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QUINQUENNIUM OF MEDICINE AND SURGERY

BEING THE

FIRST SUPPLEMENTARY VOLUME TO
GREEN'S ENCYCLOPEDIA AND DICTIONARY
OF MEDICINE AND SURGERY

EDITED BY

J. W. BALLANTYNE, M.D., F.R.C.P.E.

Edinburgh
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1911

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FOR

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EDITORIAL NOTE

In accordance with the promise made in the tenth volume of *Green's Encyclopedia and Dictionary of Medicine and Surgery* the first supplementary volume to that work now makes its appearance. Five years have nearly passed since the first volume of the *Encyclopedia and Dictionary* issued from the press, so that the present instalment may be regarded as the first of a series of quinquennial surveys of the whole field of medical practice, setting forth the notable advances which have taken place, and forming a reliable guide to the new methods of treatment which have come into use, and which seem likely to remain as permanent additions to our resources for healing disease and for alleviating suffering.

The same plan of construction as was employed for the ten volumes of the *Encyclopedia and Dictionary* has been used here. The subject headings, which number 1254, group themselves in three categories. There are first the elaborate articles of more than 1000 words in length, of which there are 96; these deal with such subjects as Abdominal Section, Abortion, Accouchement Forcé, Acidosis, Anæsthesia, Antenatal Pathology, Aphasia, Arterial Hypertonus, Arteries (Suture of), Arterio-Sclerosis, Atmocausis, Bier's Method of Treatment, Bladder (Female), Blood, Blood-Pressure, Cæsarean Section, Caisson Disease, Cancer, Cerebro-Spinal Meningitis, Cervical Ribs, Chloroma, Chorea, Chorea Gravidarum, Constipation (Surgical Treatment of), Cranio-Cleido-Dysostosis, Dementia Præcox, Diabetes, Digestion, Digestive Functions (Tests), Drugs (Recent), Eclampsia, Ectopic Pregnancy, Embryotomy, Eugenics, Fractures, Gall Bladder and Bile Ducts (Diseases), Gonorrhœa (Treatment), Heart (Diseases), Heart (Surgery of), Heredity, Hyperchlorhydria, Hypnoidal State, Immunity, Infant Feeding, Infantile Atrophy, Infantilism, Intestines (Surgery of), Ionic Medication), Jaundice (Congenital), Kala-Azar, Kidneys (Surgery of), Labour (Induction), Labour (Management), Labour (Post-partum Hæmorrhage), Leukæmia, Lumbar Puncture, Lungs and Thorax (Surgery of), Menstruation, Menstruation (Morbid), Multiple Myeloma, Natality and Depopulation, etc., etc.

Even the reading over of the names of these articles will fasten the mind upon the directions in which the main currents of medical advance have been moving in these past five years, whilst the close study of them will do much to make the medical practitioner conversant with the latest and best means at his hand for the prosecution of his beneficent art.

A second group of articles, of less than 1000 words but of more than ten lines in length, contains references to many interesting, if less vitally important, matters. They number 193. Amongst these may be named Abiotrophy, Abrams's Heart Reflex, Achylia Gastrica, Acromegaly (Surgical Treatment), Adrenal Glands, Aggressins, Alcoholism (Quinquaud's Sign and Korsakoff's Psychosis), Allochiria, Altmann's Granules, Anæmia (Pernicious and Aplastic), Anaphylaxis, Anaplasia, Aneurism (Surgical Treatment), Antitryptic Index, Apraxia, Arterio-Venous Anastomosis, Babinski's Sign (No. 2), Bang System, Biotripsis, Blackwater Fever, Blastoma, Boy-Scout Movement, Brill's Disease, Broad Ligaments of the Uterus, Camptodactyly, Carcinoma Cutis, Cardiolysis, Cataphoresis, Cerebellum (Tumours), Christian Science, Chromatophores, Convulsions in Infancy, Curettage, Danyscz's Phenomenon, Degenerates (Sterilisation of), Diet (Purin Free), Diversion of Complement, Dupuytren's Contraction, Eclampsism, Elastoid Degeneration, Embryocardia, Emmanuel Movement, Endocarditis (Chronic Infective), Enterogenous Cyanosis, Ersatz Theory, Erythræmia, Faith Healing, Fibrolysin, Fröhlich's Syndrome, Fulguration, Funiculitis (Endemic), Gastric Ulcer, Gastrostaxis, "Gouttes de Lait," Graves's Disease, Grocco's Sign, Grouse Disease, Hæmoglobinuria (Paroxysmal), Hæmorenal Salt Index, Hæmostasis (Momburg's Method), Hay Fever, Herpes Zoster, Hirschsprung's Disease, Histoplasmosis, Hormones, Hylomas, Ilosvay Reagent, Inoscopy, Kangri Cancer, Karell Cure, Kataplasia, Labour (Forceps in), Lepidomas, Light-touch Palpation, Lipoids, Liver (Cirrhosis, Surgical Treatment), Lupus Erythematosus, Madelung's Disease, Malt Extracts, Meningism, etc., etc.

The rest of the rubrics (965 in number) stand over short articles of the nature of definitions, brief descriptions, and, in some cases, of cross references. Under the headings *Abadie's Sign*, *Abrin*, *Acariasis*, *Acconci's Method*, *Acetomorphine*, *Achilles Jerk*, *Acholuric Jaundice*, "*Acid Control*," *Acroteric*,

"*Acute Abdomen*," *Adams-Stokes's Disease*, *Addiment*, *Adenomyoma*, *Adrenalin*, *Adrenin*, *Aeropathy*, *Agglutinogens*, *Air Hunger*, *Alanin*, etc., the reader will find modern medical terms which are constantly being met with in the current literature of his subject, and he will be able, in many cases, to replace a vague notion of their meaning with a clear, concise, and correct conception, which cannot fail to aid him in his study of the weekly and monthly journals to which he has access.

It may be of interest if the number of articles—short, medium, and long—in this and in the previous volumes of the work be given here in a tabular form :—

Vol.	Scope.	Articles. Long.	Medium.	Short.	Total.
I.	Aac-Bra	75	65	834	974
II.	Bre-Ear	80	200	1,478	1,758
III.	Ear-Gum	60	102	935	1,097
IV.	Gum-Int	52	54	766	872
V.	Inu-Lum	47	69	792	908
VI.	Lum-Neph	48	82	1,098	1,228
VII.	Ner-Phy	57	75	1,190	1,322
VIII.	Phy-Rhi	58	60	919	1,037
IX.	Rhi-The	68	107	1,413	1,588
X.	Thi-Zym	64	54	941	1,059
Supplementary Vol. I.	Aba-Zym	96	193	965	1,254
	Totals .	705	1061	11,331	13,097

As in previous volumes of the *Encyclopedia and Dictionary*, the articles have been written by specialists in the various departments of medicine, and the more purely dictionarial part of the work has been under editorial supervision.

