formidable operation. The use of anti-coagulants has greatly simplified transfusion, and sodium citrate is efficacious in preventing clotting, and innocuous to the patient. A solution of sodium citrate of 3·8 per cent. prevents clotting of six times the volume of blood, so that 80 to 100 ml. are necessary for the transfusion of 1 pint (568 ml.) of blood. The donor lies on a table, and a rubber tube is tied round the arm above the elbow, or a sphygmomanometer is applied, the pressure being raised to 70 to 80 mm. Hg. A small-bore needle, carrying about 10 inches (25 cm.) of rubber tubing, is inserted into a suitable vein, and the desired quantity of blood is allowed to flow into a 1,000-ml. flask, which contains the necessary amount of citrate solution. Screw-cap bottles, fitted with rubber corks, are provided by the Blood Transfusion Service for the collection of blood. Two glass tubes pass through the cork, one to act as an air vent and the other to admit the tube which withdraws blood from the donor. The risk of contamination is thus minimised, and the blood can be stored in the bottle pending use.

When prolonged transfusion is required, some apparatus which includes an interceptor is necessary, so that the flow of blood can be regulated. By means of two flasks, blood and saline can be administered simultaneously in such proportions as are most expedient, and empty flasks can be replaced without interruption of flow.

The two tubes from the containers, fitted with interceptors, are connected by a Y-shaped junction, and a single exit below leads to the patient's vein. The desired flow of blood or saline can thus be regulated.

In traumatic cases the amount of blood which should be given varies with the amount lost and the reaction of the patient. As a general rule, enough blood or fluid should be transfused to raise the systolic pressure to 100 mm. A shocked patient can safely be given 2 pints (1·14 l.) in a quarter of an hour, followed, if necessary, by further amounts at a slower rate, but hæmoglobinometer readings are necessary to regulate dosage.

Exchange Transfusion.—Replacement or exchange transfusion of an infant suffering from hæmolytic disease of the newborn may be life-saving. Rh-negative blood is used, and 5 to 10 ml. of blood are exchanged at a time. The technique is repetitive and monotonous, and as it may take several hours one person should be responsible for nothing else but checking the volumes exchanged. A syringe is used with a four-way adapter (one to baby, one to donor blood, one to citrated saline for rinsing out between each manœuvre, one to 'waste') and the transfusion, if started soon after birth, may be made via the umbilical vein (by polythene catheter passed up as far as the vena cava).

Richard Lewisohn, Contemporary, Consulting surgeon, Mount Sinai Hospital, New York, devised the citrate method in 1915.

Complications of Blood Transfusion.—The following are the more important complications of blood transfusion in order of frequency :

1. *Simple pyrexial reactions* may be due to dirty apparatus, to pyrogens in the anti-coagulant solution, to infected blood, or simply to too rapid a rate of transfusion. The more severe pyrexial reactions are accompanied by rigors.

2. *Allergic reactions* follow about 1 per cent. of transfusions, and are especially common when a patient is given repeated transfusions from the same donor. The commonest manifestation is urticaria.

3. *Hepatitis.*—Probably about 0·8 per cent. of patients receiving blood develop homologous serum hepatitis two or three months later.

4. *Right ventricular failure* is due to over-loading the circulation, especially when the cardiac muscle is enfeebled by chronic anæmia.

Patients with long-standing anæmia, especially if over the age of sixty, should not be given more than 300 ml. at one time. If anæmia is severe, packed cells should be used, i.e. the concentrated blood which remains after supernatant plasma is removed (the plasma is stored for use for the benefit of other patients).

5. *Antibody Production.*—Patients who receive repeated blood transfusions sometimes develop antibodies to many red cell antigens, and it may eventually be very difficult to find blood to which they are compatible.

6. *Incompatibility.*—These dangerous accidents should be prevented by a proper cross-matching technique, but in fact they are most often due to such human errors as wrongly labelled blood, or rightly labelled blood given to the wrong patient.

FIG. 76. — Bottle of preserved blood showing separation into corpuscular and plasma layers.

BLOOD-BANKS

The increased demand for blood has led to the establishment in suitable centres of blood-banks. The first change which occurs in stored blood is destruction of the granular cells, probably owing to proteolytic ferments which they contain, and after a week nearly all granulocytes are replaced by amorphous masses. After about a week leakage of hæmoglobin occurs from the erythrocytes, but although the red cells shrink they are not destroyed, and the vital property of ability to combine with oxygen is not seriously impaired (fig. 76). Stored blood can be transfused with safety within a month of storage, and transfusions within two months have not been followed by serious reactions.

Packed Cells.—A patient transfused for shock needs plasma more than red cells, but when the transfusion is purely for anæmia the extra plasma volume may embarrass a failing heart. In such cases it is advantageous to pipette off the supernatant plasma from a bottle of stored blood (with rigid sterile precautions) and transfuse only the red cells.

INTRAVENOUS INFUSIONS

Dextran is a complex polysaccharide of dextrose produced by the action of non-pathogenic bacteria, particularly *Leuconostoc mesenterioides*, on a substrate of sucrose and phosphate. Blood should be taken for grouping before plasma substitutes are administered, as they interfere with accurate grouping.

The organisms break sucrose into fructose and dextrose and synthesise dextran, which is composed entirely of dextrose-containing molecules of various sizes. When introduced intravenously, if the molecules are too large, they produce untoward reactions ; if they are too small, they are rapidly excreted by the kidneys. The undesirable molecules are eliminated by various processes in the manufacture of dextran.

Dextran shows little tendency to diffuse through the capillary walls, and

at least 50 per cent. of the solution should be retained in the body at the end of twenty-four hours. After that time some of it is excreted, and the remainder is katabolised slowly over about a week. These desiderata are reached by the commercial products listed in the footnote [1].

Dextran is administered in exactly the same way as plasma. It can be stated that dextran is very safe—safer than plasma or Group O blood when the time factor prevents cross-matching.

Between 1 and 2 per cent. of patients have untoward reactions during or following the infusion of dextran. This takes the form of pyrexia, with or without generalised urticaria. Possibly the patients who react have been sensitised by *Leuconostoc mesenterioides*; more probably by antigenetically [2] related pneumococci. Dextran has also a slight nephrotoxic characteristic, but the renal depression it causes is usually reversible.

According to the response of the blood pressure, the contents of one or two bottles of dextran are gravitated into a vein *comparatively quickly*. Infrequently a third bottle may be required, but *on no account must this amount be exceeded*, or the patient's blood will become so diluted that its oxygen-carrying properties will become seriously impaired. As a rule, if more fluid therapy than the contents of two bottles of dextran is required, only correctly matched whole blood should be given.

Plasma is valuable in that it can be ready for an emergency. Another is that cross-matching is unnecessary, but it carries a 1·3 per cent.[3] risk of causing virus hepatitis. Plasma is usually supplied in a dried state and can be kept almost indefinitely at room temperature. It is reconstituted by adding sterile pyrogen-free distilled water, and shaking.

Excellent results have been obtained in patients apparently moribund from shock by the intravenous administration of as much as 2, or occasionally 3, pints (1·7 l.) of plasma in half an hour, but, except in previously healthy individuals, the limit should be 2 pints (1·14 l.).

Two veins can be utilised simultaneously, or the bone marrow of the sternum offers a valuable alternative route. In cases of profound shock, although a comparatively large vein has been entered, the plasma drips into it very slowly (owing to venous spasm), whereas it runs into the bone marrow without hindrance. As the condition of the patient improves, so the flow into the vein accelerates.

Retrograde intra-arterial transfusion with correctly matched whole blood is valuable for cases of established shock. It cannot be emphasised too often that only matched blood (or in cases of desperate urgency Group O blood) must be employed for this purpose.

BLOOD

A brief summary of the *normal constituents* is included here. Examination of marrow obtained by sternal puncture has added much to our knowledge of pathological

[1] *Plasma substitutes:* 'Dextraven,' Benger Laboratories Ltd., Holmes Chapel, Cheshire; 'Intradex,' Crookes Laboratories Ltd., Park Royal, London, N.W.10; 'Plasmosan,' May & Baker Ltd., Dagenham, Essex.

[2] Antigenetic—having the properties of an antigen, an antigen being a substance which incites the formation of antibodies.

[3] If the plasma is derived from a pool of more than 10 donors, the risk rises proportionately.

conditions. For further details the reader should refer to a work on hæmatology.

Red Corpuscles.—The number varies between 5 and 6 million per c.mm. In conjunction with the number of red corpuscles present the proportion of hæmoglobin is usually estimated. The 'Colour Index' is then obtained by dividing the percentage of hæmoglobin by the number of corpuscles expressed as a percentage of the normal, and should therefore be approximately 1.

Within a few hours of a severe hæmorrhage, the volume of the blood is restored by absorption of fluid from the tissues. The red cells are replaced more rapidly than the hæmoglobin, consequently the 'Colour Index' is below 1. Hæmoglobin is replaced at an average rate of 1 per cent. each day.

Leucocytes.—Normally, 7,000 to 10,000 leucocytes are present per c.mm., and they comprise five different types :

(*a*) The Polymorphonuclear Leucocyte (63 to 72 per cent.), containing a lobed nucleus. It is formed in bone marrow, and is larger than a red corpuscle.

(*b*) The Lymphocyte (20 to 25 per cent.), with a single deeply staining nucleus smaller than a red corpuscle, and derived from lymphoid tissue.

(*c*) The large Mononuclear cell (2 per cent.), probably endothelial in origin.

(*d*) The Eosinophile Leucocyte (1 to 3 per cent.), derived from bone marrow, and has a bilobed nucleus and coarse granules.

(*e*) The Basophile, or mast cell ($\frac{1}{2}$ per cent.), constant in number and produces heparin.

Blood Platelets.—These minute bodies are formed in the bone marrow, and their normal minimum content is 230,000 per c.mm. If diminished in number, clotting is defective.

Chemical Constituents.—Calcium, phosphorus, sugar, cholesterol, and urea are the main constituents of surgical interest.

INVESTIGATIONS OF SURGICAL IMPORTANCE

(1) **Cytological.**—(*a*) *Red Cells.*—The number of cells is increased in polycythæmia and diminished in many conditions, e.g. hæmorrhage or infection. The envelope of the cell normally withstands dilution to 0·47 per cent. saline. Excessive fragility is associated with acholuric jaundice.

(*b*) *White Cells.*—Increase of polymorphonuclear cells to an extent of 15,000 per c.mm. or more is strongly indicative of suppuration, and may be of diagnostic value. Leucopœnia may be associated with typhoid fever and tuberculosis.

A relative lymphocytosis occurs in uncomplicated tuberculosis, and an absolute and sometimes enormous increase occurs in lymphatic leukæmia.

A relative eosinophilia may occur in parasitic infections, such as trichiniasis, hydatid disease, certain skin lesions, and also in anaphylactic conditions.

(*c*) *Blood platelets* (250,000 to 300,000 per c.mm.) are diminished in thrombocytopænic purpura. After splenectomy the number may increase, in which case the risk of thrombosis is present.

(2) **Colour Index.**—This is important in testing types of anæmia, e.g. it is increased in anæmia of the pernicious type and diminished in secondary anæmia.

(3) **Serological.**—This includes Widal's test, the W.R., and other complement fixation tests, and blood grouping in connection with blood transfusion.

(4) **Bacteriological.**—In septicæmic conditions the organism may be isolated from the blood by culture. In connection with the examination of films, the diagnosis of malaria and filariasis may be made.

Fernand Widal, 1862–1929. Professor of Pathology and Physician, Hôpital Cochin, Paris.

(5) **Chemical.**—The percentage of urea is an indication of the renal efficiency, and the blood-sugar curve distinguishes the true diabetic from renal glycosuria. Estimations of calcium, phosphorus, and phosphatase are of importance in the diagnosis and treatment of certain bone diseases. Hypocalcæmia occurs in acute pancreatitis.

(6) **Coagulation Time** (*syn.* Clotting Time).—This is prolonged in hæmophilia, and may be an important preliminary consideration when an operation is contemplated in the presence of jaundice. The normal coagulation time (Lee and White's method) is five to ten minutes at room temperature. It is an essential examination to control the dosage of heparin.

(7) **Blood Sedimentation Rate.**—Many pathological conditions cause an increase in the sedimentation rate, as normal cells, when damaged, act as foreign proteins. The main surgical value is that the S.R. is increased in inflammatory conditions. It is also useful as an indication of the progress of chronic infections, such as tuberculosis. The test is unreliable during infancy, pregnancy, menstruation, and if the patient is undergoing treatment by vaccines or colloidal metals. The normal sedimentation rate is 3 to 7 mm. after one hour (Westergren method). If the patient is anæmic this figure requires adjustment, as anæmia raises the B.S.R.

(8) **Prothrombin.**—Daily estimations of the prothrombin time (normally twelve to fifteen seconds) of the blood are essential if dicoumarol derivatives are administered.

ANTI-COAGULANT THERAPY

Clotting of the blood necessitates, firstly, the formation of thrombin, and, secondly, the conversion of fibrinogen into fibrin by the preformed thrombin. The various steps concerned with the formation of blood-clot can be simplified as follows :

(1) Thromboplastinogen in presence of platelet enzyme → thromboplastin.
(2) Prothrombin complex + thromboplastin = thrombin.
(3) Fibrinogen in presence of thrombin → fibrin.

The first and third reactions are enzymatic. The second is stoichiometric, i.e. the components react in fixed proportions as in any ordinary chemical reaction (E. J. Wayne).

Two types of anti-coagulant are of clinical importance, heparin and dicoumarol derivatives ; their respective advantages and disadvantages are discussed below.

Anti-coagulants are contraindicated in pregnancy, hepatic or renal deficiency, or when there is risk of hæmorrhage, e.g. within six hours of an operation, or in cases of peptic ulceration.

Heparin.—This substance is present in body tissues, especially the liver and lung. It is produced by the mast cells and prolongs the clotting time of blood. Heparin can be administered intravenously (50 mg. which equals 5,000 units) either at four-hourly intervals (as it is rapidly excreted) or by continuous infusion. In the former case polythene tubing is inserted into an arm vein, and the tube is strapped to the arm. A needle with a rubber diaphragm is attached to the free end of the tube, through which the heparin

R. I. Lee, Contemporary. Physician, Massachusetts General Hospital.
P. D. White, Contemporary. Lecturer in Medicine, Harvard Medical School.
Alfred W. A. Westergren, Contemporary. Lecturer in Medicine, Medico-kirurgiska Institut, Stockholm.
E. J. Wayne, Contemporary. Physician, Royal Infirmary, Sheffield.

is injected every four hours. Intramuscular injections, 15,000 units six-hourly, give good results, but are sometimes painful.

Heparin is an anti-thrombin and its effect is measured by prolongation of the coagulation time, which should be fifteen to thirty minutes by the Lee and White technique two hours after an injection. The rapid excretion of heparin and consequent variation in the coagulation time make accurate control difficult. Heparin exerts its full effect within two hours, but frequent injections are necessary and control is difficult.

Overdosage leads to hæmorrhage, but the effect can immediately be neutralised by an intravenous injection of protamine sulphate. Each ml. of a 1 per cent. solution neutralises 1,000 units of heparin.

Dicoumarol is now little used, since it takes two or three days to exert its effect, which persists three to seven days after ceasing administration. Thus the effects of overdosage are dangerously prolonged.

Dindevan, like all dicoumarol derivatives, depresses the blood level of the prothrombin complex. It exerts a full effect thirty-six to forty-eight hours after starting therapy, and for twenty-four hours after stopping. A loading dose of 100 to 150 mg. is given in divided doses. Prothrombin is estimated on the third day, and the amount given is then revised if necessary. Control is effected by estimation of the prothrombin time, which should be prolonged to two to three times the normal. The interval between estimations may be lengthened when a stable dose is found.

Overdosage is shown by hæmorrhage, especially hæmaturia. Vitamin K_1 (*not* the analogues) very quickly reverses the effects of dicoumarol derivatives. It is usually enough to give 10 mg. by mouth, but if the bleeding seems dangerous it may be administered by intravenous injection.

Combined Therapy.—The advantages of the above agents are utilised and their disadvantages are avoided if they are used successively. Heparin is injected for its rapid effect, and at the same time dindevan is given to lower the prothrombin. When it is judged that the dicoumarol derivative has exerted a full effect, the heparin injections are stopped and control is effected by prothrombin estimations. It must be remembered that prothrombin estimations are not valid within six hours of an injection of heparin.

HÆMOPHILIA

Hæmophilia is a hæmorrhagic diathesis caused by deficiency in the blood of a specific clotting factor known as the antihæmophilic globulin (AHG). This factor is concerned with the generation of thromboplastin, that activates prothrombin to thrombin. Females transmit the condition, but escape the disease, all sufferers being males. The incidence of hæmophilia is highest amongst Anglo-Saxon and Teutonic races; it occurs in Jews, but Latin races are apparently exempt. The well-known affection of the Spanish royal family was transmitted from the Hapsburgs.

The treatment of this condition is difficult, as the only effective method is by supplying absent AHG. This can be accomplished by giving (*a*) *fresh* blood, or plasma if prepared correctly; (*b*) by the administration of human, or better, animal AHG. It should be noted that stored blood is valueless, except to replace red cells. Animal AHG is now obtainable from several laboratories, notably the Pathological Department of the Radcliffe Infirmary, Oxford.

Christmas disease[1] is clinically indistinguishable from hæmophilia, and is due to absence of plasma-thromboplastin component. The accurate differentiation between these two diatheses can be accomplished only by the thromboplastin generation test, a time-consuming and specialised investigation. As, surgically, these diseases present as emergencies, the treatment for both should be compatible, fresh, whole blood. It should be emphasised that Christmas disease will not respond to AHG; once the diagnosis has been established, Christmas disease can be effectively treated with stored blood.

Fibrinopænia sometimes follows childbirth or thoracic operations with massive hæmorrhage, without previous history of bleeding episodes. Fibrinopænia should be treated with fibrinogen, either as a purified product or as triple-strength plasma.

HÆMOPHILIC JOINTS

In hæmophilia recurrent spontaneous hæmarthrosis is a very common incident. Strangely enough, the hæmarthrosis seems to affect certain particular joints and will often recur repeatedly in one joint, leaving other joints of the body free. The knee is the commonest site for hæmophilia and frequently recurrent hæmarthroses will occur unilaterally. The joint becomes tense and swollen and sometimes the skin is discoloured over it. Repeated effusions of blood into such a joint result in considerable disorganisation, and X-ray changes may be very puzzling unless the history of hæmophilia is known. The end-result is frequently a fibrous ankylosis.

HÆMORRHAGE

Hæmorrhage is arterial, venous, or capillary; the first variety is either primary, reactionary, or secondary in nature. If hæmorrhage is severe, the blood pressure falls, although it is partially maintained by absorption of body fluids and vasomotor constriction of the arterioles. A further result is loss of the oxygen-carrying hæmoglobin, so that tissues are deprived of oxygen. In severe cases the patient complains of thirst and impending suffocation (air hunger), and later of tinnitus (buzzing in the ears) and blindness. The pulse is rapid and easily compressible, and increasingly dicrotic as the arteries empty. The patient is restless, clammy and pallid.

Natural arrest of hæmorrhage is encouraged by increased coagulability of the blood, diminution in the force of the heart's action, and changes in the divided vessel. Thus, in the case of a completely divided artery, the elastic coat retracts within the sheath, and partially blocks the lumen, and clotting occurs as far as the distal branch, but if an artery is incompletely divided this retraction cannot occur and bleeding is encouraged. Permanent occlusion follows organisation of this intravascular clot.

ARTERIAL HÆMORRHAGE

Primary.—In cases of emergency, the external hæmorrhage can be arrested temporarily by direct digital pressure, and if from a limb, a tourniquet can then be applied. This should not be allowed to remain in position for an interval of more than thirty minutes without being loosened, and it is then tightened again if necessary. If hæmorrhage occurs from a limb, elevation discourages the loss of blood. Arrangements are then made for transport to a hospital, where the wound is explored and every effort made to ligate both ends of the divided artery.

Reactionary hæmorrhage occurs within twenty-four hours, and is due

[1] So-called after the first patient in whom the disease was discovered.

Ambroise Paré, 1509–1590. French Surgeon; first to ligate arteries. Stated, "I dressed his wounds, but God healed them."

to 'slipping' of a ligature, or dislodgment of a clot which occludes a divided vessel, owing to rising blood pressure concomitant upon recovery from shock. It is more likely to arise from small vessels (as bleeding from large vessels has probably been adequately arrested). If persistent, the vessel must be sought and ligated, or controlled by a stitch, otherwise the wound is cauterised, packed or resutured. Reactionary venous hæmorrhage is apt to occur within a few hours of operations on the thyroid gland, as coughing or vomiting causes acute engorgement of the deep veins of the neck.

Secondary hæmorrhage is due to infection and sloughing of part of the wall of an artery. It is predisposed to by pressure of a drainage tube or fragment of bone, or excessive separation of the sheath of an artery during ligation. Internal secondary hæmorrhage occurs in connection with a chronic peptic or typhoid ulcer, and phthisis.

In an infected wound or amputation stump, 'warning' hæmorrhages usually occur in the form of bright red stains on the dressing about the tenth day. Repeated losses, or a sudden severe hæmorrhage, may prove fatal.

When a definite warning hæmorrhage occurs, the wound should be freely opened, sloughs removed, and an attempt made to recognise and ligate the bleeding vessel. Failing this, the wound is packed with oxycel or other absorbable gauze, or with gauze moistened with a styptic, such as turpentine. Should hæmorrhage recur, then the main vessel of the limb is ligated (ligation in continuity), or amputation performed.

This 'warning' hæmorrhage often occurs in the case of peptic ulcers, and is a danger signal which it is imprudent to ignore, as massive hæmorrhage may follow in a few hours.

VENOUS HÆMORRHAGE

Venous bleeding is troublesome in certain situations, e.g. during dissection of nodes of the neck, as the welling blood obscures the precise source of hæmorrhage. It is important to divide no tissue under traction, as veins are thereby emptied and rendered unrecognisable. If large veins are injured, a lateral ligature can sometimes be applied without occluding the whole lumen. The entrance of air into veins is a rare event, but can occur in connection with large veins in which the pressure is below that of the atmosphere, e.g. the axillary vein, or if veins are attached to deep fascia and consequently cannot collapse when divided, notably the external jugular. The aspiration of air may be audible, and is followed by collapse of the patient, as the air is churned up with blood in the right side of the heart and impedes the circulation. Treatment consists in the immediate arrest of further entry by digital pressure, or flooding the wound with saline, and combating the collapse by posture and anti-shock measures.

ARTERIES

Injury.—An artery is sometimes ruptured subcutaneously, e.g. the popliteal in the case of a dislocated knee, or divided in a penetrating or incised wound.

In the former case a rapidly increasing swelling occurs, which may pulsate. The distal signs depend upon the degree of circulatory disturbance, and pressure on nerves may cause paræsthesia or pain. Distal pulsation is commonly absent.

If swelling increases, local infection or distal gangrene is liable to supervene. If coagulation occludes the rent and collateral circulation is efficient, the extravasated blood may organise and the limb retain its vitality.

In the case of injury to a large artery, operation should be performed, and the vessel exposed. A temporary tape ligature, or preferably a Crile's clamp (fig. 84), controls the circulation, and if possible the rent is sutured with fine silk. The judicious administration of heparin discourages intravascular clotting. End-to-end suture or grafting (p. 95) have been successfully accomplished, relaxation being obtained by posture. If the laceration is extensive, a Tuffier's tube can be introduced into the two ends as a temporary measure, in order to allow collateral circulation to become established. If these measures are impracticable autogenous vein grafting may be possible, otherwise the vessel is completely divided if it is not already severed, and the ends are ligated.

ANEURISM

An aneurism is a sac filled with blood in direct communication with the interior of an artery. A *true* aneurism is due to dilatation of an artery, whereas a *false* aneurism is a sac lined by condensed cellular tissue which communicates with the artery through an aperture in its wall.

1. **True aneurisms** are fusiform, saccular, or dissecting.

A *fusiform* aneurism is one in which the lumen is more or less equally expanded, and was formerly a common result of syphilitic mesarteritis (fig. 77).

MYCOTIC ANEURISMS arise as a result of bacterial endocarditis, and any of the large arteries may be affected. Before the advent of antibiotics these aneurisms were only incidental events in a fatal disease, but now that bacterial endocarditis is curable mycotic[1] aneurisms are of practical importance, as the majority can be cured by adequate surgical measures. Any of the larger arteries may be involved, especially the femoral and the superior mesenteric. Localised pain is the early symptom, followed, in superficial arteries, by the appearance of a pulsatile swelling. The usual treatment is proximal ligation and division of the vessel (see page 93), and this has been accomplished successfully even when the superior mesenteric artery was involved. In the case of the limbs, subsequent circulatory trouble is unlikely, as the condition mainly affects the younger age group, who readily develop an efficient collateral circulation.

FIG. 77.—Aortic aneurism which has eroded the sternum.

A *saccular* aneurism is due to stretching of part of the arterial wall, and commonly follows injury such as a penetrating wound. It usually occurs in

[1] 'Mycotic' is a misnomer, as the disease is not due to a fungus but to bacterial infection.

George W. Crile, 1864–1943. Professor of Clinical Surgery at the Western Reserve Hospital, Cleveland, Ohio.
Théodore Tuffier, 1857–1929. Surgeon, Pitié Hospital, Paris.

FIG. 78.—Saccular aneurism of the radial artery.
(*Professor Toufeeg, Lahore, Pakistan.*)

a superficial artery (fig. 78).

Dissecting aneurisms occur in the abdominal aorta, and are due to separation of an atheromatous plaque, which allows blood to insinuate itself between the inner and outer parts of the muscular coat. It is usually a post-mortem finding, unless leakage causes symptoms suggestive of an abdominal catastrophe, when laparotomy discloses an extensive retroperitoneal hæmorrhagic effusion.

Clinical Features.—(*a*) *Intrinsic.*—A swelling exhibiting expansile pulsation is present in the course of an artery. The pulsation diminishes if proximal pressure can be applied, and the sac itself is compressible, filling again in two or three beats if proximal pressure is released. A thrill may be palpable, and auscultation sometimes reveals a bruit.

(*b*) *Extrinsic.*—Neighbouring or distal structures are affected. Thus pressure on veins or nerves causes distal œdema or altered sensation, and the pulse is delayed or smaller in volume. Bones, joints, or tubes, such as the trachea or œsophagus, are sometimes affected, but structures which are resilient, such as the intervertebral discs, often withstand prolonged pressure.

Differential Diagnosis.—1. *Swelling under an Artery.*—An artery may be pushed forwards, e.g. the subclavian, by a cervical rib, and thus rendered prominent. Careful palpation distinguishes this condition.

2. *Swelling over an Artery.*—In this case transmitted pulsation is liable to be mistaken for that caused by expansion. However, proximal pressure does not reduce the size of the tumour, and posture may diminish pulsation; thus a pancreatic cyst examined in the genupectoral position falls away from the aorta, and consequently pulsation is less definite.

3. *Pulsating tumours*, such as secondary carcinoma of bone, or an osteoclastoma.—The swelling is irregular in consistency and indefinite in outline.

4. *Other causes of Deep-seated Pain.*—Cases of alleged intractable neuralgia, sciatica, etc., are occasionally due to aneurism.

FIG. 79.—Aneurism of the aorta. Extensive clotting in the sac has almost resulted in spontaneous healing.

Natural Terminations.—1. *Spontaneous Cure.*—This sometimes occurs in cases of saccular aneurism, due to gradual clotting in the sac (fig. 79).

2. *Infection.*—Occasionally follows operation, or arises from organisms in the blood-stream. Signs of inflammation supervene and, if untreated, suppuration and rupture follow.

3. *Rupture.*—This occurs either slowly as a leakage, or suddenly, in which case death follows in a few moments if a large vessel is involved.

Treatment.—*General.*—The patient's habits must be regulated, so as to avoid all physical and mental strain. A limited nitrogenous diet and minimum of fluid is allowed.

Local.—(*a*) Matas's operation. In selected cases of saccular aneurism, reconstruction has been attempted. The sac is opened, and the margins of the aperture approximated by stitches. Obliteration of the artery usually follows, but if the vessel remains patent, there is a risk that the weak fibrous suture line will subsequently yield, leading to recurrence.

In cases of fusiform aneurism the sac is sometimes obliterated by opening the sac, ligating the main vessel above and below from within, and inserting purse-string sutures to approximate the walls.

(*b*) Excision and grafting. Arterial grafting is now an accepted surgical procedure, and is the ideal treatment when local conditions permit (p. 95).

(*c*) Excision of the sac. This is usually satisfactory when access can be obtained. The artery is ligated above and below, and the intervening sac removed by dissection. If adhesions cause difficulty, the sac should be opened in order to define its limits more clearly. Even if part of the accompanying vein is removed, gangrene is unlikely, as both venous as well as arterial collateral circulations are probably efficiently established.

(*d*) Encouragement of clotting. Deposition of fibrin within the sac and subsequent organisation will result in cure of the aneurism. Intermittent proximal pressure was formerly much used, either digital or by a bag of shot, but this method is very uncertain.

If practicable, proximal ligation is the common method now pursued if excision is impracticable. Anel's operation (fig. 80) consists in tying the artery immediately on the cardiac side of the aneurism, whereas Hunter placed his ligature so that one branch intervened between it and the aneurism; e.g. if the femoral artery is tied in Hunter's canal, the anastomotica magna artery intervenes between the ligature and a popliteal aneurism. Hunter's operation necessitates the development of two systems of collateral vessels, i.e. one system to circumvent the ligature and a second to carry blood past the aneurism. This method therefore imposes a greater strain on the nutrition of the limb, and should not be used if gangrene threatens, or if marked arterial degeneration is present. On the other hand, the flow of blood through the aneurism is slowed more gradually than by Anel's method, and therefore the resultant clot will be firmer.

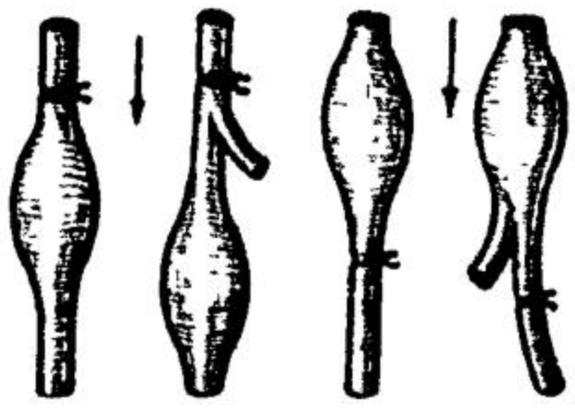


FIG. 80.—Operations on aneurisms. 1. Anel. 2. Hunter. 3. Brasdor. 4. Wardrop.

Distal ligation is practised for aneurisms anatomically situated so that proximal ligation is impossible, e.g. the vessels at the root of the neck. Brasdor ligated the artery close to the sac. In Wardrop's operation the ligature is placed so that one or more branches remain between the aneurism and the ligature (fig. 80).

Rudolph Matas, 1860–1957, of New Orleans, U.S.A., introduced aneurismorrhaphy in 1908
Dominique Anel, 1679–1730. Surgeon, Toulouse, France.
John Hunter, 1728–1793. Surgeon, St. George's Hospital, London. Founder of the Hunterian Museum.
Pierre Brasdor, 1721–1797. Professor of Surgery and Anatomy, Paris.
James Wardrop, 1782–1869 An Edinburgh graduate who became Surgeon-in-ordinary to George IV.

After ligation the pulsation of the aneurism usually disappears. Temporary return in two or three days indicates establishment of collateral circulation. If the pulsation persists or appears at a later date, further operative interference will probably be necessary.

(*e*) When the above methods are impracticable, the introduction of foreign bodies into the sac should be considered. For example, cœliac aneurisms have been cured by the introduction of wire through a special cannula.

(*f*) Amputation is required if infection or hæmorrhage occurs, or if gangrene supervenes. This procedure is also advisable if the function of the limb is seriously impaired by involvement of bones or joints, and amputation through the shoulder has been undertaken in the hope of curing a subclavian aneurism, a procedure akin to Brasdor's operation.

2. False Aneurisms

These are traumatic in origin, and the extravasated blood is enclosed in a false sac of condensed cellular tissue. In the case of large vessels, unless infection threatens or the aneurism rapidly increases in size, palliative measures should be adopted temporarily, so that collateral circulation can develop. Subsequently, the sac is opened and emptied, and the injured artery tied above and below the site of trauma.

Arterio-venous Aneurism.—This condition is usually due to a penetrating wound injuring an artery and vein lying in close contact, e.g. the common carotid artery and internal jugular vein. A communication between the internal carotid artery and the cavernous sinus sometimes follows a fractured base of the skull. Two conditions may result.

(*a*) *Aneurismal varix.*—This consists of a communication between an artery and vein, the latter becoming dilated and varicose as a result of the abnormal intravenous pressure. It is sometimes congenital, in which case it may cause overgrowth of a limb. On palpation a thrill is usually detected, and auscultation reveals a buzzing bruit. This condition often remains stationary.

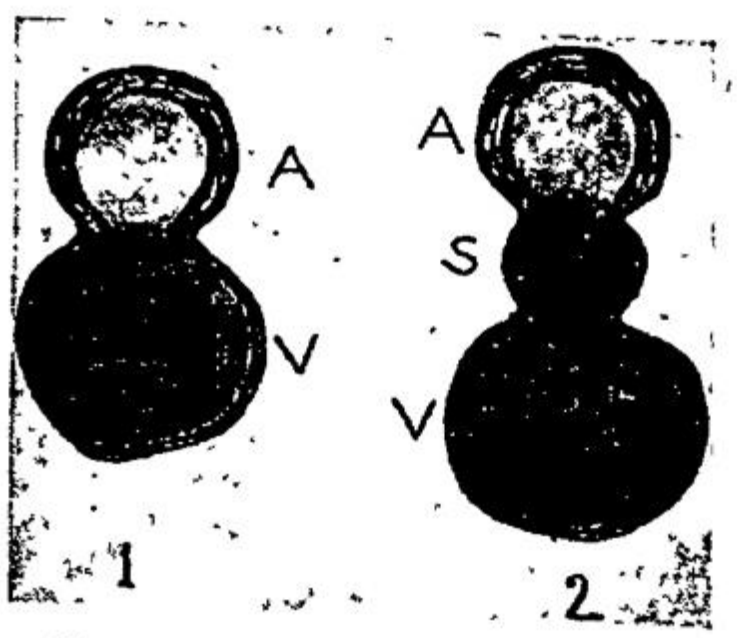


FIG. 81.—1. Aneurismal varix. 2. Varicose aneurism. A = artery, V = vein, S = sac.

(*b*) *Varicose aneurism*, which differs from the above in that a sac exists between the two vessels (fig. 81). This sac is merely composed of condensed cellular tissue and organised clot, so that it tends to enlarge and become diffuse. The physical signs resemble those of an aneurismal varix, with the addition that the intervening sac may be palpable. In both conditions some degree of tachycardia is usually present, owing to the mixing of venous with arterial blood.

As this condition is progressive, surgical treatment is indicated. The vessels are separated, and, if possible, repaired by suturing, the intervening sac being excised. More frequently quadruple ligation is necessary.

In the case of arterio-venous aneurism of the internal carotid artery and

cavernous sinus, ligation and division of the common carotid artery may diminish the pulsating exophthalmos and relieve the continuous buzzing, provided that these features are improved by compression of the common carotid artery against Chassaignac's tubercle, which is situated on the transverse process of the sixth cervical vertebra.

Ligation and division of the common carotid artery is a much safer procedure than the formerly recommended operation of ligation of the internal carotid, which procedure is likely to be followed by cerebral embolism. Lambert Rogers collected a series of thirty cases in which the common carotid was ligated with no mortality. Severance of the artery after double ligation diminishes the risk of thrombosis and embolism, and also of spasm of the distal part of the artery.

ARTERIOGRAPHY

This procedure furnishes information concerning the course and size of arteries, constrictions or dilatations, and the vascular pattern in the case of tumours. Diodone (70 per cent.), or pyelosil (30 per cent.), are satisfactory contrast media.

If the artery is easily palpable and presumably healthy, percutaneous injection is satisfactory, but exposure of the artery is advisable in fat patients or those suffering from arteriosclerosis, so that calcareous plaques can be avoided.

Aortography is accomplished by one of two methods:

(i) The retrograde route *via* a catheter, which is passed along either the common carotid or brachial artery. This is the method of choice for the thoracic aorta and its branches.

(ii) The translumbar route, in which the abdominal aorta is punctured by a needle either above or below the renal arteries. It is important to confirm that the end of the needle is in the lumen of the vessel, as dissecting aneurisms can occur if the bevel of the needle is partly in the wall of the artery.

FIG. 82.—Aortogram showing thrombosis of the left common iliac artery. *(Dr. R. Gottlieb, Vienna.)*

Aortograms are valuable for detecting abnormalities of organs, especially the kidneys, and in locating obstructive lesions in the arteries of the lower limbs (fig. 82).

ARTERIAL GRAFTING

As a result of refinements in technique, arteries removed aseptically within six hours of death from a healthy person can be stored without apparent deterioration for years by means of refrigeration. An alternative method now favoured by most technicians is freeze-drying, after which the homografts can be stored at room temperature and can be transported to different hos-

Marie Chassaignac, 1806–1879. Professor of Surgery and Anatomy, Paris.
Lambert Rogers, Contemporary. Professor of Surgery, University of Wales, Cardiff.

pitals as necessary. The encouraging results of arterial grafting will doubtless stimulate the formation of blood-vessel banks in the larger surgical centres.

Arterial homografts are used for the repair of injured vessels, and to replace segments of arteries involved by aneurism or thrombosis, and which it is anatomically possible to excise. In cases of intermittent claudication or threatened gangrene due to arterial obliteration an arteriogram may show that only a segment of the vessel is affected, in which case successful arterial grafting may restore adequate circulation.

See also Chapter 46.

Technique.—The vessel is exposed, separated from any adjacent veins or nerves, and clamped above and below the affected segment, which is then excised. The graft is cut to a suitable length, slightly shorter than the gap it is intended to bridge, so that it will be under slight tension, which diminishes the risk of thrombosis or aneurism. The adventitia is trimmed from the ends so as to avoid the possibility of fringes projecting into the lumen during suture, with consequent risk of thrombosis. The graft and vessel are anastomosed by a continuous everting mattress suture of fine silk. Some surgeons now favour a plastic prosthesis rather than an arterial graft. In the case of aortic grafts hypothermia is of value. Following the grafting of any large artery the patient should take dicoumarol or similar preparation permanently.

It is advisable to use heparin when grafting is performed for arteriosclerosis. In all cases an adequate blood pressure must be maintained so that there is a copious flow of blood through the graft, and therefore blood transfusion is usually advisable. In the case of injury and loss of tissue in healthy vessels, a segment of long saphenous vein can be utilised as an autograft if no arterial bank is available.

EMBOLISM

An embolus is a foreign body which circulates in the blood-stream, becoming finally lodged in a vessel and so causing obstruction. Their effects vary according to their size, type, efficiency of the collateral circulation, and the nature of the organ in which they are arrested, highly specialised structures, such as the brain or retina, being readily affected by circulatory changes. Emboli are simple, infective, malignant, or parasitic.

Simple emboli are due to blood-clot, vegetations from cardiac valves, an atheromatous plaque, air bubbles (p. 98), or globules of fat. Clots of blood originate in thrombosed veins or the auricular appendage. In the latter site, mitral stenosis or auricular fibrillation predisposes to their formation, which is also encouraged if fibrillation is treated with quinidine.

FAT EMBOLISM occasionally follows severe injury to bone marrow or adipose tissue. It is especially liable to occur after fracture of atrophic bones, as these bones contain more than the normal amount of fat. Cases have been recorded following convulsive therapy. Symptoms supervene three or four days after injury, and two more or less distinct types, cerebral and pulmonary, are recognised. In the cerebral type the patient becomes drowsy, restless, and disorientated (delirium tremens may be suspected). Subsequently he is comatose, the pupils become small and pyrexia ensues. The pulmonary type is ushered in with cyanosis, which increases in intensity, and signs of right heart failure.

In suspected cases the sputum should be examined for fat droplets, and later fat may be excreted in the urine. Petechial hæmorrhages sometimes occur. Oxygen therapy is valuable, and intravenous sodium desoxycholate (10 ml. of 20 per cent. solution), in a drip infusion every two hours, is worthy of trial. This increases the emulsifying power of the blood and reduces the size of fat globules. Larger doses cause hæmolysis.

Infective emboli consist of masses of bacteria or infected clot, and may cause mycotic aneurisms (p. 91), pyæmia, or infected infarcts.

Malignant emboli are more commonly sarcomatous than carcinomatous, and give rise to secondary deposits, unless sufficient blood is extravasated to isolate the malignant cells from normal tissue, a phenomenon which sometimes occurs in connection with chorion-epithelioma.

Parasitic emboli are due to the ova of *Tænia echinococcus* and *Filaria sanguinis hominis*.

In some situations the results of embolism are characteristic, e.g. :

BRAIN.—The middle cerebral artery is most commonly affected, resulting in hemiplegia, temporary or permanent.

RETINA.—Occlusion of the central artery causes a momentary flash of light, followed by total and permanent blindness.

SPLEEN.—This organ is commonly affected, in which case local pain and enlargement follow.

KIDNEYS.—Resulting in pain in the loin and hæmaturia.

MESENTERIC VESSELS.—Causing engorgement and gangrene of the corresponding loop of intestine.

ABDOMINAL AORTA.—Resulting in loss of power and anæsthesia in the legs.

LUNG.—Pulmonary embolism (Chapter 43) is a catastrophe which may fatally interrupt convalescence after operation. Fortunately the incidence is diminished by anti-coagulation therapy.