Some illustrations may be given of the way in which this supplementary volume may be turned to the best account. Let us suppose that the reader comes across the expression "*infundibular extract*" in his professional reading ; he refers to the fourth volume of the *Encyclopedia and Dictionary*, but finds no such heading there, for the sufficient reason that the term is younger than the volume ; but now, if he will turn up his supplementary volume, he will discover the name at once, and will be referred to *Pituitary Gland*, where he will find an account of the action of extracts of that gland (part of which is called the infundibulum, a fact which at once explains the above term) and an indication of the diseases in which they are believed to act beneficially. Again, he may hear a brother practitioner praising or discounting the action of some new remedy or proprietary preparation ; if he does not find it in its alphabetical place in the first ten volumes, he will in all probability discover it in the supplementary volume, along with such references as will enable him to form an estimate of the opinions which have been expressed regarding its value. Again, he may be listening to an article on some novel aspect of medicine which is being read before a medical or surgical society, or he may be attending post-graduate lectures ; if some years have elapsed since he took his medical qualification, he will probably find terms in constant use which are unknown to him, and indeed may feel almost as if he were listening to a new language (*e.g.* in the matter of *immunity* and its theories) ; here, again, this quinquennial volume will facilitate his progress and help him to keep abreast with the times or regain lost ground. Yet again, the reader may wish to have the latest knowledge regarding therapeutic methods and operative procedures so that his conscience may rest satisfied that he is discharging his full duty to his patients ; at the same time he does not wish to run after every new plan, knowing well that in this way much time may be lost and many fair hopes cherished only to be blighted ; in this work he will find the opinion of specialists provided in order to remove him at least one stage further off the chance of failure and disappointment.

It is believed that the numerous illustrations will elucidate, and even in some cases supplement, the text, especially in connection with the details of novel operative procedures.

J. W. BALLANTYNE,
Editor.

19 Rothesay Terrace,
Edinburgh, *May* 1911.

Abadie's Sign.—A phenomenon noticed in exophthalmic goitre, and consisting of spasm of the levator palpebræ superioris muscle.

Abattoirs.—Steady progress is being made in the hygiene of the slaughter-house, and in many places the methods employed are beyond reproach. The plan of killing bullocks by stunning them with a blow from a pole-axe has been criticised, but when it is done by an expert (as is always the case in large abattoirs), and when followed immediately by cutting the throat, the suffering of the animal is very little. Pigs are slaughtered by having their throats cut, and they ought to undergo an ante-mortem as well as a post-mortem examination before they are passed for food; in the former any external mischief can be detected, and the animal kept back for separate slaughtering, while by the latter (carried out immediately after the bristles have been removed) signs of tuberculosis or other disease are carefully looked for, and the carcasses are either passed, condemned, or held back for further examination. All the by-products in cattle slaughtering are now made use of: the blood is turned into a fertilising agent; the fat is used for butter and lard substitutes; the oil from the fat is utilised in making oleo-margarine; buttons are manufactured from the white hoofs and glue from the sinews; the intestines are turned into sausage skins; the bones are ground down into bone-meal, etc. The abattoirs and meat-packing houses of Toronto, which seem to be admirably managed, are interestingly described in the *Lancet* (vol. i. for 1910, pp. 331-333); a new abattoir at Sampierdarina is described by Giovanni (*Igiene mod.*, i. p. 127, 1908); Guérin and Rolants have written of rural abattoirs (*Rev. d'hyg.*, xxx. p. 942, 1908); Hoth and Hengst have dealt with different methods of slaughtering and with the Leipzig abattoir (*Zeitschr. f. Fleisch- u. Milch-hyg.*, xix. pp. 157, 163, 1909); and articles treating of different aspects of the matter have appeared in *Hyg. de la viande* (1909, iii. pp. 224, 230) and in the *Lancet* (vol. i. for 1909, pp. 793, 868).

Abdominal Section.

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ADHESIONS 5
SPECIAL TECHNIQUE 5
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AFTER-TREATMENT 7
COMPLICATIONS 9

See also CÆSAREAN SECTION; SURGERY, ASEPSIS IN; UTERUS, TUMOURS OF.

WHILST many of the details of an abdominal section (celiotomy or laparotomy) differ in no whit from those of any other surgical procedure (*see* SURGERY, ASEPSIS IN), there are some which can be most conveniently studied apart. In no department of surgery has there been more rapid progress and more brilliant success than in abdominal work; the initial advances were made by the gynæcologist in his operations upon cystic ovaries and diseased conditions of the Fallopian tubes, but the general surgeon has carried the work on into the sphere of the liver, stomach, intestine, spleen, kidney, ureter, bladder, prostate, and pancreas with marked success.

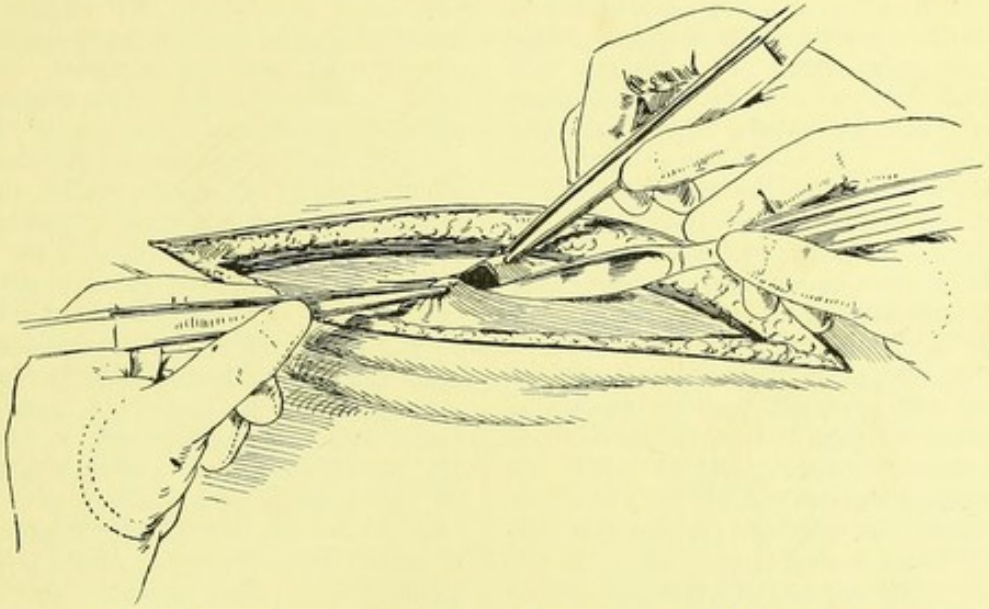
PREPARATORY EXAMINATION AND TREATMENT.—There are cases in which the abdomen must be opened at once (*e.g.* twisting of the pedicle of an ovarian cyst, ruptured gastric ulcer or ectopic pregnancy, perforated appendix vermiformis), when of course no preparatory treatment is possible, when even the preparation of the patient for the operation itself must be hurried; but in most cases of celiotomy there is abundant time to make every needful preparation and to take every possible preliminary precaution. At the same time lengthy preparation is to be avoided

in most instances, and especially in nervous women and men whose dread of operation may cause them real suffering if unduly prolonged; under these circumstances the patient may be seen one day and operated upon the next, but as a rule forty-eight hours' preparation is advisable.