FIG. 83.—Embolus removed successfully from the bifurcation of the popliteal artery. *(Mr. A. H. Southam, Manchester.)*

LIMBS.—An embolus is arrested at the bifurcation of a main vessel (fig. 83), causing pain, pallor, paralysis, and loss of pulsation, followed in most cases by transient congestion and, commonly, moist gangrene ; very occasionally spontaneous recovery ensues. More than half the cases involve the femoral artery, after which, in probable order, the common iliac, brachial, popliteal, and aorta are affected. Heparin (100 mg.) should be given intravenously as a first-aid measure, and if there is no improvement after two hours embolectomy must be performed.

Embolectomy.—Local or spinal anæsthesia is to be preferred because of the condition of the patient's cardiovascular system. The artery is exposed and occluded above the site of the embolus either by a Crile's clamp (fig. 84), or by a tape saturated in 3 per cent. sodium citrate. A half-twist of the tape occludes the flow of blood, and traction on the tape steadies the vessel. The adventitia is carefully re-

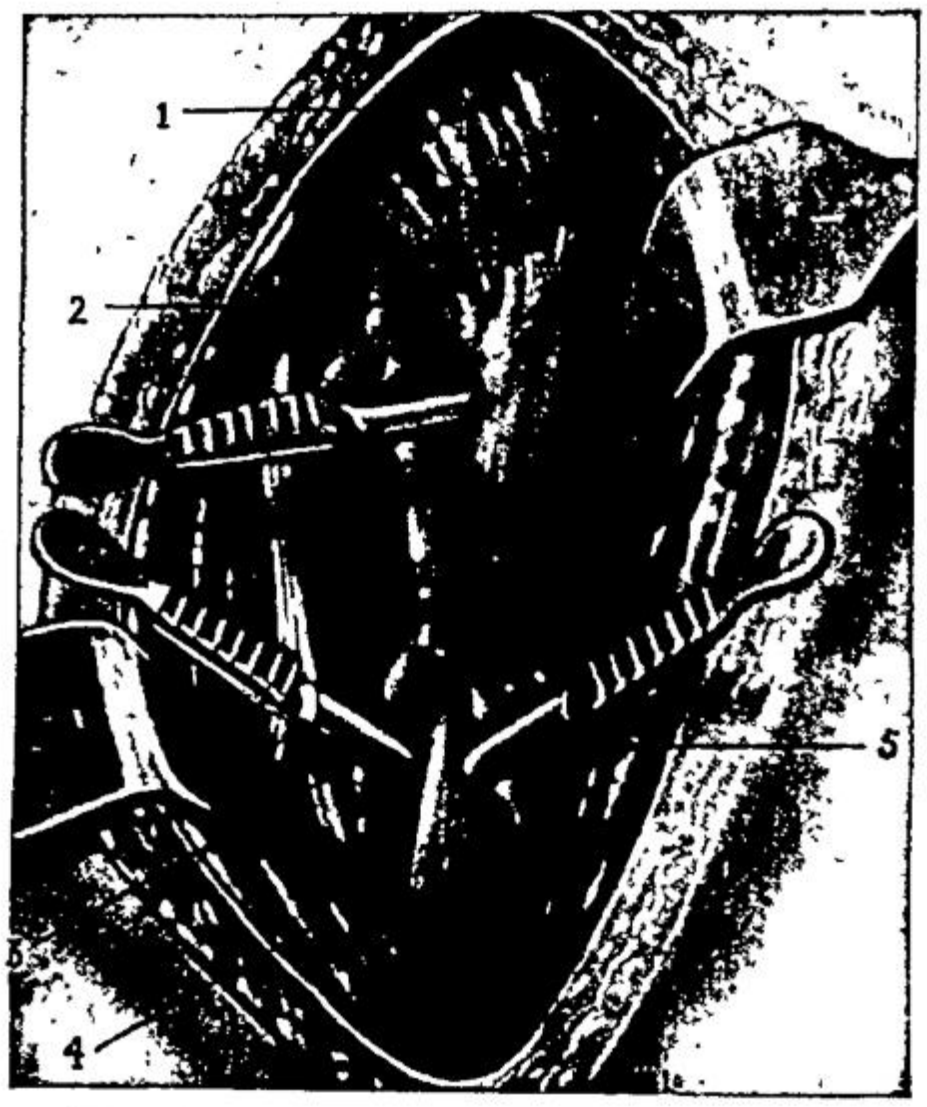


FIG. 84.—Embolectomy of the brachial artery. Crile's clamps have been applied to the brachial, radial, and ulnar arteries. 1. Biceps muscle. 2. Brachial artery. 3. Median nerve. 4. Pronator radii teres. 5. Brachio-radialis.

moved, otherwise strands are apt to be drawn into the lumen during suture, and so encourage thrombosis. A longitudinal incision is made just above the obstruction, care being taken not to injure the intima on the opposite wall. The embolus is removed by 'milking' the artery upwards, and the incision is closed with fine needles threaded with waxed Chinese silk (size ooo), the stitches passing through all coats of the vessel. During the operation the surgeon's hands and instruments are frequently rinsed in citrate solution, and afterwards the limb is kept warm and at rest for a week. Operations in the first four hours result in 62 per cent. of cures, the second four hours 50 per cent., but the third four hours only 24 per cent. Embolectomy gives better results in the arm than in the leg. Intravenous injection of heparin (50 mg. four-hourly for three doses) helps to obviate post-operative thrombosis.

AIR EMBOLISM

Venous.—Air is occasionally sucked into an open vein or accidentally injected into the venous circulation. Thus venous air embolism occasionally complicates operations on the neck or axilla if a large vein is inadvertently opened, and it may be an accessory cause of death following a cut throat. The risks associated with intravenous infusion are so well known that this cause is uncommon, especially if a drip chamber is used containing a conical glass float which plugs the exit when fluid falls to a dangerous level.

If sufficient air enters the systemic circulation, the right side of the heart becomes filled with air so that entry of blood from the systemic veins is impeded, and the patient dies of acute right-sided heart failure.

Arterial.—During artificial pneumothorax air may be injected into a pulmonary vein, and so gain entrance to the left side of the heart, and this complication occasionally follows operation on the lungs. Paradoxical embolism is due to a patent foramen ovale, as no appreciable amount of air from the right side of the heart can pass through the capillaries of the lungs. Air which enters the systemic circulation is liable to cause coronary or cerebral symptoms.

Clinical Features.—Acute heart failure from obstruction of the pulmonary artery has already been referred to. Air in the left heart may gain entry to the coronary arteries and cause acute myocardial failure. Cerebral embolism results in dizziness, visual disturbances, and unconsciousness. Mottling of the skin of the head and shoulders is often noticed in cases of arterial air embolism.

Treatment.—The foot of the bed is raised in order to hinder bubbles of air from reaching the cerebral vessels, and the patient is turned on to his left side, because, in the case of left-sided air embolus, owing to the site of origin of the coronary arteries, air is less likely to enter these vessels if the

patient is reclining on the left side. Also, in cases of right-sided air embolism this position encourages an air bubble to float into the apex of the right ventricle and cease to obstruct the flow of blood along the pulmonary artery. Aspiration of air from the right ventricle is worth attempting in desperate cases.

Inhalation of oxygen should be administered in order to counteract anoxæmia and assist in the excretion of nitrogen. Artificial respiration may be required, and a tracheostomy should be performed if obstruction to the airway cannot otherwise be relieved.

VEINS

Thrombosis of veins is predisposed to by :

(1) Change in the vessel wall, causing desquamation of endothelium, e.g. inflammation or injury. Thrombosis of the axillary vein is not uncommon, and can occur after unaccustomed use of the corresponding arm. 'Spontaneous' thrombosis may be due to a pyjama sleeve becoming twisted around the axilla during heavy slumber, with consequent compression of the vein. Thrombosis of the axillary vein results in venous œdema of the arm, with dilatation of the collateral veins (fig. 85). The condition usually subsides within three months.

(2) Diminished rate of blood flow, as in debilitating conditions, such as myocardial degeneration or typhoid fever.

(3) Increased coagulability of the blood, such as occurs in infective conditions, or after hæmorrhage. Some such blood change is the probable explanation of Trousseau's sign—thrombosis of superficial veins in association with visceral carcinoma.

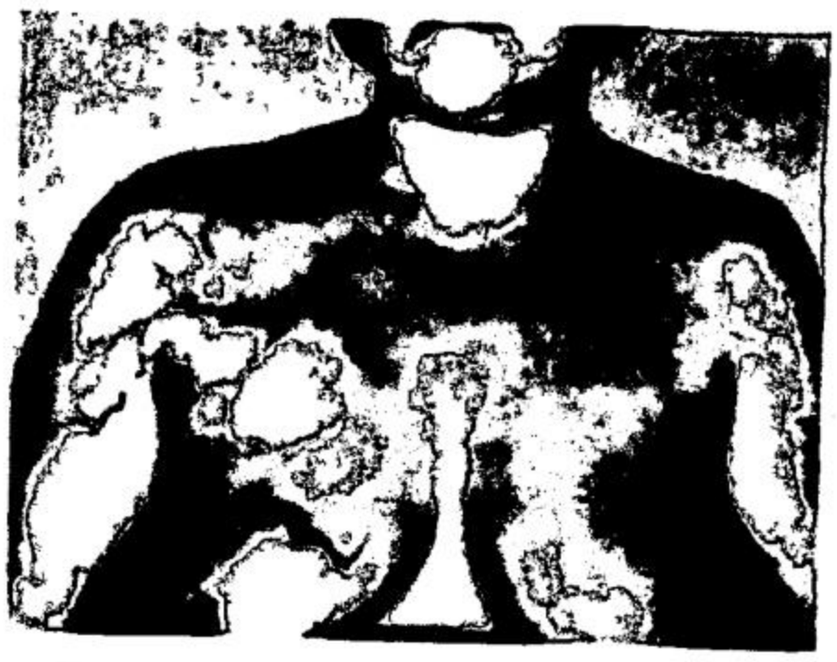


FIG. 85.—Infra-red photograph showing collateral venous circulation following thrombosis of the axillary vein. *(Mr. Max Pemberton, Enfield, London.)*

The *results* of thrombosis are as follows :

(1) *Locally*.—The clot may organise into fibrous tissue, which possibly later becomes canalised. Calcification occasionally follows, resulting in the formation of a phlebolith, so commonly seen in pelvic veins. Suppuration sometimes occurs, forming a localised abscess, or giving rise to pyæmia.

(2) *Distally*.—Œdema may occur, the degree depending on the size of the vessel affected. The collateral circulation is soon established, as may be evinced by widespread varicosity of the superficial veins.

(3) *Proximally*.—Thrombosis may extend upwards to larger veins, and portions of clot are liable to become detached, particularly if infected. The resultant emboli may cause pulmonary infarcts, or, if the portal area is affected, multiple foci of infection will riddle the liver.

Thrombosis of deep veins is a troublesome post-operative complication which is sometimes the forerunner of pulmonary embolism. In suspected or established cases anti-coagulants should be employed (p. 87).

Armand Trousseau, 1801–1867, Physician, Hôtel-Dieu, Paris, noted this sign as his own death warrant, as it confirmed his suspicion of gastric carcinoma.

Thrombophlebitis migrans, as the name implies, is a condition in which successive thrombosis occurs in veins in many parts of the body. Pulmonary veins may be involved, and local congestion of the lung results in pleurisy and possibly an effusion. Symptoms sometimes suggest that a coronary vein is implicated. As in the case of thrombosis of deep veins, some elevation of temperature is to be expected. In one case under our observation the disease lasted for over a year before subsiding.

VARICOSE VEINS

A vein is stated to be varicose when it is dilated, lengthened, and tortuous. The condition commonly occurs in connection with the veins of the leg, also the spermatic, œsophageal, and hæmorrhoidal veins are frequently affected. The three latter conditions are dealt with elsewhere.

Ætiology.—Varicose veins are part of the penalty we pay for the adoption of the erect posture. Animals do not suffer from this condition. The precipitating cause is a failure of one of the valves guarding the many communications between the superficial and deep venous systems of the leg, most commonly the sapheno-femoral valve lying at the junction of the internal saphenous and common femoral veins, 1 inch (2·5 cm.) distal to the midinguinal point. Next in order of frequency comes the sapheno-popliteal valve, leading to dilatation of the external saphenous system. It must be emphasised that varices may commence at the site of any incompetent communicating vein, either alone or in conjunction with one of the above (fig. 86).

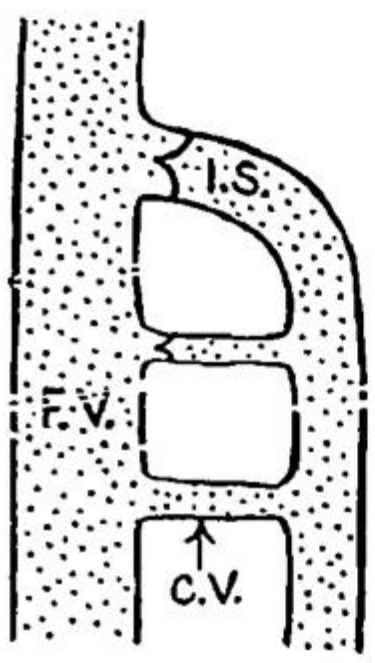


FIG. 86. — A valveless communicating vein (C.V.).

Varicose veins of the leg are sometimes associated with a congenital deficiency of the valves, or muscular coat, the condition occurring early in life and involving the same group of veins in members of the same family. Varicosity is predisposed to by any obstruction which hampers venous return, e.g. tumours and pregnancy. The condition may be widespread in both legs, or a single varix is sometimes present. If this is situated close to the saphenous opening, it is readily distinguished from a femoral hernia on account of the characteristic thrill when the patient coughs.

Symptoms.—The word ' saphenous ' is of Arabic derivation and means ' seen easily.' Thus a number of patients present themselves for treatment for cosmetic reasons alone, and examination reveals a centripetal venous flow with no incompetent superficial-deep valves. These cases, in general, are better left untreated, but if considered desirable, injection is the method of choice.

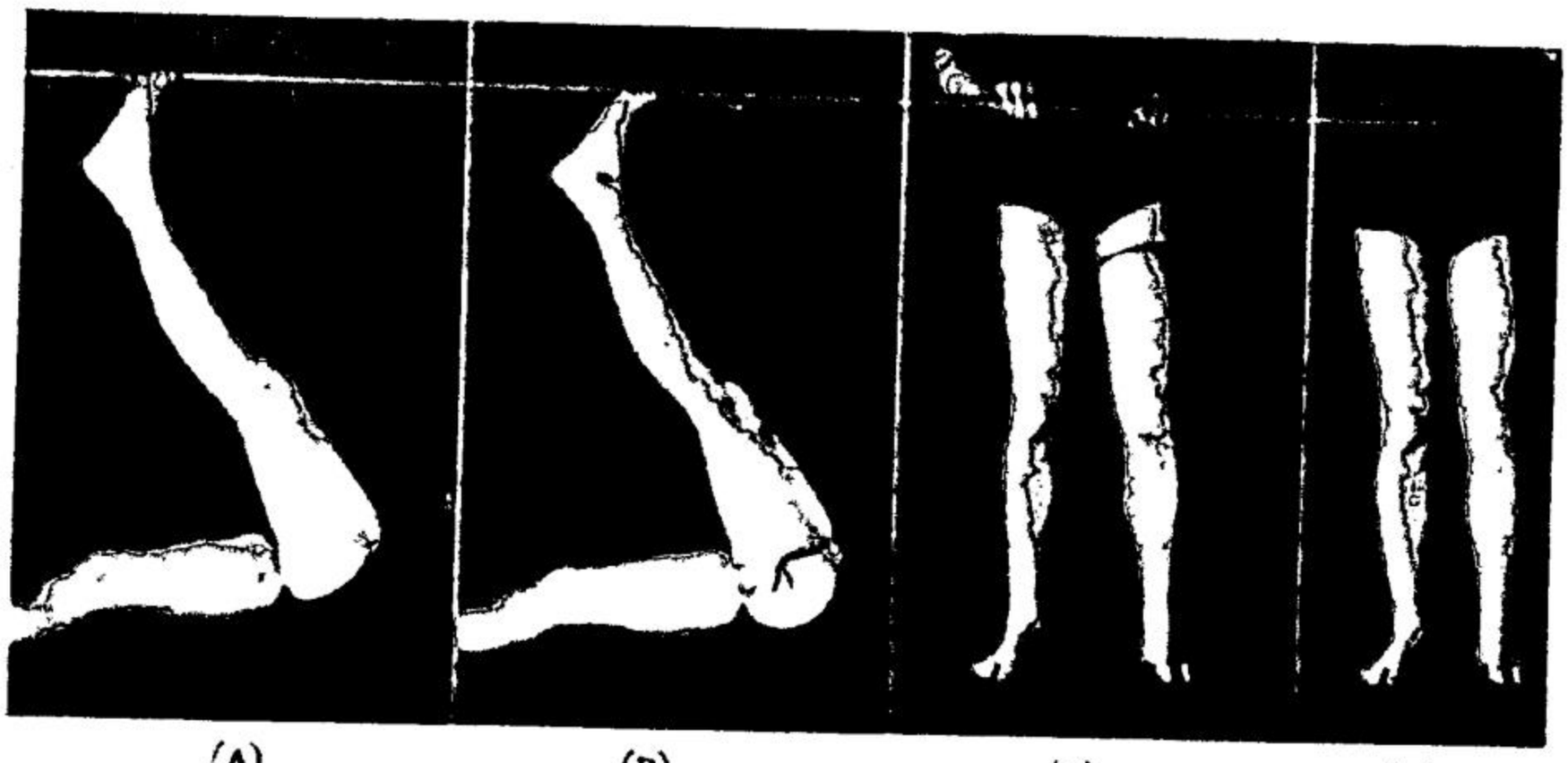
Symptoms only occur in connection with varicose veins when there is a retrograde flow, and they depend on the extent of the back pressure. They consist of a tired and aching sensation, felt in the whole of the lower leg, and especially in the calf, towards the end of the day. Sharp pains, when present, are localised to the site of the varices, and are especially noticeable in grossly dilated thigh veins. The ankle may swell towards evening, or the skin of the leg may itch. Some patients suffer from cramp in the calf shortly after retiring to bed; this is due to a sudden change in the calibre of the

communicating veins which stimulates the muscles between which they pass.

Examination.—The examination of the varices is most important, for upon it depends the success, or failure, of treatment. The aim is to locate the site of the incompetent superficial-deep valves, remembering that with an incompetent valve present the venous flow is retrograde, so that veins, when emptied, fill from above, whereas normally they fill from below. The examination is based upon the principles enunciated by Trendelenburg in 1890, and involves what has aptly been described as 'the intelligent use of the tourniquet.'

Briefly, the patient lies upon his back and raises his leg to empty the veins (fig. 87A). A venous tourniquet is applied just below the saphenous opening (fig. 87B), and he stands up (87C). The constriction is then released (87D). If the sapheno-femoral valve is incompetent, the veins fill immediately from above; if not, the veins fill slowly from below. The veins may fill rapidly from above, even though the tourniquet has not been released; this means that the varices are commencing, totally or in part, from an incompetent communicating valve, or the sapheno-popliteal valve, lower down. In this case, the tourniquet test must be repeated, with application at successively lower sites on the thigh and leg, until the point of origin is shown by prevention of the abnormal direction of flow.

Treatment.—(i) *Palliative* treatment consists of removing any possible



(A) (B) (C) (D)

FIG. 87.—Trendelenburg's test (see text). (*Dr. S. M. Rubin, London.*)

cause. The veins are supported by crêpe or elastic bandages, or elastic stockings; rubber bandages interfere with the evaporation of perspiration and predispose to eczema, so they should be worn only for limited periods of physical stress, e.g. an important golf match.

(ii) *Injection.*—At one time the injection method was widely practised as the primary treatment for all types of varicose veins, but experience showed that in the presence of an incompetent sapheno-femoral and/or communicating valve, the recurrence rate was of the order of 80 per cent. This does not apply to external saphenous veins, for which, except in advanced cases, injection is still the method of choice.

Injection (or sclerosant) treatment is therefore limited to the following:

(*a*) Following ligation at the site of the incompetent valve(s), in order to thrombose the remaining varices.

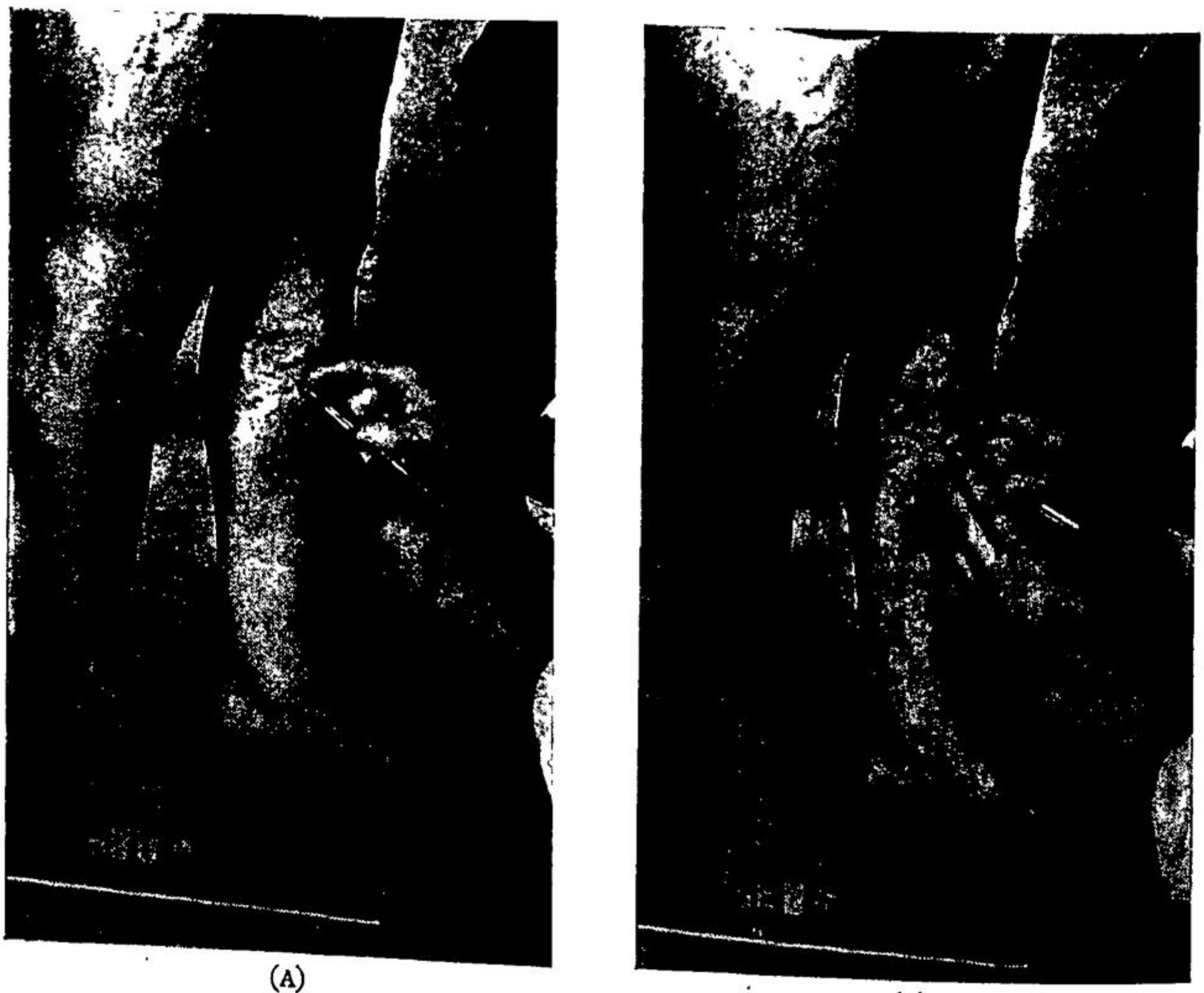
Friedrich Trendelenburg, 1844–1924. Professor of Surgery, Leipzig.

(*b*) For external saphenous varices.

(*c*) Possibly for cosmetic reasons, as described above.

Sclerosants act by damaging the intima of the vein, so that a firm thrombosis, and later sclerosis, develops. Intimal damage will only take place whilst the sclerosant is able to act in sufficient concentration ; as soon as it is diluted by the blood in the deep veins the effect is lost, and it passes into the blood-stream to be excreted as an inert substance. If, however, a large quantity of the sclerosant is injected at one site, it may reach the deep veins in sufficient concentration to initiate a thrombosis at that point before it becomes sufficiently diluted to render it harmless. *The minimum fully effective dose* for a sclerosant should always be known, and should not be exceeded by injection at any one point. The artificial thrombus formed is remarkable for its tenacity, so that the possibility of fragments becoming detached to form emboli is extremely remote.

Technique of Injection.—The patient stands on a low platform. The site is cleaned with spirit and the injection made with a 5-ml. all-glass Luer-mount syringe using a ½-inch (1·25 cm.) 27 needle. The needle is first inserted into the vein, from which blood is withdrawn (fig. 88A). It is then steadied with the right hand and the sclerosing fluid is slowly injected (fig. 88B). The needle is withdrawn from the vein and firm digital pressure applied with a sterile swab for two minutes. If



(A) (B)

FIG. 88.—Injection of varicose veins (see text).

the ' empty vein ' technique is used, the patient sits down after the introduction of the needle, and the leg is carefully elevated. The injection is then made and smaller quantities of sclerosants are adequate, with less risk of a ' spill-over ' into a deep

vein. An adhesive dressing is applied and the patient instructed to continue his normal work. Further injections are given at weekly intervals.

Sclerosant Solutions.—

(*a*) Sodium salicylate.
(*b*) Quinine and urethane.
(*c*) Sodium morrhuate.

These solutions were very popular during the heyday of injection treatment. Their main disadvantage lies in their liability to produce an injection ulcer should some of the injection leak from the vein. Sodium morrhuate can produce dangerous anaphylactic effects, and should be abandoned.

(*d*) Monoethylolamine oleate (5 per cent.) with benzyl alcohol (2 per cent.) ('Ethamolin,' Glaxo) is the most satisfactory sclerosant for out-patient use. Injection ulcers are extremely rare. Allergy can occur, but only after a prolonged course which, with modern treatment, should not be necessary; nevertheless, a solution of 1 : 1,000 adrenaline should always be to hand in case of emergency. The maximum dose at any one point is 2 ml., and no more than 6 ml. should be given at a sitting. It is usual to commence treatment with a test dose of ½ ml. so that the extent of the local reaction may be gauged and the dose modified as necessary.

(*e*) Phenol (2 per cent.), glucose (30 per cent.), glycerin (2 per cent.), known as 'P2G,' is a relatively new sclerosant. It is not as suitable as ethamolin for out-patient use, owing to the larger volume required and the poorer local thrombosis. It is, however, the solution of choice for retrograde injection at operation, where a relatively large volume (10 ml.) is needed. Its use is pain free, which is important when the operation is performed under local anæsthesia.

(iii) *Operative.*—This consists essentially of ligation and division of the internal saphenous vein at the site of the incompetent sapheno-femoral and/or communicating valve, as previously determined by examination (fig. 87). Most cases will be found to require sapheno-femoral ligation, the operation being termed 'Juxta-femoral Ligation.' This implies that the internal saphenous vein should be ligated and divided at its junction with the femoral vein, and all the tributaries are ligated (fig. 89). Although there are only three named tributaries in this region, the anatomy is inconstant, and commonly five or six may be encountered. The operation may be performed under local anæsthesia. Some surgeons practise retrograde injection of the vein at the time of operation, as it greatly reduces the number of post-operative injections required. Others recommend 'stripping' of the vein, which is more likely to result in permanent cure. Additional ligations in the region of the knee or lower leg are sometimes desirable.

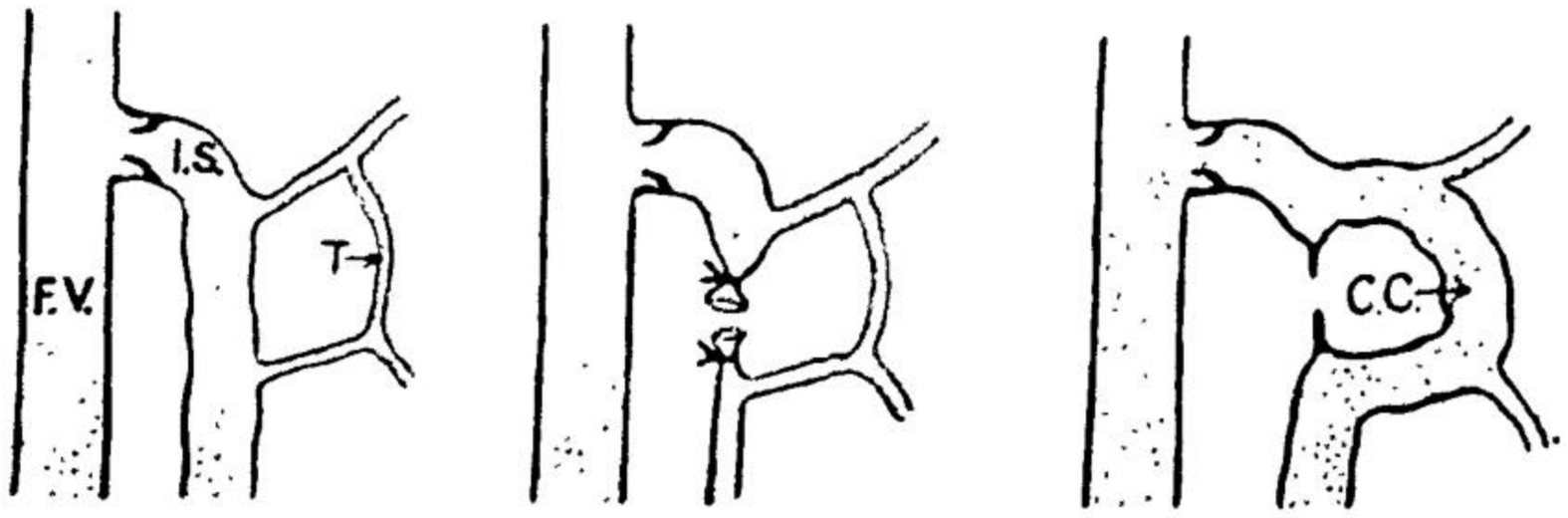


FIG. 89.—Tributaries (T.) must be ligated as well as the internal saphenous vein (I.S.), otherwise a collateral circulation (C.C.) subsequently develops.

Technique.—An oblique incision is made just below the groin, commencing over the pulsation of the femoral artery and extending 2½ to 3 inches (6 to 7 cm.) medially (fig. 90). The vein is exposed by gauze dissection, and divided between forceps. If retrograde injection is to be carried out, the distal segment is opened, under

FIG. 90.—Juxta-femoral ligation of internal saphenous vein.

traction, and either 12 inches (30 cm.) of a ureteric catheter or a 12-inch cannulated needle with a smooth olivary head (fig. 91) made specially for the purpose is introduced, and 10 ml. of P2G is injected whilst

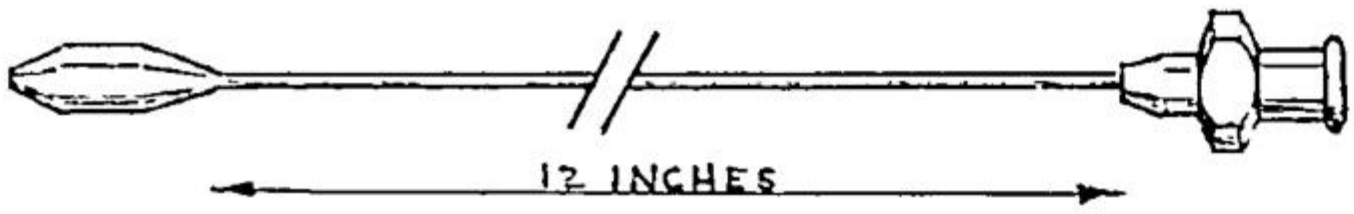


FIG. 91.—Cannulated smooth olivary-tipped needle for retrograde injection.

the needle is slowly withdrawn. The vein is then ligated below the opening. The proximal portion of the vein is traced to the femoral junction, which may lie ½ inch (1·25 cm.) deep to the fossa ovalis, dividing and ligating all tributaries encountered on the way. It is then tied flush with the femoral vein. It is wise to place a second ligature on the distal side of the first in order to obviate the risk of a slipped ligature, as the proximal end of the vein is in direct communication with the right auricle.

Before commencing ligation of a communicating vein, its site is carefully determined and marked upon the skin. The vein is exposed at that point and the communicating vein will be seen passing through the deep fascia. It should be divided and ligated. The superficial vein should be ligated and divided too, and, if required, retrograde injection may be carried out through its distal end.

Stripping of veins is practised by some surgeons, i.e. an olivary-tipped probe is passed down the vein for some inches. The end of the probe is exposed through a small incision, and the vein is divided between ligatures. The proximal end is then attached to the probe which is withdrawn with the avulsed vein.

Contraindications to Injection and Operative Treatment

(*a*) *Acute Infective Thrombophlebitis.*—At least three months should be allowed to pass, after this has completely subsided, before injecting.

(*b*) *Deep Thrombosis.*—Due to any cause and revealed by a history of prolonged confinement to bed with a painful swollen leg. Perthes' test is informative if doubt exists regarding the patency of the femoral vein. The saphenous vein is occluded by a tourniquet applied immediately below the saphenous opening, and the patient walks 15 to 20 yards (13·5 to 18 metres). Normally, the veins below the constriction become less obvious, but if the communicating veins or the femoral vein is obliterated, these subcutaneous veins become engorged.

COMPLICATIONS OF VARICOSE VEINS

Thrombophlebitis of superficial veins reveals itself as a reddened, tender cord in the subcutaneous tissues. Ambulatory treatment is easy, safe, and convenient. Strips of 'Sorbo-rubber' or 'Dunlopillo,' the edges of which are bevelled, are laid over the inflamed vein, and an inch above it a double thickness is placed transversely. The pressure so obtained obviates the risk of embolism. The leg is then bandaged with flexible adhesive plaster from above downwards (fig. 92). The strapping is removed after a fortnight. This procedure gives immediate relief, and it need only be renewed if tenderness persists.

Eczema, or, more correctly, chronic infective dermatitis, is usually due to minor trauma or to the patient scratching his itching skin, but may be an allergic manifestation resulting from ointment or strapping applied

Georg Perthes, 1869–1927. Professor of Surgery, Tübingen, Germany.

for treatment. The condition should be treated *before* dealing with the varices, and this is easily accomplished by the application, twice daily, of an ointment consisting of Lassar's Paste with crude coal tar. As soon as the skin is healthy, the varices should be treated, otherwise a recurrence of the itching predisposes to a further excerbation of the eczematous condition.

Ulceration.—It must be remembered that ulceration of the leg (fig. 93) may be due to other factors than varicose veins, and that an ulcer occurring on the lower half of the leg should not automatically be termed 'varicose.' The next most common cause of leg ulcers, after varices, is a previous thrombosis of deep veins, e.g. 'white leg' following parturition, and an ulcer arising as a result of this may take some years to develop. Venous stasis is the fundamental cause of both types, and consequently they may be grouped together under the term 'Gravitational Ulcers.' It is important to differentiate between these two main types, for, whereas a varicose ulcer responds promptly and satisfactorily to ambulatory treatment by compression with adhesive elastic plaster, post-thrombotic ulcers are refractory to treatment and may require bed rest with possibly excision and skin grafting. Syphilitic ulcers of the leg, which are serpiginous and sometimes multiple, are far less common. Factitious or artificial ulcers commonly exhibit straight edges. Carcinomatous changes may occur in a chronic ulcer (fig. 34).

FIG. 93.—Varicose ulcers, with pigmentation of skin.

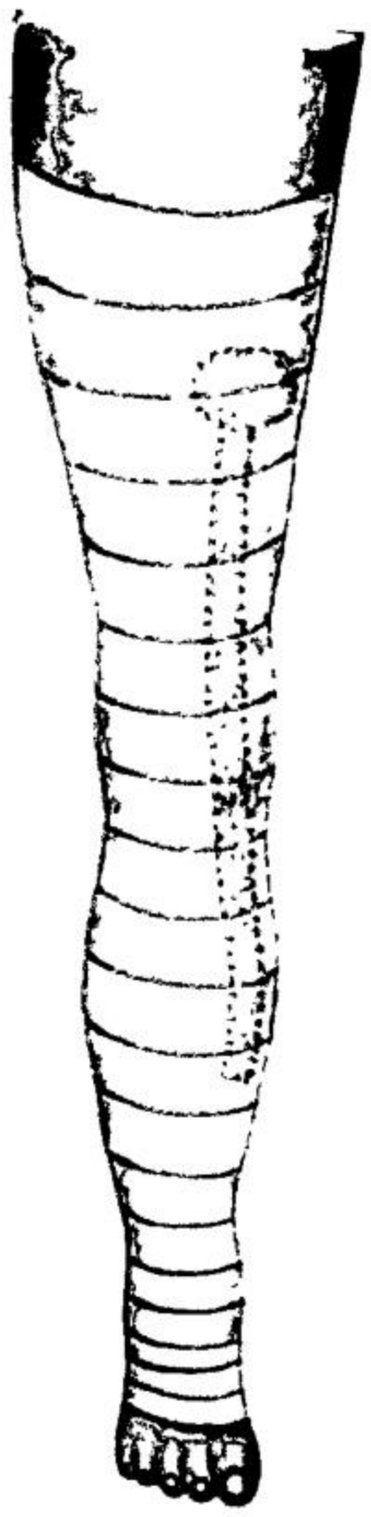


FIG. 92.—Ambulatory treatment of thrombophlebitis.

Treatment of Gravitational Ulcer.—The treatment of this distressing condition, usually occurring in the lower third of the leg, is the application of Elastoplast or Viscopaste bandages. The method of application of these bandages is most important, as a badly applied bandage is very uncomfortable.

The response of the long-standing ulcer to this treatment often appears miraculous to the patient, but in the early stages they often look askance at the application of an adhesive bandage to the ulcer without any underlying dressing.

TECHNIQUE OF APPLICATION.—One or two vertical strips are laid upon the leg from the level of the tibial tubercle to the foot, so as to cover the surface of the ulcer (fig. 94A). This is to prevent the spiral turns of bandage, to be applied later, from cutting into the healing ulcer. It is unnecessary either to clean the ulcer or to apply any dressing over it.

O. Lassar, 1849–1907. Dermatologist, Berlin.

Two more vertical strips are now applied (fig. 94B). The first stretches from the tibial tubercle to the base of the toes along the anterior surface of the leg. The second, along the posterior surface from behind the knee,

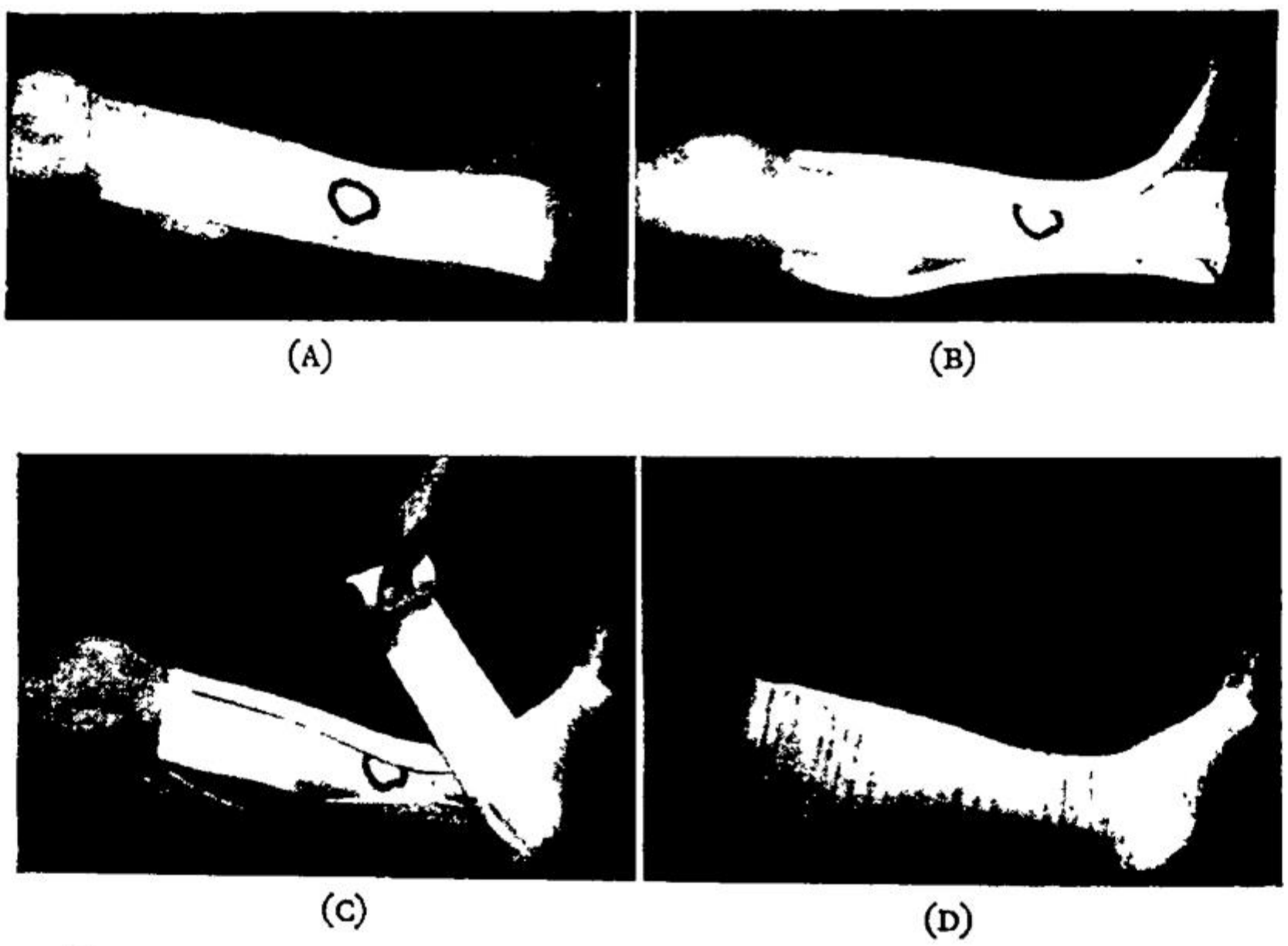


FIG. 94.—The application of flexible adhesive plaster bandage for a varicose ulcer. (*Dr. S. M. Rivlin, London.*)

over the calf and behind the heel to the base of the toes on the sole. These, too, are to prevent cutting in of the bandage when walking. Both these strips should be nicked transversely at various points so that the plaster lies snugly in apposition with the skin.