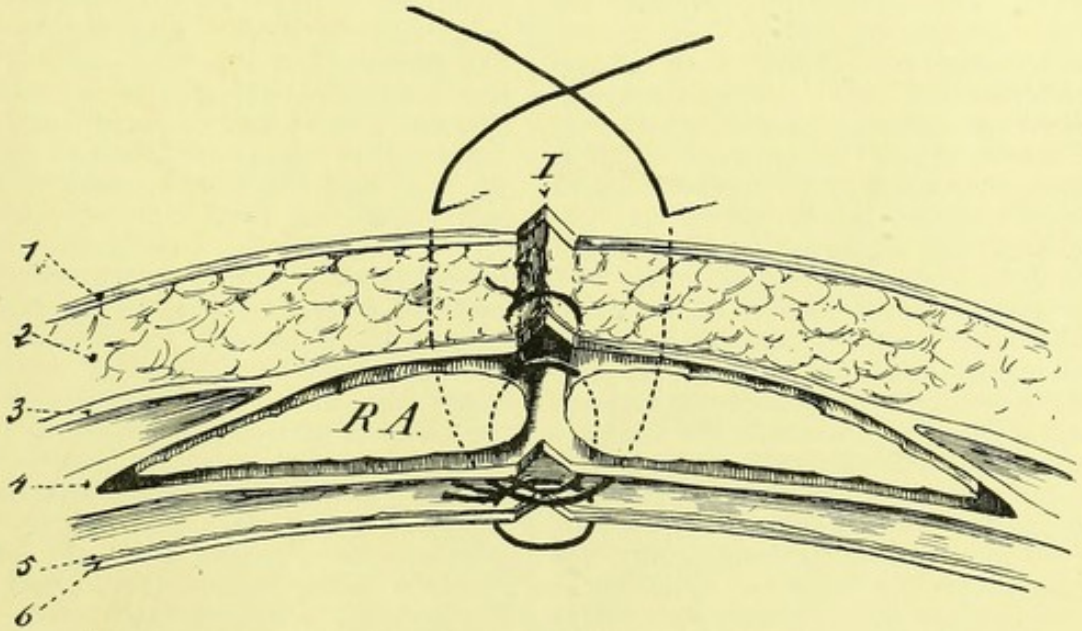
The *heart* and *lungs* ought to be carefully examined, for the presence of cardiac or pulmonary lesions will modify to some extent the after-treatment and the prognosis, and will influence the choice of the anæsthetic. Valvular heart lesions, if unaccompanied by the symptoms and signs of want of compensation (cough, dyspnœa, œdema), need not increase the dangers of a celiotomy; but the signs of cardiac dilatation, with indications of fatty degeneration of the organ, will give the operator concern. Acute bronchitis or pneumonia call for a postponement of all operations save those of extreme urgency, and even the more chronic inflammatory maladies indicate waiting till a quiescent state has been reached; in both circumstances chloroform is to be preferred to ether on account of the irritating effect which the latter has on the bronchial and pulmonary mucous membrane. Careful examination of the *blood* before operation is not yet widely employed, but its value in some cases is very great, and it is likely to be more and more utilised; it will include the counting of the red and white cells, the estimation of the hæmoglobin percentage, and it may include the discovery of the rapidity of coagulation, and the detection of bacteria. Anæmia will always increase the risks of operation, and if well marked will call for preparatory medicinal and dietetic treatment; but there are instances, *e.g.* bleeding uterine fibroids, where the indication for operation is also the immediate cause of the anæmia, and in them it may be necessary to operate at once and take the risks, although sometimes local treatment of the hæmorrhages may be temporarily successful, and then, of course, some delay may be allowed for this purpose. If the hæmoglobin percentage fall below 40 per cent., and certainly if it is below 30 per cent., operation should be delayed till it can be raised, although even under these circumstances the general condition of the patient will have to be taken into account. Leucocytosis is of value in the diagnosis of many intra-abdominal morbid states (*e.g.* abscess, especially if there be also a positive iodine reaction), and its presence may be an encouragement to operate in cases, for instance, of peritonitis, whereas the existence of the opposite state (leucopenia) would point to a condition so grave as to be almost hopeless. The rapidity of coagulation of the blood need not often be tested before operation, but if there exist the suspicion of hæmophilia, or if there be purpuric signs, it ought to be carried out, and surgical interference delayed till it can be increased. The detection of bacteria in the blood (*e.g.* streptococci, staphylococci, etc.) is of more value from the diagnostic standpoint than for the purpose of deciding the advisability of operating or not. The examination of the *kidneys* (by testing the urine) should never be omitted before surgical procedures in the abdomen, and some operators demand that this shall be done on two or more separate occasions, for the presence of nephritis or of diabetes is a very serious complication. The total amount of the urine with its specific gravity should be ascertained, and the presence or absence of albumen, sugar, casts, blood, pus, and sediment; the percentage of urea is important in some cases, and the presence of indican points to toxic absorption from the bowel. It goes without saying that if the operation be on the kidney the examination should be very thorough, and the surgeon should make certain that the other kidney is present and is functionally active. The presence of diabetes or of nephritis is not necessarily a contra-indication to operation, but in the former one has to bear in mind the risk of diabetic coma following upon the shock of the surgical procedure, and in the case of the latter there ought to be more prolonged and thorough pre-operative preparation, and chilling during operation should be specially guarded against. In some instances the morbid state of the kidney may be due to the state for which the operation is being performed (*e.g.* hysterectomy for uterine fibroids which press on the kidneys or ureters); then the surgeon's knife will remove the cause of the renal disease.

The preparation of the *operation area* is considered elsewhere (*vide* SURGERY, ASEPSIS); but with regard to abdominal section in particular, the iodine method has introduced a welcome simplification in technique, for it is rapid and easy, and it shows to the eye the extent of the sterilised area, it obviates active scrubbing and forcible manipulation in such cases as suspected rupture of the intestine or of an ectopic pregnancy, and it need not be done long before the operation. The iodine method has the disadvantage of setting up inflammatory reaction in the skin of some specially predisposed patients, but this is almost the only objection that can be made to it. The umbilical scar is a great source of danger in laparotomy, and ought to be very thoroughly treated before as well as at the time of operation.

Another very important part of the preparatory treatment of an abdominal section patient is the thorough *emptying of the bowel* and the *regulation of the diet*. So many abdominal disorders are accompanied by obstinate constipation that it is essential to clear out the alimentary canal. Castor-oil, a large dose, should be given on the day before, so that it shall act thoroughly twelve hours before the time fixed for the operation, and on



Method of incising the peritoneum so as to avoid wounding the intestine.



Cross section of abdominal wall showing one way of closure of wound after a Median incision.

I. Incision.

1. Skin.
2. Fat.
3. Aponeurosis of external oblique.

R.A. Rectus abdominus.

4. Aponeurosis of internal muscles.
5. Connective tissue.
6. Transversalis fascia and peritoneum.

the following morning a large enema (*e.g.* of salt solution) should be administered. Some operators prefer calomel (2 or 3 grains in divided doses), followed by a saline purgative (*e.g.* Epsom salts). The chief point is that the bowels shall have been thoroughly emptied some hours before operation, and that their action shall have ceased at the time when the surgeon arrives. The diet should be of the kind given to an invalid for two or three days prior to operation; for twenty-four hours he should have nothing save liquid food, and breakfast should be at least three hours before operation, and should consist of a cup of tea and some toast, or of a bowl of meat soup.

The patient should rest in bed for a day or two so as to accustom himself to invalid ways (use of bed-pan, etc.) and to encourage the regular action of the skin, and for this latter object he should take two or three baths. If he be in feeble health a longer time may be required, during which he may be fed up, may receive massage, and may take such tonics as tincture of nux vomica, iron, and possibly digitalis.

Immediately before the operation the patient empties the bladder. After he has taken his place on the operating table the administration of the anæsthetic is begun, and the final sterilisation of the abdomen is carried out; this should include the back if operation on the kidneys is contemplated, and the lower part of the thorax if the liver or stomach is to be operated upon, but, as has been pointed out by Treves and Hutchinson (*op. cit.*, i. p. 74), there is no need in every case to shave and prepare the skin "from the nipples to the knees." It is important that the patient's body (the part of it not within the operation area) be warmly clad during the operation.