The main portion of the bandage is now applied as a series of continuous circular turns, from the base of the toes to the tibial tubercle and enclosing the heel (fig. 94C). Each turn should overlap the one preceding by two-thirds of its width. The whole bandage should be applied tightly (fig. 94D). It is essential that there should be no rucking of the bandage on application, as each imperfection is faithfully reproduced upon the underlying skin, and may give rise to discomfort. Upon removal of a well-applied bandage, no marks or lines are visible upon the skin.

The patient is instructed to continue his usual work, and to wash off any discharge which may percolate through the bandage.

The first application is removed after one week, and thereafter the bandage is renewed at fortnightly intervals until the ulcer is healed. The area of the ulcer should be measured at each visit, so that the decrease in size may be noted. Even a large ulcer is usually healed in three months.

As soon as the ulcer is healed, the associated veins are treated by the methods outlined in the previous section.

Hæmorrhage follows rupture, usually of a thin-walled ampulla. Bleeding occurs from both ends of the vein, and is usually profuse. Fatalities

FIG. 95.—Calcified varicose veins, with periostitis of the tibia.

have occurred when the patient was asleep or drunk. Elevation of the leg and the application of a firm pad and bandage easily control the bleeding.

Calcification occasionally occurs in veins which have been tolerated for many years (fig. 95).

Periostitis occurs in long-standing cases if the ulcer is situated over the tibia. Osteitis of the bone and ossification of the interosseous membrane are liable to follow.

FIG. 96. — Talipes equinus following prolonged ulceration.

Talipes equinus may result from a long-standing ulcer. The patient finds that walking on the toes relieves the pain, and after some years the tendo achillis becomes contracted (fig. 96). Treatment should be prophylactic, and consists of remedial exercises in the early stages.

CHAPTER VII

LYMPHATICS AND LYMPH NODES

McNeill Love

Acute lymphangitis is due to infection of lymphatics from a wound in the area drained by the involved vessels. The infection is usually limited to the nodes immediately proximal to the site of infection; these nodes become inflamed, but occasionally infection 'jumps' a group of lymph nodes and affects those at a higher level. Thus, as a result of an infected wound of the leg, the external iliac nodes occasionally become inflamed, and form a mass in the corresponding iliac fossa. Errors in diagnosis are likely to arise, especially as the wound is sometimes healed and forgotten by the time the mass appears.

Acute lymphangitis is characterised by the appearance of subcutaneous red streaks, which correspond to the inflamed lymphatics (fig. 97). If

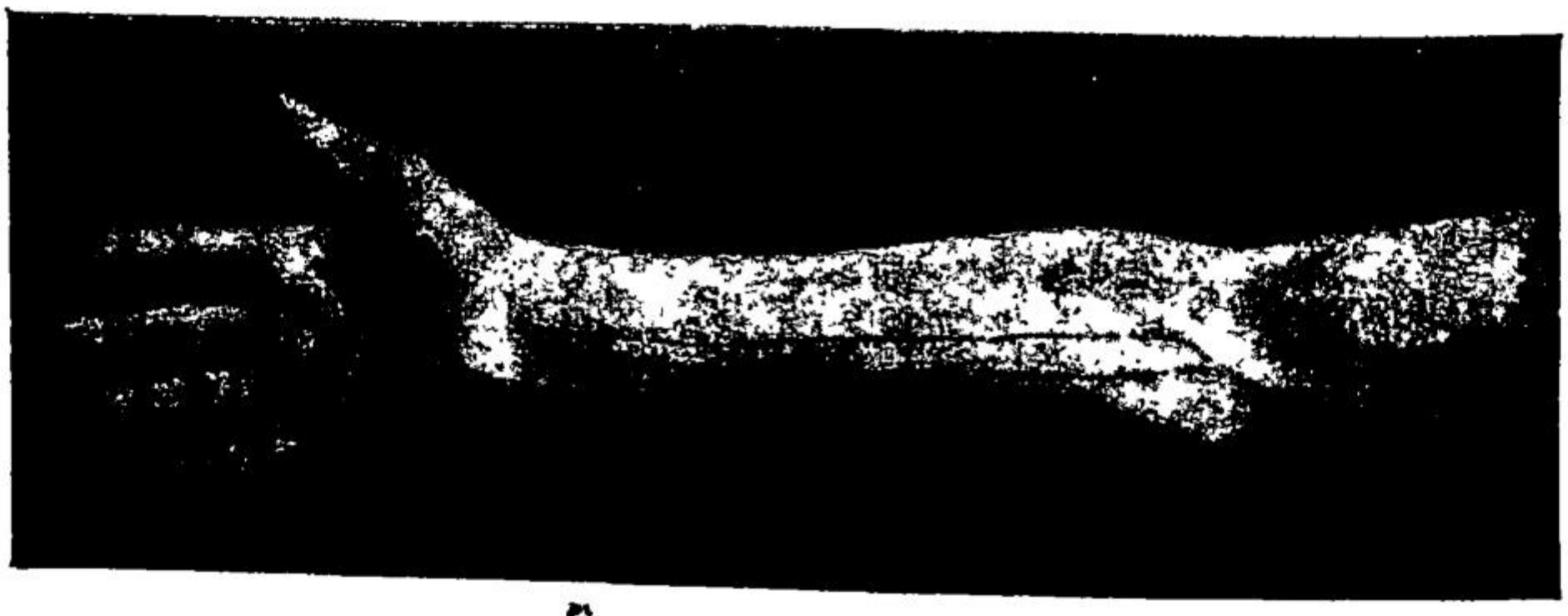


FIG. 97.—Acute lymphangitis of the arm.

large trunks are affected, they are sometimes palpable as tender cords. Toxæmia is often severe, and depends upon the virulence of the causative organism and the resistance of the patient. As a rule chemotherapy or antibiotic therapy speedily checks infection. Local suppuration may occur in the course of the inflamed lymphatics. Permanent occlusion sometimes follows acute lymphangitis, leading to persistent lymphatic œdema (fig. 16).

Treatment consists of dealing with the wound, unless, as is frequently the case, it is insignificant or already healed. If a limb is affected, it must be kept at rest in a slightly elevated position. General measures are taken to combat infection.

Chronic lymphangitis may follow acute lymphangitis, or is, more commonly, due to repeated subacute attacks of infection. The 'wiry' lym-

phatics passing along the dorsal aspect of the penis are characteristic of a primary chancre, and may be associated with œdema of the prepuce. Tuberculous lymphangitis occasionally occurs, notably in the peri-ureteric lymphatics; the resulting fibrosis and contraction leads to the ureter pursuing a straighter course than normal, and to the characteristic 'golf-hole' ureteric orifice.

LYMPHATIC OBSTRUCTION

1. **Congenital,** giving rise to lymphangiectasis (p. 110).
2. **Trauma** as a result of excision of lymph nodes, e.g. lymphatic œdema of the arm, which occurs shortly after removal of the axillary nodes. It is sometimes due to division of lymphatics, as by an incision along the lower and outer margin of the orbit, which divides lymphatics passing to the preauricular nodes, and leads to œdema of the lower eyelid (fig. 16).
3. **Inflammation,** due to fibrosis of lymphatics, which may follow an acute lymphangitis, such as erysipelas (fig. 16), or result from persistent chronic infection, e.g. tropical ulcer.
4. **Neoplasm,** as typified by the 'peau d'orange,' due to permeation of lymphatics by carcinoma, and resultant obstruction. The 'brawny arm' which develops some months or years after a radical removal of the breast for carcinoma is due to lymphatic permeation by malignant cells.

FIG. 98.—Solid œdema of the right leg, due to lymphatic obstruction of unknown origin.

5. **Parasites.**—The Filaria sanguinis hominis[1] is transmitted by a mosquito (*Culex fatigans*). The female worm enters and obstructs the inguinal lymph vessels. The legs and scrotum are chiefly affected and enormous thickening of the subcutaneous tissue may result. Chemotherapy has a beneficial effect on the associated cellulitis and lymphadenitis.

In addition to these recognised causes, elephantiasis of the lower limbs occasionally occurs for no apparent reason (fig. 98).

As a result of lymphatic obstruction, a solid œdema occurs, the subcutaneous tissue becomes brawny and shows little pitting on pressure. At a later stage the skin becomes coarse and rough, and the limb is often enormously swollen, a condition referred to as elephantiasis. Lymphatic vesicles sometimes appear in the skin and tend to rupture, thus leading to ulceration and recurrent infection.

Treatment.—Lymphatic obstruction is usually an unsatisfactory condition as regards surgical treatment. Elevation and elastic pressure often relieve early cases. The introduction into the subcutaneous tissues of sterilised silk (lymphangioplasty) sometimes gives temporary relief in the

[1] Sir Patrick Manson, 1844–1922, discovered the filaria in China in 1877. The organisms may be discovered microscopically in a nocturnal blood smear.

arm, but is useless in the leg on account of gravity. Excision of long strips of deep fascia (Kondoléon's operation) is occasionally followed by some improvement, but more often results are disappointing. The object of this operation is to remove the fascial barrier between superficial and deep lymphatics, so that lymph is returned by the latter channel. Amputation is occasionally necessary if the patient is anchored to the bed by weight of the limb, or if ulceration and infection supervene. Filariasis has been benefited by removal of the parent filariæ when their situation has been recognised. Usually the condition progresses, and removal of the scrotum or affected limb is eventually necessary.

Idiopathic Œdema.—An intractable, idiopathic œdema occasionally occurs in the legs and feet, especially in young women. Possibly this is due to abnormal permeability of lymphatic vessels and capillaries. Elastic pressure and elevation yield little relief, but improvement usually follows increased alkalisation of the blood by large doses of potassium citrate and carbonate.

DILATATION OF LYMPHATIC VESSELS

Congenital types include the following varieties :

(*a*) *Capillary Lymphangioma.*—When this condition occurs in the skin, it is known as lymphatic nævus, and consists of brownish papules or wartlike excrescences. On examination with a lens small vesicles can be seen.

(*b*) *Cavernous lymphangioma* is often associated with the preceding variety (fig. 99), and consists of masses of lymphatic cysts, particularly in the neck or axilla, the condition being termed a cystic hygroma (p. 187). An ill-defined spongy mass results, the skin over which may be semi-translucent, a condition which was formerly described as 'hydrocele of the breast' when occurring in that organ.

FIG. 99.—Cavernous lymphangioma of the tongue, the surface of which is covered with lymphatic nævi.

(*c*) *Lymphangiectasis* usually occurs as a congenital condition, and gives rise to enlargement of different parts, e.g. tongue (macroglossia) or lip (macrocheilia). The condition occasionally affects the subcutaneous lymphatics of a limb (Milroy's disease), and amputation may then be required.

Acquired lymphatic dilatation is due to obstruction of main lymphatics. Thus, pressure on the thoracic duct may cause engorgement of the alimentary lymphatics and chylous ascites; also cases of chylous hydrocele have been described, due to obstruction of lymph drainage.

LYMPH NODES

Acute inflammation follows infection of the appropriate lymphatics, although, as already mentioned, a group of lymph nodes may escape obvious

Emmerich Kondoléon, 1879–1943. Professor of Surgery, Athens.
William F. Milroy, 1855–1942, Professor of Clinical Medicine, University of Nebraska, described the condition in 1892.

infection, whereas a more proximal group may evince a marked reaction. The affected nodes become enlarged, firm, and tender. Resolution, fibrosis, or suppuration follows.

Treatment consists of dealing with any cause, the application of warmth locally, and chemotherapy. If suppuration occurs, pus is evacuated.

Chronic inflammation is either simple or specific :

1. *Simple*, or non-specific, adenitis is due to intermittent or prolonged infection of low virulence, e.g. infected tonsils or pediculi capitis, or sometimes follows incomplete resolution of acute adenitis. The nodes become enlarged, firm, and slightly tender, and occasionally quietly suppurate.

Treatment consists of removal of any local focus of infection and attention to the general health.

2. *Specific adenitis*

(*a*) Tuberculous infection of nodes is common in children and adolescents, particularly among those who live in unhygienic surroundings, or who inherit a predisposition to tuberculosis. The cervical nodes are the commonest to be affected, at least as far as clinical evidence is concerned, although the bronchial or mesenteric nodes are commonly invaded, and calcification is frequently noted in an X-ray. The axillary or inguinal nodes sometimes suffer, particularly if there is some tuberculous focus in the area of lymphatic drainage, such as lupus verrucosa.

FIG. 100.—A tuberculous node, showing typical giant cells.

Tubercle bacilli most commonly reach the node by lymphatics, tubercles first forming in the cortex, but blood-borne infection sometimes occurs, in which case the medulla of the node is the first part to be affected. Microscopically, endothelial cells are in evidence, and giant cells are commonly seen with many nuclei arranged around the periphery like a horseshoe (fig. 100).

Clinically, the affected nodes enlarge, and become characteristically matted together owing to periadenitis. Caseation may follow, to be succeeded by suppuration. Pus is no respecter of fascia, and often burrows through the deep fascia, so that the pus is superficial and the causative node deep to this structure, forming a 'collar-stud' abscess (fig. 199). If the condition progresses, the skin becomes blue and thin, eventually giving way, a tuberculous sinus resulting. Occasionally under appropriate treatment, caseous material is absorbed and replaced by fibrous

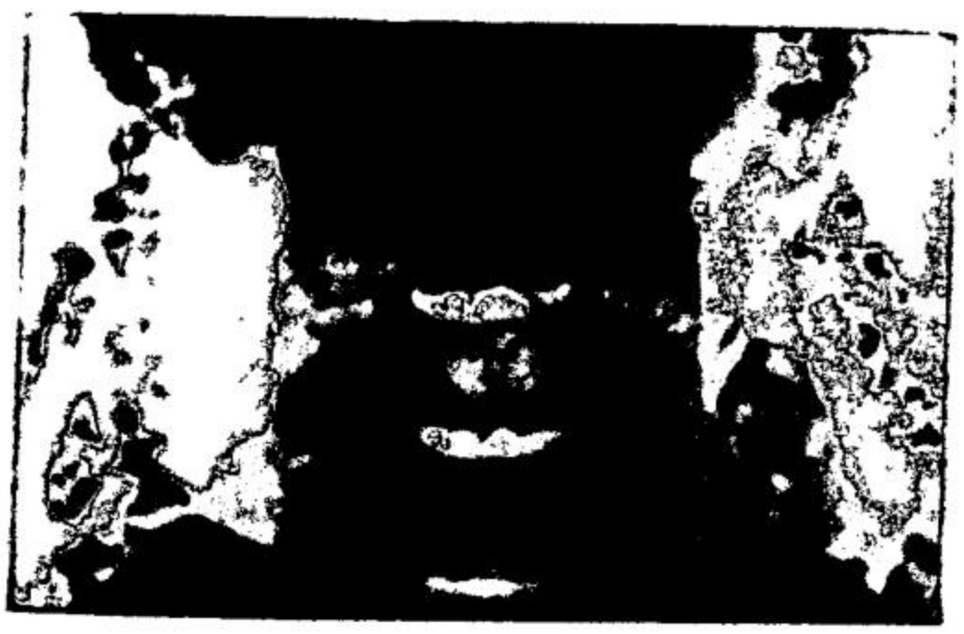


FIG. 101.—Extensive calcification of cervical lymphatic nodes.

tissue or calcification (fig. 101), in which case the nodes are stony hard on palpation.

Treatment consists of dealing with any possible source of infection, combined with antibiotics (p. 8) and care of the general health. If improvement does not occur within one month, then accessible nodes should be removed, otherwise suppuration is likely to supervene. Thus, in the case of cervical nodes, collar incisions are made, and infected nodes, often surprisingly large, are removed. This is a tedious operation, needing patience and a good light. Normal anatomy is distorted, and no tissue should be divided under traction, as veins are thus rendered unrecognisable and liable to injury. The welling blood obscures the actual site of hæmorrhage, and groping with artery forceps is likely to damage important structures. The hypoglossal and spinal accessory nerves are commonly embedded in a mass of nodes, and are therefore particularly prone to injury.

If abscesses are present they are aspirated, and some surgeons inject streptomycin into the resulting cavity. If suppuration persists, then operation should be undertaken, as otherwise the skin will become eroded, and sinuses and secondary infection follow. On opening the superficial abscess pus is evacuated and granulation tissue gently curetted; the track through the deep fascia is then enlarged so that the deeper nodes can be exposed and removed. The operation field is smeared with iodoform paste, and a drain inserted for twelve to twenty-four hours on account of the oozing.

If sinuses are present, excision should be performed, and the extensive wounds heal in a remarkable manner. Any small sinuses are packed with malachite green and corrosive sublimate, 1 per cent. of each, in surgical spirit, an application which gives particularly gratifying results with tuberculous sinuses in any situation.

The ideal treatment, which in our opinion should be followed more frequently, is to remove tuberculous nodes if a short course of general treatment results in no improvement. Early removal diminishes the risk of sinuses and resulting scars, of prolonged convalescence, and of dissemination elsewhere from the active focus.

(*b*) Syphilitic adenitis can occur in any stage of the acquired infection. 'Rubbery' nodes associated with a genital chancre are characteristic. During the secondary stage a generalised enlargement of nodes occurs, especially those above the internal epicondyles and along the posterior border of the sternomastoid. In the tertiary stage a gumma may occur in a lymph node, but is rare. More commonly the nodes enlarge as a result of secondary infection from a broken-down gumma.

CHRONIC ENLARGEMENT OF LYMPH NODES

Chronic enlargement is due to the following causes:
Inflammation (p. 111).
Reticulosis.
New-growth.

THE RETICULOSES

Various diseases which were formerly considered to be separate clinical entities are now known to arise as a result of proliferative conditions of the lymphoid or lympho-reticular tissue, with subsequent differentiation. Proliferation may begin in the follicles, medulla, or sinuses, and in most cases, as would be expected, the lymph nodes are first affected. Sooner or later other lymphoid tissue is involved, such as the spleen, liver, Peyer's patches, and the bone marrow. Histological examination is usually required in order to establish the diagnosis, and most of the conditions are radio-sensitive.

The reticuloses comprise a very complex group of conditions, but the more important ones of surgical interest can be classified as follows :

Hæmic.—The leukæmias.

Metabolic.—Gaucher's disease (p. 389).
Schuller-Christian's disease (Chapter 47).

Neoplastic.—Benign—Boeck's sarcoid (p. 177).
Malignant—Lymphadenoma.
Lymphosarcoma (p. 114).
Reticulosarcoma.
Multiple myeloma (Chapter 47).
Ewing's tumour (Chapter 47).

Lymphatic leukæmia is of little surgical interest except from the point of view of differential diagnosis. Cytological examination is diagnostic—the leucocytes are enormously increased, and may number 150,000 per c.mm., of which 90 to 99 per cent. are lymphocytes. Splenic enlargement is more characteristic of chronic lymphatic leukæmia than of Hodgkin's disease.

LYMPHADENOMA (syn. HODGKIN'S DISEASE)

Histologically, the picture varies with the stage of the disease. At first there is a proliferation of leucocytes, which is followed by the appearance of pale round endothelial cells. Characteristic giant cells (described by Dorothy Reed) are often in evidence ; these contain two or more pale nuclei which overlap each other. Plasma and eosinophil cells, the latter often in large numbers, are usually to be seen. In the later stages fibroblasts and fibrous tissue are the predominant features.

Gordon's Test.—Occasionally the histological appearances are inconclusive. In such instances Gordon's test is helpful. A suspension of an affected lymph node produces encephalitis when injected into the cerebrum of a rabbit.

Clinical Features.—It is commoner in males, and usually affects young adults, but cases vary widely as regards age incidence and virulence. Occasionally, and especially in children, the course of the disease is merely a matter of weeks, the associated irregular and often high temperature leading to errors of diagnosis. More commonly the patient first notices a painless swelling in the supraclavicular region, associated with malaise and an irregular temperature. Pressure effects, due to deep nodes, especially mediastinal, may follow, or occasionally cause the first symptoms. On examination the nodes are discrete, painless, and rubbery in consistency. The spleen is enlarged, but rarely enough to be palpable. The enlargement may be diffuse, or whitish nodules may project from the surface, the organ then

Thomas Hodgkin, 1798–1866. Sometime Curator to the Museum, Guy's Hospital, London. He unsuccessfully applied for the office of Physician.
Dorothy Reed (Mrs. Mendenhall), Contemporary. Formerly Fellow in Pathology, Johns Hopkins Hospital, Baltimore, U.S.A.
Mervin H. Gordon, Contemporary, Consulting Bacteriologist, St. Bartholomew's Hospital, London, described his test in 1932.

bearing some resemblance to toffee studded with almonds, known as 'hard-bake.' In the late stages most organs in the body become affected, and periodic bouts of temperature occur at intervals of two or three weeks (Pel-Ebstein). Osseous involvement and pathological fractures are not uncommon, and an X-ray reveals 'punched-out' areas in the affected bone which resemble multiple myelomata.

Blood examination reveals a secondary anæmia, with occasionally slight eosinophilia, and serves to distinguish other conditions, e.g. lymphatic leukæmia. Excision of an appropriate node usually clinches the diagnosis, and may differentiate the condition from secondary deposits (fig. 102).

FIG. 102.—Melanomatous deposits in a lymphatic node. The primary may be insignificant. (*Dr. L. C. D. Hermitte, Sheffield.*)

Treatment consists of the administration of arsenic, which may be beneficial for the anæmia, and which possibly has a specific action. Nitrogen mustard, especially if combined with prednisone, is sometimes beneficial. X-rays cause a temporary reduction in the size of the nodes. Excision may be considered if a localised group of nodes only are affected, or when pressure symptoms are caused by nodes which have become tolerant to X-rays. The disease is characterised by remissions and exacerbations, but inevitably runs a fatal course, although patients may survive for ten years or so.

Lymphadenoma and Leukæmia.—There seems to be some relationship between these two diseases, as some cases of Hodgkin's disease develop leukæmia. Also cases have been reported in which patients have suffered from both diseases at the same time. Irradiation of Hodgkin's nodes does not appear to encourage leukæmic changes.

PRIMARY LYMPHOSARCOMA

This condition can commence in any adenoid tissue, e.g. nodes, tonsils, or Peyer's patches. When affecting the nodes, those most commonly involved are the cervical group. Rapid, steadily progressive enlargement occurs, and later the growth erodes the capsule of the node and infiltrates surrounding structures. Dissemination occurs to other lymphoid tissue in the neighbourhood.

Excision is sometimes practicable in early cases. Radium or X-ray therapy causes retrogression, but unfortunately dissemination is only too likely to have occurred already.

Pieter K. Pel, 1852–1916. Professor of Medicine, Amsterdam.
Wilhelm Ebstein, 1836–1912. Professor of Medicine, Göttingen, Germany.
Johann Peyer, 1653–1712. Anatomist of Schaffhausen, Switzerland.

CHAPTER VIII

FACE AND JAWS, INCLUDING THE PALATE

HAMILTON BAILEY

EMBRYOLOGY OF THE FACE

ABOUT the sixth week of fœtal life a depression appears in front of the head. Around this depression, called the stomodæum or primitive mouth, five processes appear: a single one at the cephalic end, the frontonasal process, and on each side a maxillary and a mandibular process (fig. 103). Soon the frontonasal process becomes subdivided, by the appearance of the olfactory pits, into a solitary median nasal process and two lateral nasal processes. The median nasal process becomes bluntly bifurcated, and the excrescence so formed is known as the processus globularis. Thus it comes about that finally there are seven processes. These coalesce to form the face. The process of budding and cohesion is a rapid one, for it is commenced and completed in the brief space of three weeks. Thus every congenital deformity of the face has existed from the ninth week of fœtal life.

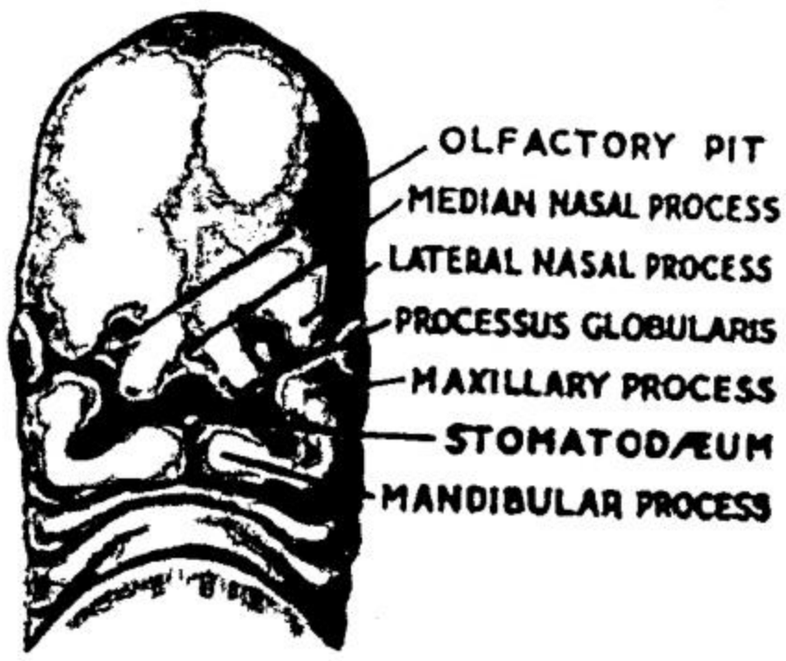


FIG. 103.—The head of an eight-week embryo.

Failure of union of the median nasal process with the maxillary process and/or the maxillary process with its fellow accounts for most of the congenital facial abnormalities, which are:

1. Cleft-lip.
2. Cleft-palate.
3. Facial cleft.
4. Macrostoma.

Excessive union results in microstoma. Facial cleft, micro- and macrostoma (fig. 104), all congenital abnormalities, are exceedingly rare. Microstoma is sometimes acquired (fig. 105).

FIG. 104.—Macrostoma.

FIG. 105.—Microstoma due to lupus vulgaris. *(Professor A. K. Toufeeq, Lahore, Pakistan.)*

The pinna is developed from six tubercles situated around the posterior end of the first branchial cleft.

ABNORMALITIES OF THE FIRST BRANCHIAL CLEFT

Preauricular Sinus.—Imperfect fusion of the six tubercles that form the pinna results in a preauricular sinus, the opening of which is usually found at the root of the helix or on the tragus. The tract runs downwards and slightly forwards, and ends blindly. A preauricular sinus gives rise to no symptoms unless the tiny opening becomes occluded, when a cyst is prone to develop. If the cyst becomes infected and it bursts or is incised, a cutaneous preauricular ulcer is liable to follow. This ulcer (fig. 106) refuses to heal, for infection is maintained from the sinus (F. A. R. Stammers).

Francis Alan Roland Stammers, Contemporary. Professor of Surgery University of Birmingham.

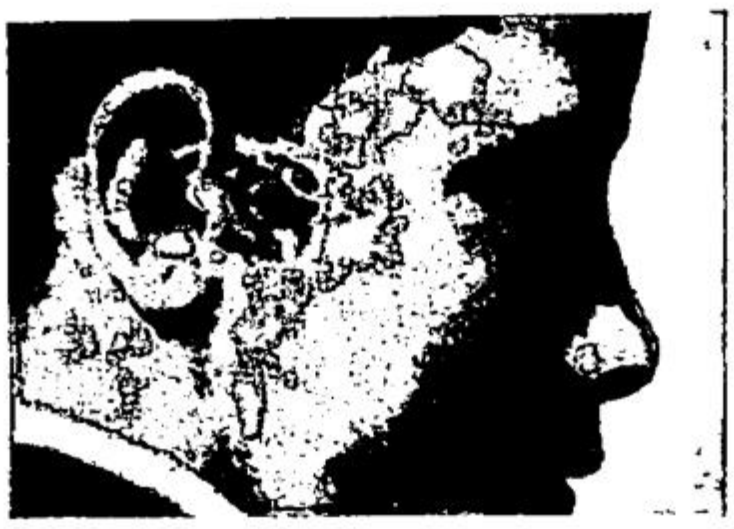


FIG. 106.—Preauricular sinus with ulcer. Note the sinus in the root of the helix.

The condition is often mistaken for a tuberculous sinus associated with a preauricular or parotid lymph node. The only treatment is complete excision of the sinus.

Fistula Arising from the First Branchial Cleft.—Occasionally a preauricular or intrameatal sinus is continuous with a fistula of the first branchial cleft, the anterior orifice of which lies in the shadow of the mandible. After delineating the tract by the injection of a radio-opaque fluid and radiography, the whole fistula should be dissected out. The fistula passes through the parotid gland and is related closely to the mandibular branch of the facial nerve, which must be preserved carefully during the operation.

Periauricular dermoid cyst is due to inclusion of epithelium during fusion of two contiguous embryological aural tubercles. Usually the cyst is posterior to the pinna (fig. 107).

FIG. 107.—Post-auricular dermoid cyst.

FIG. 108.—Congenitally short frænum labii.

CONGENITAL SHORT FRÆNUM[1] OF THE UPPER LIP

While both lips are furnished with a frænum, that of the lower lip is poorly developed, and never gives rise to any abnormal condition. This is not the case with the frænum of the upper lip, which sometimes is congenitally short, and occasionally contains a small cyst. A short frænum in this situation (fig. 108) causes a wide gap between the permanent central maxillary incisor teeth. The reason for this is that the tight fibrous band extends from the lip to the apex of the central inter-dental papilla, the pull of which prevents union of the palatal part of the globular processes of the maxilla in the midline. If this ugly dental malposition and malocclusion, and often a sibilant lisp in the speech, are to be prevented, the frænum must be excised early in life, the resulting edges of the mucous membrane undercut and brought together longitudinally. If operation is postponed until the appearance of the second dentition, excision *per se* seldom is successful, but improvement in the position of the erupting teeth can be effected by the addition of an orthodontic appliance. Nevertheless, when the dental appliance has been discarded, recurrence of the malposition occurs rather frequently.

[1] Frænum—Latin = a bridle.

CONGENITAL FISTULÆ OF THE LOWER LIP

This condition is unexplained by embryology, and occurs in certain families. There are two blind pits, one on either side of the mid-line of the lower lip (fig. 109). They are, apparently, wide-open mucus-secreting labial glands and are found also in certain quadrupeds (Sir John Bland-Sutton). The treatment is complete excision.

FIG. 109.—Congenital fistulæ of the lower lip. *(After Sir John Bland-Sutton.)*

CLEFT-LIP AND CLEFT-PALATE

Cleft-lip and cleft-palate are but variations of one and the same congenital defect. Failure of normal union of the developing processes [1] (see fig. 103) results in either (*a*) a cleft of the lip alone, (*b*) a cleft of the lip and alveolus, (*c*) a cleft of the lip, alveolus, and palate, or (*d*) cleft palate alone. For a reason that has never been explained, clefts on the left side greatly outnumber both those on the right side and bilateral clefts. In at least 19 per cent. of cases the condition is familial, while in 10 per cent. the deformity is associated with other abnormalities of the head, such as hydrocephalus, congenital blindness, and mental deficiency.

Relative Distributions of the Various Types of Cleft.—Based on a study of the records of 703 Danish patients operated upon for one or other of these anomalies, P. Fogh-Andersen found that the incidence was as follows :

Cleft-lip alone	25 per cent.
Cleft-lip and cleft-palate	50 per cent.
Cleft-palate alone	25 per cent.

Seventy-five per cent. of the cases were unilateral.

Suckling.—An infant with a large opening between the mouth and the nose, as occurs with a cleft-palate, is unable to suck properly, for sufficient negative pressure cannot be established. If, as is often the case, there is a cleft-lip in addition, sucking is impossible. At first sight this would seem a serious matter, but it is overcome by a simple expedient. If the puncture in the rubber teat of a feeding-bottle is enlarged, or an ether dropper is substituted, milk can be made to drip evenly into the babe's open mouth, and in a few days he learns to receive his nourishment at regular intervals in this way. Alternatively, spoon-feeding can be employed.

FIG. 110. — Lateral cleft-lip. *(Mr. Nils Echhoff, London.)*

CLEFT-LIP (or HARE-LIP ?)

Lateral cleft-lip (fig. 110) is the most frequent congenital facial deformity; it occurs once in 2,500 births. In about 15 per cent. cleft-lip exists on both sides. Sometimes a narrow bridge of skin passes across the cleft, usually in the region of the nostril. Cleft-lip is commoner in boys (2 : 1) than girls. Cases of true median cleft-lip are exceedingly rare,

[1] Cortisone given to a woman early in pregnancy favours cleft-palate in her baby: cortisone therapy interferes with the normal fusion of the maxillary process.
[2] The upper lip of the hare is cleft in the mid-line.

Sir John Bland-Sutton, 1855–1936. Surgeon, Middlesex Hospital, London.
Paul Fogh-Andersen, Contemporary. Surgeon, Rigshospitalet, Copenhagen.

and are due to absence of the frontonasal process (see fig. 103).

Treatment.—Repair is usually undertaken at the age of six months.

In all cases of complete cleft-lip it is important to observe the nostrils. If, as is commonly the case, the naris of the affected side is flattened and the cleft extends into the floor of the nostril, this must be treated precisely as the lip is treated.

Rose's operation consists in freshening and uniting the edges of the cleft (fig. 111). An essential objective is to restore the continuity of the orbicularis oris.

In order to lessen strain on the suture line while healing occurs Logan's tension bow (fig. 112) is a useful adjunct.

A well-performed cleft-lip operation should render the patient's lips in after-life indistinguishable from normal, even on close inspection.

FIG. 111.—Method of repairing a double cleft-lip. (*After Denis Browne.*)

FIG. 112.—The arms are kept extended with cardboard splints. Note Logan's bow in position. (*Professor W. E. M. Wardill, Baghdad.*)

Double Cleft-lip with an Unfused Premaxilla (fig. 113).—The premaxilla must not on any account be removed, for the subsequent deformity is hideous. When the premaxilla juts out considerably a V-shaped piece can be removed from the front of the nasal septum, to which the premaxilla is attached. This allows the protuberant process to be pressed back sufficiently for the lip to be reconstituted.

FIG. 113.—Bilateral cleft-lip associated with an unfused premaxilla and cleft-palate.

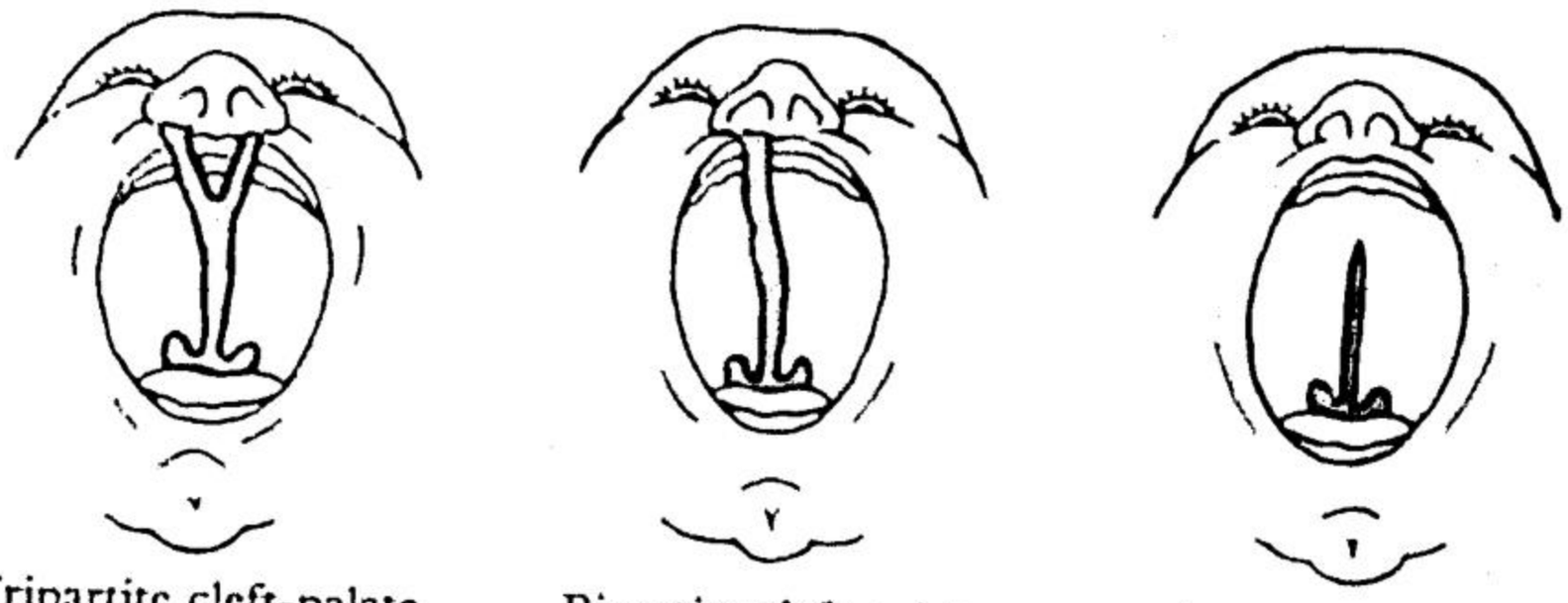
CLEFT-PALATE

There are three degrees of cleft-palate—the tripartite, the bipartite, and the intermaxillary cleft (fig. 114).

In the tripartite, and to a lesser extent the bipartite, varieties of cleft-palate, the premaxilla, which is derived from the globular processes and which is, morphologically, the prognathus or snout of lower animals, juts out, causing a hideous deformity (see fig. 113). In contradistinction to cleft-lip, cleft-palate is much more common in girls.

William Rose Jnr., 1847–1910. Surgeon, King's College Hospital, London.
William Hoffman Gardiner Logan, 1873–1943. Professor of Oral Surgery, Loyola University, Chicago.
Sir William Fergusson, 1808–1877, Surgeon, Royal Infirmary, Edinburgh, later Professor of Surgery, King's College Hospital, London, performed 134 cleft-palate operations with only five failures.

Treatment.—Successful operative treatment was by no means unknown before the Listerian era. The majority of surgeons in Britain prefer to operate during the



Tripartite cleft-palate. Bipartite cleft-palate. Intermaxillary cleft.

FIG. 114

first year of life, when the infant has reached 14 lb. (7 kgm.) in weight, that is between the fifth and sixth month after birth. In the United States of America a later period is favoured—between the ages of eighteen months and two years.

In every operation for cleft-palate an ideal at which to aim is that the patient will be enabled to speak distinctly. To accomplish this, it is necessary to provide an oro-nasal sphincter which is even more important than closing the palatal gap.

When the operation is undertaken after speech is established, it is not always satisfactory from a phonetic point of view, although considerable improvement often accrues from speech training.

Pre-operative Treatment.—It is a great advantage for the child to get accustomed to its nurse, who teaches it to be spoon-fed before the operation. As the most usual cause of failure is sepsis, carious teeth and infected tonsils must be eradicated. Another excellent precaution is to get the child accustomed to mouth-spraying before the operation.

Operation.—Endotracheal anæsthesia is employed and the head is well extended.

The operations that have been designed to close the cleft are numerous; the following meet every contingency:

Two-flap method (fig. 115A) resembles the original operation of Langenbeck. As in the other operations to be described, lateral incisions (shown in red) are made to release tension. The hamular processes are broken to relax the tensores palati. The mucoperiosteum is separated from the hard palate, and the attachment of the soft palate to the posterior margin of the hard palate is divided. The edges of the cleft are freshened and united by two layers of sutures. The first layer joins the nasal mucous membrane; the second layer unites the palatal periosteum and its attached buccal mucous membrane.

Three-flap method (fig. 115B) gives greater relaxation to the forepart of the area to be approximated.

Four-flap method (Wardill, 1933), like the three-flap operation, results in lengthening of the palate (fig. 115C).

Cuthbert's (1951) *Modification of Lane's Operation.*—The left flap is swung across the middle line of the cleft (fig. 115D).

Lord Lister, 1827–1912. Professor of Surgery at Glasgow, Edinburgh, and London.
Bernard Rudolf Konrad von Langenbeck, 1810-1887. Professor of Surgery, Berlin.
William E. M. Wardill, Contemporary. Professor of Surgery, Royal Medical College, Baghdad.
James Brown Cuthbert, Contemporary. Plastic Surgeon, General Hospital, Johannesburg.
Sir Arbuthnot Lane, 1856–1943. Surgeon, Guy's Hospital, London.

The Gillies-Fry (1921) *Operation* (fig. 115E).—After freeing the soft from the hard palate, the former only is united. The latter, along with the aperture created behind it, is later occluded by a dental plate.

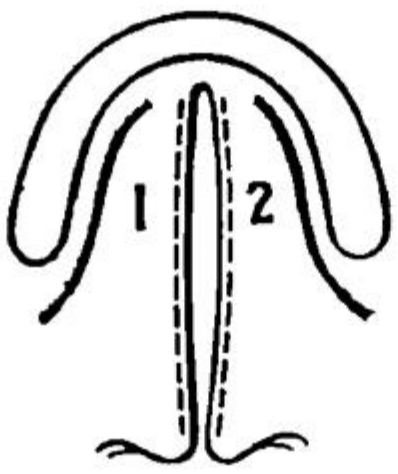


FIG. 115A.—Two-flap method.

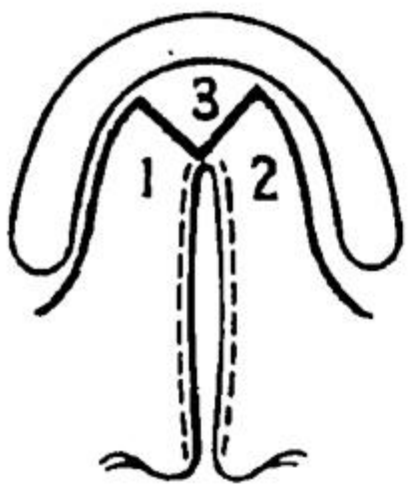


FIG. 115B.—Three-flap method.

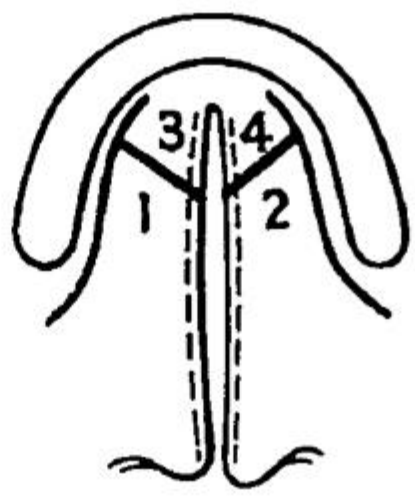


FIG. 115C.—Four-flap method.

FIG. 115D.—Cuthbert's flap-method of closure.

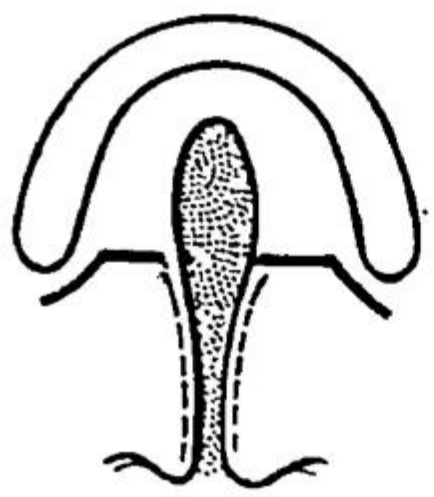


FIG. 115E.—The Gillies-Fry operation.
(*After W. G. Holdsworth.*)

Operations for cleft-palate should not be performed during times of prevalent respiratory infections in the winter months.

Post-operative Treatment.—In order to prevent excessive crying, constant petting and attention are necessary. Cardboard splinting of the arms is advisable (fig. 112). Spoon-feeds of sterilised foods are given; adequate nourishment is essential. Irrigation and spraying of the mouth with mild antiseptics are carried out every four hours or more often. Ten to twelve days after the operation the stitches are removed under an anæsthetic. When the suture line has healed sufficiently the palate is massaged. Post-operative speech training is necessary if the operation is performed after the child has commenced to talk.

FIG. 116.—Twenty-five years after operation for bilateral cleft-lip and complete cleft-palate. Operation by the late Sir James Berry.

Complications.—Complete or, much more frequently, partial breaking down of the suture line, particularly near the spot where the soft was attached to the hard palate, is the result of an impoverished blood supply, infection, or both.

LESIONS OF THE LIPS

Pigmented Lips and Buccal Mucous Membrane.—Brown pigmented spots on the lips, the inside of the cheeks, and the palate occur in cases of familial intestinal polyposis (Peutz' syndrome) (see p. 543). Addison's disease (see p. 259) must be excluded.

Macrocheilia.—Chronic enlargement of the lip, usually the lower, may arise from inflammatory causes, but true macrocheilia is due to a lymphangioma, akin to lymphangiomatous macroglossia (p. 159). Its treatment is similar to that condition.

Sir Harold Delf Gillies, Contemporary. Emeritus Plastic Consultant, Rooksdown House, Basingstoke.
Sir William Kelsey Fry, Contemporary. Consulting Dental Surgeon, Guy's Hospital, London
Sir James Berry, 1860–1946. Surgeon, Royal Free Hospital, London.

Cracked Lip.—Chapping of the lips is very common, and a definite crack in the middle of the lower lip is a frequent complaint in cold weather. The crack is deep and bleeds readily. It is liable to be associated with an infection which produces some swelling of the lip.

Treatment consists in the local application of aqueous silver nitrate (1 per cent.) and, if necessary, strapping together the two halves of the lip for several weeks. In obstinate cases excision of the crack followed by suture should be performed.

Cracks at the corners of the mouth (see p. 154).

FIG. 117.—Primary chancre of the upper lip. *(Dr. David Erskine, London.)*

Chancre of the Lip.—A Hunterian chancre on a lip (fig. 117), usually the upper, is not a rarity. Unlike a similar lesion on the genitals, the neighbouring lymphatic nodes become *greatly* enlarged.

NEOPLASMS OF THE LIP

The existence of a lymphangioma in this situation has been referred to under Macrocheilia (p. 120). Cavernous hæmangioma is another rare, innocent neoplasm in this region.

Carcinoma of the lip is usually seen in men between sixty and seventy years of age who have followed an outdoor occupation. So often has a patient with a carcinoma of the lip led an outdoor life that it is known colloquially as 'countryman's lip.' Only recently has the importance of sunlight, wind, and rain been stressed in the ætiology of this neoplasm. In particular, bright sunlight causes exfoliation of the lips—more especially the lower lip. Actinic cheilitis should be considered as a precarcinomatous condition and 40 per cent. of patients with carcinoma of the lip give a history of recurrent blistering cheilitis.

This carcinoma, nearly always of the squamous-celled variety, usually takes the form of a shallow ulcer with the typical everted edge. Any ulcer of the lip which refuses to heal should always be viewed with suspicion. The lower lip is affected in 93 per cent. of cases, the upper lip in 5 per cent., and 2 per cent. occur at one of the angles of the mouth. Rutherford Morison was the first to point out that a carcinoma occurring at the angle of the mouth[1] and involving *both* lips, however slightly, is far more malignant than the more usual varieties. In its typical form (fig. 118) carcinoma of the lip is a comparatively slow-growing neoplasm and a particularly favourable lesion to treat.

FIG. 118.—Carcinoma of the lower lip.

Treatment.—*Excision.*—For early growths, V-shaped excision with a

[1] The angle of the mouth has a double lymphatic drainage.

John Hunter, 1728–1793. Surgeon, St. George's Hospital, London.

margin of ½ inch (1·25 cm.) of healthy tissue, gives good results. The operation can be conducted under infiltration anæsthesia. For larger neoplasms a quadrilateral resection of the lip is to be preferred. In neglected cases, resection of the whole of the lip with plastic reconstruction is sometimes necessary.

Except in feeble, elderly patients, it is advisable to perform a suprahyoid (see p. 210) or, if necessary, a more extensive block dissection of the neck some weeks after the treatment of the primary lesion has been completed.

Radium also gives excellent local results. The needles are placed below and through the lesion parallel to each other and in two blocks. They are left in position for six to seven days, the aim being to deliver a dose of approximately 7,000 r.[1] to the growth.

Prognosis.—The five-year survival rate after treatment (all varieties) is 50 per cent.

Carcinoma of the lip must be distinguished from:

Molluscum pseudo-carcinomatosum, commences as a tiny, painless papule that grows rapidly and achieves its maximum size in about eight weeks. When mature, the nodule is rounded, with slight erythema at its base. It is not long before its summit gives place to a crater filled with friable keratotic material covered by an adherent dark brown crust. As the mouth of the crater widens, so the base of the papule appears to be the rolled edge of a deep ulcer, resulting in a counterfeit carcinoma ready to beguile the clinician. Often non-tender enlargement of the sub-mental lymph nodes complete the deception.

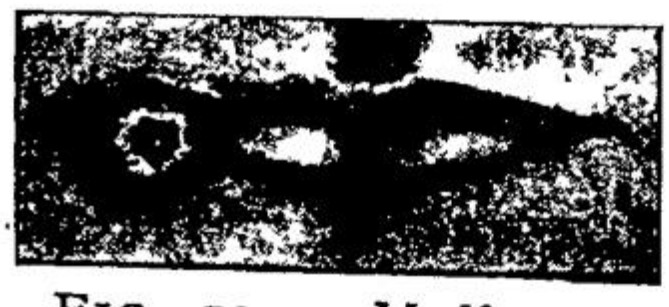


FIG. 119.—Molluscum pseudo-carcinomatosum. (*After S. O. Burman, et al.*)

Molluscum pseudo-carcinomatosum, which occurs frequently on the lower lip (fig. 119) and other parts of the face, but sometimes elsewhere, is not malignant, and is cured by simple excision. Undoubtedly examples of this condition swell the list of cures claimed for carcinoma of the lip, for unless the pathologist is familiar with molluscum pseudo-carcinomatosum the erroneous diagnosis of carcinoma is likely to be confirmed histologically.

THE JAWS

ACUTE OSTEOMYELITIS OF THE JAWS

Maxilla.—The patient is usually an infant. The first sign is a puffiness of the face under the eyes due to suppuration involving the maxillary antra. When the response to penicillin is not prompt and definite, the abscess or abscesses should be opened early into the mouth through an incision similar to that of the Caldwell-Luc operation (p. 127). As a rule these patients recover with surprisingly little deformity.

Mandible.—Subacute osteomyelitis is fairly common; the usual causative organism being *Staphylococcus aureus*. While it can occur at any age, most patients with this condition are between twenty and forty. The symptoms are commonly present for two or three weeks before the diagnosis is made; it should be understood that there is no radiological evidence of necrosis of the bone before that time. Pain and swelling are present and trismus supervenes if the molar region is involved. There is often a purulent discharge from a tooth socket. While the condition may complicate any alveolar abscess, it is particularly liable to do so when an offending tooth is extracted during the acute stage of inflammation, especially under local anæsthesia.

[1] The letter 'r.' is the symbol used to denote the roentgen, which is the unit employed for measuring X-ray or gamma-ray dosage for medical purposes.

Treatment.—In suspected cases of acute osteomyelitis antibiotic therapy should be commenced forthwith, and necrosis of the jaw with consequent sequestration may be avoided thereby. The necessary incision should be made, if possible, within the mouth, and carious teeth in the inflamed area are extracted only after the acute stage of the infection has abated. Suitable mouth-washes are ordered until the sequestrum separates. These sequestra are often comparatively large (fig. 120). Involucrum formation in the jaws is decidedly poor, but it does occur when the patient is young. After middle life there is practically no regeneration of bone.

FIG. 120.—Osteomyelitis of the lower jaw shortly after a very large sequestrum had been removed.

CHRONIC OSTEOMYELITIS (syn. NECROSIS OF THE JAW)

The mandible is many times more often affected than the maxilla, and the necrosis occurs in a number of ways :

1. **Following a fracture,** for fractures of the mandible are almost invariably compound into the mouth.

2. **Following Peridental Suppuration.**—Most of the patients are over fifty years of age. In 50 per cent. of cases dental extraction precedes the onset of symptoms. It is often months before the patient seeks advice.

3. **Chemical necrosis of the jaws** can be caused by radium, mercury, bismuth, phosphorus, or arsenic.

Radium and irradiation are by far the commonest causes of non-bacterial necrosis of the jaws at the present time. Reference to this will be found in several places in this book when it occurs as a complication of irradiation treatment of neoplasms in the area. An industrial cause is in the making of luminous watch dials; the workers are wont to moisten their paint brushes with saliva and convey radium salts to the mouth.

Mercury necrosis sometimes occurs in workers in this metal.

Phosphorus.—White and yellow phosphorus are the poisonous varieties, and the chemical enters tooth sockets usually as fumes. Since prohibitive legislation against white phosphorus in the manufacture of matches came into force, necrosis from this source has been practically eliminated.

Arsenic.—Occasionally chemical necrosis is seen after arsenic has been used injudiciously in dental practice to kill the nerves of teeth.

4. **Tuberculous, syphilitic, and actinomycotic necrosis** of the jaws can occur. The well-known clinical entity of a hole in the hard palate following a gumma (*vide infra*) is an example of syphilitic necrosis.

Necrosis of the mandible is often a very chronic condition. Radiography is helpful, particularly in indicating the presence of sequestra.

Treatment.—Antibiotic therapy is instituted. Comparatively early dependent drainage gives the best results. A suitable incision is made beneath the mandible, and a trough is chiselled in the bone, any sequestrum present being removed. The wound is left open and packed with petroleum jelly gauze.

FIG. 121.—Perforation of the hard palate. Wassermann strongly positive.

Perforation of the Palate (fig. 121).—A hole in *the mid-line* of the hard palate is nearly always due to a bygone gumma or to a partially successful operation for cleft-palate. A hole *to one side of the mid-line* is due to the bursting of an empyema antri through the floor of the antrum.

Treatment.—In some cases the perforation can be closed by a plastic operation, but usually a well-fitting dental plate is all that is required.

MEDIAN MENTAL SINUS

Median mental sinus (fig. 122) is a clinical entity which is often diagnosed and treated incorrectly. It is produced by a periodontal abscess when pus has tracked between the two halves of the lower jaw to the point of the chin. The patient has a discharging sinus on, or less frequently just below, the chin, but always in the mid-line. He usually states that it has been scraped and packed many times. A radiograph of the bone in the immediate neighbourhood reveals nothing, but a radiograph of the lower incisor teeth, which on clinical examination often appear to be sound, shows areas of rarefaction around the roots. After extraction of the affected teeth, the sinus heals within a fortnight.

FIG. 122.—Median mental sinus.

CYSTIC SWELLINGS OF THE JAWS OF NON-DENTAL ORIGIN

Giant-celled reparative granuloma is often wrongly called an osteoclastoma—it only mimics that bone tumour, and it is important to refrain from calling it a giant-celled *tumour* (H. L. Jaffe). The lesion appears to be related to the occurrence of hæmorrhage—hence its name. Somewhat rare, it occurs more frequently in females than in males, and nearly always between the ages of ten and twenty-five years, whereas a *bona fide* giant-celled tumour appears in patients between twenty-five and forty years of age. The lesion causes a painless swelling of the jaw, situated much more frequently in the mandible than in the maxilla.

FIG. 123.—Radiograph showing a giant-celled reparative granuloma of the mandible. (*Dr. H. L. Jaffe, New York.*)

Radiography.—There is a rounded or oval area of radio-translucency (fig. 123). The granuloma thins and expands, but does not perforate the cortex.

Pathology.—Multinuclear giant cells are small, sparse, and distributed unevenly, and histologically it is difficult or impossible to distinguish this lesion from the so-called brown tumour of hyperparathyroidism.

Differential Diagnosis.—One should always make sure that the patient is not suffering from hyperparathyroidism by ascertaining the serum calcium

Henry L. Jaffe, Contemporary. Directory of Laboratories, Hospital for Joint Diseases, New York.

level and by radiography of the whole skeleton (see p. 250). It is also equally important to exclude an adamantinoma (see p. 147), for the treatment of the latter condition must be more radical. This differentiation is often possible by radiography (cf. figs. 123 and 174). Should trabeculation be ill-defined, at operation a giant-celled granuloma will be found to consist of opaque, semi-solid, dark red material, whereas an adamantinoma is filled with transparent fluid or jelly.

Treatment.—The therapeutic treatment of choice is thorough curettage through an external incision with avoidance of opening the bone cavity into the mouth. Should the condition recur, hyperparathyroidism must again be excluded.

Globulo-maxillary cyst occurs in the bony alveolus at the point of fusion of the processus globularis and the maxillary process. The cyst, which is lined with columnar ciliated and stratified squamous epithelium, causes a swelling of the maxilla above the canine tooth, filled with serous fluid. Possibly because of the absence of typical pathological findings after secondary infection, to which these cysts are prone, the rarity of this lesion is apparent rather than real.

PAGET'S DISEASE OF THE JAWS

The condition can be a part of a generalised Paget's disease, or confined mainly to the jaws. The maxillæ are involved in all cases, and occasionally the mandible, in addition. Undue prominence of one or both cheeks producing asymetrical or symetrical deformity is the usual main complaint. Dentures have to be eased or remade at frequent intervals. Neuralgia is the leading symptom in 50 per cent. of cases. The palate is flattened and greatly widened.

FIG. 124.—Paget's disease of the maxillæ. After partial resection of both upper jaws the patient emigrated to New Zealand.

In well-marked cases the face assumes an expressionless, mask-like appearance (fig. 124).

Radiography shows osteoporosis in early cases, osteosclerosis in late cases, when the condition simulates and may be related to leontiasis ossea (see Chapter 47). Radiography of other bones is likely to show typical changes of Paget's disease (see Chapter 47).

Treatment.—As the need arises the alveolus and, if necessary, the anterior surface of the maxilla is reduced in size by chiselling away the excessive bone formation.

Complication.—Sarcoma develops in about 50 per cent. of cases.

INFECTION OF THE MAXILLARY ANTRUM

Surgical Anatomy.—The maxillary antrum (of Highmore) is rudimentary at birth and attains full development by the age of twelve years. Lined with ciliated epithelium, it communicates with the middle meatus of the nose by a small ostium situated high on its medial wall (fig. 125). The apices of the roots of the second premolar and the first and second molar teeth are in close apposition to the floor of the antrum; in some cases one or more of them are separated from the antrum only by periosteum and mucous membrane. Rarely, the first premolar and the canine teeth are related similarly.

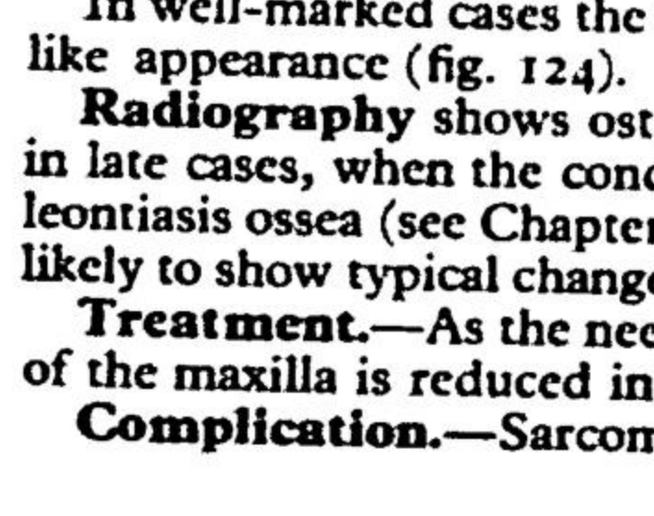


FIG. 125.—Coronal section of the maxillary antrum.

Maxillary sinusitis may be unilateral or, much less frequently, bilateral. Usually infection occurs as an extension from the nose. One epidemic of acute respiratory infection (common 'cold') brings as an aftermath many cases of

Nathaniel Highmore, 1613–1685. Wrote a treatise on anatomy. Practised at Sherborne, Dorsetshire

infection of the accessory nasal sinuses, of which the maxillary antrum always heads the list; while another epidemic, in all other respects similar, is free from this complication. A less frequent cause of maxillary sinusitis is penetration of the floor of the antrum by bacteria and their products from a periodontal abscess connected with a carious tooth of the anatomical variety described above.

Acute Empyema Antri.—As a rule the general symptoms are severe, especially when the pus is confined by occlusion of the natural ostium. Pain and tenderness are present over the affected maxilla; sometimes the pain is referred from the second to the third or the first division of the trigeminal nerve. Frequently the affected side of the face is swollen and the lower eyelid is suffused. Breathing through the nostril on the side of the lesion is impaired and often obstructed completely. A relevant tooth with periodontal suppuration must not be overlooked. Provided the ostium is patent, which is unusual in acute cases, a flow of pus can be obtained when the head is held downwards and forwards with the affected side uppermost.

Both transillumination of the antrum and a radiograph of the region (fig. 126) are likely to reveal relative opacity of the affected antrum.

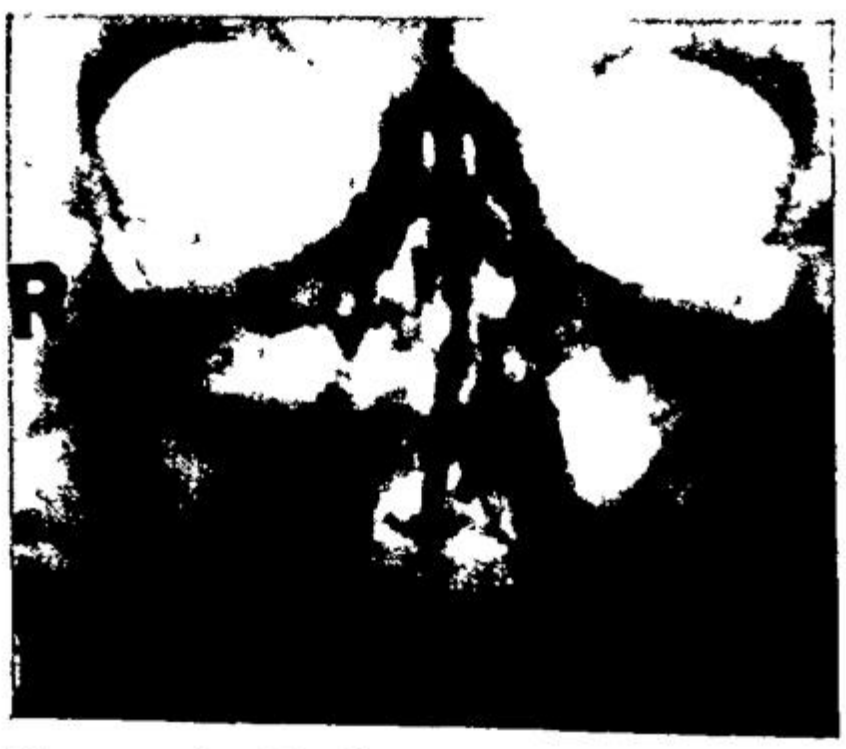


FIG. 126.—Radiograph showing pus in the right antrum of Highmore.

FIG. 127.—Pus exuding from beneath the middle turbinate.

The diagnosis can be confirmed or disproved by puncturing the antrum with a stout hollow needle passed beneath the inferior turbinate bone after the application of surface anæsthesia. If pus is present, it can be aspirated.

Chronic Empyema.—Pain and swelling are often absent, and frequently the only symptom is an intermittent flow of pus from the nostril on the affected side. When the ostium is patent, the information gained by an examination with a nasal speculum may be so explicit (fig. 127) as to render evidence obtained by the examinations detailed above largely corroborative.

Treatment.—In the majority of instances acute infection of the antrum of Highmore subsides as a result of systemic antibiotic treatment combined with antral lavage. In rare cases, particularly those of dental origin, it is necessary to resort to operation, and usually the Caldwell-Luc is the procedure of choice, as also for chronic cases that do not respond quickly to

antral puncture and lavage with normal saline solution. Alternatively, intranasal antrostomy can be performed, either alone or in conjunction with the operation about to be described.

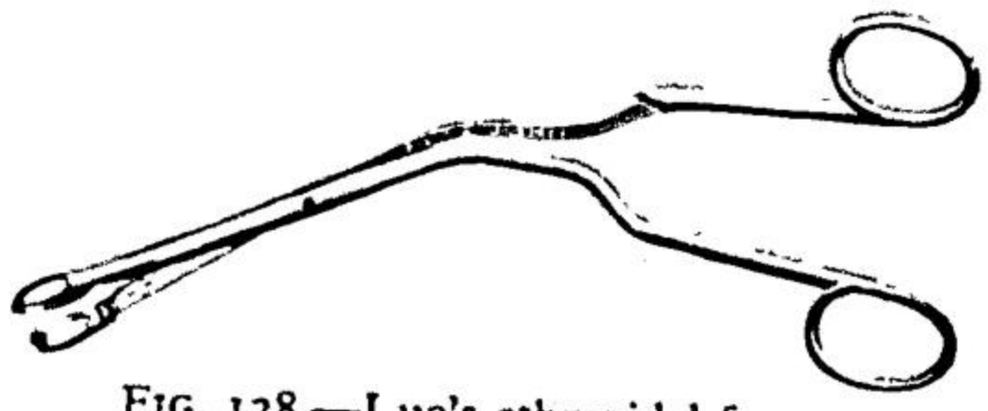


FIG. 128.—Luc's ethmoidal forceps.

The Caldwell-Luc Operation.—A transverse incision is made in the sulcus between the gum and the cheek above the bicuspid and first molar teeth. Employing a periosteal elevator, the anterior wall of the antrum is laid bare to within a finger's breadth of the infraorbital foramen. The wall of the antrum is opened with a gouge and hammer, the resulting hole being enlarged with nibbling forceps. Pus is evacuated and the œdematous mucous membrane loosened and extracted with Luc's forceps (fig. 128). A quadrilateral piece of bone is removed from the nasal wall of the antrum (fig. 129) without tearing the nasal mucous membrane; the latter is cut as a flap to form a carpet for the floor of the antrum. The buccal mucous membrane is left unsutured and the nasal cavity is packed for twenty-four hours with strips of gauze soaked in liquid paraffin. If the infection is of dental origin, the offending tooth must be extracted.

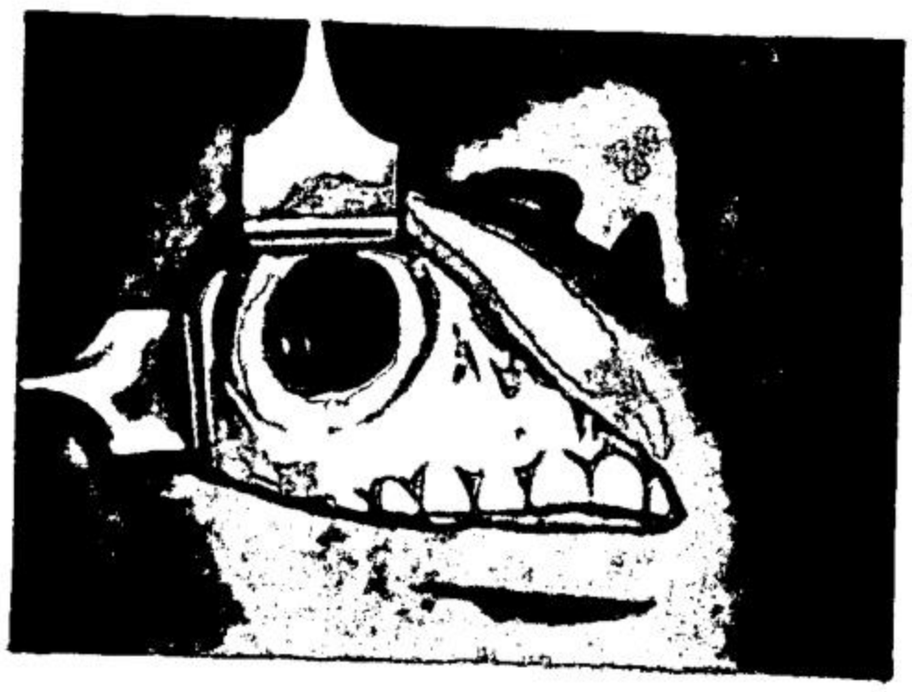


FIG. 129.—The Caldwell-Luc operation completed.

Nasal Polypi.—Although they do occur independently, so intimate is the relationship between chronic empyema antri and nasal polypi that a description of the one is virtually incomplete without the other. Notwithstanding their intimate relationship to chronic infection of the nose, nasal polypi were formerly classified as neoplasms, either myxomata or œdematous fibromata. Microscopically they are found to be composed of granulomatous infiltration of the submucous tissue that cannot be differentiated from hyperplasia. Consequently it is best to look upon them as an expression of ethmoiditis.

Nasal polypi are usually multiple and are found growing from the region of the middle turbinate (see fig. 125) and are recognised by their glistening gelatinous appearance when light is focused upon them.

They are practically confined to adults, and patients suffering from them complain of nasal obstruction, nasal discharge, and some loss of smell. Many of the sufferers are allergic to dusts and pollens that initiate in them attacks of sneezing and acute rhinitis.

In contradistinction to the common variety of nasal polyp, one that bleeds spontaneously or when touched gently with a probe should be regarded as a malignant neoplasm and treated accordingly (see p. 129).

Treatment.—Nasal polypi together with pieces of carious ethmoid can be removed under surface anæsthesia with Luc's forceps, but in cases complicated by sinusitis the underlying cause must be eradicated also.

George Walter Caldwell, 1866–1946. He practised otorhinolaryngology successively in New York, San Francisco and Los Angeles, but never obtained a major hospital appointment.
Henri Luc, 1855–1926. Otolaryngologist, Paris. His private clinic was frequented by otorhinolaryngologists from all countries.

BENIGN NEOPLASMS OF THE MAXILLA

Ivory osteoma can arise from either the maxilla (fig. 130) or the mandible. Excision of that portion of the bone from which it springs is essential. Often this entails removal of most or all of the maxilla, which is the bone affected more frequently.

FIG. 130. — Ivory osteoma of the left maxilla. The tumour has been growing slowly for eight years.

Leontiasis Ossea (see p. 1236).

Odontomata (see p. 146).

MALIGNANT NEOPLASMS OF THE MAXILLA

The clinical diagnosis of 'malignant upper jaw' embraces a number of pathological conditions.

1. *Osteogenic sarcoma* is usually of the round-celled variety; rarely it is a highly differentiated fibro-myxochondrosarcoma. One-third of malignant tumours of the upper jaw are osteogenic sarcomata.

FIG. 131. — Sarcoma of the upper jaw. *(The late Mr. J. A. C. Macewen, Glasgow.)*

2. *Squamous-celled carcinoma*—derived from the epithelium overlying the hard palate, from a tooth socket, or from the gum.

3. *Columnar-celled carcinoma*—arising from the maxillary antrum or nasal cavities.

4. *Invasion of the maxilla by a sarcoma of the ethmoid.*

Osteogenic Sarcoma.—While neither sex nor any age is exempt, curiously this disease has a distinct predilection for women (fig. 131) about the age of forty. When of the periosteal variety—and this is the more usual—it is the *anterior* aspect of the jaw which is maximally affected, but the condition soon shows itself on the inferior or palatal wall as well. Until perhaps during the terminal stages of the disease, there is no nasal obstruction and no epiphora.[1] Pain is a late symptom.

Carcinoma commencing in the maxillary antrum is much more frequent than the foregoing, and the age incidence of this group is similar to that of carcinomata elsewhere. These neoplasms are divided about equally between the sexes, and most cases are associated with secondary infection of the nasal sinuses. Growths that originate on the floor of the antrum frequently cause pain in the teeth, and a dental surgeon is consulted, but without relief of the pain; however, pain usually results in a comparatively early diagnosis. When it occurs, epistaxis is a valuable early symptom, as also is unusually free bleeding associated with antral puncture, which should always bring to mind the possibility of carcinoma of the antrum. Unfortunately, with these exceptions, the symptoms of neoplastic growth in the maxillary antrum are usually late in appearance. In no less than 30 per cent. of cases,

[1] Epiphora—Greek, ἐπιψορά = overflow. An abnormal overflow of tears down the cheek usually due to stricture of the lacrimal duct.

by the time the patient seeks advice metastasis has occurred, most commonly in the regional lymph nodes, but sometimes in distant organs, and occasionally in long bones. Even in cases which appear to have remained localised one must remember that the main lymphatic field is retropharyngeal, and unless grossly enlarged, lymph nodes in this situation are inaccessible to clinical examination. The main clinical features vary in accordance with the direction in which the tumour spreads :

If posteriorly, there is little if any alteration in contour of the face.

If the antero-lateral wall is involved, there will be swelling of the face (fig. 132).

If the floor of the antrum is transgressed, the hard palate is the first to bulge.

If the roof is invaded, there will be proptosis and diplopia.

FIG. 132.—Carcinoma commencing in the maxillary antrum. Compare the patient's age with that of the patient in fig. 131.

Comparatively early symptoms include unilateral nasal obstruction and sometimes a unilateral semi-purulent discharge.

In early cases radiography is not much value as an aid to diagnosis.

FIG. 133.—Trotter's incision for removal of the upper jaw. Ugly œdema of the lower eyelid is avoided by carrying the incision through the eyelid just outside the punctum lacrymale, along the orbital margin inside the lid, and thence as shown in the figure, avoiding the outer canthus.

Treatment.—Even in pre-anæsthetic days complete excision of the upper jaw (fig. 133) was practised. It was for this purpose that Fergusson invented lion forceps (fig. 134). Since the introduction of intratracheal anæsthesia the operative mortality is low. There is surprisingly little deformity after this formidable operation, especially if a prosthesis is constructed by a dental expert as soon as the wound has granulated. Such treatment offers hope of a cure (fig. 135).

FIG. 134.—Fergusson's lion forceps.

Somervell, after a vast experience of malignant disease of the jaws in Southern India, considers surgical removal superior to radiotherapy for this condition.

No matter what form of treatment is undertaken, tumours composed of undifferentiated round cells (sarcoma) nearly always prove fatal within two years.

FIG. 135.—Patient two years after excision of the upper jaw and the eyeball for a carcinoma springing from the antrum and invading the orbit. Three years later he was at work as a night watchman.

Combined Irradiation and Conservative Surgery for Carcinoma of the Maxilla.—In several clinics the following plan is adopted :

Joseph Gensoul, 1707–1866, of Lyons, performed the first successful resection of the upper jaw for malignant disease in 1827.
Wilfred Trotter, 1872–1939. Surgeon, University College Hospital, London.
Theodore Howard Somervell, Contemporary. Formerly Surgeon, Travancore, Southern India.

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(*a*) A course of high-voltage irradiation or gamma rays from a teleradium unit is given.

(*b*) Six to eight weeks after the conclusion of the irradiation, by which time the inflammatory reaction has abated, palatal antrostomy (fig. 136) is performed. The plate of bone forming the antro-nasal wall is nibbled away. The inferior and middle turbinate bones and the tissue involved in the growth are removed with a diathermy needle, as far as possible in one piece; doubtful areas are coagulated. A light plastic obturator, previously prepared, is inserted. The patient is given penicillin for a week.

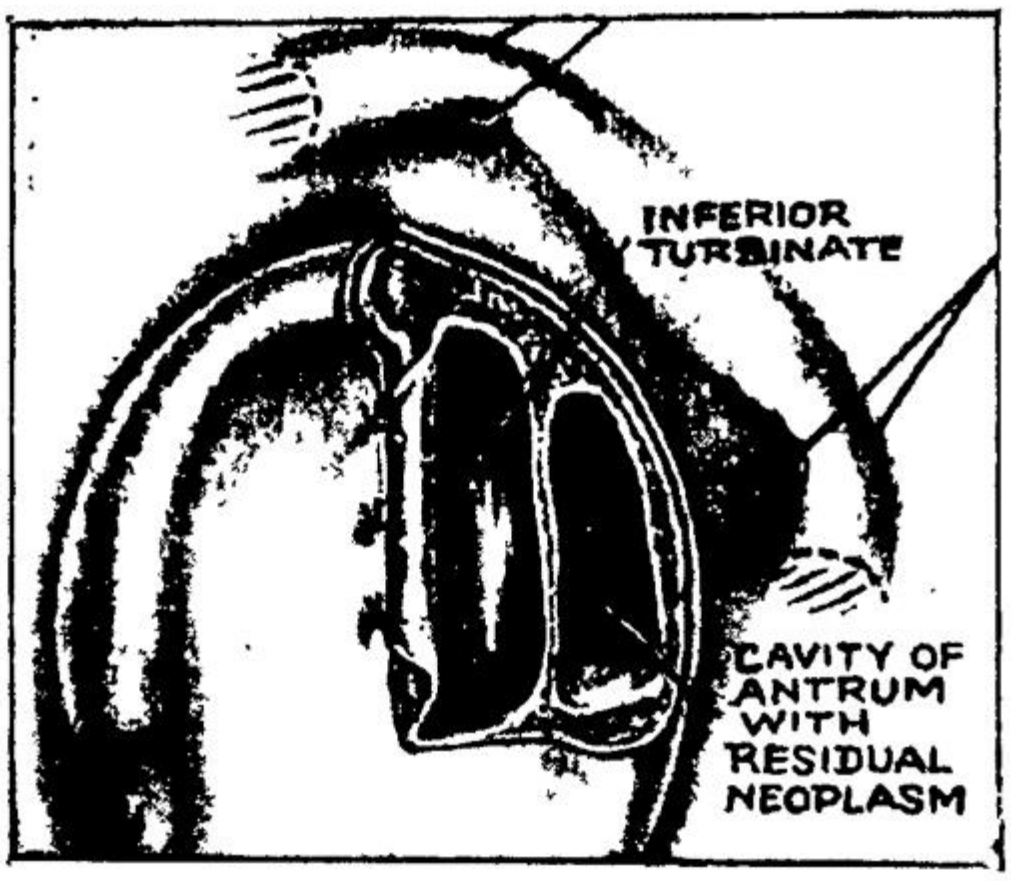

FIG. 136.—Palatal antrostomy.
(*After C. P. Wilson.*)

(*c*) In 30 per cent. of cases the tissue removed shows no evidence of malignancy, and nothing more is done. When the tissue removed at operation shows evidence of active malignancy a hollow plastic applicator, made by a dental surgeon, is filled with wax and drilled so as to take radium tubes. In this way further irradiation is given. If the post-ethmoidal or sphenoidal regions are involved, radium needles are inserted directly into those areas.

(*d*) A block dissection of the neck is undertaken in necessary cases.

(*e*) A permanent obturator bearing teeth is not fitted until at least three months after operation.

MALIGNANT NEOPLASMS OF THE MANDIBLE

The mandible is rarely the site of a primary malignant neoplasm or of a metastasis. However, rather frequently it becomes *directly* involved by an advancing primary carcinoma of the tongue or of the floor of the mouth. Sometimes an advanced carcinoma of the lip spreads to this bone through the mental foramen. A third method of neoplastic involvement is occasioned by the relation of the facial lymph node which lies in juxtaposition to the mandible near the groove on this bone for the facial artery. Should this inconstant node become the seat of a secondary deposit, it tends to become parasitic on the mandible, and to invade the bone by direct encroachment.

Treatment.—So regularly does irradiation cause necrosis of the mandible that when the mandible is involved, usually it is necessary to resect a portion of it or, more often, to perform hemi-mandibulectomy; if the chin itself can be spared, gross deformity is obviated. In cases of very early involvement sometimes it is justifiable to remove the periosteum and a scale of underlying bone along with the primary growth.

SARCOMA OF THE ETHMOID

Sarcoma of the ethmoid is a comparatively rare condition. As it expands it widens greatly the space between the orbits and flattens the nasal bones, producing that well-known clinical entity the 'frog-faced man' (fig. 137). Still later the superior maxillæ are invaded.

Treatment.—When the air sinus is infected, drainage is essential before irradiation is commenced. In other respects

FIG. 137.—Frog-faced man.
(*Musgrave Woodman.*)
(*British Journal of Surgery.*)

the treatment by combined irradiation and operation does not differ in principle from that just described for carcinoma of the maxillary antrum.

CYSTS ABOUT THE ORBIT

From the point of view of clinical surgery it is convenient to group together certain conditions which have but one point in common—they form cystic swellings in the neighbourhood of the orbital margin. Passing latero-medially (figs. 138, 139, 140, 141, and 142) we may recognise :

FIG. 138.—External angular dermoid.

1. **External Angular Dermoid.**—This is perhaps the commonest situation for a dermoid cyst (fig. 138), and its position is so constant that it allows the diagnosis to be made with irrefutable accuracy. The treatment is excision.

2. **Meibomian cyst** usually occurs in the upper eyelid (fig. 139). It is due to a staphylococcal infection of a Meibomian gland, the swelling being, for the most part, retained Meibomian secretion. It must be distinguished from a hordeolum (stye) (fig. 140), which is due to an infection of an eyelash follicle.

Treatment of a Meibomian cyst consists in making an incision into the

FIG. 139.—A Meibomian cyst.

FIG. 140.—Hordeolum (stye).

cyst from its conjunctival aspect, at right angles to the margin of the lid, and scraping out the sac wall with a small sharp curette.

3. **Mucocele of the lachrymal sac** (fig. 141) is the result of lachrymal obstruction with distension of the sac and secondary infection of its walls (dacryocystitis).

Treatment consists in washing out the sac by means of a lachrymal syringe and removing the cause of the obstruction.

4. **Cyst over the Root of the Nose.**—If the swelling is beneath the skin and does not empty with pressure, it is almost certainly a dermoid cyst (fig. 142). If it can be made to empty, a meningocele is probable, but a sinus pericranii, connected with one of the intracranial venous sinuses, also must receive due diagnostic consideration. Especially when the swelling is not strictly median, the possibility of a mucocele of the frontal sinus or ethmoidal cells should be borne in mind.

FIG. 141.—A mucocele of the lachrymal sac. (*The late Mr. S. Mayou, London.*)

FIG. 142.—Dermoid cyst at the root of the nose.

Heinrich Meibom, 1638–1700. Professor of Medicine, Helmstädt. Resigned the Chair for that of History and Poetic Art.

(*a*) A course of high-voltage irradiation or gamma rays from a teleradium unit is given.