The Instruments.—Many of the abdominal operations require special instruments, but those enumerated here are common to all cases of laparotomy. There will be two or three knives, one of which should be curved and probe-pointed; two pairs of dissecting forceps; two pairs of scissors (curved and flat); numerous small pressure forceps (ten to twenty pairs); three or four pairs of large pressure forceps; abdominal retractors, simple or self-retaining, two at least; needle-holders (easily worked); needles, curved and straight; ligatures and sutures (catgut, silkworm gut, silk, perhaps kangaroo tendon); swabs or sponges (a definite number), and sponge-holders. These are all placed on a tray or trays on the instrument table, which is in immediate proximity to the operator (usually behind him), and may be in charge of an instrument clerk; near him also will be basins containing sterile water and an antiseptic solution for hand-cleansing during the operation. The anæsthetist's armamentarium (mask, tongue forceps, hypodermic syringe, anæsthetics, etc.) will be near him (as he sits at the head of the operating table) on a small table or stool. What has been called the supply table is usually in charge of a nurse or sister, and on it will be found the dressings, antiseptics, jars of sterile water, brushes, towels, and exceptionally used apparatus such as cautery, saline solution jar, cannula and tubing, catheters, extra gloves sterilised in bag, and medicines.

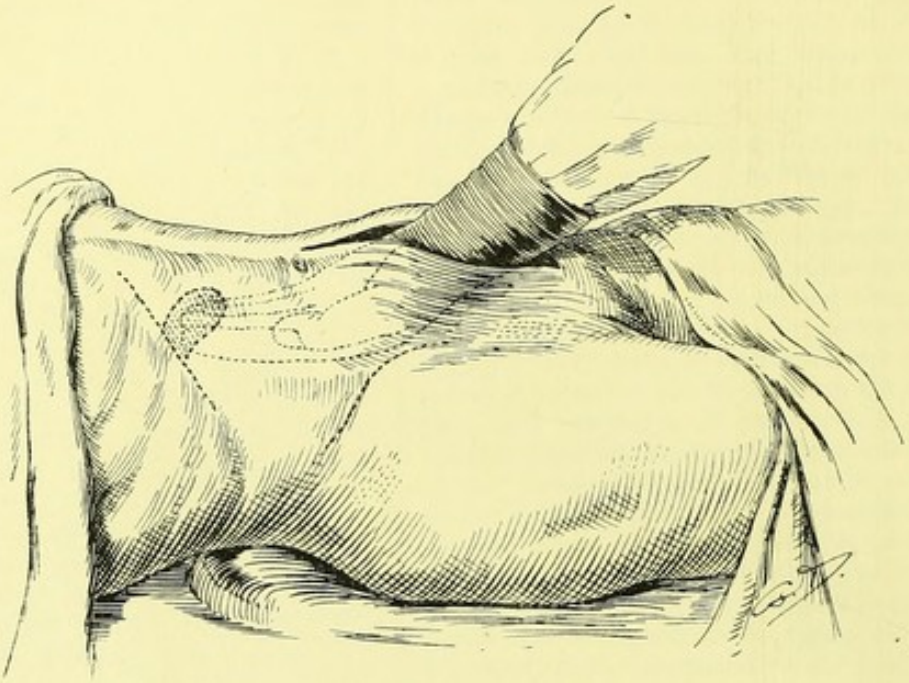
The Incision.—When the patient is put on the operating table (a narrow one, known and tested immediately before for conversion into Trendelenburg posture, etc.) a blanket should be wrapped round his lower limbs, and this should be carefully covered by a mackintosh; his upper limbs should be protected by a flannel jacket or another blanket and mackintosh; the abdominal area should be surrounded on all sides by dry sterilised towels so that nowhere shall the blankets or mackintosh come within touch of the operator's hands or instruments. The patient's arms should be kept out of the way and fixed at the wrists by bandages passed under the table. The sterile gauze pad covering the abdomen must now be removed and the skin finally cleansed.

The operator, having ascertained that the patient is fully under the anæsthetic, and having steadied the tissues of the abdominal wall with his left hand, makes a clean cut with the knife held in his right hand. The usual incision is a median vertical one, and it is usually made between the umbilicus and the symphysis pubis. The first cut should go through the skin and subcutaneous tissue down to the aponeurosis. As there is much difference in the amount of fat in the anterior abdominal wall, an attempt should be made to gauge it beforehand by picking up a fold of the parietes between the fingers and thumb. Any bleeding points should be accurately caught up by catch forceps, which can be left on for a little time. Keeping carefully to the middle line the operator cuts through the recti muscles in their sheaths; no time need be wasted trying to find the linea alba, but if the tissues of the abdominal wall be much stretched it will be possible to make the incision between the recti and without opening their sheaths; the handle of the knife may be used to separate the fibres of the recti muscles. The transversalis fascia is now reached and must be divided, as must also the subperitoneal or (better) preperitoneal fat behind it; folds of the fat should be picked up with the dissecting forceps and cut through so as to avoid premature division of the peritoneum itself, and it is important not to mistake the fascia for peritoneum and the fat for omentum. Having cut through the above-named structures, the operator must be prepared to find the peritoneum; he and his assistant should pick up a fold of the membrane

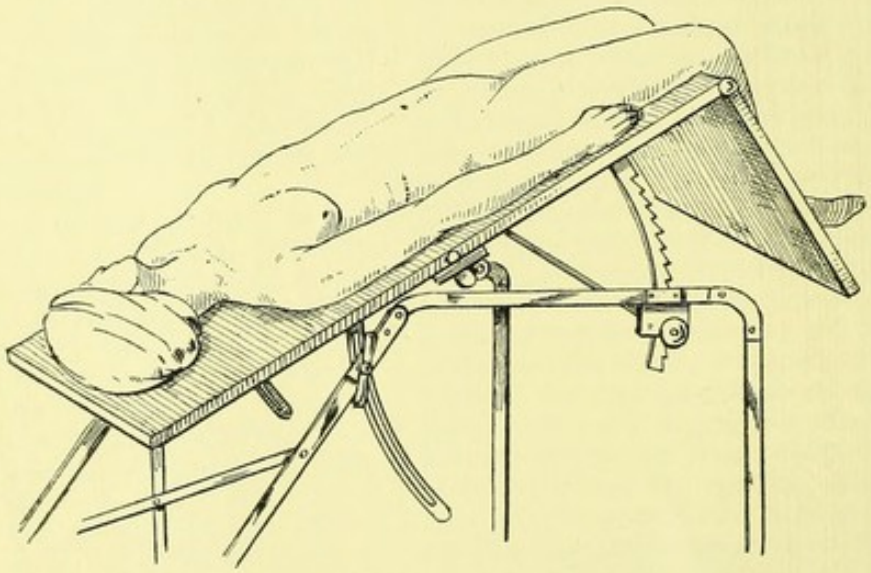
with two pairs of catch forceps so as to isolate and elevate it from the underlying bowel or tumour, the raised fold is then to be carefully cut through. As soon as a small opening is made the abdominal contents will fall back from it, and the operator will now introduce two fingers into the cavity and enlarge the peritoneal incision to the same length as that of the skin one, using a pair of probe-pointed scissors or a bistoury, guided and protected by his two fingers introduced first towards the upper and then towards the lower end of the incision. The catch forceps should be left attached to the edges of the peritoneum, as that membrane may retract; and some surgeons take the precaution, at the end of the operation, of excising the small pieces of the peritoneum which have been caught in the bite of the forceps, believing that their vitality is dangerously lessened. In some cases there is real difficulty in incising the peritoneum without wounding the underlying structures; these are usually instances of adhesions between the intestines or other organ or tumour and the abdominal wall, or of upward displacement of the bladder, but the knowledge of the possibility of such difficulties is the surgeon's best safeguard. It is a good rule before cutting through a piece of membrane regarded as peritoneum to lift it up and roll it between the finger and thumb in order to demonstrate its freedom from underlying structures. In cases of wide adhesion of an ovarian cyst to the abdominal wall the operator may, notwithstanding all his precautions, find himself in the tumour cavity before he expects, and this is very likely to occur with retroperitoneal growths in which the peritoneum of the posterior abdominal wall has been pushed forward into apposition with that of the anterior wall; careful exploration with the hand introduced into the cavity will reveal the state of matters.