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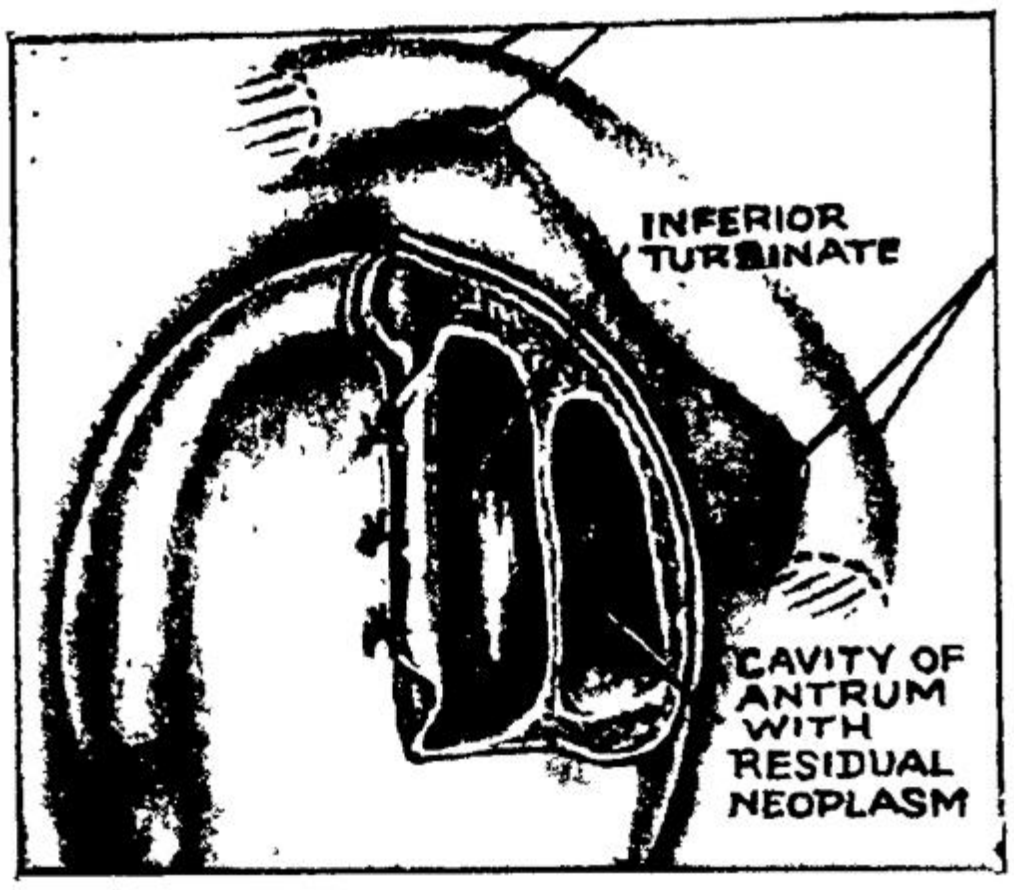

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FIG. 137.—F
faced
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possible, followed by deep X-ray therapy. Because of intracranial extension along the optic nerve, recurrence after enucleation occurs in about 50 per cent. of cases, in which event death occurs usually within a year. If the patient is free from recurrence for four years, a permanent cure is practically certain.

Melanoma is the most important intra-ocular tumour of adults. Usually it originates in the posterior part of the choroid, but it may arise in the ciliary body or the iris. Always unilateral, it grows as a disc-like mass until it breaks through the elastic membrane covering the choroid, when it spreads beneath the retina in a mushroom-like manner, often causing retinal detachment. Very occasionally a melanoma of the eye remains small and seemingly benign, but most of these tumours are highly malignant. Malignant intra-ocular melanoma shows comparatively little tendency to spread into the orbit, but metastases are carried especially to the liver (fig. 145) where they sometimes grow to an immense size, even weighing 20 lb. (9 Kg.). The patient is nearly always between forty-five and sixty years of age. When present, a characteristic early symptom is a fixed black spot in the visual field, but the most frequent symptoms are those of retinal detachment. There is no pain until secondary glaucoma has set in, by which time the tumour has reached a considerable size. If the globe is removed early in the course of the disease, dissemination may be limited, but rarely is the expectation of life more than three years. Sometimes, after early diagnosis and excision of the globe, the metastasis is delayed for many years, and then arises a classical pitfall for the unwary diagnostician. Wherefore it has been remarked, with much wisdom, that the clinician should "beware the patient with a large liver and a glass eye" (fig. 146).

FIG. 145.—Section of liver showing secondary melanoma. The primary growth was intra-ocular.

FIG. 146.—Patient with a greatly enlarged liver, who for many years had worn a glass eye.

PULSATING EXOPHTHALMOS

Unilateral pulsating exophthalmos is a rare condition that always excites clinical interest. The principal causes are as follows:

1. An arterio-venous aneurism between the internal carotid artery and the

FIG. 147.—Pulsating exophthalmos due to an intracranial arterio-venous aneurism. (*British Journal of Surgery.*)

cavernous sinus (fig. 147); usually traumatic in origin.

2. An aneurism of the ophthalmic artery.

3. A cirsoid aneurism involving the orbit.

4. Thrombosis of the cavernous sinus. However, pulsation is not a usual feature of this condition.

5. A rapidly growing vascular intra-orbital neoplasm.

Subjective Symptoms.—In the first three conditions the patient notices a buzzing noise in the head and failing of vision.

Treatment.—The first variety, which is the most common, is the most amenable to treatment. Ligation of the orbital veins is often successful. Adson recommends two small incisions, one over the inner canthus (angular vein) and one under the inner end of the eyebrow (superior ophthalmic vein). Loops of the veins are freed and segments of them are resected between ligatures. When this fails, ligation of the *common* carotid artery is resorted to. These combined measures cure about two-thirds of the patients belonging to the first three groups. Should this fail, the advisability of ligation of the *internal* carotid artery must receive full consideration, bearing in mind that ligation of the internal carotid artery is a more dangerous procedure than ligation of the common carotid artery. For the other varieties of aneurism the reader is referred to p. 91.

ORBITAL CELLULITIS

Cellulitis of the orbit (fig. 148) gives rise to proptosis, œdema of the eyelids, and œdema of the conjunctiva (chemosis). The most frequent cause of the condition is a spread of infection from one of the paranasal sinuses. The constitutional symptoms are often severe. There are two outstanding dangers of infection of this space. Firstly, thrombophlebitis of the cavernous sinus may follow via the ophthalmic plexus of veins, and, secondly, the globe of the eye may become infected.

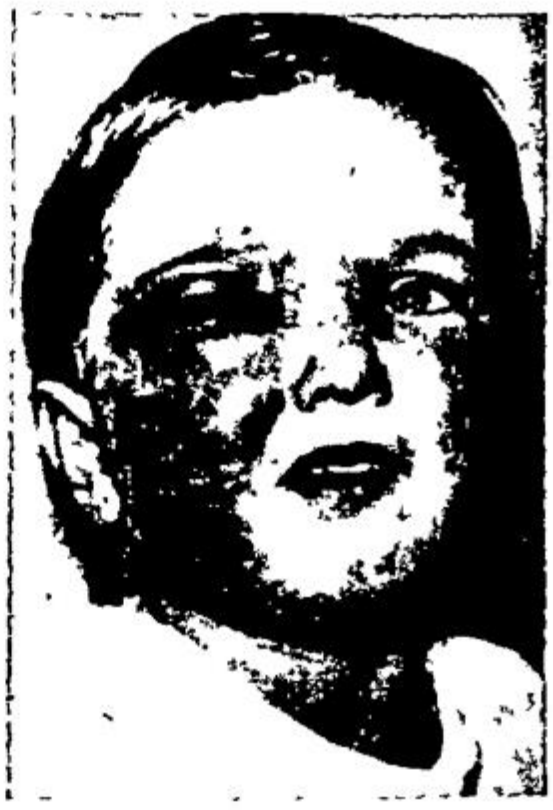

FIG. 148.—Orbital cellulitis.

Treatment.—In early cases, antibiotic therapy, which should be instituted at once, sometimes results in resolution of the infection. Unless full response to penicillin is undoubted, an incision along the inferior orbital margin followed by blunt-nosed forceps passed into the intra-orbital fat should not be delayed; this will relieve tension in the orbit and provide drainage.

INJURIES OF THE EYE

Injuries of the eye belong properly to the domain of ophthalmology. It is necessary here to call attention to a peculiar danger of perforating wounds of the globe. After a penetrating wound of the eye, particularly when a portion of the uveal tract prolapses, there is always a danger of sympathetic ophthalmitis occurring in the sound eye. When this occurs, the sight of both eyes may be lost. The only certain way of avoiding sympathetic ophthalmia is to excise at once a wounded eye in cases where there is no perception to light.

Alfred W. Adson, Contemporary. Professor of Neuro-Surgery, Mayo Clinic, Rochester, U.S.A.

EXCISION OF AN EYEBALL

Indications
- Trauma.
- Foreign bodies.
- Iridocyclitis.
- Phthisis bulbi.
- Neoplasms.
- Anterior staphyloma.
- Irremediable glaucoma.

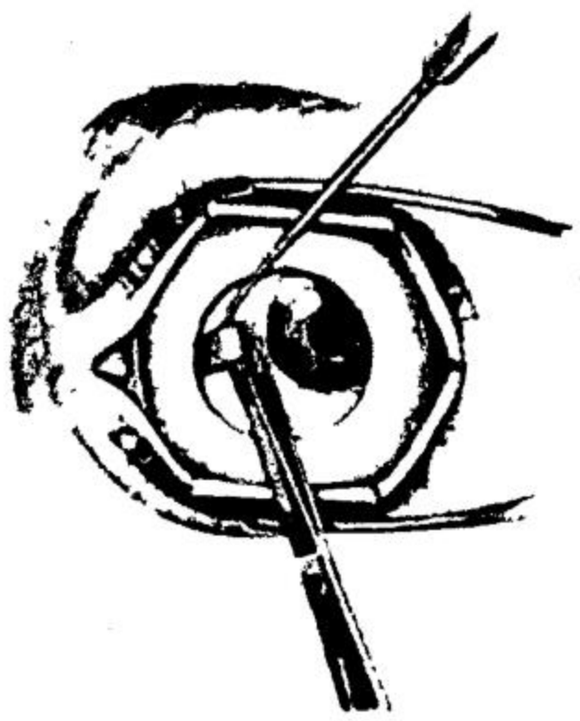

FIG. 149.—Excision of an eyeball. Medial rectus tendon being divided, aided by a strabismus hook.

The Operation.—The speculum is introduced between the lids, and opened. The conjunctiva is picked up with toothed forceps and divided completely all round as near as possible to the cornea. Tenon's capsule is entered, and each of the rectus tendons is hooked up on a strabismus hook and divided close to the sclerotic (fig. 149). The speculum is now pressed backwards and the eyeball starts forward. Blunt scissors, curved on the flat, are insinuated on the inner side of the globe, and these are used to sever the optic nerve. The eyeball can now be drawn forward with the fingers, and the oblique muscles, together with any other strands of tissue which are still attaching the globe to the orbit, are divided. A swab moistened with 1 : 1,000 adrenalin and pressed into the orbit will control the hæmorrhage.

EVISCERATION OF THE EYEBALL

Owing to the danger of opening up lymphatic spaces at the back of the globe and thus favouring meningitis and sympathetic ophthalmitis, evisceration is much to be preferred to excision in panophthalmitis. The sclera is transfixed with a pointed knife a little behind the corneo-sclerotic junction, and the cornea is removed entirely by completing the encircling incision in the sclera. The contents of the globe are then scraped out by means of a sharp spoon, care being exercised to remove all the uveal tract. At the end of the operation the interior must appear perfectly white.

THE FACE

WOUNDS

It is most fortunate that owing to the abundant blood supply of the face, contrary to excision of a wound elsewhere, not only can the eight-hour limit for primary closure of wounds be extended (in the case of clean-cut wounds to twenty-four hours), but débridement of a facial wound can be reduced to an absolute minimum. Ragged skin edges are merely trimmed, tags of fat and muscle are snipped away, while a piece of skin partially or wholly detached, after removal of all its subcutaneous fat, is sutured loosely into position and protected with a firm dressing. When skin edges cannot be brought together without tension, under-cutting is required. After hæmostasis, which is often troublesome, has been effected according to its depth, the wound is sutured *in layers*. In the case of a deep wound stitches are passed through the muscular layers in an inverted manner, so that

FIG. 150.—Method of inserting intradermal sutures. (*After A. Kazanjian and J. M. Converse.*)

Jacques R. Tenon, 1724–1816. Surgeon, Hôpital Salpêtrière, Paris.

when each knot is tied and its free ends cut, the knot will be buried ; accurate apposition of the base of the dermis is achieved by inserting inverted intradermal sutures (fig. 150) so that these knots also are buried. Lastly, the very finest skin sutures are inserted, the cosmetic result being enhanced by employing skin sutures mounted on an eyeless needle. The skin sutures should be passed so that their points of entrance and exit are near the margins of the incision, but a broad bite of the subcutis is included (fig. 151); in this way inversion of the skin edges is avoided.

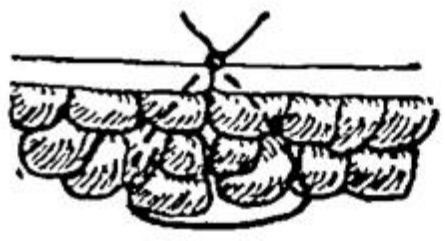

Fig. 151.—Method of avoiding inversion of the skin edges. (*After T. P. Kilner.*)

A thin layer of gauze moistened with saline solution is placed over the skin to absorb the exudate. Over this is placed a layer of fine-mesh petroleum-jelly gauze. This, in turn, is covered by foam rubber or mechanic's waste and retained as a pressure dressing with flexible adhesive plaster. Skin stitches should be removed on the fourth day.

When a considerable portion of the cheek or a lip has been lost, at the initial operation, after débridement, the skin is sewn to the mucous membrane. When a portion of the eyelid has been lost, the lids are stitched together lightly to protect the conjunctiva. In each of these instances, when the danger of infection has passed, a plastic operation is undertaken by a surgeon experienced in this work

ACUTE INFECTIONS OF THE FACE

Carbuncle of the face has a sinister reputation, and the upper lip and the nose are the most frequent sites of this most serious condition (fig. 152). The public should be warned not to prick, squeeze, or otherwise tamper with a pimple in this area, for such a practice favours this dangerous condition. It is particularly dangerous because infection can, and often does, spread

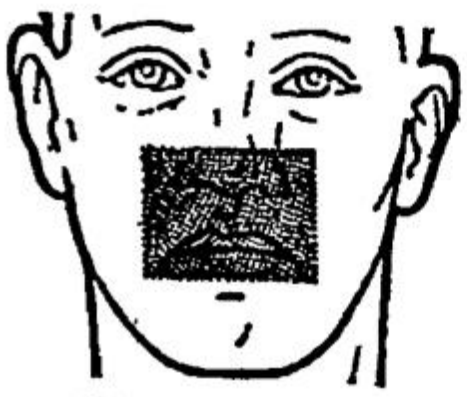

Fig. 152.—The 'danger' area of the face.

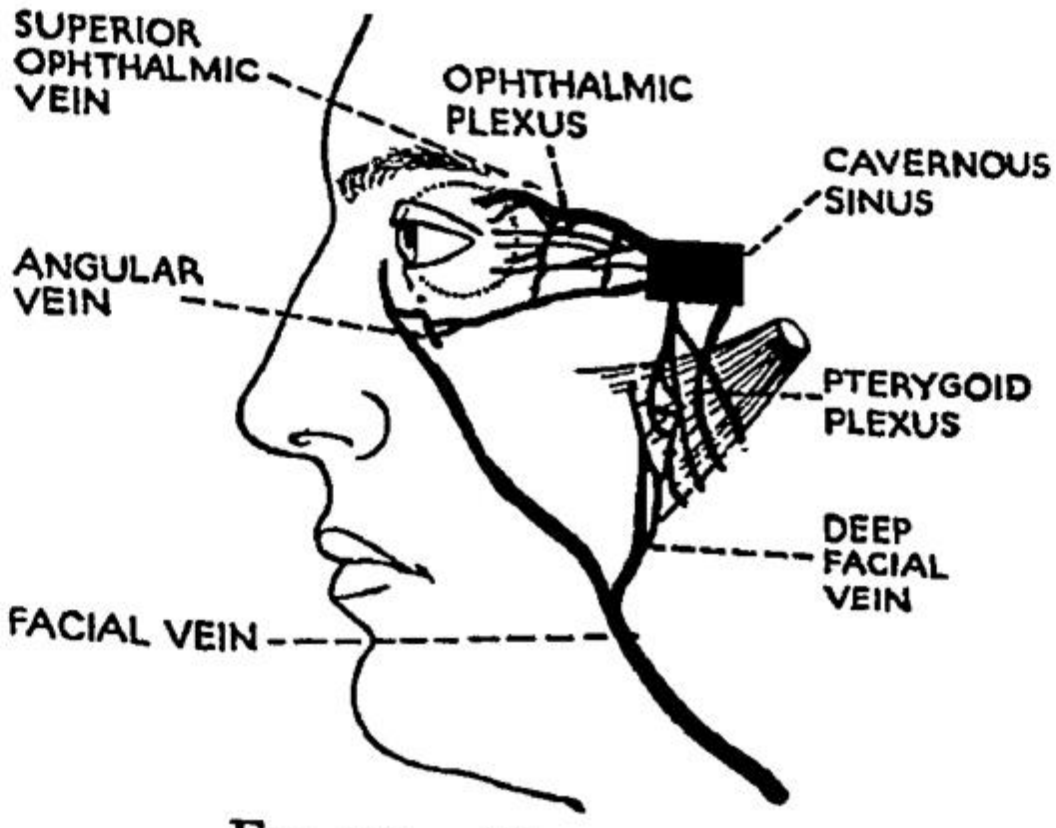

Fig. 153.—The cavernous sinus and its connections.

Fig. 154.—Thrombophlebitis of the cavernous sinus secondary to a furuncle of the naris. (*Mr. P. Reading, London.*)

along the angular vein to the ophthalmic plexus, and thence to the cavernous sinus (fig. 153). In pre-antibiotic days thrombophlebitis of the cavernous sinus proved almost inevitably fatal. Massive (25,000,000 units of penicillin

daily) and prolonged antibiotic therapy, combined with treatment by systemic anti-coagulants, has brought this condition (fig. 154) into the realms of curability. Because many of these cases are due to a penicillin-resistant staphylococcus, while awaiting the bacteriology report it is best to administer terramycin or penicillin combined with streptomycin. A good method of local treatment is hot applications of gauze soaked in a saturated solution of magnesium sulphate until the slough separates. A carbuncle of the lip should never be incised.

Although the patient's life is usually spared, frequently there are serious, or even tragic, sequelae; to wit: a lesion of one or more of the cranial nerves that traverse the outer wall of the cavernous sinus and unilateral, or even bilateral, blindness.

Anthrax.—While cutaneous anthrax can occur in any part of the body exposed to infection, the face is the commonest site for the so-called 'malignant pustule,' prompt recognition of which is so important. A differential diagnosis must be made between anthrax and two conditions easily mistaken for it. The first is a virulent furuncle, and the second accidental vaccinia. The contagion in accidental vaccinia often takes place in the following way. The recently vaccinated child with the cutaneous lesion on its arm in full activity, while being carried by its mother or nurse, places the vaccinated area against her cheek (fig. 155). Final and absolute diagnosis of anthrax rests in demonstrating the anthrax bacillus (see p. 19).

FIG. 155. — The commonest cause of accidental vaccinia.

Chronic Infections.—See Lupus, Chapter 37.

Facial Palsy. See p. 181 and Chapter 39.

NEOPLASMS

Benign :

Simple nævi (cutaneous hæmangiomata) are often found on the face. Small tumours can be satisfactorily removed by an application of carbon-dioxide snow. Larger ones may yield to treatment by radium, but the very extensive variety calls for the highest efforts of plastic surgery.

Pigmented and Hairy Moles.—The face is a common situation for pigmented or hairy moles, a condition for which the patient seeks relief on account of disfigurement. Their removal is also to be urged on account of the danger of a melanoma developing in the pigmented area. Hairy moles are treated successfully by excision followed if necessary by skin grafting.

FIG. 156.—Rhinophyma. *(Dr. B. B. Ash, Birmingham.)*

Rhinophyma (*syn.* Potato Nose).—The skin of the nose, particularly the distal part, becomes surmounted with irregular bosses (fig. 156), on which the openings of the sebaceous follicles are easily

discerned. The capillaries become dilated and the nose assumes a bluish-red colour. Histologically, the condition appears to be due to sebaceous adenomata.

Treatment.—Paring away the protruding masses with a scalpel until the nose is of normal dimensions gives pleasing results. Care must be taken not to encroach upon the cartilages or the nostrils. The brisk hæmorrhage is controlled by hot applications, after which a dressing of tulle gras is all that is necessary. Skin grafting is not required.

Malignant :

FIG. 157.—An early rodent ulcer. (*Sir Norman Paul, Sydney.*)

Rodent Ulcer (Basal-celled Carcinoma).—Rodent ulcers are almost confined to that portion of the face situated above a line joining the tip of the lobule of the ear with the angle of the mouth, the site of election being near the inner canthus (fig. 157).

Ætiology.—Exposure to bright sunlight appears to be a causative factor. In parts of Australia where sunlight is powerful, the condition is very common, especially in the fair-skinned (as opposed to the darker Italian) members of the labouring population (W. Boyd).

The 'ulcer' appears as an irregular sclerotic scar surrounded by an area of small grey elevations (fig. 158), traversed here and there by a fine capillary vessel. Rodent ulcer is essentially very chronic, but usually steadily progressive. In process of time it does, as its name implies, become a real ulcer and it eats its way into muscle, cartilage, and bone, producing ghastly disfigurement, the interior of the orbit, nose, and even the brain being exposed by the ulcer. Death releases the victim by erosion of a large artery or by inhalation broncho-pneumonia. Even in advanced cases metastases never occur unless, as rarely happens, the rodent ulcer takes on a squamous-cell carcinomatous change.

FIG. 158.—Another common type of rodent ulcer.

Treatment.—Excision of the area with a margin of healthy tissue is curative in comparatively early cases. X-ray treatment is also employed, but recurrences are rather frequent and inadequate dosage may induce a carcinomatous change.

FIG. 159.—Carcinoma of the pinna.

Squamous-celled Carcinoma (*syn.* Epithelioma).—As opposed to rodent ulcer, squamous-celled carcinoma rather commonly attacks the pinna (fig. 159). If diagnosed and treated early, favourable results accrue from excision of a part, or

the whole of, the pinna. Although the lesion is obvious, for some obscure reason the condition is often comparatively far advanced before the patient seeks relief.

Before concluding this chapter, the opportunity will be taken to give an account of a common emergency:

EPISTAXIS

Source and Cause of the Bleeding.—The bleeding may be arterial or venous. In 60 per cent. of cases it comes from veins (sometimes varicose) of Kiesselbach's plexus situated in Little's area (fig. 159a) on the antero-inferior portion of the septum. The most frequent cause of hæmorrhage from this area is picking the nose—epistaxis digitorum. In traumatic cases (fracture of the nasal bones or fracture of the anterior cranial fossa) the bleeding can be either venous or arterial, from the anterior ethmoidal vessels. Posterior bleeding, which is common in patients with hypertension, usually is due to rupture of a branch of the sphenopalatine artery. The possible causes of epistaxis are numerous, but summarising, it can be stated that seldom is there a deficiency of the clotting mechanism but rather a leak through the wall of a blood vessel.

FIG. 159a.—Little's area.

Treatment.—Trotter's method alone is successful in 70 per cent. of cases. The patient is propped up with a comfortable inclination to one side, and a nest of wool is so arranged that he can dribble into it. A dental prop is placed between the teeth and he is exhorted not to breathe through the nose or to swallow. A substantial dose of morphine is administered. Blood transfusion is given if required.

FIG. 159b.—Method of inserting a posterior nasal tampon (Dickie's method).

Cauterising the bleeding-point with trichloracetic acid, 50 per cent., or diathermy is undertaken if the bleeding-point can be seen.

Packing: *Anterior Packing.*—After anæsthetising the mucous membrane with 4 per cent. xylocaine, ribbon gauze saturated in BIPP[1] is inserted so as to fill the nasal cavity, and if the bleeding is from the septum the nasal cavity of the opposite side is packed also. Penicillin is administered to combat infection. *Posterior Packing.*—When the bleeding is posterior the insertion of a cone-shaped gauze tampon (fig. 159b), moistened with liquid paraffin or BIPP, is much the most satisfactory method, for it minimises complications (e.g. hæmotympanum). The pack can be left in for five days if an antibiotic is administered.

Arterial Ligation.—When the above methods fail, or profuse hæmorrhage recurs and it is probable that the source of the bleeding is posterior, ligation of the *external carotid artery* is indicated. In a number of instances both external carotid arteries have been ligated with success for intractable epistaxis. Ligation of the *anterior ethmoidal artery* in the orbit is indicated particularly in traumatic cases, when other methods fail.

[1] BIPP = Bismuth, Iodoform, Paraffin, Paste.

Wilhelm Kiesselbach, 1839–1902. Professor of Otology, Erlangen.
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William Boyd, Contemporary. Professor of Pathology and Bacteriology, University of Toronto.

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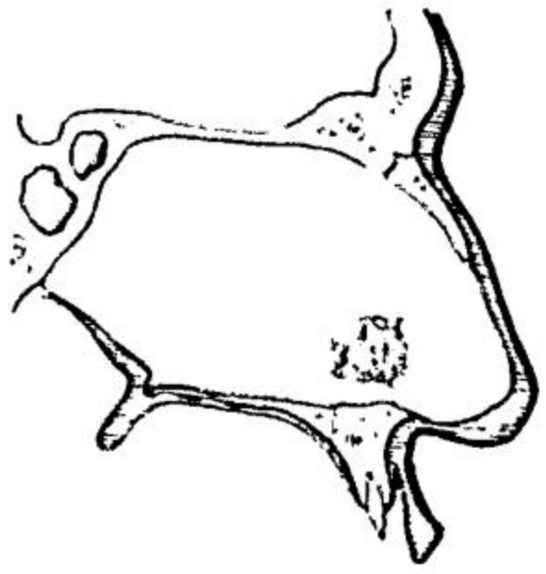

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CHAPTER IX

THE TEETH AND GUMS

HAMILTON BAILEY

TEETH commonly congenitally absent are the third molars and upper second incisors. The occurrence of supernumerary teeth is fairly common; occasionally clusters of them are present.

IMPACTION OF A TOOTH

A tooth is prevented from normal eruption by the presence of adjacent fully erupted teeth. The tooth most often to be affected in this way is the third lower molar. When a partially erupted tooth is in communication with the mouth, the unerupted portion of the crown is overhung by a pocket or flap of the gum, known as an operculum, viz.:—

where food débris collects, resulting in infection, which tends to spread to the cheek and sometimes to the neck. In such cases trismus[1] is often present.

Treatment.—If trismus is otherwise insurmountable the patient should be given a general anæsthetic. This releases the spasm of the muscles of mastication and permits the insertion of a mouth prop; if an abscess is present beneath the operculum, it is incised. Unless there are signs of a closed fascial space infection (see p. 196), reliance is placed on systemic antibiotic therapy, frequent mouth-washes, and syringing beneath the flap. When the acute symptoms have subsided, the impacted tooth should be extracted; the exception being if one of the molar teeth anterior to it is carious. Extraction of the carious tooth may afford room for the impacted molar to erupt.

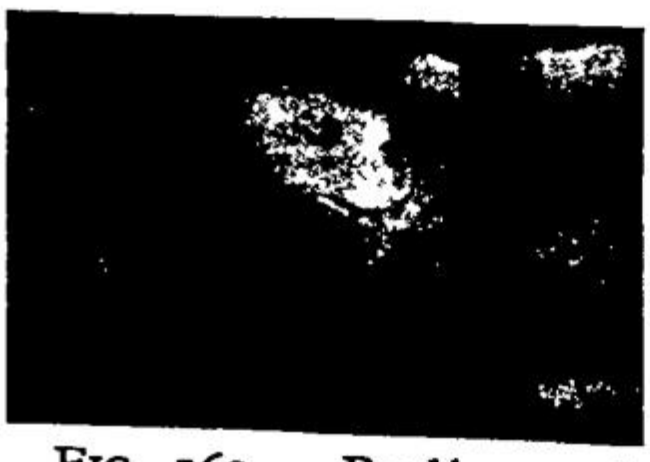


FIG. 160.—Radiograph showing horizontal impaction of third molar. (*Dr. Sydney Blackman, London.*)

In horizontal impaction (fig. 160) the second molar must be extracted before the third impacted molar can be removed by (*a*) chiselling away the overlying alveolus; (*b*) splitting the tooth vertically with a chisel; (*c*) removing the deeper fragment with an elevator, viz.

Instructions for removing the more

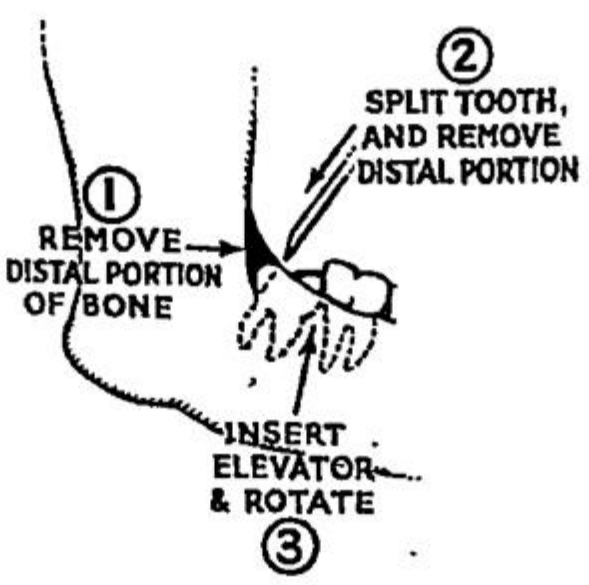


FIG. 161.—Steps in extracting a vertically impacted mandibular molar tooth. (*After Professor H. H. Stones.*)

[1] Trismus—Greek τρισμός = clenching.

usual vertically impacted wisdom tooth are shown in fig. 161.

* * *

In order to master the conditions about to be described, it is of paramount importance to be able to visualise the structure of a tooth and the tissues surrounding it (fig. 162).

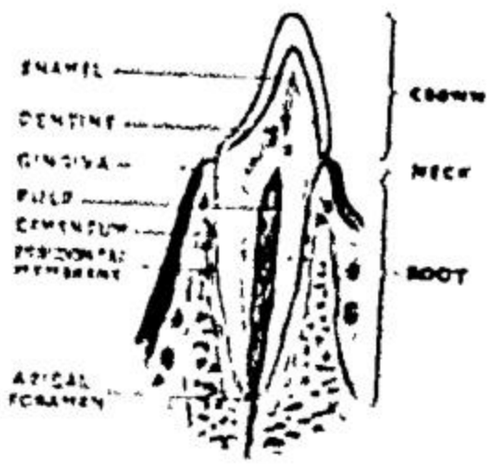


FIG. 162. — Sagittal section through an incisor tooth *in situ*.

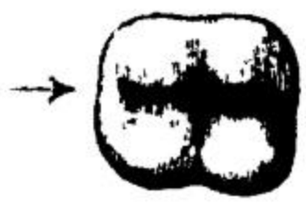
DENTAL CARIES[1]

Ætiology.—*Diet.*—The teeth of those Esquimaux who live exclusively on fish, flesh and fowl, and of African pygmies who consume uncooked foods only, are almost free from dental caries (J. R. Mummery). The incidence rises steeply among civilised people whose diet includes carbohydrates in highly prepared forms, e.g. white bread.

Acid-producing and Proteolytic Oral Bacteria.—Carbohydrate material clinging to the teeth is subjected to the activity of enzymes liberated by amylolytic oral bacteria isolated by Goadby. A principal end-product of the reduction of carbohydrates is lactic acid, which is capable of dissolving dental enamel. Once the enamel shell has been penetrated, proteolytic enzymes, generated by other bacteria, disintegrate dentine, which forms the bulk of the tooth.

In fully 90 per cent. of patients dental caries commences in the enamel, the hardest tissue in the body ; in the remainder, all of whom are past the meridian of life and have receding gums, it may begin in the exposed cementum. Speaking generally, decay commences in those parts of the tooth that are not subjected to the friction of mastication. In order of frequency, these locations are :

1. The natural sulci on the occlusal surfaces of molars and premolars ..... viz. :



2. In the vicinity of the point of contact between two teeth ..... viz. :

3. On the neck of a tooth near the gingival margin, viz. :

4. At the margin of a filling or a gold or porcelain crown.

5. In exposed cement after the gums have receded, viz. :

The decay spreads to the dentine, and cavitation undermining the enamel results. Unchecked, it reaches the pulp, and in due course the concomitant inflammation involves the nerve-endings and the familiar pain of toothache is produced.

[1] Evidence of dental caries was found in an herbivorous dinosaur of the estimated antiquity of 100,000 years.

John Rigden Mummery, 1809–1886. Dentist, Royal Dental Hospital, London.
Sir Kenneth Goadby, Contemporary. Formerly Lecturer on Bacteriology, National Dental Hospital, London.

If untreated, infection is liable to pass through the apical canal into the periodontal tissues and the adjacent bone, when an acute or chronic abscess results.

Clinical Features.—Caries is rife before the age of twenty-five, and particularly so in early childhood[1], the deciduous teeth being vulnerable to dental decay. After the fiftieth year, for reasons that have been given, there is again some increase in the incidence. The stages of dental decay are four :

Stage 1.—*Erosion of the enamel* is symptomless, and will almost certainly be overlooked unless each tooth is examined systematically with a dental probe.

Stage 2.—*Dissolution of dentine* is also painless until it has progressed to near the pulp, when thermal changes (heat, and especially cold) and mastication of sweets may bring on toothache. Tapping the tooth causes no pain.

Stage 3.—*Part of the crown collapses*, due to undermining. The cavity is now more easily discernible on visual examination. In all other respects the symptoms and the signs are the same as those of stage 2, with the addition that pressure of débris in the cavity causes pain ; such pain may be referred to a sound tooth on the same side.

Stage 4.—*Acute Pulpitis.*—Pulpitis may be acute or chronic. In acute cases the pain is throbbing and intermittent. Except in the early stages, thermal changes cause pain. Tapping the tooth is painless, but pressure of a piece of cotton-wool inserted into the cavity is painful. Pulpitis terminates in disintegration of the pulp.

Untreated, acute pulpitis is liable to lead to an alveolar abscess, whereas chronic pulpitis is the harbinger of a periapical abscess.

For the treatment of dental caries the reader must be referred to works on dental surgery.

ALVEOLAR ABSCESS

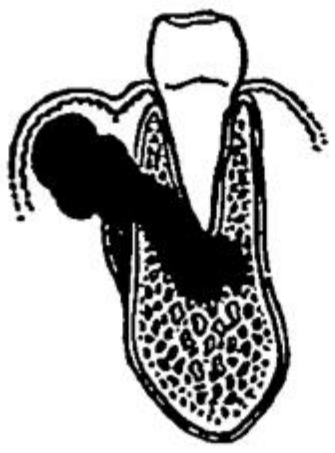


FIG. 163.—Alveolar abscess eroding the lateral plate of the alveolus. This is the most common course, because the roots point in this direction, and the lateral plate is about half the thickness of the medial plate.

While an acute alveolar abscess can occur at any age, it does so most often during childhood and early adult life. Abscesses connected with the first dentition are distributed equally between the two jaws, while those connected with the second dentition concern particularly the teeth of the lower jaw, more especially a molar tooth.

Pathology.—Usually as a result of acute pulpitis, the putrifying pulp generates gases that exert pressure through the root canal into the osseous tissue around the apex of the tooth. Localised osteitis and abscess formation ensue. The pus frequently burrows through the bony alveolus, causing a swelling on the labial (fig. 163) or on the lingual aspect of the alveolus, or tracks through the periodontal membrane to point beneath the gingival sulcus, the first being most common. Occasionally, in relevant cases, the abscess bursts into the maxillary antrum, or, very rarely, into the floor of a nasal fossa. The alveolar abscess beset with the most dangerous complications, e.g. Lud-

[1] Children on reaching school age have an average of five decayed teeth.

Wilhelm von Ludwig, 1790–1865. Professor of Surgery and Midwifery, University of Tübingen.

wig's angina, is one connected with a wisdom tooth that bursts through the medial wall of the alveolus. When early resolution is not brought about by antibiotic therapy, unless the abscess is drained promptly and effectively, some degree of necrosis of the alveolus is to be expected. Osteomyelitis of the jaw sometimes results (see p. 123).

FIG. 164.—Extensive alveolar abscess.

Clinical Features.—The pain is dull and constant; applications of cold or iced water, by decreasing the volume of gas in the pulp chamber, relieve it, whereas heat (e.g. a hot mouth-wash) increases it, as does biting on the tooth or tapping on it. Swelling of the cheek (fig. 164) and redness and œdema of the gum in the neighbourhood of the culpable tooth are also characteristic signs. The general reaction to the infective process may be considerable; in over 40 per cent. of cases a peak temperature of 102° F (38·9° C) or more is registered, and a tender enlargement of the regional lymph nodes is usual.

Radiography.—Only when sufficient time (ten days or more) has elapsed for resorption of bone to occur will rarefaction around the apex of the affected tooth become apparent.

FIG. 165.—Sinus following bursting of an alveolar abscess externally.

Treatment.—Hot fomentations and poultices of all kinds should be avoided, for they tend to promote the pointing of an alveolar abscess externally (fig. 165), which, for cosmetic reasons, is the very thing to be prevented, if possible.

Antibiotic therapy has proved amazingly successful in the treatment of cases of alveolar abscess. With rare exceptions, the infecting organisms are Gram positive; consequently penicillin is usually employed, although aureomycin is equally effective. The temperature chart is a reliable index of the patient's progress under this treatment; reduction in the temperature usually heralds a favourable outcome. In over 50 per cent. of cases resolution follows, permitting the offending tooth to be extracted in the quiescent stage.

Physical Agents.—Cold applications externally and hot intra-oral irrigations are useful adjuncts.

Drainage of an Alveolar Abscess

(*a*) *Into the Mouth.*—When a cystic swelling in relation to the gum becomes apparent, the abscess should be opened into the mouth by incising the periosteum (fig. 166).

(*b*) *Extra-oral Drainage.*—When the abscess is pointing externally an external incision must be made. When possible this incision should lie in the shadow of the jaw, by making

FIG. 166.—Incising a dento-alveolar subperiosteal abscess.

Hans Christian Joachim Gram, 1853–1938. Professor of Medicine, Copenhagen.

it ½ inch (1·3 cm.) below and parallel to the lower border of the mandible. Extra-oral drainage is required but seldom.

(*c*) *Drainage by Extraction of the Offending Tooth.*—In the case of the primary dentition this is an accepted and generally successful procedure. In the case of the second dentition it should be avoided studiously, for even if the extraction is performed under antibiotic cover, there is a possibility of causing extension of the inflammatory process in the soft parts, and engendering osteomyelitis of the jaw.

An interval of ten days should elapse between resolution or incision of an alveolar abscess and extraction of the offending tooth.

ROOT ABSCESSES

FIG. 167.—Dental radiograph showing root abscesses of the lower incisor teeth. (*Dr. Sydney Blackman, London.*)

While alveolar abscesses are usually acute, root abscesses are nearly always chronic. They arise by extension of infection from the pulp through the apical canal. Only too often there are no external signs of a root abscess, which is only revealed by a dental radiograph (fig. 167). The causative bacteria are for the most part staphylococci and non-hæmolytic streptococci; the absorption of the toxins of the latter is often the cause of ill-health. Remarkable cures of some forms of arthritis have been effected by extraction of infected teeth.

HÆMORRHAGE AFTER TOOTH EXTRACTION

Considering the large number of teeth extracted, severe or continued hæmorrhage is not a very frequent complication. In young males, the possibility of a hæmorrhagic diathesis should be ruled out by enquiring about previous difficulty in stopping bleeding; in the majority of instances continued bleeding is not due to hæmophilia (see p. 88).

Within the socket there is an open artery that in more accessible situations would have been ligated in the first instance. Moreover, in many instances the bony alveolus has been fractured, and occasionally there is present a loose fragment or an attached spicule of bone. Either of these prevents firm clotting within the wound.

Treatment.—Provided the blood pressure is satisfactory the patient should sit bolt upright. A mouth gag having been placed in position, with one pair of dissecting forceps the edge of the socket is everted, and with another pair of dissecting forceps the cavity is mopped with suitable pledgets of cotton-wool. Loose bone or spicules, if present, are removed. Firm pressure with a pledget for a few minutes may stop the hæmorrhage. Should the hæmorrhage come from the gum margin, the flow can be arrested by a stitch passed through the gum on either side of the tooth socket. When the hæmorrhage comes from the depths of the socket many dental surgeons use liquor ferri perchlor. as a styptic, and having packed the cavity, a small roll of gauze, upon which the patient bites, is placed over the socket; a firm four-tailed bandage is applied. Snake venom (stypven) is also a good local application.

For more persistent cases ordinary absorbable gauze or gelatine sponge can be applied as a packing. A special gelatine sponge for dental use is manufactured by Allen & Hanburys Ltd.; it is impregnated with 0·1 per cent. dequadin chloride, and is applied as directed above in place of the wool pledget.

In severe or recurrent cases suture of the gum should be carried out. In order to approximate the lips of the wound without cutting out, the sharp edges of the bony alveolus must be removed with nibbling forceps. The operation is conducted under thiopentone anæsthesia.

Whenever the loss of blood warrants it, blood transfusion should be given.

ORO-ANTRAL FISTULA

The surprising number of cases of oro-antral fistula now being encountered can be explained by the tendency to consider that once extraction has been undertaken every

tooth apex must be removed, and to the use of narrow elevators (B. W. Fickling). If a piece of bone is attached to the antral aspect of the root of an extracted tooth, an opening into the maxillary antrum should be suspected, and confirmed by asking the patient to blow his nose. The injection of radio-opaque medium into the socket and a radiograph is the absolute diagnostic test.