But the median vertical incision is not always that of choice. In order to avoid the presence of an evident scar on the skin of the abdomen *Küstner* introduced the *transverse incision* which is known by his name. This is a semilunar incision (with its concavity looking upwards) made through the skin and subcutaneous fat above the symphysis pubis. The upper flap is dissected and turned upwards, and then the aponeurosis, the rectus muscle and sheath, and the peritoneum are incised vertically in the usual way. It is claimed as the chief advantage of this incision that the scar is hidden by the natural folds of the skin (in fat individuals at least there is a fold just above the symphysis) and by the growth of the pubic hair, but it gives less room for manipulation, and is more prone to infection (from its proximity to the genital organs and the adjoining skin) than the vertical one. It is doubtful whether its advantages (which are purely cosmetic) outweigh these disadvantages, and it is questionable whether the *Pfannenstiel incision* is much better. The last-named incision is made at a higher level in the anterior abdominal wall than the Küstner, and runs more directly transverse from side to side between the outer borders of the recti and divides the skin, fat, and aponeurosis; the remaining structures are cut through vertically. There possibly is less risk of resulting ventral hernia after the Pfannenstiel incision, but it is not suitable in the case of fibroid tumours of the uterus and other solid growths. In *Mackenrodt's incision*, also a transverse (semilunar) one, none of the tissues of the abdominal wall is divided vertically; of course the after-suturing of the divided muscles and peritoneum must be very carefully done if hernia is not to result; certainly it gives plenty of room for manipulation, and has been, in consequence, specially recommended in the radical operation for cancer of the uterus. Perhaps one is not justified in finally deciding in favour of the median vertical as against the transverse incision, or *vice versâ;* but whilst transverse incisions give more room for exploration and treatment, especially of pelvic disorders, whilst they give, according to Maylard (*Brit. Med. Journ.*, ii. for 1907, pp. 895-901) and others, more secure cicatrices, the vertical ones involve the division of fewer blood-vessels and can be closed more easily and rapidly (by through-and-through sutures if time presses).

In addition to what has been already said about the incision it may be pointed out that for special operations *special incisions* have been recommended. Thus, for removal of the appendix vermiformis a lateral incision is in vogue. This may be made in the linea semilunaris at or rather just within the outer border of the right rectus muscle and just below the level of the umbilicus; the centre of this incision will be a line joining the umbilicus and the right anterior superior iliac spine. If sutured in layers Noble (Kelly and Noble's *Gynecology*, i. pp. 524-526) claims that the resulting cicatrix is strong and does not develop a hernia. M'Burney's incision is a little further out and a little lower down than the above; it is made parallel to the fibres of the external oblique muscle, which are split and not cut, as are also the fibres of the internal oblique and transversalis; but the line of separation of the internal oblique and the transversalis, and of the incision in its fascia and the peritoneum, is almost at right angles to the incision in the skin and external oblique, *i.e.* it is nearly transverse. This incision is about 1 inch internal to the right anterior superior iliac spine, and is usually about 4 inches in length; it also gives a firm cicatrix. For disease of the gall-bladder a vertical incision in the right linea semilunaris or in the substance of the rectus muscle is usually preferred; it is about 3 inches in length, and the guide to



Exploring the gall bladder through an abdominal incision.



Trendelenburg position for pelvic and abdominal operations.

its exact position is found in the tumour, which can be felt, or in the anatomical situation of the fundus of the gall-bladder; and Treves and Hutchinson (*op. cit.*, i. p. 149) recommend the making of two small transverse cuts at the upper and lower end of the incision (the upper one passing inwards and the lower one outwards) so as to make the incision sigmoid in shape. For gastrostomy an incision running obliquely downwards and outwards and ending just within the left linea semilunaris is advised; it is parallel to and about 1 inch distant from the margin of the left costal cartilages; its centre will correspond to a point a little less than an inch below the margin of the liver (left lobe), and it should not be much more than 2 inches in length. The incision for the radical cure of inguinal hernia is made parallel to and above Poupart's ligament on the affected side, the aponeurosis of the external oblique is exposed and incised (usually from one inguinal ring to the other), and the superficial epigastric artery and vein secured (with catch forceps); the holding apart of the edges of the incision and some dissection will reveal the cord and the sac of the hernia.

In exceptional cases the abdomen is opened by two incisions, a median vertical one and one over the affected organ. Thus in cases of disease of the gall-bladder Kelly has advised the opening the abdomen in the middle line, the introduction of the left hand and its passage upwards to the neighbourhood of the gall-bladder, and the making of an incision over that organ by the knife held in the right hand and with the left acting as a guide and protection. This is a method of procedure which may be employed in other instances and which ought perhaps to be more often used.

The Exploration of the Abdominal Cavity.—The next step in most celiotomies is to pass the hand (gloved or ungloved, according to the surgeon's practice) into the peritoneal cavity and explore it. However accurate may be the opinion formed by the operator before opening the abdomen, it is capable of revision when a hand is actually inside, and it may perhaps be said with confidence that surprises are the rule rather than the exception. Thus such an examination with the intra-abdominal hand may reveal cancer of the liver as well as of the stomach, stone in the gall-bladder accompanying intestinal disease, a pedunculated fibroid of the uterus where solid tumour of the ovary had been expected, the presence of both ovaries (with dermoid cysts in them) packed one on the top of the other in the pouch of Douglas, the absence of the other kidney in cases of renal displacement and malformation, pyosalpinx when inflamed appendix had been diagnosed, etc. Another matter which such a manual exploration will disclose is the presence or absence of ADHESIONS between the affected organ and its neighbouring structures. If these be recent they will usually also be easy of separation (*e.g.* in localised peritonitis of short duration): the simple passage of the hand between the adherent parts may be sufficient, or they may be sponged apart by means of a sterile swab or sponge; of course if one is working deep down in the pelvis it will be wise to put the patient in the Trendelenburg posture and guide one's manipulations by sight, the edges of the wound being held apart by the retractors. Any hæmorrhage will usually be checked by the continuous pressure of a swab, but a surface which persistently bleeds may require to be sewn over or sewn in ("sequestrated"). Chronic adhesions which are commonly fibrous and not spidery in their nature require greater care and may need other methods of separation, especially when they exist between the affected organ and the bowel. Sometimes they may be safely separated with the fingers or cut through with scissors, but care has to be taken that one does not injure the peritoneal or even the muscular coat of the intestine in so doing. If they are to any degree vascular they will need to be ligatured, and this is specially necessary in connection with omental adhesions—then the adhesion may be in one mass if small, or in sections if large, or, better still, the individual vessels may be secured. It is not bad practice to leave even considerable portions of adhesions attached to the bowel—indeed it may be much safer than prolonged attempts at separation. In a few instances an inflamed ovary may be so embedded amongst pelvic adhesions as to be altogether incapable of separation, unless the operator is prepared to deal with a large rent in the rectum. Where the adhesion is firm and affects the intestinal coils, binding them to the tumour, it will be wise always to approach it through the tumour, getting under the peritoneum. Then in the case of a parovarian cyst it will be advisable to tap the cyst first and then with the hand inside the collapsed cyst to strip off the capsule of that tumour, leaving the peritoneal investment at the point of adhesion untouched (enucleating the growth in fact by the subperitoneal route). The same plan may have to be adopted with adherent fibroid tumours of the uterus. The ligature material will be strong catgut or fine silk.