Treatment.—1. The immediate treatment should be approximation of the socket margins by a suture, and completion of the occlusion by the use of ribbon gauze as a cover, not as a pack.

2. Cases first seen with gross sinusitis are given an antibiotic parenterally, and the sinus is irrigated daily through the fistula with normal saline solution. When the infection has abated, the sinus should be irrigated occasionally for six weeks.

3. If healing does not occur at the end of six to eight weeks, operation must be undertaken.

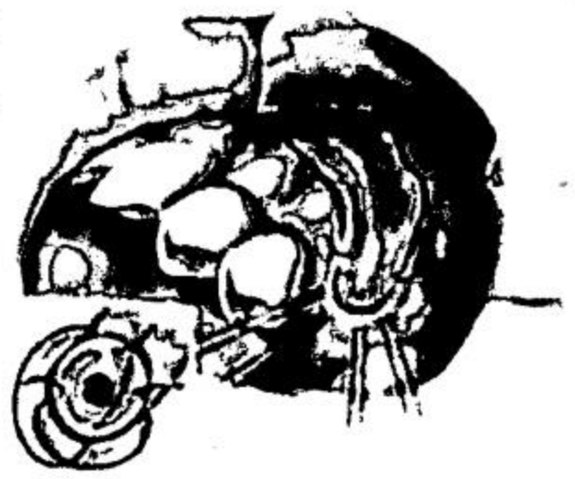


FIG. 168.—Method of closing an oro-antral fistula. *After B. W. Fickling.*)

Operation.—An ink-well inversion of the freed circularly incised mucosa is performed (fig. 168, inset). A long mucoperiosteal flap is dissected up. Near its base the periosteum of the flap is incised transversely, and freed from the mucosa towards the bone; this gives the distal part of the flap (which consists of periosteum and mucous membrane) mobility, and it is used to reinforce the defect (fig. 168).

ALVEOLAR CYSTS

First it is necessary to define two confusing terms—dentigerous and dental cysts.

Dentigerous cyst (*syn.* follicular odontome) arises in connection with a non-erupted permanent tooth. The swelling consists of a cyst containing a tooth, most commonly an upper canine or a lower third molar, often well developed except for a truncated root, lying obliquely in a cavity filled with viscid fluid, viz.: ——→

When a dentigerous cyst is connected with a canine tooth, the patient complains of the swelling during adolescence or early adult life, while in the molar region the symptoms are frequently more delayed.

Dental (root) cyst occurs in connection with the root of a normally erupted, but chronically infected, usually pulpless, tooth, viz. :- - -→ Epithelial cells, believed to be derived from the enamel-organ, proliferate and break down, forming a cyst. The cyst enlarges, causing expansion of the alveolus (fig. 169), and eventually most of the epithelial lining disappears. These cysts, which can appear at any age, are more

FIG. 169.—Dental (root) cyst expanding the alveolus.

FIG. 170.—Radiograph of a dental (root) cyst.

frequent in the upper jaw, and when they attain a large size they encroach upon the antra or the nasal fossæ, but rarely open into these cavities. Usually the fluid in the cyst (fig. 170) is clear, and it often contains choles-

Benjamin William Fickling, Contemporary. Dental Surgeon, St. George's Hospital, London.

terol crystals; as a rule it is sterile, but secondary infection can occur. When not infected the condition is painless.

FIG. 171.—Naso-palatine cyst.

Naso-palatine Cyst.—Cysts simulating dental root cysts, but unconnected with the teeth and seldom containing cholesterol, occur in the premaxillary region (fig. 171). They arise in connection with the naso-palatine canal. The importance of segregating this class of cyst is that, as it is not connected with the incisor teeth, the latter need not necessarily be sacrificed (H. T. Roper-Hall).

The Treatment of Alveolar Cysts.—As a preliminary measure the teeth not in the immediate vicinity of the swelling are scaled, and should any be carious they receive suitable attention. About a week later the lesion itself is dealt with as follows:

Operation.—Both dental and dentigerous cysts are approached by turning back a flap of the mucoperiosteum overlying the external wall of the expanded alveolus. Having evacuated the mucoid contents, every particle of the cyst lining is avulsed and the tooth or teeth implicated in the cyst are extracted. When the requisite amount of the expanded alveolus has been removed with nibbling forceps, the flap of mucoperiosteum is stitched back into position. It should be noted that such treatment is applicable only to the upper jaw, where, provided the hygiene of the mouth is attended to carefully, the wound usually heals by first intention. In the lower jaw, and in cases that are infected, after the lining membrane has been removed (*vide supra*), the bone, if greatly expanded, is crushed so as to reduce the size of the cavity, which is then packed. When packing is necessary, healing is comparatively slow.

In non-infected cysts of the lower jaw, we have made a suitable external incision. After removing the lining membrane of the cyst without entering the mouth, the cavity in the mandible has been packed with absorbable gauze, and the incision closed without drainage. Thus the patient is spared weeks of intrabuccal packing and repacking.

ODONTOMATA

An odontome is a tumour composed of the constituents of dental tissue in varying proportions and different degrees of maturity, derived from one or more of the embryological components of a tooth in the process of development.

There are seven varieties of odontomata. Only the seventh becomes malignant, and that very occasionally. An easily remembered classification that embraces all types is as follows:

1. **Follicular odontome** is another name for a dentigerous cyst (see p. 145); the swelling contains a tooth..... →

2. **Fibrous odontome** is identical with the above, except that the unerupted tooth is surrounded by fibrous tissue instead of fluid ..... viz. :→

3. **Cementome.**—In process of time the fibrous tissue of the above calcifies. Most cases have occurred in women about forty years of age, with a very high ratio of mandibular to maxillary teeth. Around the unerupted tooth there is cementum ... viz. :→

H. T. Roper-Hall, Contemporary Dental Surgeon, Birmingham and Midland Eye Hospital

4. **Compound Follicular Odontome.**—The capsule surrounding the tooth ossifies sporadically, and contains cement, dentine, and enamel in varying proportions. Sometimes these dental elements are so well formed and arranged as to be dignified by the name of denticules, or tiny teeth .....viz. :

5. **Composite Odontome.**—The three dental elements—dentine, enamel, and cement—are mixed in a conglomerate fashion within the capsule, which contains no recognisable tooth, viz.:

6. **Radicular odontome** occurs in connection with the root of an *erupted* tooth, and causes difficulty in extraction .....viz. :

It follows that in all the above types of odontomata, except the radicular, which is very rare, the accompanying expansion of the alveolus is associated with a missing tooth not accounted for by extraction.

Treatment.—Excision of the odontome as opposed to excision of a portion of the jaw is indicated. It is advisable to display the radiograph (fig. 172) during the operation. Instructions for removing a follicular odontome —much the commonest variety—have been detailed already.

FIG. 172.—Dental radiograph showing both a composite odontome and an unerupted tooth.

7. **Adamantinoma** (*syn.* ameloblastoma ; multilocular cystic disease of the jaw; Eve's tumour) is an epithelial tumour of the jaw, less uncommon in coloured than in white races, possibly arising from ameloblasts, and consequently classified as an odontome. On the other hand, R. A. Willis holds that this tumour is a basal-celled carcinoma arising in ectodermal epithelium of the stomodæum. An adamantinoma is a slowly growing neoplasm, remaining locally malignant for years. Only occasionally does the tumour metastasise. The condition occurs more frequently in the mandible (fig. 173) than in the maxilla, and it usually commences in the region of the second or third molar tooth. While it is found at any age, it is most common in the third decade. As the condition progresses it expands the jaw, and in advanced cases eggshell crackling can be elicited. In the absence of secondary infection it is quite painless.

FIG. 173.—Adamantinoma of the mandible. (*Mr. A. H. Landon, Adelaide.*)

FIG. 174.—Radiograph of an adamantinoma of the mandible. The tumour is divided by septa into many compartments (the 'soap-bubbles' X-ray). Unless these are clearly visible, it is almost impossible to distinguish this tumour from a giant-cell tumour of the jaw.

Pathology.—Within a firm, fibrous capsule are a number of cystic and solid areas, varying greatly in size and separated by well-formed fibrous septa (fig. 174) carrying blood-vessels. The solid areas consist of fibrous tissue, stroma and a palisade of tall columnar epithelial cells. The cysts are filled with viscid brownish fluid, and lined by epithelial cells. In the larger cysts the epithelial wall frequently becomes obliterated.

Sir Frederick Eve, 1876–1916. Surgeon, The London Hospital.
Rupert A. Willis, Contemporary. Formerly Professor of Pathology, University of Leeds.

Treatment.—Evacuation and curettage of the cysts is followed invariably by recurrence. X-ray or radium therapy is without permanent value. Therefore resection of that portion of the jaw bearing the tumour, together with a margin of healthy bone, is essential. Before this is undertaken provision should be made for retention of the remaining portions of the bone in normal relationship by means of dental fixation. Provided no recurrence takes place, after an interval of several months the mandibular defect can be filled with a bone graft.

FIG. 175.—The lead line. The patient was a painter, and he was sent to the out-patient department complaining of attacks of colicky abdominal pain.

THE GUMS

GINGIVITIS

Usually inflammation of the gums is associated with generalised stomatitis (p. 151). The gums are swollen, spongy and bleed readily. Often fœtor oris is extreme. The teeth become loose and sometimes fall out. These symptoms also are in evidence in scurvy and in chronic mercurial poisoning. In chronic lead, and also bismuth poisoning, there is a characteristic narrow line of blue-black dots on the gums near the dental margin (fig. 175).

Treatment consists in removing the cause and in dental hygiene. The administration of vitamin C is specific in the case of scurvy and sub-scurvy states.

Vincent's gingivitis. See Vincent's Stomatitis, p. 152.

PYORRHŒA ALVEOLARIS

The periodontal membrane is a thin fibrous membrane and corresponds to the periosteum of bone. Its fibres are so arranged as to form a sling for the root (or roots) of a tooth in its bed of bone (see fig. 162).

Pyorrhœa alveolaris is a very chronic form of gingivitis. The fundamental predisposing cause of the condition is an excessive deposit of tartar. Unless the teeth are scaled regularly and with especial care to remove tartar below the gum margin, the tartar pushes the gingival margin away from the teeth, with the result that the periodontal membrane is broken, the gum recedes, particles of food accumulate between the gum and the teeth, and suppuration ensues.

Clinical Features.—The gums bleed when touched, and in advanced cases beads of pus can be expressed from the gingival pockets.

Treatment.—Comparatively early cases are often benefited by regular scaling, daily massage of the gums with the fingers, removing débris with a wooden toothpick and the frequent use of an astringent mouth-wash, e.g. Tinct. myrrh minims 5 (0·3 ml.) to a tumbler of water. If, after a trial, this treatment is unsuccessful and the majority of the remaining teeth are sound, in order to eradicate the periodontal pockets, gingivectomy (see p. 150) should be undertaken.

When the condition is fully established, treatment is difficult, if not impossible, without extracting the teeth implicated.

Dangers of Dental Extraction in Pyorrhœa Alveolaris.—Clearing the jaws

of teeth is not to be undertaken lightly in cases of pyorrhœa alveolaris, for myriads of virulent bacteria are thereby released both into the mouth and into the circulation. The bacteræmia that follows is liable to set up broncho-pneumonia, and is also a recognised cause of subacute bacterial endocarditis; in fact, subacute bacterial endocarditis due to *Streptococcus viridans* (a common causative organism in this condition) never occurs in a patient who has been edentulous (as shown by radiography for stumps) for years or months, and frequently the onset of the endocarditis dates from dental extraction (F. G. Hobson). Therefore extraction in cases of pyorrhœa alveolaris should be carried out only under full antibiotic cover, and the antibiotic, usually penicillin, must be continued for not less than three days. It is advisable for the patient to be admitted to hospital for this period. As a rule, the teeth should be removed a few at a time, and if a major surgical operation—for instance, gastrectomy for peptic ulcer—is contemplated, the operation, when possible, should be postponed until the gums have healed.

TUMOURS OF THE ALVEOLUS

It is customary to aggregate these under the general heading of 'Epulis,' an ancient term which has no pathological significance, merely signifying a solid swelling 'situated on the gum.' There are four varieties of epulides:

1. *Granulomatous Epulis.*—A mass of granulomatous tissue forms around a carious tooth, or at the site of irritation by a denture.

Treatment consists in extraction of the tooth and scraping away the granulations.

FIG. 176.—Fibrosarcomatous epulis.

2. *Fibrosarcomatous Epulis* (fig. 176).—The majority of epulides belong to this group. Usually they are relatively benign, but they vary greatly in malignancy. At one end of the scale the fibromatous element predominates, and the tumour is practically benign. At the other end the tumour is almost a pure sarcoma. The more sarcomatous element there is present, the softer does the tumour feel and the more readily does it bleed. A radiograph may show an unsuspected cause (fig. 177).

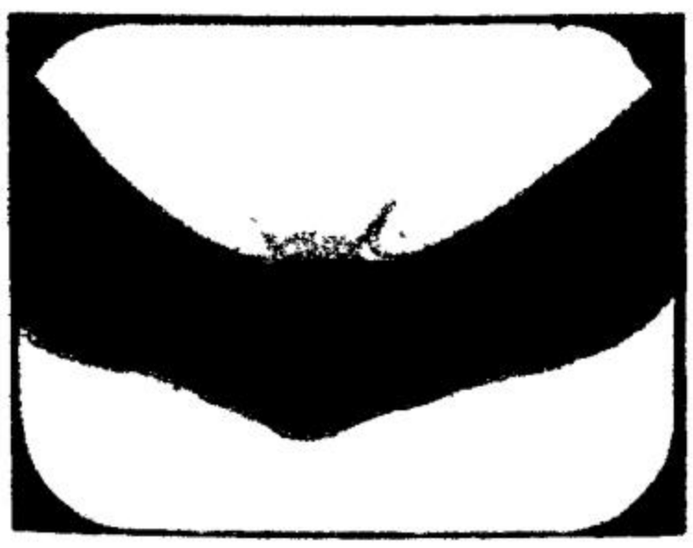


FIG. 177.—Elongated tubercles of the geniohyoglossi situated beneath a fibrosarcomatous epulis. The patient wore a lower denture.

Treatment.—After removal of the tooth or teeth in the immediate neighbourhood, a wedge of bone, including the portion of the gum containing the growth, is excised.

3. *Myelomatous epulis* is an obsolescent term. See giant-celled granuloma of the jaw (p. 124).

4. *Carcinomatous epulis* is a particularly undesirable term, as it is but another way of saying that the carcinoma commences on the gum. The treatment of a carcinomatous epulis follows that described for carcinoma of the mouth (see p. 168).

Frederick Greig Hobson, Contemporary. Physician, Radcliffe Infirmary, Oxford.

FIG. 178.—Hyperplasia of the gums. (*Prof. H.H. Stones, Liverpool.*)

HYPERPLASTIC GINGIVITIS

Usually first noticed in childhood, the condition persists and often progresses until adequate treatment is undertaken. The patient is a mouth breather, and not infrequently the front teeth are protuberant. The gums around the labial aspect of the upper incisors and their interdental papillæ are affected most (fig. 178). Bleeding from the gums is a frequent symptom. On pressure, usually pus oozes from the gingival pockets. In some long-standing cases the hypertrophied gum almost buries the teeth.

The administration of soluble phenytoin (e.g. epanutin (Parke Davis)) in the treatment of epilepsy, leads to hyperplasia of the gums in some individuals who are susceptible to the toxic influence of this drug.

Treatment consists in gingivectomy or, if a radiograph shows the bone to be hypertrophied, alveolectomy in addition. In advanced cases post-operative radiotherapy should be given to prevent recurrence.

Localised hypertrophy of the gum due to pressure of an ill-fitting denture is common. Clinically, the condition is indistinguishable from a fibrosarcomatous epulis.

If removal of the cause does not remedy matters in a fortnight, the hypertrophied area should be excised and examined histologically.

GINGIVECTOMY

Indications.—(1) Hypertrophy of the gums; (2) to remove periodontal pockets around otherwise sound teeth.

Operation.—The operation can be carried out under local anæsthesia. With a sharp, pointed scalpel the excess of gum is excised *obliquely* (fig. 179) on both the labial and the lingual sides, together with the interdental papillæ. Bleeding is arrested by diathermy coagulation, and the raw surface is covered with a sedative paste containing zinc oxide and eugenol[1] with a little asbestos fibre to stiffen it. The pack can remain *in situ* for a week. Granulation is thus prevented and epithelialisation follows. The operation, when both alveoli are involved, is conducted in three stages at fortnightly intervals: (*a*) both left gingival margins are removed as far as the canine teeth; (*b*) both right gingival margins similarly; (*c*) the remainder.

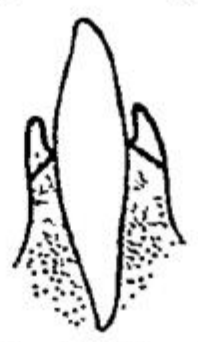


FIG. 179.—Gingivectomy. The obliquity of the resection promotes drainage and prevents recurrence.

FIG. 180.—Alveolectomy.

ALVEOLECTOMY

Indications.—When hypertrophy of the gums is associated with hypertrophy of the underlying bone, alveolectomy is advisable before fitting a denture. Alveolectomy is also necessary when the alveolus has been mutilated by dental extractions and gross irregularities of the bony contour exist. Occasionally, the operation is advisable in cases of extensive epulis.

Operation.—Any remaining teeth are extracted. With a stout scalpel, an incision is made right down to the bone. Employing a periosteal elevator, a flap is raised on the labial aspect, and a similar one on the palatal aspect. The irregularities of the bone are removed with a hammer and chisel. Any excess of mucosa is trimmed before suturing the cut edges over the now level alveolus (fig. 180).

[1] Eugenol—an active principle extracted from oil of cloves.

CHAPTER X

THE MOUTH IN GENERAL. THE TONGUE, THE FLOOR OF THE MOUTH, AND THE CHEEK

HAMILTON BAILEY

INFECTIONS

STOMATITIS is a general term that embraces all infections of the mouth. As a rule it presents in an acute, or subacute, form.

Clinical Features.—The mucous membrane is swollen, of a dusky red colour, and bleeds readily. The buccal mucous glands secrete copious viscid mucus, which later may become ropy and purulent. Eating is painful, and small superficial ulcers occur frequently.

There is a great variety of causes of stomatitis. Some of these, and their resulting lesions, must be considered in more detail :

Traumatic stomatitis can arise from the incorrect use of a hard tooth-brush. Unclean, ill-fitting dentures are quite a common cause of stomatitis, particularly of the hard palate, and cultures frequently yield one of the saccharomyces. A jagged tooth is often responsible for an ulcer on the mucous membrane of the cheek ; the better-known lingual dental ulcer from the same cause is described on p. 164. Accidental burning of the mouth with hot food or liquid is a frequent cause of minor traumatic stomatitis, affecting particularly the forepart of the palate.

Catarrhal stomatitis arises as a complication of acute inflammation of the neighbouring naso-pharyngeal mucous membrane. Considering the frequency of the common cold, catarrhal stomatitis is rare. Sometimes it occurs during the teething of infants.

Stomatitis due to Hypovitaminosis.—As far as the mouth is concerned, vitamin deficiency gives rise to the following manifestations :

Vitamin B_1 (thiamine).—Extreme deficiency—beri beri—is seen in the Far East, and is usually due to a staple diet of polished rice. One of the manifestations of deficiency of this vitamin is a herpes-like eruption of the palate and under-surface of the tongue.

Vitamin B_2 (riboflavine or lactoflavine) deficiency causes cheilosis (see p. 154), glossitis (p. 160), and general stomatitis. It occurs as a remote complication of complete gastrectomy, is part of the Plummer-Vinson syndrome (see p. 312), and is seen in some of the anæmias, particularly pernicious anæmia. Many examples were observed in those subjected to the privations of war.

Vitamin C deficiency (scurvy) was rife in the days of the sailing-ships. It was stamped out in the Royal Navy[1] by a compulsory ration of lime juice. Leading features of the stomatitis due to this cause are bleeding gums and loosening of the teeth. For Scurvy-Rickets, see Chapter 47.

Vitamin P-P (nicotinic acid) deficiency causes pellagra, a disease confined to

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[1] Lind urged the use of lemon juice, and it was due to him that scurvy was eventually eradicated from the Royal Navy. British sailors are known abroad as 'limeys.'

James Lind, 1716–1794. Surgeon's Mate, Royal Navy; later Physician (civilian), Royal Naval Hospital, Haslar.

countries where maize is the staple diet, e.g. in some parts of Japan. Pellagra is characterised by peculiar dermatitis as well as stomatitis. There is no risk of pellagra on an ordinary mixed diet.

Stomatitis due to Drugs.—Excessive doses of bismuth, lead, iodides, and especially mercury give rise to stomatitis, gingivitis, profuse salivation, and loosening of the teeth.

Treatment.—The principles in the treatment of stomatitis are to remove the cause, if possible, and to supply the necessary vitamin, if that be lacking. For instance, riboflavine deficiency responds quickly to ingestion of marmite and eggs. As regards mouth-washes, a normal saline wash and gargle, followed by a rinse with pure glycerol thymol, is extremely efficacious in the acute stages. As some improvement sets in, T.C.P.[1] ʒi (4 ml.) to the tumblerful of warm water is recommended, and at a later stage minims 5 (0·3 ml.) of tinct. myrrh to a tumbler of water is an astringent mouth-wash that cannot be bettered.

Vincent's Stomatitis[2] (*syn.* Ulcero-membranous Stomatitis; Trench Mouth).

Ætiology.—*Borrelia vincenti* is an anaerobic spirochæte, with three to five spirals. Seen in a wet smear on dark-ground illumination, it lashes violently. *Fusobacterium plauti-vincenti* is a Gram-negative anaerobic organism of considerable size. In Vincent's stomatitis both these organisms are present in large numbers (fig. 181). They live in symbiosis, both participants being necessary for the production of the lesions. Whether they are the cause of the disease is debatable. Many authorities consider, for good reasons, that Vincent's stomatitis is due to a filterable virus, and that these organisms are secondary invaders. The incidence of this affection in service personnel and civilians reached almost epidemic proportions during both world wars. Deficiency of nicotinic and ascorbic acids in war-time diet has been held responsible for enfeebling resistance against the infection. The disease is *not* communicable (findings of the Research Commission of the American Dental Association).

FIG. 181.—*Borrelia vincenti* and *F. plauti-vincenti.*

Clinical Features.—The disease is one of early adult life; it occurs rarely after the age of thirty-five and almost never in the edentulous. In acute cases the prodromal symptoms are general malaise, pyrexia, and increased salivation. About thirty-six hours afterwards the patient complains of bleeding from the gums and dull toothache. On examination there is characteristic halitosis. The gums, especially the interdental papillæ of the incisors, and around the third molars, are red and inflamed, and later covered by a yellowish-white pseudo-membrane. If a portion of the membrane is removed and the gum wiped free from blood, small ulcers are revealed. Untreated the ulceration often spreads to the cheeks, palate, fauces, and pharynx, but rarely to the tongue. The regional lymph nodes become enlarged and tender. When the fauces are involved, the condition must be distinguished from diphtheria and secondary syphilis. In subacute and chronic varieties the gingivæ are

[1] T.C.P.—an aqueous solution of halogenated phenolic bodies (British Alkaloids Ltd.).
[2] Sometimes called (incorrectly) Vincent's *Angina.* Angina means choking.

Jean Hyacinthe Vincent, 1862–1950. Professor of Medicine, Val-de-Grâce (Military) Hospital, Paris.

dark red and swollen, and there is gradual destruction of periodontal tissue with pocket formation.

Treatment.—Penicillin lozenges, sucked almost continuously for two or three days, are often very beneficial, but sometimes with their use an *E. coli* stomatitis supplants the initial infection. Terramycin lozenges are just as effective and free from this objection. A most important factor in treatment is thorough buccal irrigation; the mechanical action of the irrigating solution is more important than its composition. Half-strength hydrogen peroxide, followed by normal saline solution, cannot be bettered. A dental hygienator for the application of the latter is desirable, so that the solution can be forced between the teeth.

In more chronic cases 2 per cent. gentian violet applied to the gums on pledgets of cottonwool is helpful in eradicating the infection.

When the active stage has subsided entirely, the teeth should be scaled and, if periodontal pockets are present, arrangements should be made for gingivectomy (see p. 150), otherwise the condition is likely to become chronic with acute exacerbations.

Acute coccal stomatitis presents symptoms and signs very like the foregoing, nevertheless the objectionable fœtor is absent. A concrete diagnosis can be made only by bacteriological examination. The treatment consists in systemic antibiotic therapy and 2 per cent. gentian violet applied to the affected areas, followed by mouthwashes and penicillin lozenges.

Parasitic stomatitis occurs in weakly infants, most often those in maternity hospitals and crèches, and occasionally in adults with advanced phthisis or other debilitating diseases. It is due to the *Candida albicans*[1] (also known as the *Monilia* or *Oidium albicans*), a mycelial fungus found in sour milk. The disease appears as spots on the buccal mucous membrane, varying in size from a pin's head to a pea. They are at first red, and later become covered with a white exudate composed of desquamated epithelium entangled in branches of the mycelium. Pain and salivation are constant accompaniments. The condition subsides gradually without treatment, but the mouth should be kept clean with boroglycerol applied on a swab stick. Precautions must be taken to ensure that the milk is fresh and the utensils in which it is served are scrupulously clean.

Cancrum Oris.—This very fatal condition is now seldom seen except as a complication of kala-azar. It was perhaps related to the now extinct ' hospital gangrene,' and attacked children debilitated by acute infectious fevers. Various bacteria have been isolated, but there is no conclusive proof that cancrum oris is due to any one organism, although *Borrelia vincenti* and *F. plauti-vincenti* are usually present in large numbers. The lesion first appears as an indurated area on the under-surface of a lip. This soon becomes an ulcer, and is followed by a gangrenous process destroying the lips, cheeks, and gums (fig. 182). In a few days the whole face sometimes becomes a black, putrefying mass. If given early, antibiotics (penicillin and streptomycin) control the infection.

FIG. 182.—Cancrum oris.

Foot and Mouth Disease.—Occasionally this well-known disease of cattle is transmitted to man by direct contact or through infected milk. A virus present in the fluid of the vesicles transmits the disease. The incubation period is from two to five days. In man the constitutional symptoms are usually of moderate severity. The

[1] In several outbreaks in institutions, more than 20 per cent. of the nurses in the wards have been found to have *Candida albicans* in their throats, without symptoms.

countries where maize is the staple diet, e.g. in some parts of Japan. Pellagra is characterised by peculiar dermatitis as well as stomatitis. There is no risk of pellagra on an ordinary mixed diet.

Stomatitis due to Drugs.—Excessive doses of bismuth, lead, iodides, and especially mercury give rise to stomatitis, gingivitis, profuse salivation, and loosening of the teeth.

Treatment.—The principles in the treatment of stomatitis are to remove the cause, if possible, and to supply the necessary vitamin, if that be lacking. For instance, riboflavine deficiency responds quickly to ingestion of marmite and eggs. As regards mouth-washes, a normal saline wash and gargle, followed by a rinse with pure glycerol thymol, is extremely efficacious in the acute stages. As some improvement sets in, T.C.P.[1] ℥i (4 ml.) to the tumblerful of warm water is recommended, and at a later stage minims 5 (0·3 ml.) of tinct. myrrh to a tumbler of water is an astringent mouth-wash that cannot be bettered.

Vincent's Stomatitis[2] (*syn.* Ulcero-membranous Stomatitis; Trench Mouth).

Ætiology.—*Borrelia vincenti* is an anaerobic spirochæte, with three to five spirals. Seen in a wet smear on dark-ground illumination, it lashes violently. *Fusobacterium plauti-vincenti* is a Gram-negative anaerobic organism of considerable size. In Vincent's stomatitis both these organisms are present in large numbers (fig. 181). They live in symbiosis, both participants being necessary for the production of the lesions. Whether they are the cause of the disease is debatable. Many authorities consider, for good reasons, that Vincent's stomatitis is due to a filterable virus, and that these organisms are secondary invaders. The incidence of this affection in service personnel and civilians reached almost epidemic proportions during both world wars. Deficiency of nicotinic and ascorbic acids in war-time diet has been held responsible for enfeebling resistance against the infection. The disease is *not* communicable (findings of the Research Commission of the American Dental Association).

FIG. 181.—*Borrelia vincenti* and *F. plauti-vincenti*.

Clinical Features.—The disease is one of early adult life; it occurs rarely after the age of thirty-five and almost never in the edentulous. In acute cases the prodromal symptoms are general malaise, pyrexia, and increased salivation. About thirty-six hours afterwards the patient complains of bleeding from the gums and dull toothache. On examination there is characteristic halitosis. The gums, especially the interdental papillæ of the incisors, and around the third molars, are red and inflamed, and later covered by a yellowish-white pseudo-membrane. If a portion of the membrane is removed and the gum wiped free from blood, small ulcers are revealed. Untreated the ulceration often spreads to the cheeks, palate, fauces, and pharynx, but rarely to the tongue. The regional lymph nodes become enlarged and tender. When the fauces are involved, the condition must be distinguished from diphtheria and secondary syphilis. In subacute and chronic varieties the gingivæ are

[1] T.C.P.—an aqueous solution of halogenated phenolic bodies (British Alkaloids Ltd.).
[2] Sometimes called (incorrectly) Vincent's *Angina*. Angina means choking.

Jean Hyacinthe Vincent, 1862–1950. Professor of Medicine, Val-de-Grâce (Military) Hospital, Paris.

dark red and swollen, and there is gradual destruction of periodontal tissue with pocket formation.

Treatment.—Penicillin lozenges, sucked almost continuously for two or three days, are often very beneficial, but sometimes with their use an *E. coli* stomatitis supplants the initial infection. Terramycin lozenges are just as effective and free from this objection. A most important factor in treatment is thorough buccal irrigation; the mechanical action of the irrigating solution is more important than its composition. Half-strength hydrogen peroxide, followed by normal saline solution, cannot be bettered. A dental hygienator for the application of the latter is desirable, so that the solution can be forced between the teeth.

In more chronic cases 2 per cent. gentian violet applied to the gums on pledgets of cottonwool is helpful in eradicating the infection.

When the active stage has subsided entirely, the teeth should be scaled and, if periodontal pockets are present, arrangements should be made for gingivectomy (see p. 150), otherwise the condition is likely to become chronic with acute exacerbations.

Acute coccal stomatitis presents symptoms and signs very like the foregoing, nevertheless the objectionable factor is absent. A concrete diagnosis can be made only by bacteriological examination. The treatment consists in systemic antibiotic therapy and 2 per cent. gentian violet applied to the affected areas, followed by mouthwashes and penicillin lozenges.

Parasitic stomatitis occurs in weakly infants, most often those in maternity hospitals and crèches, and occasionally in adults with advanced phthisis or other debilitating diseases. It is due to the *Candida albicans*[1] (also known as the *Monilia* or *Oidium albicans*), a mycelial fungus found in sour milk. The disease appears as spots on the buccal mucous membrane, varying in size from a pin's head to a pea. They are at first red, and later become covered with a white exudate composed of desquamated epithelium entangled in branches of the mycelium. Pain and salivation are constant accompaniments. The condition subsides gradually without treatment, but the mouth should be kept clean with boroglycerol applied on a swab stick. Precautions must be taken to ensure that the milk is fresh and the utensils in which it is served are scrupulously clean.

Cancrum Oris.—This very fatal condition is now seldom seen except as a complication of kala-azar. It was perhaps related to the now extinct 'hospital gangrene,' and attacked children debilitated by acute infectious fevers. Various bacteria have been isolated, but there is no conclusive proof that cancrum oris is due to any one organism, although *Borrelia vincenti* and *F. plauti-vincenti* are usually present in large numbers. The lesion first appears as an indurated area on the under-surface of a lip. This soon becomes an ulcer, and is followed by a gangrenous process destroying the lips, cheeks, and gums (fig. 182). In a few days the whole face sometimes becomes a black, putrefying mass. If given early, antibiotics (penicillin and streptomycin) control the infection.

FIG. 182.—Cancrum oris.

Foot and Mouth Disease.—Occasionally this well-known disease of cattle is transmitted to man by direct contact or through infected milk. A virus present in the fluid of the vesicles transmits the disease. The incubation period is from two to five days. In man the constitutional symptoms are usually of moderate severity. The

[1] In several outbreaks in institutions, more than 20 per cent. of the nurses in the wards have been found to have *Candida albicans* in their throats, without symptoms.

buccal mucosa becomes congested and swollen, and two or three days later vesicles appear on the lips, tongue, cheek, and pharyngeal wall. Later the vesicles rupture, leaving tender, reddish, shallow ulcers, which soon heal. Similar lesions on the hands and feet, particularly round the nails, are usual. The attack confers no lasting immunity, and the same patient may have several visitations of the condition.

Treatment consists of potassium permanganate mouth-washes.

Angular Stomatitis (*syn.* Cheilosis[1]).—(*a*) *Due to Infections.*—Cracks at the *corners* of the mouth are a recognised manifestation of congenital or tertiary syphilis. Radiating scars in this situation should arouse at once a suspicion of previous syphilitic ulceration (rhagades). Other infections, especially of the respiratory and gastro-intestinal tracts, may also cause the condition, including moniliasis (see above).

(*b*) *Due to Ariboflavinosis.*—This has been discussed already (see p. 151).

(*c*) *Due to Seborrhœic or Flexural Eczema.*—Angular stomatis (fig. 183) often occurs as a part of these conditions, to some extent clearing and relapsing with the other lesions. Cortisone lotion relieves the irritation. In resistant cases superficial X-ray treatment is often effective.

FIG. 183.—Angular stomatitis due to riboflavine deficiency following gastrectomy. (*Professor Charles Wells, Liverpool.*)

(*d*) *Due to Allergy to Dentures.*—Vulcanised dental plates that have been insufficiently vulcanised (and consequently contain an excess of sulphur) are one source of this affection, but vulcanite has been largely supplanted by acrylic resin in the making of dentures. Acrylic dentures are proving a potent source of angular stomatitis in patients who become sensitised to this material and it is probable that the substance responsible is the colouring matter. A suspicion that the dentures are the cause can be proved absolutely by taking a scraping of the patient's own denture, applying it to the skin, and holding it in place with adhesive plaster. This patch test should be pronounced negative only after ninety-six hours, with a preliminary inspection at the end of forty-eight hours. Treatment is to replace acrylic dentures with vulcanite ones, or vice versa.

(*e*) *Perlèche*[2] is a superficial ulceration limited to the angles of the mouth that appears in children of school age, and is of interest chiefly because it has to be distinguished from syphilis. The corners of the mouth are somewhat brown in colour, and often moist fissures make their appearance. There is a burning sensation, and the patient licks the patches, hence the name. Most observers believe the condition to be due to an infection by an anaerobic streptococcus. Others consider it to be a manifestation of vitamin B deficiency. It should be noted that, unlike the lesion of syphilis, the radiating grooves do not extend to the mucous surface, and that in healing they leave

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[1] Cheilosis—Greek, χεῖλος = a lip.
[2] Perlèche—French, *pourlécher* = to lick.

no scar. Treatment consists of applying 2 per cent. tinct. iodine, and adding vitamins to the diet.

CYSTS

Retention cyst of a buccal mucous gland (fig. 184) occurs from time to time in any part of the mucous surface of the mouth. It forms a translucent globular swelling which should be dissected out under local anæsthesia.

FIG. 184.—Retention cyst of a buccal mucous gland.

RANULA

A ranula[1] implies a *transparent* cystic swelling in the floor of the mouth, mainly, if not entirely, unilateral.

Simple Ranula.—The patient may state that the swelling has come up before and burst, perhaps several times. When the swelling (fig. 185) is observed closely, tortuous veins can be seen coursing over it, and at one point towards the apex the buccal mucosa seems deficient, as though the cyst was bursting through its covering. An opaque strand can often be made out traversing the anterior wall of the cyst; this is Wharton's duct, which, although displaced by the cyst, takes no active part in the pathological process. Before concluding the examination the possibility of a deep prolongation of the cyst must be excluded by palpating beneath the mandible. The diagnosis of simple ranula is, as Butlin remarked, "plainly written on the face of the tumour."

FIG. 185.—A large ranula.

Pathologically, a simple ranula is to be regarded as a myxomatous degeneration of a mucous gland. The gland at fault may be the sublingual, the gland of Blandin and Nühn, or one of the solitary glands studded over the buccal mucous membrane. The gland of Blandin and Nühn is a variable structure, which is situated in the inferior surface of the tongue (fig. 186).

Treatment.—*Complete Excision.*—A difficulty hindering ideal treatment is that the cyst bursts before dissection can be completed. If some of the fluid within the cyst can be aspirated before commencing enucleation, complete dissection is usually possible. Often, however, the contents are of the consistency of jelly, and will not flow through a hollow needle.

Partial Excision with Marsupialisation.—A considerable portion of the cyst wall, together with its superimposed mucous membrane, is excised. The cut edge of the cyst wall is then united by sutures to the cut edge of the mucous membrane; thus the cavity becomes part of the floor of the mouth.

Whichever method is practised, it is necessary to preserve the integrity of Wharton's duct.

FIG. 186. — Myxomatous degeneration of the gland of Blandin and Nühn.

[1] So named by Hippocrates, who likened this swelling to the belly of a little frog.

Thomas Wharton, 1614–1673. Physician, St. Thomas's Hospital, London.
Sir Henry Butlin, 1845–1912. Surgeon, St. Bartholomew's Hospital, London.
Phillipe Blandin, 1798–1849. Surgeon, Hôtel Dieu Hospital, Paris.
Anton Nühn, 1814–1884. Professor of Anatomy, Heidelberg.

Deep or plunging ranula, from the mouth, appears to be a typical ranula, but when the neck is examined a cervical prolongation is found continuous with the intrabuccal one. Possibly these cysts are derived from the cervical sinus—an embryological structure. At any rate, this hypothesis furnishes a logical basis for adequate surgery; this type of ranula must be approached through the neck. Sometimes by this route complete extirpation is possible but, occasionally, the ramifications of the cyst render its complete removal impossible.

SUBLINGUAL DERMOID

Although congenital, sublingual dermoids are seldom noticed under the age of ten. The patient usually seeks advice between the ages of thirteen and twenty-five. These swellings are divided into two varieties, median and lateral. Each is again subdivided into those situated above and those situated below the diaphragm of the mouth (the mylohyoid muscles).

Lateral Variety.—*When situated above the mylohyoid* (fig. 187), there is an opaque swelling in the floor of the mouth to one side of the middle line as opposed to a transparent one (a ranula).

When situated below the mylohyoid, a cystic swelling in the region of the submandibular salivary gland is present.

Median Variety.—*When situated above the mylohyoid*, the cyst often attains considerable dimensions (fig. 188) with, apparently, but little inconvenience.

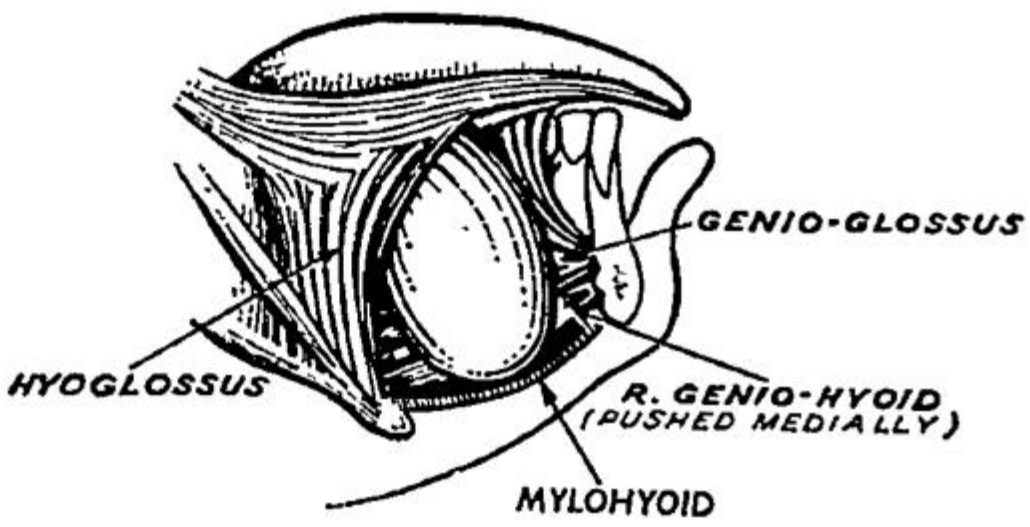

FIG. 187.—Relationships of a lateral sublingual dermoid situated above the mylohyoid.

FIG. 188.—Large median sublingual dermoid.

When situated below the mylohyoid, the patient, if a female, often seeks advice because of a double chin. In this situation considerable care must be exercised in making a diagnosis, for it is not possible to rule out with certainty a suprahyoid thyroglossal cyst. An ectopic thyroid must also be taken into consideration.

Lateral sublingual dermoids are probably derived from the second branchial cleft, and the median variety from inclusion of ectoderm between the halves of the developing mandible.

In both instances the swelling is a thin-walled cyst filled with sebaceous material, and, unlike other dermoid cysts, never contains hair.

Treatment of all varieties is removal by dissection through an external incision beneath the mandible.

TUMOURS

Hæmangioma sometimes occurs under the mucous membrane of the cheek and the floor of the mouth (see p. 45).

Papilloma is not uncommon, particularly on the mucous lining of the cheek (fig. 189).

Carcinoma can arise in any part of the mucous lining of the mouth. It is often the aftermath of some form of chronic irritation. In Western races carcinoma of the mouth usually attacks the tongue and the floor of the mouth, and is considered more fully on p. 165. In those Eastern races who indulge in chewing the betel-nut and store the quid thereof in their cheek, carcinoma of the mucous aspect of the cheek is a common occurrence.