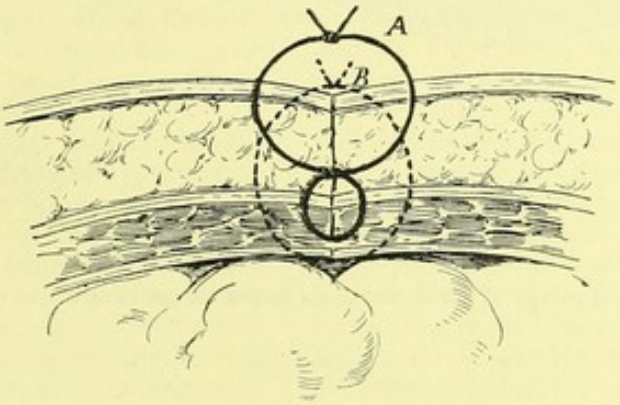
Special Technique.—The next step in the celiotomy will depend upon the morbid state for which the operation has been undertaken, and the organ affected. It may turn out that nothing more than exploration is possible (as in some cases of advanced malignant disease), or it may end, and end happily, in simple removal of the fluid contents of the peritoneal sac (as in tuberculosis of the peritoneum); then the closing of the abdominal wound follows almost immediately upon its opening. In other cases more

or less complicated procedures occupying a longer or a shorter time are undertaken by the laparotomist, and the special technique may be that of an appendicectomy, a cholecystotomy, a gastrotomy, a gastrectomy, a gastropexy, a pyloroplasty, a gastro-enterostomy, an intestinal anastomosis, a colotomy or colostomy, an incision of the pancreas, a splenectomy, a suprapubic prostatectomy or lithotomy, an abdominal nephrectomy, a hysterectomy, an ovariotomy, a myomectomy, a hysteropexy, an Alexander-Adams operation, a salpingo-oophorectomy, or a Cæsarean section.

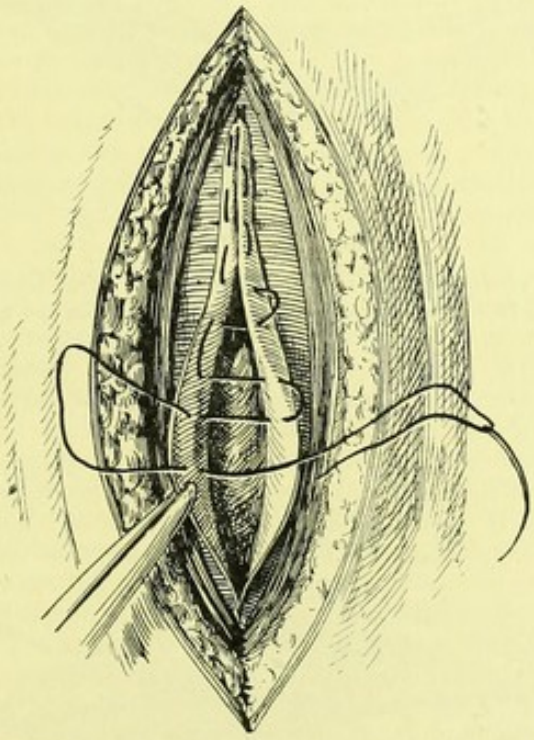
THE PERITONEAL TOILETTE.—It is doubtful whether the use of the words "peritoneal toilette" have not given too great an emphasis to the part of the technique of an abdominal section which is indicated by them. Certainly it is well to remove blood clot, cyst-fluid, shreds of tissue and the like from the peritoneal cavity before it is closed, but in non-septic cases it will be well not to spend much time and not to exercise too much vigour in the cleansing or clearing out of this serous sac, for under such circumstances the peritoneum will usually absorb any little quantity of fluid, etc., which may be left behind. Neither continued swabbing with pledgets or sponges nor prolonged irrigation are safe procedures. If, however, a septic focus has been opened during the operation (*e.g.* by the rupture of a pyosalpinx), or if purulent peritonitis exist, then time may be, should be, devoted to cleansing the peritoneal cavity, preferably by irrigation; but even here general flushing will not take the place of careful local management of the focus of mischief (perforated bowel or stomach, pus-tube, etc.), and the upper part of the abdominal cavity (the so-called "diaphragmatic area") with its greater sensitiveness should, if possible, be left alone. The *counting of instruments*, especially catch-forceps and needles, and of *swabs* and sponges is probably of far more importance than what is usually meant by the peritoneal toilette. Every swab or forceps used during the operation should be accounted for, and their number should be compared with the list (hung up on the wall or placed in some other conspicuous place); the fact that the best operators have occasionally left a pair of artery forceps or a pledget in the abdomen is no excuse for carelessness but an additional call for the most scrupulous care. Special notice should be taken of any swab or instrument used by the assistant during the operation (*e.g.* during unexpected hæmorrhage or other emergency), for it is more likely to be overlooked. The attaching of tapes to the swabs is a precaution of considerable value. Finally, if the operator closes the abdominal incision upon a large flat pledget or sponge he must never tie his sutures till he has removed it.

THE CLOSURE OF THE INCISION.—The incision may be closed by the "through-and-through" method of suturing, or it may be done layer by layer ("in tiers"). The former is perhaps to be preferred when the operation has been a long one, for it occupies far less time, but the resulting cicatrix is more apt to yield to hernial protrusions than when layer is accurately attached to layer in the tier method, and there is also some evidence that suppuration of the wound is more frequent. The "through-and-through" method is likewise indicated in the somewhat rare cases in which drainage is to be employed.

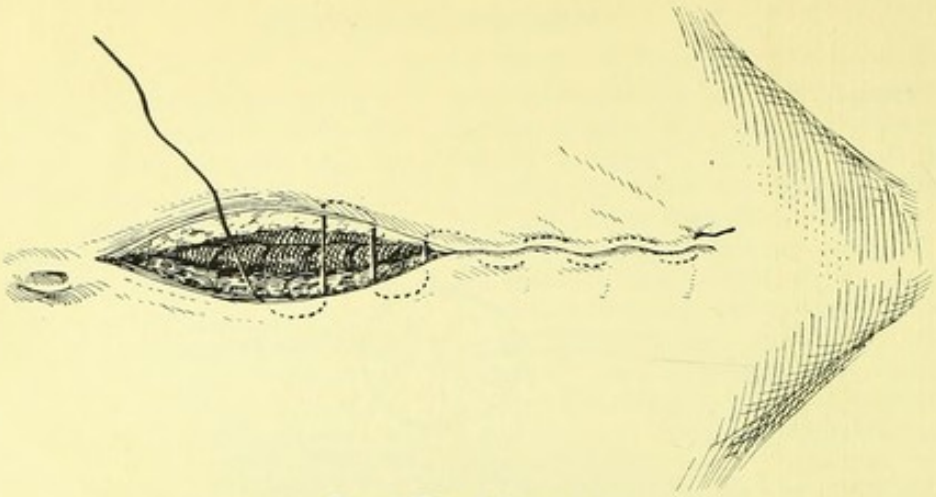
The technique of the "through-and-through" plan is as follows:—The suture material which is to be preferred is silkworm gut, silk being too prone to become infected. Curved needles applied by a needle-holder are usually employed, but in some operations (*e.g.* Cæsarean section) straight ones are better suited; as a rule the needle in the fixed handle is rather clumsy. The needles should be ready threaded so that no time may be lost. A large flat pledget or thin sponge is placed inside to protect the intestines during the suturing, and this must, of course, be removed before the sutures are tied. There are many kinds of needle-holders, but the best form is that which gives a secure hold of the needle and which releases the same when its handle is compressed; a special one may be needed if very fine needles are being used, but this want does not arise when the "through-and-through" method is the one chosen. Grasping the needle (carrying the silkworm gut suture) in his right hand, and picking up the margin of the lower end of the incision with the thumb and forefinger of his left, the operator introduces the first suture. If any of the tissues have retracted (as is often the case) it is well to draw them forward with a pair of dissecting forceps, and care must be taken that the peritoneal margins are brought together. The needle is introduced into the skin about a quarter of an inch from its cut edge and should be then directed outwards until it reaches the peritoneal fat of the wall, then it is turned inwards and made to traverse the peritoneum about a quarter of an inch from the peritoneal edge of the incision; it is next brought through with its suture and inserted in the opposite side of the wound in the reverse order (first through peritoneum, then through muscular and fascial layers), and finally brought out through the skin at about the same distance from the edge of the wound as that at which it entered. The suture is now held fast by a pair of catch-forceps, but is not tied until all the others have been passed. The operator works his way upward, passing the sutures at a distance of about a third of an inch from one another, taking care that no blood clot is included, and being accurate in introducing and bringing out the needle at the