FIG. 189.—Papilloma of the mucous membrane of the cheek.

The most effective form of treatment is :

Patterson's Operation.—An incision is made along the lower border of the mandible. The incision is only skin deep, and the skin is dissected upwards until it is well above the area of the tumour. The facial vessels are then defined and divided between ligatures. Should the carcinoma extend far back on the cheek, it is advisable to excise a portion of the masseter muscle and nibble away a portion of the ascending ramus. This provides adequate access. The next step is shown in fig. 190A. Excision of the growth is carried out with a diathermy knife through the mouth (fig. 190B), which is gagged open widely. At the end of this stage (fig. 190C) the flap, which consists of skin only, is sutured into place lightly.

Prognosis.—After the operation just described, more than 60 per cent. of the patients survive at least five years.

A B C

FIG. 190.—(A) After the skin flap has been raised, a saline-soaked swab is inserted to protect the skin from the heat of the diathermy during the buccal stage of the operation. (B) Excising the growth from within the mouth. (C) View of the extirpated area seen from the external aspect (Patterson's operation).

Mixed Tumour of a Molar Gland.—The molar glands are four or five in number. They lie on the outer side of the buccinator, their ducts piercing that muscle to open into the vestibule of the mouth. Occasionally a cyst or an ectopic salivary tumour occurs in one of these glands.

This is a convenient point to discuss briefly the differential diagnosis of other localised swellings of the cheek not arising in the integument or the mucous membrane.

A Lipoma developing in the Sucking Pad of the Infant.—The sucking pad is a ball of fat situated between the masseter and the buccinator. Well developed in infancy (fig. 191), it atrophies during childhood. On occasions a lipoma arises in the vestige that remains.

Norman Patterson, 1877–1950. Surgeon, Ear, Nose, and Throat Dept., The London Hospital.

FIG. 191.—Well-developed sucking pad.

Adenitis of the Facial Lymph Node.—Few individuals possess a facial lymph node; consequently infection coursing along the lymphatics of the cheek usually passes direct to the submandibular nodes. When a facial lymph node is present its enlargement will perplex the diagnostician unaware of its existence.

THE TONGUE

Tongue-tie is really very rare, though nearly every mother fears that her first-born is tongue-tied. A former generation of surgeons must have agreed with the mothers; for witness, the grooved director (fig. 192) is even today fitted with a guard for use when dividing the frænum linguæ. This shield is held against the uplifted tongue and the frænum snipped near the

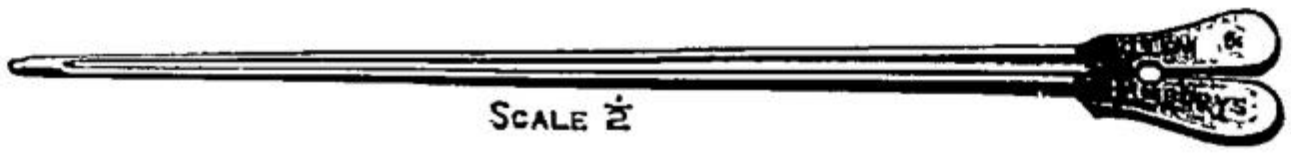

FIG. 192.—Director with guard and frænum slit.

floor of the mouth, the better to avoid the frænal artery. The operation should be performed only if the child cannot protrude the tongue between the lips, and it must be done with prudence, for if the frænum is divided too deeply, the over-mobile tongue may be 'swallowed' and asphyxia result. Occasionally patients of more mature years are seen with a short frænum linguæ (fig. 193). This may be the cause of an impediment in speech.

FIG. 193.—Short frænum linguæ.

The Lingual Tonsil.—There are really two lingual tonsils—a right and a left—but they lie together so closely that they appear to be a single structure. A lingual tonsil is subject to all the diseases of the faucial tonsils (see p. 269) and like the latter, simple hypertrophy is the most common. "In the infant, think of adenoids; in the child, tonsils; and in the adult the lingual tonsil" (John Shea). When much hypertrophied, the enlarged lingual tonsil can be seen by merely depressing the tongue (fig. 194); lesser degrees become apparent when viewed in a laryngeal mirror. Hypertrophy of the lingual tonsil is the commonest cause of a patient complaining that he or she feels that there is a lump in the throat. The condition is accompanied by a dry cough, worse at night because when the tongue falls back the lymphoid mass tends to touch the epiglottis. Lingual quinsy is especially dangerous (laryngeal obstruction).

FIG. 194.—Hypertrophied lingual tonsil. (*After N. Jesberg.*)

An enlarged lingual tonsil should be dissected out in much the same way as a faucial tonsil.

John Shea, 1889–1952. Otorhinolaryngologist, Baptist Hospital, Memphis, U.S.A.

MACROGLOSSIA

While acute parenchymatous inflammation results in very great enlargement of the tongue (see p. 160) the term macroglossia should be reserved for cases of chronic painless enlargements of the organ.

Lymphangioma.—When noticed soon after birth there is usually only a small circumscribed patch of dilated lymph vessels. This may remain stationary in size for long periods, but more often it increases rapidly. Attacks of inflammation occur at irregular intervals. At last the swollen tongue protrudes permanently from the mouth—lymphangiomatous macroglossia. Treatment by radium has given encouraging results. When this fails, partial glossectomy must be performed.

Hæmangioma (see fig. 208), when widespread, can result in macroglossia. Occasionally a congenital fistula between the lingual artery and vein gives rise to an enormous protruding tongue that sometimes pulsates. Partial excision or, in the case of an arterio-venous fistula, ligation of both lingual arteries, followed by partial glossectomy, is the treatment.

Neurofibroma is on rare occasions the cause of macroglossia, which is sometimes confined to one-half of the tongue. Usually other manifestations of Von Recklinghausen's disease of nerves (see p. 44) are present.

Muscular macroglossia is practically confined to idiots and cretins (see p. 215). The large tongue protrudes from the mouth and is liable to become dry and cracked. It is being bitten constantly, and there is no doubt that if the patient has attained the age of three years, the protruding portion should be excised.

Syphilis is a rare cause of macroglossia.

Primary Mesodermal Amyloidosis.—Attention is sometimes drawn to this disease by the macroglossia which it produces.

CONGENITAL FISSURED TONGUE (*syn.* CONGENITAL FURROWING)

When a patient presents a fissured tongue, too often it is assumed that he or she is suffering from hereditary or acquired syphilis. Fissures, even deep fissures, are often due to congenital furrowing. John Thomson, after a study of a large number of cases, showed that the furrowing of the tongue was not present at birth, but was acquired in early childhood, and in his opinion it was due to tongue sucking. What is very important is that in congenital fissured tongue the fissures are *always transverse* (fig. 195), whereas in syphilitic fissured tongue they are inclined to be longitudinal.

FIG. 195. — Congenital fissured tongue. Note the transverse direction of the fissures.

INJURIES

Anæsthetists are familiar with the possibility of the unconscious patient biting his tongue, and so commonly does this accident occur in epileptics that attendants are provided with rubber gags to put between the patient's teeth when a seizure is imminent. The most common deep wound of the tongue follows a blow or a fall while the patient is smoking a pipe, which breaks and is driven into the musculature of the tongue.

As a means of checking severe hæmorrhage from the posterior part of the tongue, Heath recommended passing the finger as far back as possible and hooking the tongue forward on to the jaw, and so applying pressure on the lingual artery.

Sutured wounds of the tongue heal readily with simple mouth-washes, and an almost completely divided segment, if sutured into position, will often remain viable and unite.

Friedrich von Recklinghausen, 1833–1910. Professor of Pathology, Strasbourg.
John Thomson, 1866–1928. Physician, Hospital for Sick Children, Edinburgh.
Christopher Heath, 1835–1905. Surgeon, University College Hospital, London

FIG. 191.—Well-developed sucking pad.

Adenitis of the Facial Lymph Node.—Few individuals possess a facial lymph node ; consequently infection coursing along the lymphatics of the cheek usually passes direct to the submandibular nodes. When a facial lymph node is present its enlargement will perplex the diagnostician unaware of its existence.

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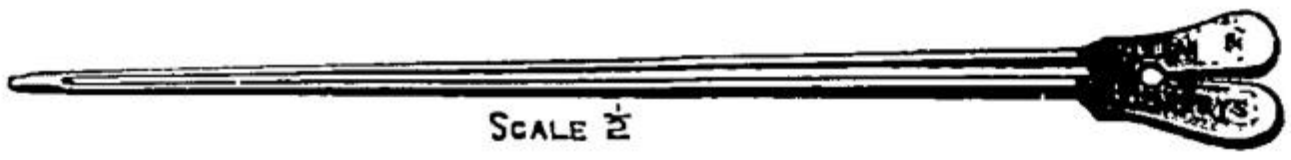

FIG. 192.—Director with guard and frænum slit.

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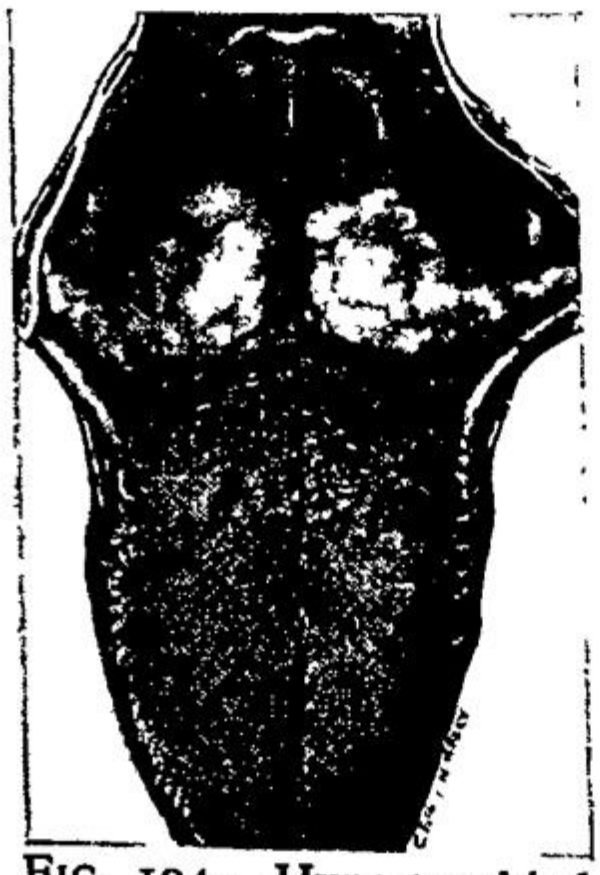

FIG. 194.—Hypertrophied lingual tonsil.
(*After N. Jesberg.*)

An enlarged lingual tonsil should be dissected out in much the same way as a faucial tonsil.

John Shea, 1889–1952. Otorhinolaryngologist, Baptist Hospital, Memphis, U.S.A.

clinical entity. Smaller areas are known as patches, usually smoker's patch. Nerve terminals are exposed and the tongue is painful.

Stage 4.—Submucous fibrosis occurs, causing cracks and fissures (fig. 199). Warty projections and sometimes an ulcer are prone to follow. Chronic superficial glossitis is an established precancerous condition, and by the time the fourth stage has appeared the development of a carcinoma in one of the warty projections, ulcers, or fissures is not far distant.

FIG. 199.—Chronic superficial glossitis, fourth stage.

Treatment

1. Remove obvious sources of irritation, viz. rough teeth, vulcanite dentures, some metallic fillings. Unless the patient is edentulous at least dental scaling is required.

2. Stop pipe smoking altogether ; spirit drinking must be given up.

3. When required, give thorough antisyphilitic treatment.

4. A glycerol thymol mouth-wash is prescribed. The patient is advised to smear some white petroleum jelly over his tongue before retiring.

If carried out conscientiously, these measures will improve considerably comparatively early cases. In particular patches will disappear, but lingual papillæ, once lost, cannot regenerate.

'Touching up' patches with caustics of any kind must be eschewed rigorously, as the development of carcinoma is encouraged thereby. It is essential for the patient to report once a fortnight, when the clinician reviews the case, watching for the possible development of malignancy.

In stage 4 an ulcer that does not heal, or a small warty projection, should be excised and examined histologically ; very early carcinomata are discovered in this way. When after a reasonable trial of conservative measures the whole tongue is not improving or if it is getting worse, Butlin's operation should be advised. This operation is an excellent one. The principle is to remove a slice of the dorsum, including the diseased area (fig. 200), and to unite the resulting raw edges with sutures.

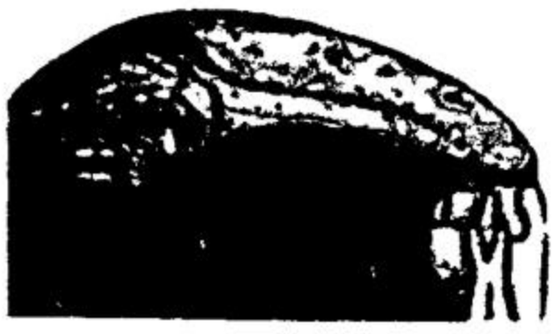

FIG. 200.—Butlin's operation, showing the portion of tongue to be removed.

GEOGRAPHICAL TONGUE OF CHILDREN

Red rings with a yellow border are characteristic. The distribution is, as the name implies, irregular, and the disease runs a very chronic course. Itching and salivation are the leading symptoms. The treatment follows general lines.

RAW TONGUE

On some part of the dorsum there is a sore red surface deprived of its filiform papillæ (fig. 201). The area is not ulcerated ; it is partially denuded of epithelium. As the hair falls out after certain fevers, so in some persons do the papillæ

the more common types of ulcers of the tongue, as their differential diagnosis is so important in the practical application of clinical surgery.

Non-specific.—**Dental ulcer** occurs always at the side of the tongue (fig. 206). It is inclined to be rather elongated, after the nature of a scratch or crack. It is usually painful, but not necessarily so. A decayed or broken tooth, or the clasp of a denture, will be found to be the causative agent. The treatment is to remove the cause and apply the ointment described below.

FIG. 206.—Dental ulcer caused by the sharp edge of the clasp of a denture.

Aphthous ulcer (*syn.* dyspeptic ulcer) is a small rounded painful erosion with a white centre. It often occurs near the tip of the tongue, and is more common, not in the 'chronic dyspeptic individual,' but during adolescent life. The possibility of it being an allergic manifestation has been advanced, and the question of a virus being the causative agent is under consideration. The vesicles that form in the early stages are produced as a result of intra-epithelial œdema. As the vesicles break down an ulcer is formed; this is extremely painful. Two and a half per cent. hydrocortisone incorporated in a broad spectrum antibiotic ointment applied six times a day for several days is the best form of local treatment. The saliva must be held in the mouth for as long as possible after inunction. Sometimes after about a week healing occurs, but often the condition recurs at irregular intervals.

Post-pertussis ulcer is seen at the frænum linguæ. Of necessity, this occurs only in children with whooping-cough.

Chronic non-specific ulcer is a clinical entity that gives difficulty in diagnosis. The ulcer is not very painful, moderately indurated, and is usually situated on the forepart of the tongue (fig. 207). There is no history or obvious cause to attribute the lesion to trauma. The Wassermann reaction is negative. There is no evidence of tuberculosis in the lungs or on histological examination of the lesion.

Local excision should be carried out in order to confirm the diagnosis, as well as to cure the condition.

FIG. 207. — Chronic non-specific ulcer of the tongue.

Specific.—**Syphilitic Ulcer.**—The most typical is the gumma, situated in the middle line of the dorsum, rather nearer the base than the tip of the tongue (see fig. 205).

Tuberculous ulcers (see p. 162).

Malignant.—**Carcinomatous ulcer** has typically the clinical features of a squamous-celled carcinoma—viz. an everted edge and an indurated base.

If doubt exists as to the nature of an ulcer—and it is sometimes difficult to be certain when dealing with cases of early carcinoma—a fragment should be removed under local anæsthesia and submitted to histological examination. In this instance a Wassermann reaction is a hindrance rather than a help in establishing the diagnosis, for even at the present time it is not unusual for a patient with carcinoma of the tongue to have syphilis as well; in the pre-antibiotic era it was the rule.

NEOPLASMS OF THE TONGUE

Benign neoplasms are comparatively rare. They are completely overshadowed by the appalling frequency of carcinoma of this organ. The following, in order of frequency, occur from time to time:

Papilloma is the commonest benign tumour of the tongue. It may be sessile or pedunculated, and must be distinguished from a Hutchinson's wart (see p. 163). To ensure non-recurrence, it should be excised, preferably with a diathermy knife, together with a small wedge of normal tissue about its base and submitted to histological examination.

Angioma in this situation is usually venous (fig. 208). The veins which form the tumour are liable to become wounded and bleed. Such hæmorrhage may be so persistent as to render the patient severely anæmic, as we have witnessed. The treatment is excision of the tumour: a diathermy knife is particularly useful in this instance.

FIG. 208.—Venous hæmangioma of the tongue in a woman of twenty-three.

Lymphangioma (see Macroglossia, p. 159).

Plexiform neuroma, Neurofibroma (see Macroglossia, p. 159).

Lipoma is rare, and never large; as a rule it is about the size of a coffee-bean.

Osteoma of the tongue is a clinical curiosity, only 9 cases having been reported in the past forty years. In all a hard swelling has been discovered in the posterior third of the tongue, and removed. Most of these osteomata have been centred beneath the foramen cæcum. The bone arises from a remnant of a branchial arch.

Lingual thyroid (see p. 214)

MALIGNANT TUMOURS

Carcinoma of the tongue is diminishing in frequency: there has been a steady decline in the incidence in males since 1910. More thorough treatment of syphilis, the passing of the clay pipe and the price of tobacco, the welcome activity of our dental colleagues, and possibly the decrease in the consumption of spirituous liquors are the chief reasons for this decline. Notwithstanding, the disease is still common.

Site.—By far the most frequent locations are the lateral margins of the anterior two-thirds of the tongue (fig. 209).

Clinical Features.—The patient is frequently a middle-aged or elderly man (fig. 210); during the past twenty years the number of women victims

of this fell disease has increased to about 15 per cent. If the patient is observant, he or she seeks advice because of the actual lesion on the

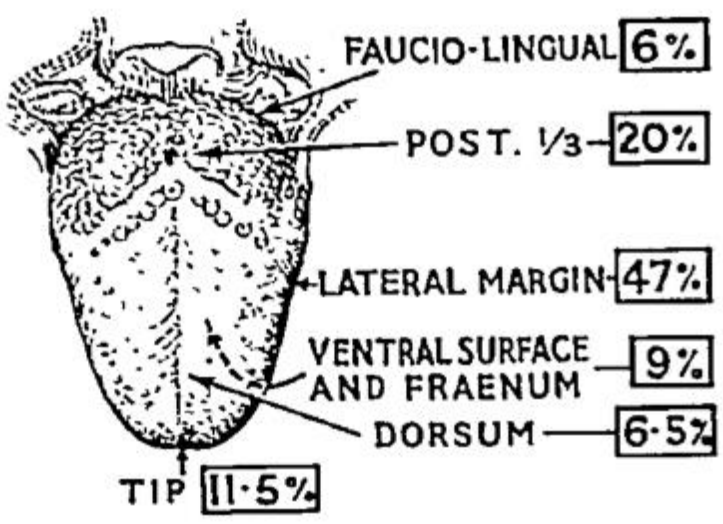

FIG. 209.—Relative frequency of the seat of carcinoma of the tongue. (*Birmingham United Hospitals' Statistics.*)

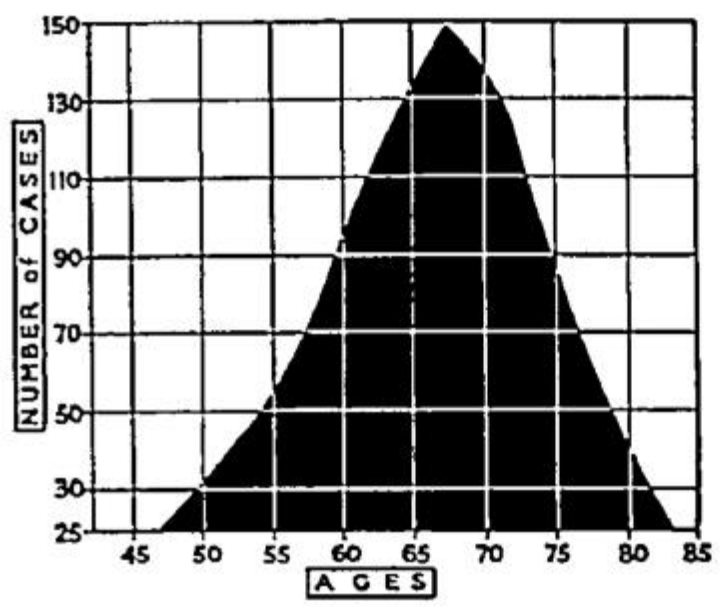

FIG. 210.—The age incidence of primary carcinoma of the tongue. (*Birmingham United Hospitals' Statistics.*)

tongue. The carcinoma, which is squamous-celled, may take the form of :

1. An ulcer (fig. 211).
2. A warty outgrowth.
3. A fissure.
4. An indurated mass. This variety is exceptional.

It is a sad fact that a large number of patients fail to notice or else disregard the lesion in its early stages ; consequently the average lapse of time between the onset of symptoms and seeking relief is five months, the patient reporting only because of one or more of the later symptoms, which are :

1. *Pain.*—This may be in the tongue or referred to the ear. The latter is not unusual, and many a patient with carcinoma of the tongue comes with a wad of cottonwool in his ear, complaining solely of earache. The explanation of this phenomenon is that the lingual nerve is involved and the pain is referred to another branch of the third division of the fifth cranial nerve, to wit, the auriculo-temporal.

2. *Salivation.*—Profuse salivary secretion is common in lingual carcinoma. It is well known that if an elderly man, sitting in the surgical out-patient department, is seen to spit repeatedly into his handkerchief, it is highly probable that his case is one of carcinoma of the tongue. In late stages the saliva is blood-stained.

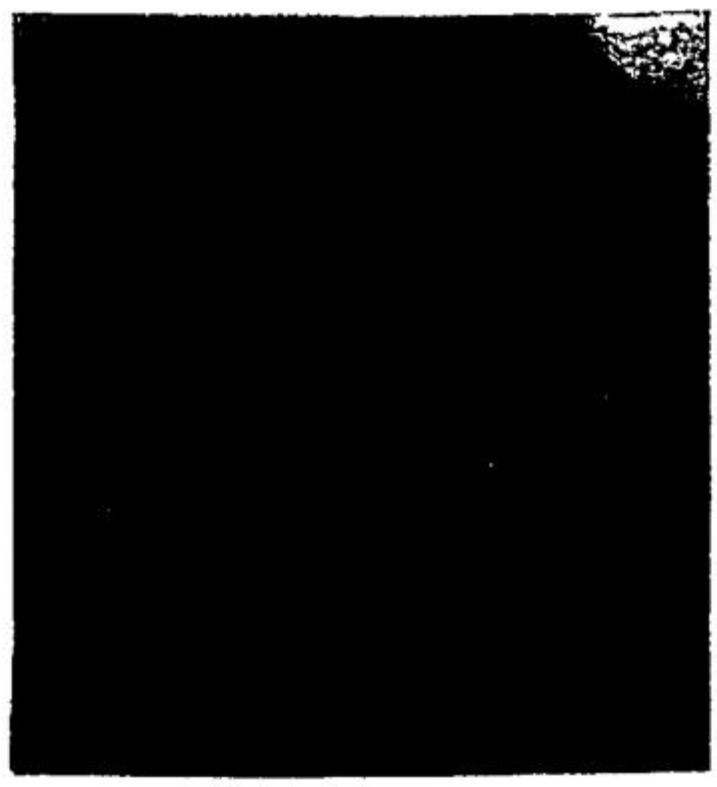

FIG. 211.—Carcinomatous ulcer of the tongue.

3. *Ankyloglossia.*—The tongue cannot protrude fully and deviates to the affected side. This bespeaks extensive carcinomatous infiltration of the lingual musculature or the floor of the mouth.

4. *Dysphagia.*—The patient experiences difficulty in swallowing. This

symptom is more pronounced when the growth is in the posterior third of the tongue.

5. *Inability to Articulate Clearly.*—Factors 2, 3, and 4 may all play a part (fig. 212).

6. *Fœtor.*—The patient becomes offensive to his associates because of the secondary bacterial stomatitis.

7. *A lump in the neck*, due to secondary deposits in the cervical lymph nodes.

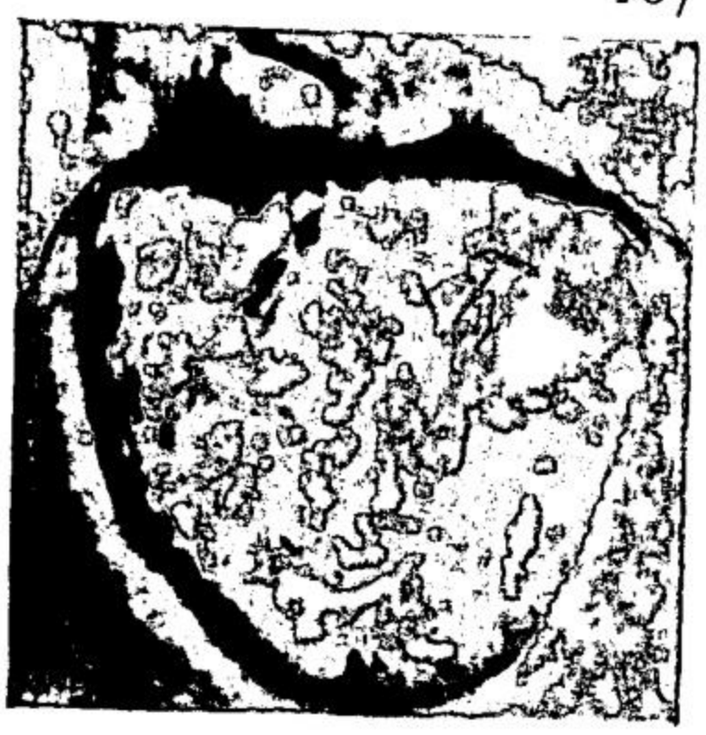

FIG. 212.—The patient sought advice because of difficulty in speaking and swallowing. Referred from a radiotherapist as growth unsuitable for radiotherapy. (See fig. 216, p. 170.)

A growth situated right at the back of the tongue often escapes the notice of an intelligent patient and even of his medical adviser. *Early alteration of the voice* is often a feature of these cases. Palpation of the posterior part of the tongue and laryngoscopic examination are cardinal methods in detecting a neoplasm in this situation. Because the diagnosis of a growth in this secluded area is late, its average diameter is greater and the incidence of palpable cervical metastases is higher than when a carcinoma is situated in other parts of the tongue.

Before leaving the subject of clinical features of carcinoma of the tongue, the reader's attention is drawn to the importance of precarcinomatous conditions that favour the development of lingual carcinoma.

Precarcinomatous conditions.

1. Chronic superficial glossitis (see p. 160).
2. Inflammatory ulcers of the tongue, particularly chronic dental ulcer (see p. 164).
3. Papilloma of the tongue (see p. 165).
4. Occasionally (in women) the Plummer-Vinson syndrome (see p. 312).
5. Syphilis was formerly the major predisposing cause; now only about 12 per cent. of these patients have a positive Wassermann reaction. The incidence of carcinoma of the tongue has fallen proportionately.

Spread of the Disease:

(*a*) Local

Carcinoma of the anterior two-thirds of the tongue tends to invade the floor of the mouth, but when the neoplasm is situated on the side of the tongue it seldom extends across the middle line, where there is a fibrous septum.

Carcinoma of the posterior third of the tongue tends to spread to the corresponding tonsil, the epiglottic vallecula and the soft palate.

(*b*) **Lymphatic.**—It is important to realise that in 50 per cent. of individuals the lymphatic vessels draining the anterior two-thirds of the tongue and the floor of the mouth traverse the periosteum of the mandible on the way to the submental and submandibular lymph nodes. Long before car-

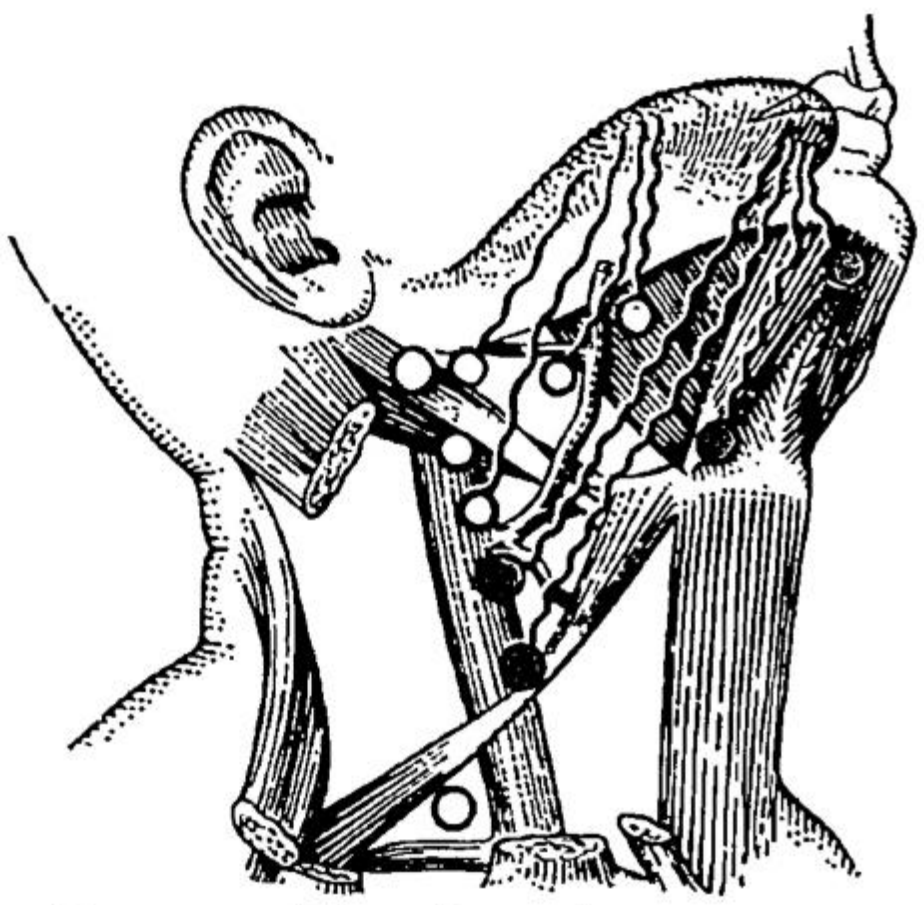

FIG. 213.—The primary lymph nodes of the tongue. Green—drain the tip and anterior third. Yellow—drain the dorsum and posterior two-thirds. The nodes involved most frequently are the deep cervical in the region of the bifurcation of the carotid artery. (*After Taylor and Nathanson.*)

cinoma-bearing cervical lymph nodes (fig. 213) are palpable, careful microscopical scrutiny reveals that some of them are implicated. On the other hand, palpable lymph nodes, unless stony hard are not necessarily the seat of neoplastic invasion; sometimes their enlargement is due to superadded infection of the primary growth. The clinical criterion is, therefore, are the palpable lymph nodes unduly hard? Because of their secluded position and consequent late diagnosis, growths of the posterior part of the tongue show the highest incidence of cervical metastases.

Terminal Events.—Untreated, the disease runs a variable, but inevitably fatal, course. Death occurs usually in one of the following ways:

1. *Inhalation bronchopneumonia*, from the superadded oral sepsis.
2. *Combined cancerous cachexia and starvation.*
3. *Hæmorrhage*, from the primary growth, or on account of metastatic lymph nodes eroding an artery.
4. *Asphyxia*, which is due either to secondary carcinomatous cervical lymph nodes pressing upon the air passages or to œdema of the glottis. The latter is rare, and occurs as an extension of lymphatic œdema around a growth at the back of the tongue.

It should be noted that carcinoma of the tongue is essentially a disease that remains confined to the mouth and neck until the end. Distant metastases occur in only 2 per cent. of patients, and in these the neoplasm is situated in the extreme posterior part of the tongue in almost every instance.

Treatment.—Carcinoma of the floor of the mouth and the antero-lateral two-thirds of the tongue should be considered as a single clinical entity from the viewpoints of lymphatic drainage and treatment. Vital as are early and adequate extirpation or destruction of the primary growth, these are of little avail unless involved lymph nodes are eradicated also.

World opinion has veered from wide surgical extirpation of the primary growth and, whenever possible, its lymphatic field, to radium and other forms of irradiation (see p. 171), then back again to (when necessary) even wider surgical extirpation. The reason for the latest swing of the pendulum is the relatively poor results of irradiation and the frequent complication of radium necrosis of the mandible. Modern anæsthesia, blood replacement, and particularly antibiotics (which have prevented a high incidence of pulmonary complications) are the reasons for the restoration of the operative treatment of lingual cancer to its pristine eminence. Notwithstanding, in early cases radium treatment is often highly satisfactory.

possible, the cosmetic result is enhanced without jeopardising the prospect of a cure.

Radium therapy is often curative in very early cases. Radium needles are inserted into and around the growth, parallel to each other and 1 cm. apart. The eye ends of the needles should be just below the mucous membrane. They are removed in seven days, a dose of 6,000 to 7,000 r. being delivered.

External radiation by a beam unit or X-rays is employed when the chances of a cure are remote. As a general rule, such treatment has been found to give considerable palliation.

Peroral X-ray treatment is an improvement on external irradiation with its frequent sequelæ of damage to the skin and radio-necrosis of the mandible. The special apparatus, known as a 'tubixol' tube, which is highly flexible, gives an adequate depth dose at 100 kV. Such treatment may render an apparently inoperable growth operable.

Prognosis.—The five-year survival rate after treatment (all varieties) is :

Tongue, 25 per cent.[1]

Floor of the mouth, 40 per cent.

SARCOMA OF THE TONGUE

Sarcoma of the tongue is very rare, and almost invariably fatal. An example came under our observation. The patient was a man of twenty-eight, who complained of a lump in the left side of the tongue. Deep X-ray therapy caused the lump to disappear, and the nodes of the left side of the neck were removed. Two months later enlarged lymph nodes appeared in the right side and a block dissection was carried out. A few months later the sarcoma became widely disseminated, and death resulted.

NERVE LESIONS OF THE TONGUE

Lingual neuralgia can occur idiopathically, or be due to the lingual nerve being caught up in scar tissue or neoplastic infiltration. A not infrequent cause is as an aftermath of lingual herpes. In severe and persistent cases section of the chorda tympani brings relief. The chorda tympani contains not only gustatory and secretory fibres, but also sensory fibres. The nerve can be severed in its canal close to the posterior border of the tympanic membrane. The operation can be conducted under local anæsthesia.

Glossodynia, or burning tongue, is a troublesome condition : it is a symptom, and not a disease. When it occurs in connection with an observable lesion, the treatment consists in removing the cause. However, in many cases, especially in women over forty years of age, nothing amiss with the tongue can be discovered, and such cases are liable to be confused with lingual neuralgia. Vitamin B complex is stated to be of some value in treatment ; probably it is a placebo.

Hemiatrophy of the Tongue.—In so far as the tongue, the floor of the mouth, and the submaxillary region are concerned, hemiatrophy of the tongue is the result of severing the hypoglossal nerve. This causes paralysis of the musculature of the tongue on the affected side. There is some thickening of speech and interference with deglutition. Usually, however, after a few months the patient manages to accommodate his speech and eating habits to his glossal weakness.

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[1] Some of the results published in 1956 where surgical procedures alone were employed show a five-year survival rate as high as 65 per cent.

Posterior Third.—Circumscribed, well lateralised lesions can be extirpated via the intra-oral route, as described for the middle third. Often the tonsillar bed must be included in the dissection. The mucous membrane can usually be brought together to cover the defect. More advanced lesions require an external approach (see below), combined with block dissection of the neck.

FIG. 216.—Total glossectomy. The patient, who had lived in France, could converse freely in French and English. (Photograph three years after operation.)

Dorsum.—A generous elliptical incision (usually transverse) after strong retraction of the tongue to give adequate exposure, is the method of choice when the lesion is sufficiently circumscribed. If possible, the hypoglossal nerve should be preserved. The continuity of the tongue is restored by closing the defect with fine interrupted chromic catgut sutures. More extensive lesions of the dorsum can be eradicated only by total glossectomy which sometimes gives surprisingly good results (fig. 216). After splitting the lower lip in the midline, the incision is carried down to the level of the hyoid bone. The mandible is bisected with a Gigli's saw, and the whole tongue removed.

Combined Lingual and Cervical Procedure (the Commando[1] operation, so named because of its extensive nature).—Whenever a posterior lesion invades the faucial pillar, or an anterior lesion involves the gingiva, mandible, or its periosteal covering, the wide exposure of the oral cavity afforded by performing a block dissection of the neck followed by hemimandibulectomy (fig. 217) enables the surgeon to excise accurately extensive lesions of the tongue. In cases of a carcinoma of the middle or posterior third of the tongue, frequently the mental area of the mandible can be preserved. When this is

FIG. 217.—The so-called commando operation. Preliminary tracheostomy is performed as a routine. Hemimandibulectomy having been performed, wide access is afforded to the posterior part of the tongue. Note that the external carotid artery has been ligated. (*After Hayes Martin.*)

[1] For want of a better name, these operations were given the name of 'Commando' by the house-surgeons of the Memorial Hospital, New York, in 1942, at the time of the combined commando operations against Dieppe.

Leonardo Gigli, 1863–1908, Italian Gynæcologist, invented his saw for pubiotomy.

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CHAPTER XI

THE SALIVARY GLANDS

HAMILTON BAILEY

THE PAROTID GLANDS

Surgical Anatomy.—After years of scepticism, and sometimes scorn, on the part of many anatomists and surgeons, the concept that the parotid is a bilobed structure has now been accepted; 350 cervico-facial halves, dissected in the Department of Anatomy directed by Professor Barry Anson, showed that the facial nerve and its peripheral rami were distributed between the deep and superficial lobes of the gland, and that in this location the main facial nerve trunk divided into its temporo-facial and cervico-facial branches (fig. 218).

FIG. 218.—Showing the disposition of the seventh nerve in a case when the superficial lobe has been removed.

The superficial lobe varies in size and shape. A large superficial lobe often extends as much as 2 inches (5 cm.) downwards into the neck, where its enlargement is liable to cause diagnostic perplexity.

The isthmus also is of variable dimensions. Sometimes it is relatively broad; even so, the primary divisions of the facial nerve seem always to embrace it.

The Deep Lobe.—In approximately 40 per cent. of cases the deep lobe is relatively small, ovoid in shape, and overlies the base of the condylar process. In the remainder the deep lobe is contiguous with a prolongation that plunges behind the posterior border of the mandible towards the styloid process, which it often surrounds.

The facial nerve, which can be looked upon as the meat in a parotid sandwich, enters the posterior part of the gland a little below its middle, and comes to lie in a groove in the under-surface of the superficial lobe, from which it can be separated by blunt dissection from the mobilised gland, aided here and there, in certain cases, by sharp dissection of some fibrous bands. On reaching the parotid isthmus the nerve divides into an upper (temporo-facial) branch which passes above the isthmus, and a lower (cervico-facial) branch that passes below it. Because of the relatively small size of the deep lobe, outlying subdivisions of the nerve, i.e. the pes anserinus, rest between the superficial lobe and the masseter muscle. Particularly from a surgical point of view, the temporo-facial division, which is often the larger of the two divisions, is the more important. In a number of instances, after the two primary divisions of the nerve have embraced the isthmus, they are connected at a varying distance in front of the isthmus by one or more anastomotic twigs (see fig. 218). No doubt this accounts for some cases of unexpected late recovery of partial facial paralysis following parotidectomy.

Stensen's Duct.—In over 80 per cent. of cases Stensen's duct is a rounded structure no larger than an intravenous needle. It is exceptional for the duct to be the size of a goose quill, as described and illustrated in works on anatomy. In 7 per cent. of cases the duct is duplicated.

The socia parotidis (accessory parotid gland), which is often depicted in anatomical illustrations, is present only on rare occasions.

Sialography is an important method of investigating the parotid gland.

Barry F. Anson, Contemporary. Professor of Anatomy, Northwestern University Medical School, Chicago.
Niels Stensen, 1638–1686. Copenhagen Anatomist. He abandoned the profession of medicine for that of the church, and rose to the rank of bishop.

A watery (not thick and oily) solution of lipiodol, such as neohydriol (May & Baker), is injected into Stensen's duct through a fine ureteric catheter and an enlightening radiograph of the parotid tree is often obtained. By this means, obstruction, e.g. by a radio-translucent parotid calculus, can be confirmed or eliminated.

CONGENITAL PAROTID SIALECTASIS

Sialectasis denotes a state of dilatation of the ductules and alveoli of any salivary gland, but it is the parotid that is affected almost exclusively.

Ætiology and Pathology.—The secretion of a normal parotid gland is watery; that of a parotid the seat of sialectasis is viscid, tenacious, and frequently contains epithelial débris and plugs of mucus. In these respects it resembles fibrocystic disease of the pancreas (see p. 461).

Clinical Features.—The condition is usually unilateral, and the symptoms commence in infancy or in very early life, but are seldom diagnosed correctly until the patient has at least reached puberty. Attacks of painful swelling of the gland, often accompanied by considerable pyrexia, are usually diagnosed as anomalous mumps until their frequent repetition makes such a diagnosis absurd. As a rule, the next condition that comes to mind is a parotid calculus. However, in cases of parotid sialectasis, invariably a calculus is absent. By this time chronic infection of the dilated ducts and acini is almost a *sine qua non* of a condition which in many respects can be compared with bronchiectasis.

Allergy.—Some patients with sialectasis show an allergy to certain foodstuffs, as demonstrated by positive skin reactions. With this exception diagnosis rests upon:

1. Symptoms commencing in infancy.
2. Sialographic appearances.
3. When no lasting benefit accrues from measures that cure chronic parotitis *per se*.

Sialography reveals no obstruction to Stensen's duct or the main branches of the parotid tree, but the ductules and alveoli are grossly dilated (fig. 219).

FIG. 219. — Sialograph displaying sialectasis.

Treatment.—Avoidance of particular articles of diet to which the patient is allergic has brought relief in some cases. An investigation, to ascertain if allergy is present, carried out by an expert, is always worth while. Except for this, treatment should follow that of chronic parotitis, but it is seldom lasting.

Five personal cases failing to respond to any form of conservative measures have been treated by complete parotidectomy, with satisfactory results.

PAROTID CALCULUS

Compared with submandibular calculi, parotid calculi occur infrequently. The symptoms are those one would expect—a painful swelling of the gland, especially at meal-times. To suspect a parotid calculus is easier than to

FIG. 220.—Stones in the parotid gland.

establish the diagnosis conclusively, for a small calculus is often difficult to visualise by radiography (fig. 220).

Sialography.—A parotid calculus too small or too radio-translucent to cast a shadow on a plain radiograph can be demonstrated by contrast.

Treatment.—If the stone can be palpated from within the mouth, it can be removed by slitting up Stensen's duct, but we are seldom so favoured. More often it is deeply placed within the parotid tree. The best method of treatment is to expose the gland by Blair's incision (see fig. 222) and remove the calculus through a transverse incision in the gland substance. Not only is this method extremely satisfactory in the matter of unhindered access, but it practically eliminates the possibility of the development of a parotid fistula. Many of the scars are difficult to discern after a year.

INFLAMMATIONS

Acute Parotitis.—As a rule bacteria reach the gland by retrograde infection from the mouth; in a few instances the infection is blood-borne. In fulminating cases the causative organism is nearly always a hæmolytic *Staphylococcus aureus*. In some of the less severe examples the pneumococcus is responsible.

In contradistinction to epidemic parotitis, the infection is often confined to one parotid gland, although in a small percentage of cases the other becomes implicated later.

Ætiology.—Acute parotitis is encountered in several dissimilar circumstances.

1. *Idiopathic*.—In not a few instances there is no predisposing cause. The patient presents for the first time with signs of acute parotitis.

2. *Post-operative parotitis* has become relatively infrequent; the reason for the decline is the almost routine use of antibiotics after major operations, combined with better oral hygiene, better control of fluid and electrolytic balance, and blood replacement. At the present time, when post-operative parotitis does occur, it is uræmic subjects who are more likely to be attacked than others, and the organism is frequently a penicillin-resistant staphylococcus.

3. *As a complication of debilitating medical disease*, especially typhoid and cholera. As in post-operative parotitis, a dry infected mouth is the probable reason for the supervention.

4. *As a Complication of Acute Pancreatitis*.—The structural and functional similarity of the pancreas and the parotid glands is seemingly a good reason for both structures being attacked via the blood-stream by organisms having an affinity for secretory glands of this type.

5. *Secondary to Obstruction of Stensen's Duct*.—Two patients of mine developed acute parotitis while awaiting admission for removal of a parotid calculus. Foreign bodies sometimes find their way along Stensen's duct. An infant developed acute parotitis; suppuration followed, and on incising

the abscess a large (hen's) feather was withdrawn from the interior of the gland (M. G. Pascoe).

6. *As a Complication of Septicæmia.*—Embolic parotitis is not unusual.

Clinical Features.—There is a brawny swelling on the side of the face, as is shown in fig. 221. Signs of toxæmia are variable; usually the temperature is well over 100° F. (37·8° C.). On many occasions pus or purulent fluid can be expressed from Stensen's duct, enabling the sensitivity of infecting organisms to be tested against antibiotics.

FIG. 221.—Acute parotitis.

Treatment.—If acute parotitis threatens, no effort should be spared to cleanse the mouth. Boroglycerol is a useful adjunct in this respect. A sialogogue, in the form of chewing-gum, is also valuable.

Early unilateral cases often respond to antibiotic therapy.

Fulminating Cases.—When the response to the above measures is not obvious within forty-eight hours, and particularly in bilateral cases, early decompression of the gland or glands is strongly recommended. It should be noted that antibiotics may mask the general signs, but the glandular swelling will still be in evidence.

Decompression of the Parotid Salivary Gland.—Local anæsthesia is entirely satisfactory. Blair's method should be employed. A vertical incision is made down to the capsule of the gland. With suitable undercutting of the skin nearly the whole of the parotid gland can be exposed (fig. 222). In order to spare the branches of the facial nerve, the capsule is incised transversely, if necessary in several places. The skin is closed with a few interrupted sutures and drainage is provided at the lower end of the wound.

FIG. 222.—Blair's incision for exposing the parotid gland.

Thirteen consecutive patients treated by me in this way recovered. In the fourteenth case, which was bilateral, too much confidence was placed in penicillin therapy, consequently decompression of the glands was undertaken too late, and the patient succumbed.

If decompression is not performed, provided the patient is not overwhelmed by toxæmia, suppurative parotitis goes on to abscess formation. If incision is withheld, the abscess may burst externally, usually between the bony and cartilaginous parts of the external auditory meatus.

Recurrent subacute and chronic parotitis are rather more common than acute cases. *Pneumonococcus* or *Streptococcus viridans* are the usual causative organisms. The condition can be unilateral but is frequently bilateral (fig. 223).

M. Gilbert Pascoe, Contemporary. Pædiatrician, Brantford General Hospital, Ontario.
Vilray P. Blair, Contemporary. Emeritus Professor of Oral Surgery, University of Washington.

Children and young women are the usual sufferers. Inspection of the orifice of Stensen's duct while gentle pressure is exerted over the gland often reveals a gush of purulent saliva in process of ejection (fig. 224), and the

FIG. 223.—Bilateral chronic bacterial parotitis. Present for nine months. Slight variations in the size of the swellings noticed.

FIG. 224.—Purulent saliva being ejected from Stensen's duct.

diagnosis, which up to that time is often in doubt, becomes indisputable. Parotid calculus (p. 173) must be eliminated. Ill-fitting dentures, by pressing on the orifices of Stensen's ducts, can cause symptoms similar to those of chronic parotitis; indeed, by obstructing salivary secretion they predispose to actual infection.

FIG. 225.—Sialograph in a case of chronic parotitis (lateral view).

Sialography.—In a chronic parotitis the main duct, the ductules, and the acini are all dilated (fig. 225) (cf. sialectasis).

Treatment.—Oral hygiene and antibiotic therapy can be tried, but these measures are frequently disappointing. Patients with chronic parotitis are benefited, often dramatically, by catheterising Stensen's duct with a fine ureteric catheter and injecting a bland antiseptic fluid, such as 1 per cent. mercurochrome. This measure can be repeated as necessary.

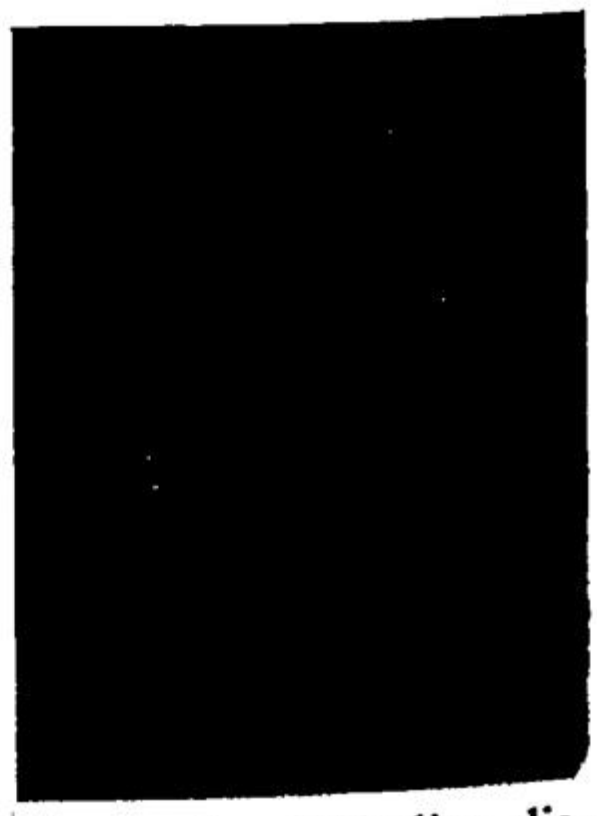

FIG. 226.—Mikulicz disease. (*C. Fischer.*)

Mikulicz Disease.—Mikulicz decreed the following triad as constituting the disease: (1) Symmetrical enlargement of salivary glands; (2) Narrowing of the palpebral fissures due to involvement of the lachrymal glands; (3) Parchment-like dryness of the mouth.

In its fully developed form (fig. 226) it can hardly be mistaken. It is necessary to draw attention to the fact that Mikulicz disease can be limited to one or both parotid glands.

Johannes von Mikulicz-Radecki, 1850–1905. Professor of Surgery, Breslau.

Differential Diagnosis.—When limited to the parotid glands the condition usually is asymptomatic. The *whole* parotid is enlarged, which helps to distinguish the condition from a parotid tumour. Moreover, the incidence of bilateral occurrence is greater than that of any parotid neoplasm. Like parotid sialectasis, the swelling is stated to vary in size, but unlike sialectasis, the swelling is always present. A plain radiograph sometimes reveals small areas of calcification throughout the involved gland, a finding that is believed to substantiate chronic inflammation.

Sialography shows displacement of the duct system around a central mass, and always clubbing of the terminal ducts, which again favours chronic inflammation.

Pathology.—The microscopical findings reveal replacement of salivary tissue by lymphoid tissue containing islets of epithelial tissue, the amount of lymphoid replacement being proportional to the duration of the disease. While most pathologists consider that the condition is due to an obscure chronic inflammation, few would care to state dogmatically that it is not a benign neoplasm.

Course.—A number of cases of spontaneous cure after several years have been reported.

Treatment.—If a confident diagnosis can be made, X-ray therapy should be employed. When, at operation, the whole parotid gland is found to be enlarged, if possible frozen section biopsy should be performed, and if the diagnosis is Mikulicz disease, it may be considered unnecessary to proceed. On the other hand, massive deformity such as in the case illustrated (fig. 226) calls for removal of the submandibular salivary glands, and possibly bilateral superficial lobectomy of the parotids. The lachrymal glands are better left alone.

Boeck's sarcoidosis, a granuloma of unknown origin, can attack any tissue. It is usually, but not necessarily, associated with cutaneous lesions. Sarcoidosis of the skin consists typically of multiple bluish-red plaques, darkening to yellowish-brown, and resembles lupus in some respects, but ulceration does not occur. More deeply placed lesions take the form of tumours. When both parotid glands are attacked, Boeck's sarcoidosis simulates in several respects Mikulicz disease. If one parotid alone is involved, the swelling is usually diagnosed as a mixed parotid tumour. Sarcoid of the parotid, which is perhaps the most characteristic manifestation of Boeck's disease, is frequently associated with inflammation of the uveal tract (iridocyclitis). In all cases of sarcoidosis the regional lymph nodes become involved. In a number of instances the mediastinal and broncho-pulmonary nodes become affected. Localised rarefaction in bones is not uncommon and is especially evident in the fingers and toes. In the last stages of the disease there is often distressing scarring of the face and blindness: often only after many years does the condition prove fatal from lung involvement or superadded pulmonary tuberculosis.

Treatment.—Streptomycin, P.A.S., and isoniazid have not been found to be of any value. Calciferol has given more encouraging results, while cortisone and ACTH bring about temporary improvement.

SALIVARY FISTULA

A salivary fistula may be internal or external. As an internal fistula does not give rise to symptoms, and as an external fistula of the submaxillary gland is both rare and cured readily by removal of that gland, the subject resolves itself into a consideration of the troublesome condition *external fistula of the parotid.*

Parotid Fistula.—The amount of discharge varies with the site of the fistula. Apart from some moisture on the face when eating, an external fistula connected with the gland itself produces but little inconvenience. On the other hand, a fistula of a large duct is associated with extreme discomfort. Every time the patient has a meal, smells food, or even thinks of it, there is an outpouring of parotid secretion on to the cheek. In addition to the annoyance of such a phenomenon, the skin in the neighbourhood tends to become excoriated. These fistulæ usually follow a badly placed incision for the opening of a parotid abscess, but may be an aftermath of a penetrating wound; although some leakage of saliva occurs for several

Caesar P. M. Boeck, 1846–1917. Dermatologist, Christiania (Oslo), Norway

days, a persistent fistula following partial parotidectomy is of rare occurrence. A salivary fistula that has continued to discharge for several months seldom closes spontaneously. Usually the external opening is pin-point.

Sialography is invaluable in these cases. It will indicate whether it is the main duct or a ductule that communicates with the surface. From the information thus gained the proper course to adopt for the cure of the fistula can be formulated.

Treatment.—When a fistula has been proved to be connected with a minor branch of the parotid tree, the atropine-like effect of probanthine (propantheline bromide) 50 mg. every six hours for a week, or failing that X-ray treatment, is likely to succeed. In other circumstances operative measures must be invoked. Of many plans suggested, Newman and Seabrook's is the most satisfactory.

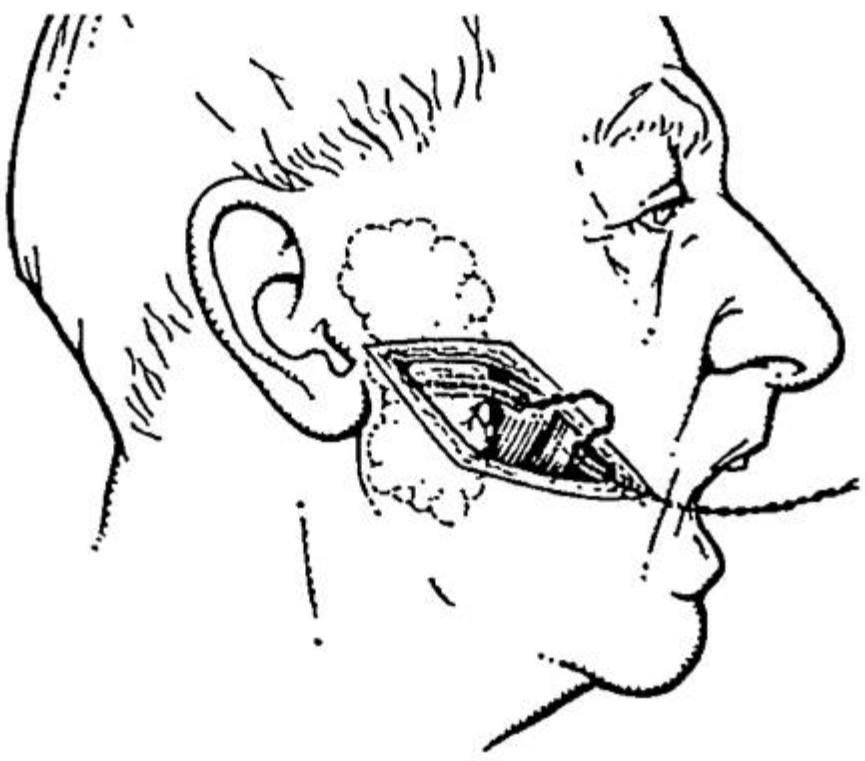

FIG. 227.—Newman and Seabrook's operation for parotid fistula.

Operation.—Prophylactic systemic antibiotic therapy is commenced twenty-four hours before the operation. One probe is introduced through the orifice of Stensen's duct and another through the external fistula. With the probes in position, a suitable incision is made in the cheek, so as to display Stensen's duct and the area of gland containing the probes. After a tedious dissection to free the severed conducting mechanism of the gland, No. 10 tantalum wire, which is twisted on itself, is passed as shown in fig. 227. Any portion of the twisted wire that lies exposed is buried with fine catgut sutures, and the skin is closed. The distal end of the wire is suitably bent around the corner of the mouth, and anchored there by adhesive plaster.

Post-operative Treatment.—Antibiotic therapy is continued for several days. Oral hygiene is most important, and each day the wire splint is moved very gently; it should remain in place for three and a half weeks.

Should a reconstructive operation such as the above prove a failure, avulsion of the auriculo-temporal nerve will diminish the amount of saliva secreted by the gland (R. Leriche).

THE AURICULO-TEMPORAL SYNDROME (FREY'S SYNDROME)

Most examples of this condition have followed injury to fibres of the auriculo-temporal nerve at the time of incision for the relief of suppurative parotitis. When the patient eats, the cheek becomes red, hot, and painful; this is followed by beads of perspiration appearing upon it (fig. 228). There is also cutaneous hyperæsthesia in front of and above the ear, especially during shaving.

The explanation of the phenomenon is open to dispute. A satisfying hypothesis is that, presuming the nerve has been severed, axis cylinders conveying secretory impulses grow down the sheaths of the cutaneous element of the nerve. In this way a stimulus intended for saliva production evokes cutaneous hyperæsthesia and sweating.

The only effective treatment is avulsion of the nerve, but cases severe enough to merit this undertaking are few and far between. In most instances the patient, having tried many remedies, becomes resigned to endure the inconvenience; in a few, years of patience brings some amelioration.

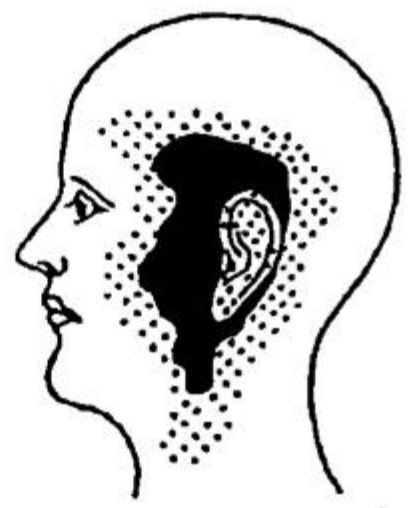

FIG. 228.—Black area = region of sweating; stippled area = region of hyperæmia. (*After P. D. Goatcher.*)

Saul Charles Newman, Contemporary. Clinical Instructor in Otolaryngology, New York Post-Graduate Hospital.
Dean Baynard Seabrook, Contemporary. Professor of Surgery, Oregon University, U.S.A.
Réne Leriche, 1879-1956. Successively Professor of Surgery at several French provincial universities, he was elected Professor of Medicine at the Collège de France, Paris—the highest professional honour in France.
Lucja Frey, 1889-1944. Physician, Neurological Clinic, Warsaw. She was killed during the German occupation of Poland.

CYSTS OF THE PAROTID GLAND

Most cysts of the parotid gland occur in the region overlying the angle of the jaw, and as they are often found to be lined with epithelium, it seems probable that they are derived from the first branchial cleft. The condition is much more uncommon than papillary cystadenoma lymphomatosum which, however, is seldom so fluctuant when as small as the cyst (which was lined by squamous epithelium) shown in fig. 229. Occlusion of a main branch of the parotid tree by a calculus occasionally gives rise to a cyst.

The treatment is extracapsular excision. In the case of a cyst secondary to a calculus, removal of the stone will probably cure the condition.

FIG. 229. — Cyst of the parotid.

NEOPLASMS

Parotid Tumours
- *Benign* = Papillary cystadenoma lymphomatosum.
- *Potentially malignant* = Mixed parotid tumour.
- *Malignant from the start*, though for some time not obviously so = Adenocarcinoma

Papillary Cystadenoma Lymphomatosum (Warthin's tumour).—Although classified as an innocent *parotid* tumour, were it able to do so, the parotid gland, with some justification, might disclaim paternity. Embryological studies of this region have shown that frequently ductal structures from the primary parotid bud grow into the developing juxtaparotid lymph nodes. This having come to pass, the encompassed ductules lose all connection with the parotid tree. At least one juxtaparotid lymph node containing normal salivary tissue is found in all infants. Here lies the explanation of the birth of a cystadenoma lymphomatosum: it is an epithelial tumour arising within a periparotid lymph node.

Pathology.—Most frequently the neoplasm is situated outside the parotid capsule or just beneath the capsule, embedded in the superficial lobe. On macroscopical section multiple cysts are revealed, varying in size from a pin's head to a hazel nut, and greyish-pink in colour. Microscopically the essential components are papillary epithelium embedded in a lymphoid stroma—an extremely characteristic picture. The tumour grows slowly, and is absolutely benign.

Clinical Features.—Warthin's tumour is not uncommon. In 90 per cent. of cases it does not commence to appear until the patient is over forty years of age. Males are considerably more often affected than females (5:1). The tumour appears to be confined to white races. While its commonest location is similar to that of a mixed parotid tumour (*vide infra*), not infrequently at least some part of the swelling is situated in the neck below the angle of the mandible. This neoplasm is never stony hard, and in 30 per cent. of cases it is sufficiently cystic for fluctuation to be elicited, in which event it is possible to make an intelligent guess that the tumour in question is a Warthin's tumour.

Treatment.—Extracapsular excision of the tumour is curative. The

Alfred Scott Warthin, 1866–1931. Professor of Pathology, University of Michigan.

tumour is not sufficiently radio-sensitive to warrant recommending X-ray therapy which, if unsuccessful, makes excision, otherwise straightforward, more difficult.

'**Mixed parotid tumour,**' the commonest parotid tumour, is a well-known clinical entity that occurs with equal frequency in either sex, and usually first appears in early adult life. For some obscure reason parotid tumours are seldom, if ever, confined to the upper part of the gland. A firm somewhat, rounded, slowly growing neoplasm, nearly always commencing in that part of the parotid gland overlying the angle of the jaw (fig. 230), renders the diagnosis tolerably simple. Usually benign for a varying period from several months up to ten or twenty years, it sooner or later breaks its confines and exhibits characteristics of malignancy. It now tends to invade the pterygoid fossa and the upper part of the neck, and sometimes causes facial paralysis from involvement of the seventh nerve. When first seen in a comparatively advanced state it is difficult to diagnose from other malignant tumours of the region.

FIG. 230.—Mixed parotid tumour, typical location.

Pathology.—A mixed parotid tumour commences its existence as a pleomorphic adenoma containing fibrous, myxomatous, pseudo-cartilaginous, and epithelial elements in varying proportions. After growing very slowly, on reaching a certain size the tumours remain almost stationary for periods varying from months to years and then, wearying as it were of their inconspicuous rôle, comparatively suddenly the variegated epithelial elements burst into mitotic activity and become a pleomorphic carcinoma. On rare occasions one epithelial component alone runs riot, and a highly malignant anaplastic carcinoma results.

Adenocarcinoma.—Many of these tumours are of peculiar histological pattern, in which alternating layers of cylinders of cells and hyaline material are arranged around a central cavity that sometimes contains mucus. The tumour, which cannot be distinguished clinically from a mixed parotid tumour, is more quickly and more highly invasive and in all respects more malignant than a mixed parotid tumour. If it is not removed *in toto* early, relentless recurrence is inevitable. Whereas mixed tumours of the parotid gland are divided equally between the sexes, two-thirds of all adenocarcinomata of cylindromatous type occur in women. The tumour is radio-resistant.

Treatment of Tumours of the Parotid Gland.—Nearly all of these tumours are radio-resistant, consequently the patient should be urged to have the tumour extirpated while it is comparatively small. The aim must be to excise the tumour, together with its capsule, without opening the latter. In order to accomplish this, good exposure (fig. 231, inset) is essential. To enucleate the tumour and leave the capsule invites early recurrence and

extension of the neoplasm, because tumour cells are spilled during the operation and many are left attached to the walls of the capsule which remains.

1. **Extracapsular excision** is suitable for small superficial tumours. Unless *extracapsular* excision (fig. 231) is carried out, recurrence usually takes place within two years.

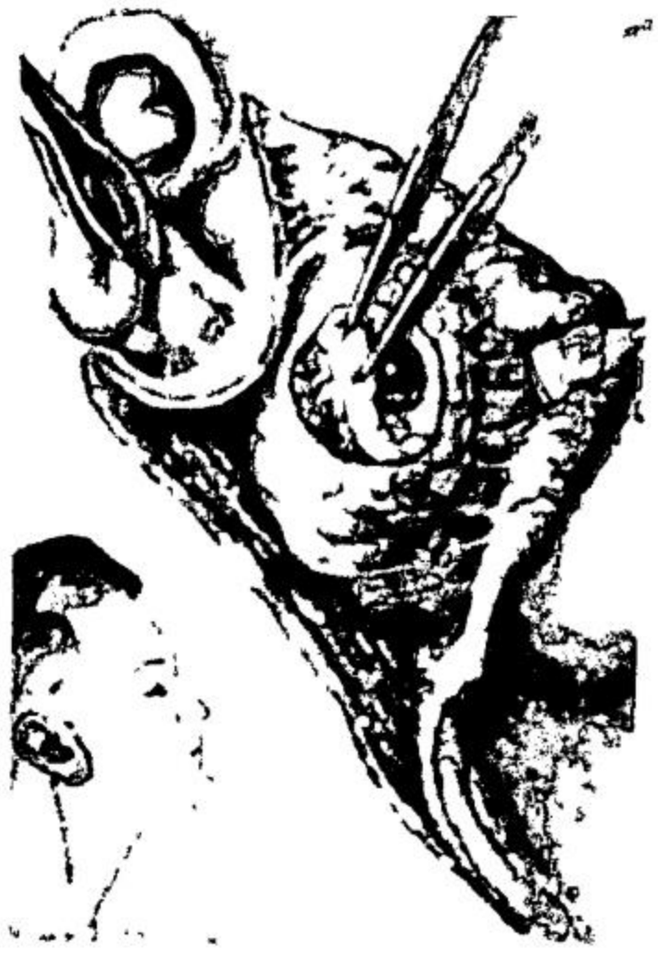

FIG. 231.—Extracapsular excision of a moderate-sized parotid tumour. The tumour must be removed with a layer of healthy parotid tissue without encroaching upon the capsule. Inset shows the skin incision.

2. **Superficial lobectomy** is advised for larger tumours. The dissection is commenced at the postero-inferior border of the parotid and the main trunk of the seventh nerve is found. As explained on p. 172, by meticulous dissection it is possible to follow and preserve the two divisions of the facial nerve and their branches between the two lobes. The superficial lobe having been mobilised on all sides, it is amputated. Most tumours of the parotid gland lie in the superficial lobe (fig. 232).

FIG. 232.—Superficial lobectomy nearing completion.

3. **Complete parotidectomy** is indicated (1) where the tumour has broken its confines and has commenced to enlarge comparatively rapidly, and (2) when the tumour has recurred after local excision.

While the patient must be warned that it may be impossible to preserve the facial nerve, the results of superficial lobectomy and total (fig. 233) parotidectomy show a low incidence of permanent facial palsy—considerably

FIG. 233.—Mixed parotid tumour of over twenty years' duration, latterly increasing rapidly in size. Complete parotidectomy under local anæsthesia with preliminary ligation of the external carotid artery. The facial nerve was preserved. The patient was free from recurrence twelve years later.

FIG. 234.—A strip of fascia lata inserted subcutaneously as shown helps to overcome the deformity of facial palsy. (*After W. O. Lodge.*)

lower than when extracapsular excision is performed for comparatively deep tumours, and indeed when the tumour is left untreated or treated by radiotherapy. On the other hand, when the tumour is frankly malignant or is recurrent, it is often impossible, and indeed inadvisable, to spare the seventh nerve at the expense of complete extirpation of the growth.

In cases where facial paralysis is permanent, the resulting deformity can be mitigated later, to a large extent, by a plastic procedure such as that illustrated in fig. 234, or by substituting tantalum wire for the fascia. Part of the temporal muscle can be used to help the lower eyelid to close.

A graft of the seventh nerve with the great auricular nerve has proved successful in some cases.

THE SUBMANDIBULAR SALIVARY GLANDS

Calculus.—The most common sites for a salivary calculus are within the submandibular salivary gland (fig. 235) or its duct (Wharton's duct). Indeed,

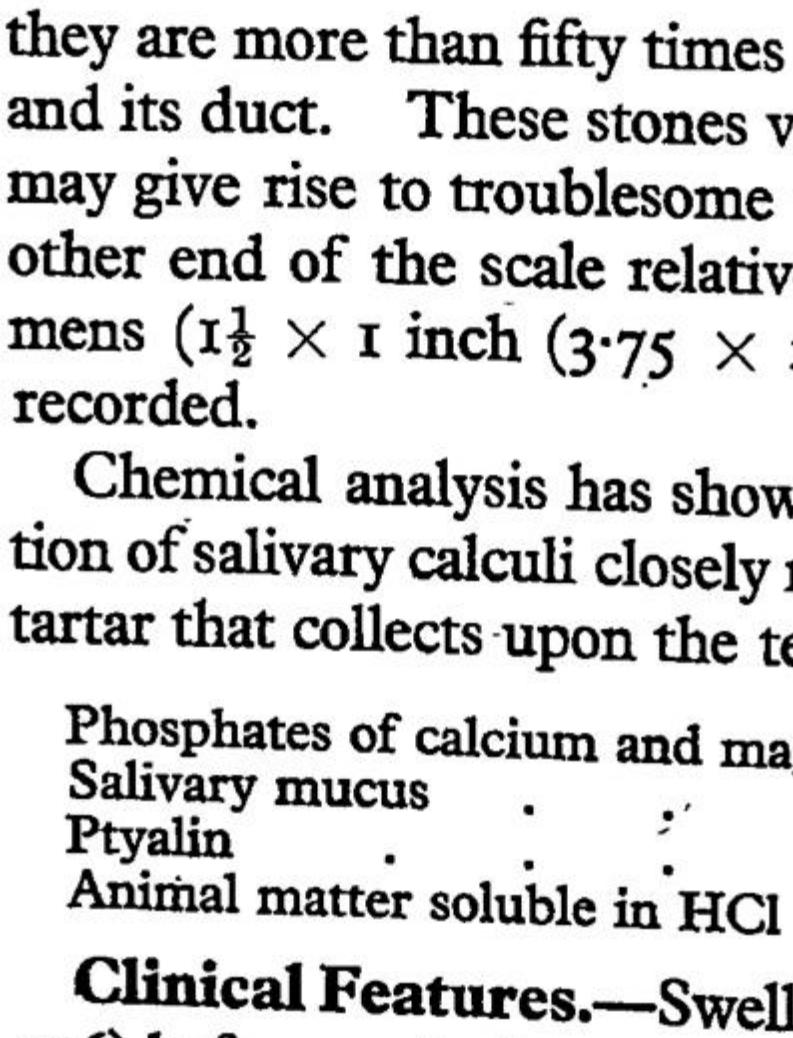

FIG. 235.—Comparatively large salivary calculus situated within the submandibular salivary gland.

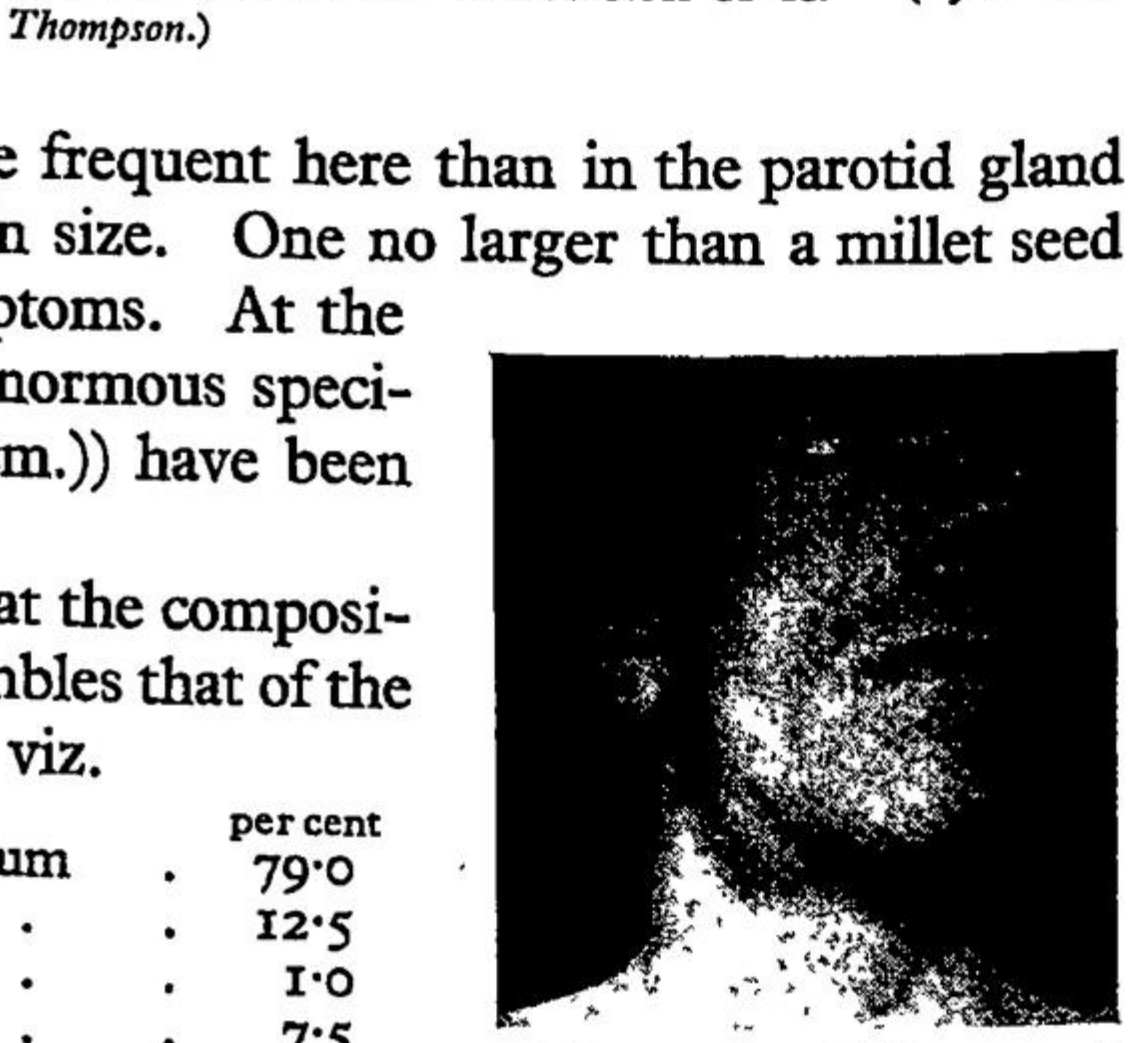

FIG. 235a.—Dissection to show Wharton's duct and the structures in relation to it. (*After Allen Thompson.*)

they are more than fifty times more frequent here than in the parotid gland and its duct. These stones vary in size. One no larger than a millet seed may give rise to troublesome symptoms. At the other end of the scale relatively enormous specimens ($1\frac{1}{2} \times 1$ inch ($3{\cdot}75 \times 2{\cdot}5$ cm.)) have been recorded.

Chemical analysis has shown that the composition of salivary calculi closely resembles that of the tartar that collects upon the teeth, viz.

	per cent
Phosphates of calcium and magnesium	79·0
Salivary mucus	12·5
Ptyalin	1·0
Animal matter soluble in HCl	7·5

Clinical Features.—Swelling of the gland (fig. 236) before or during meals is pathognomonic of

FIG. 236.—Enlargement of the submandibular salivary gland due to a calculus in Wharton's duct.

William O. Lodge, Contemporary. Otorhinolaryngologist, Royal Halifax Infirmary, Halifax, Yorkshire.
Thomas Wharton, 1614–1673. Physician, St. Thomas's Hospital, London.

the condition. In order to reproduce the swelling at the time of the clinical examination the patient should be given some lemon juice, or substitute, to taste. The orifices of Wharton's ducts are then examined, and compared. Saliva will be seen pouring forth on the non-affected side, whereas little if any is ejected on the side of the swelling. If a stone is in Wharton's duct, not infrequently it can be seen, and always it can be detected by bidigital palpation.

Salivary colic sometimes occurs, typically at the commencement of a meal. The pain is described by the patient as like toothache; on this account he is liable to be referred to a dental surgeon. The pain is also sometimes referred to the tongue; this is due to irritation of the lingual nerve as it hooks around Wharton's duct.

FIG. 237. — Radiograph of stone in Wharton's duct.

Radiology.—A calculus (or calculi) in Wharton's duct casts a particularly clear shadow (fig. 237), but in this instance the radiograph is superfluous, for the stone can be felt. When a calculus or calculi is displayed in the gland itself the information gained is extremely valuable, but a negative X-ray does not eliminate a stone of comparatively low mineral content.

Treatment.—A stone in Wharton's duct can be removed under local anæsthesia in the following manner. After infiltrating 1 per cent. procaine solution in the region of the duct, the stone is fixed by passing a stitch beneath and behind it, in order to prevent the stone slipping back into the gland and thus becoming inaccessible. An incision is then made on to the stone in the long axis of the duct, and the stone is removed with a small scoop. The wound is left unsutured.

FIG. 238.—Incision for excising the submandibular salivary gland.

When this stone lies within the submandibular salivary gland extirpation of the gland through a transverse incision (fig. 238) is a highly satisfactory procedure.

The lower edge of the skin incision is dissected from the platysma, which is incised at a lower level and retracted upwards. In this way the cervical branch of the seventh nerve is protected from injury.

Excision of the submandibular salivary gland (see fig. 235) also is recommended in cases of recurrent calculus. Should there be a calculus in Wharton's duct, if it cannot be milked through the cut duct, it must be removed separately through the mouth as described above.

FIG. 239.—Mixed tumour of the submandibular salivary gland. Duration forty years.

Neoplasms.—Mixed tumours of the submandibular salivary gland (fig. 239) are not ex-

cessively rare. If diagnosed reasonably early, the treatment is eminently satisfactory, for the submandibular salivary gland can be excised *in toto* so readily. More rapidly growing neoplasms of the submandibular salivary gland, some of which are cylindromas, also occur, and in my experience they are not so rare as is generally supposed.

FIG. 240.—An ectopic salivary tumour of the cheek. It lies superficial to the buccinator muscle. (*After L. J. Fifield.*)

ECTOPIC SALIVARY TUMOURS

Tiny, unnamed salivary glands are dotted here and there in the bucco-pharyngeal cavity; therefore it is not surprising to learn that salivary tumours occur in locations other than those of the large salivary glands.

Ectopic salivary tumours are found in the palate, the cheek (fig. 240), the tongue (more often near its base), the floor of the mouth, the maxillary antrum, and the post-nasal space. The commonest site is the hard palate, and more than half of all cases are situated on the hard or in the soft palate.

Pathology.—Considerably under half of these neoplasms are mixed tumours. The remainder are cylindromas (K. Harrison).

Clinical Features.—The great majority of these tumours are quite symptomless and are first noticed accidentally. Only occasionally are they reported by the patient within a few months of being discovered; usually they are concealed for much longer periods, but rarely for more than five years. By the time the patient reports often the surface of the tumour is ulcerated (fig. 241). Two-thirds of the patients suffering from ectopic salivary tumour are females, usually between thirty and seventy years of age. As might be expected, when the tumour is situated in the base of the tongue the patient has difficulty in speaking. When the tumour is situated in the maxillary antrum there is a painful swelling of the maxilla. In the most usual situation on the hard palate or in the cheek a clinical diagnosis is by no means impossible; in other situations the result of a biopsy being returned as a salivary tumour always causes consternation to those who have not encountered this condition. Unless the tumour is excised early and widely, local recurrence is relentless, and eventually metastases occur in the regional lymph nodes and sometimes in the viscera and skeleton.

FIG. 241.—Ulcerating palatal salivary tumour: commonest site.

Treatment.—In accessible situations such as the palate, the tongue, and the cheek, the tumour should be excised widely. In the case of the palate, after the operation an obturator is fitted. Radiotherapy is not advised, because most of these tumours are radio-resistant.

Kenneth Harrison, Contemporary. Lecturer in Otolaryngology, University of Manchester.

CHAPTER XII

THE NECK

HAMILTON BAILEY

THE BRANCHIAL APPARATUS AND ITS ABNORMALITIES

IN a fœtus approximately thirty-five days old, four grooves can be seen on the side of the neck. These are the branchial clefts, which resemble the gills of a fish; the intervening bars are the branchial arches. Each arch contains a central cartilage. The clefts in human embryos are, more correctly speaking, grooves—grooves on the outside (fig. 242) and on the inside (pharynx). The first cleft persists as the external auditory meatus, the second, third, and fourth clefts normally disappear. The whole, or a portion of one of these vestigial structures, may persist and give rise to one of the following anomalies:

FIG. 242. — Fœtus, showing branchial grooves and arches.

Branchial Cyst.—A cyst arising from the second branchial cleft is the most common of these vestigial remnants, and it is highly important to recognise it; so frequently is it mistaken for a tuberculous abscess. Usually the cyst makes its first appearance between the twentieth and twenty-fifth years, but its advent may be postponed until the patient is over fifty. Its position is constant, viz. in the upper part of the neck beneath the upper third of the sternomastoid, protruding beneath its anterior border (fig. 243). The cyst is nearly always lined by squamous epithelium, and its contents bear a striking resemblance to tuberculous pus. If, however, a few drops of branchial fluid are examined in a fresh state under the microscope with a one-sixth power lens, usually an abundance of cholesterol crystals (fig. 244) can be seen. In this way a branchial cyst can be differentiated from a tuberculous collar stud abscess (see p. 199). It should be noted that from time to time these cysts are wont to become inflamed, which heightens their similarity to an abscess. In spite of this, the confirmatory test just described is always positive unless the contents of the cyst has been aspirated recently.

FIG. 243. — Typical branchial cyst.

FIG. 244.— Branchial fluid. Note the abundance of cholesterol crystals (rectangular, with a notch at one corner).