Through-and-through sutures.
A. In figure eight. *B*. Simple.

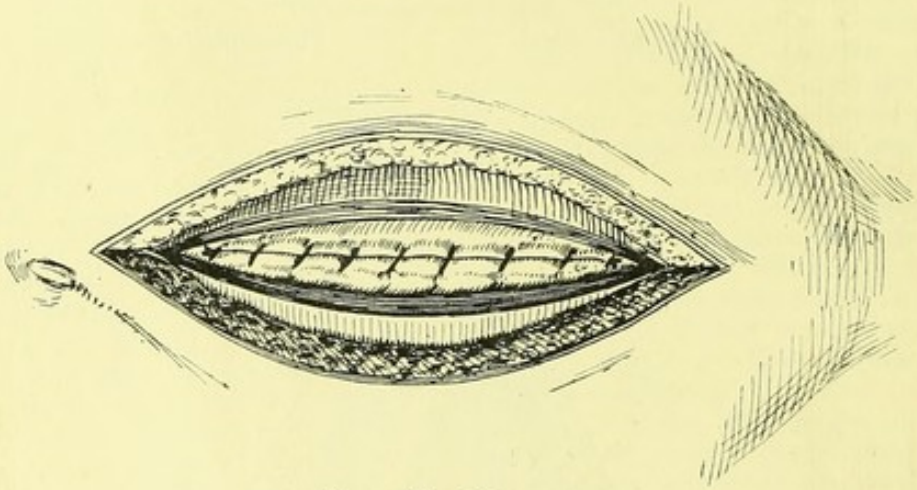


One way of suturing peritoneum as to produce an ectropion of the cut edges to avoid post-operative adhesions at the line of incision.



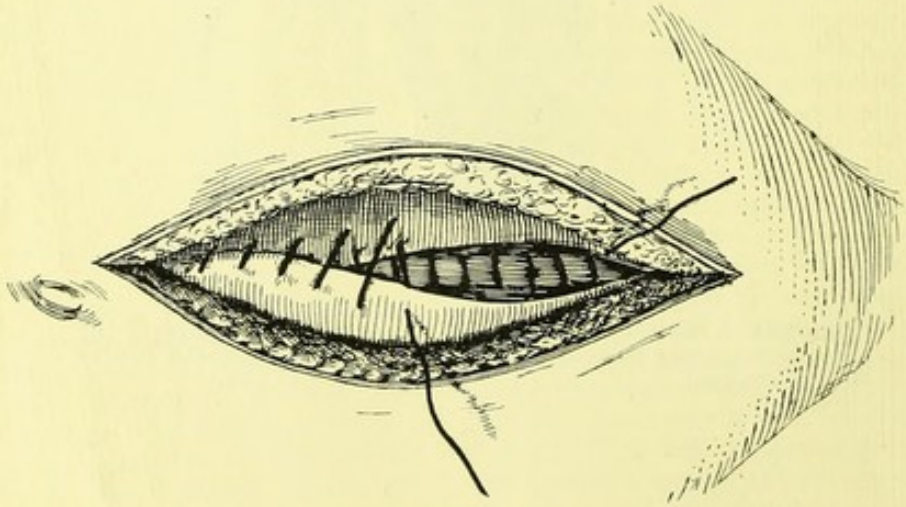
THE "TIER" SUTURE.

After the suture of the aponeurosis comes the sutracuticular suture.



THE "TIER" SUTURE.

Peritoneum closed with a continuous suture. The aponeurosis is detached from the fat and will be detached from the muscles.



THE "TIER" SUTURE.

The rectus muscle is sutured and the aponeurosis is being overlapped with a continuous suture.

same level. The gauze pledget or flat sponge is now withdrawn (with a pair of dissecting forceps), the sutures being relaxed to allow it to pass out easily; the omentum is drawn down so as to lie behind the incision, and the edges of the wound are swabbed clean; the sutures are tied from above downwards, and sufficiently tight to bring the different layers into exact opposition. They should be left in for from ten to fourteen days.

The "tier" plan of suturing may be done in various ways. Thus each layer (peritoneal, fascial, muscular, subcutaneous, and cutaneous) may be in turn dealt with, or, what is more usual, the peritoneum is first united by a continuous catgut suture and the remaining layers brought together by silkworm gut. The assistant operator with a pair of dissecting forceps holds in apposition the peritoneal margins at the lower end of the wound, and the operator transfixes them with a catgut suture in a curved needle held in a needle-holder or simply with his fingers. This first suture is knotted and fixed, and then the operator works his way upward, passing a continuous catgut suture through the peritoneal edges till the whole incision in the serous membrane has been closed; the second last stitch is not drawn quite tight, so as to leave the means of tying a knot. Then beginning at the top and working downwards the surgeon passes a second continuous catgut suture through the opposed edges of the recti muscles and aponeurotic layers; and finally he works his way up again, suturing the subcutaneous tissues, and so bringing together the skin edges with another buried suture. In introducing the last-named suture it is well to pass the catgut vertically upwards in the subdermal tissue on the one side of the wound, then cross it transversely over to the other side, where it is introduced at a slightly lower level and again run vertically upwards and crossed back again to the other side. In this way a very accurate approximation of the skin edges can be got. This method takes some time, and therefore many operators prefer to close the peritoneum and perhaps, also, the aponeurotic layer with a continuous catgut suture, and then to approximate the more superficial structures by interrupted silkworm sutures; the last-named sutures must, of course, be removed. Other surgeons have used one or two silver wire sutures or silver filigree to give stability to the scar—these are left buried in the tissues—but, on the whole, this method has not been widely employed.

The Dressing of the Wound.—The wound must now be covered with a dressing, and very various plans have been followed. There is a tendency to use more and more simple forms of dressing nowadays, especially if the practice of painting the whole incision, the sutures, and the surrounding skin with iodine be adopted. A few layers of sterilised gauze or of sublimate gauze, slightly moist, are then laid upon the wound; these are covered by a layer of sterile cotton-wool, and the whole dressing is held in position by strips of sticking plaster, or collodion may be painted on fixing the application to the wall, but the former is probably to be preferred. Over all the binder is applied, care being taken that its lower edge (which comes close to the symphysis pubis) should not ruck up and expose the lower end of the incision. In order to prevent this happening some operators pass (on each side) a strip of bandage attached to the lower edge of the binder between the patient's thighs and bring it round on the outside, fixing it with a safety-pin to the binder in the neighbourhood of the iliac crest. Some surgeons omit the binder and make use of strips of sticking plaster alone; these have the advantage of leaving the back and sides of the abdomen unswathed, and by cutting them on one side the dressing can be raised and the wound inspected easily.

The After-Treatment. — Considerable changes have of recent years been made in the after-treatment of abdominal sections. In Germany the principle of *early rising* has been introduced, and an attempt has been made to get patients on to their feet on the second, third, or fourth day instead of leaving them in bed for three weeks or thereby. Carl Hartog did much to introduce this innovation, although the idea came from Ries of Chicago (*Zentralbl. f. Gynäk.*, xxxii. p. 1529, 1908); H. Kümmell (*Arch. f. klin. Chir.*, lxxxvi. No. 2, 1908), F. Cohn (*Zentralbl. f. Gynäk.*, xxxii. p. 1233, 1908), and many others produced evidence in favour of allowing laparotomy patients to rise early. Cohn, for instance, allowed 13 out of 100 patients to rise on the first day, 16 on the second, 21 on the third, and 30 on the fourth day; there were three cases of thrombosis, but it was of a transitory nature. It was thought that the results were beneficial and that the moral effect on the patient was favourable. The danger of thrombosis and embolism following such early rising has been discussed by Zurhelle (*Zentralbl. f. Gynäk.*, xxxii. p. 1421, 1908), by Fromme (*ibid.*, xxxiii. p. 15, 1909), by Hofmeier (*ibid.*, p. 21, 1909), by Bidwell (*Practitioner*, lxxxii. p. 214, 1909), by F. Mendel (*Münch. med. Wochenschr.*, lvi. No. 42, 1910), and several others, and it would seem that the risk is not imaginary. Mendel (*loc. cit.*) even gives the name *thrombophilia* to the peculiar tendency towards thrombosis which some patients show—a sort of inverted hæmophilia—and it is not unreasonable to think that there will be increased danger of embolism if such patients are allowed to rise early; there is certainly no evidence that early rising after laparotomy prevents the formation of thrombi in a predisposed subject. Possibly Professor Schücking (*Zentralbl. f. Gynäk.*, xxxii. p. 1634, 1908) is on safer lines when he recommends gymnastic exercises in the horizontal position rather

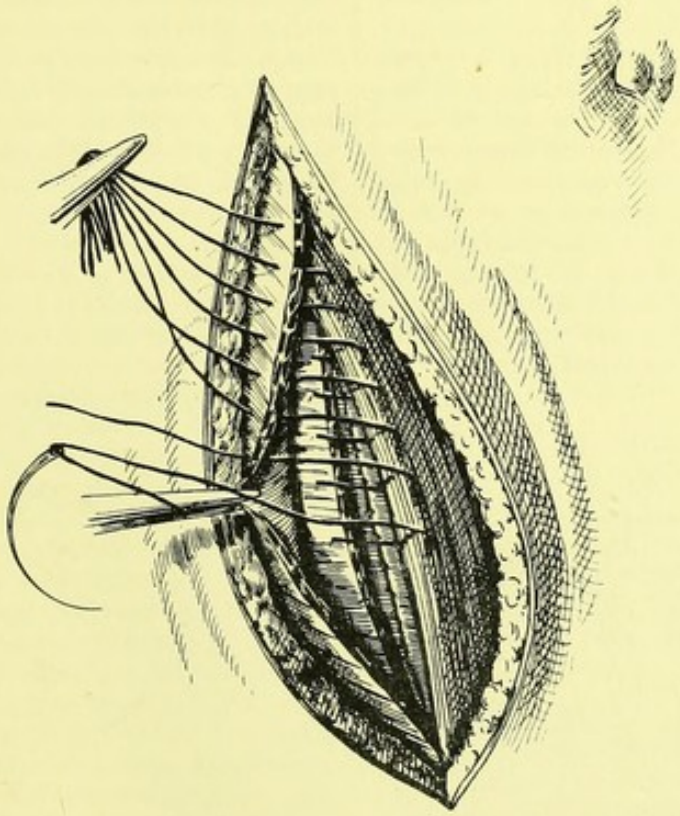
than resumption of the erect posture after abdominal section. The conventional rigid immobility was, no doubt, wrong in principle, and systematised movements without leaving the horizontal position give a means of preserving muscular tone and general health without the risk of thrombosis and embolism.

The *immediate* management after abdominal section is concerned with avoiding evil results from the anæsthetic and from shock. The patient, well wrapped in blankets and already partly conscious, is to be transferred to a bed prepared by having hot bottles in it. Too much care cannot be taken to prevent burns from these bottles, as such burns are easily inflicted during the semi-conscious weakened condition of the patient; they ought to be separated from him by the blanket, and a nurse ought to be in charge to see that he does not disturb them by his restlessness. The head is kept low. The nurse will also watch the respiration and pulse, and will be ready to support the abdominal wall with the hands if vomiting (from the anæsthetic) occur. Oxygen inhalation is often of benefit. Morphia is, as a rule, to be avoided, but the use of warm saline enemata (1 or 2 pints) is of great value in the state of post-operative shock, and many surgeons order such as a matter of routine. A stimulant (whisky or brandy) may be added to the saline, and strychnine may be given hypodermically. The enemata lessen the thirst and restore fluid to the circulation, and so they enable the patient to get through the first eight or nine hours without swallowing anything by the mouth. Certainly, the less given in this way the better. Ice is generally condemned, and the best thing will be hot water in small quantities (tablespoonful) every two hours; but, as has been said, low saline enemata (every six hours) will greatly lessen the need for putting anything into the stomach, and will thus prevent much of the distress of the post-operative sickness. The stage of reaction, indicated by the rising of the temperature from subnormal to normal, should be watched; it may be accompanied by free diaphoresis, rendering it necessary to change the patient's underclothing. The temperature is not likely to rise above 100° F. during the first twenty-four hours. An opportunity should be given, some eight or ten hours after operation, for the patient to pass his urine; the use of the catheter may be needed, but in most abdominal operations its employment is little called for.

During the *second twenty-four hours* in normal cases the temperature may be a little over the 100° (possibly 100·6° in the evening), with a tendency to fall to the normal. If vomiting should continue, the drinking of a quantity of warm water containing soda will relieve the patient by causing free vomiting, but if it be bilious in type and still continue, washing out the stomach with a stomach tube will often be beneficial, and may save the patient prolonged nausea. Vomiting and nausea which continue beyond the second twenty-four hours usually point to commencing peritonitis; in such cases the washing out of the stomach is to be done, followed by the administration (by the tube) of a saline cathartic (*e.g.* an ounce or two of magnesium sulphate). During the second day, if the nausea has stopped, the hot water by the mouth is continued, or a little hot tea may be given in its place; milk, as a rule, is to be avoided, as it increases flatulence, but meat juice will sometimes be very welcome. The pulse will be in most cases about 100 for the first two days, and ought to fall below that towards the close of the second day; if it remains quick thereafter, more especially with a rising temperature, there is danger. The patient's position should still (on the second twenty-four hours) be mainly dorsal, and may be entirely so unless he finds it irksome; but he may be turned on the side if it be thought desirable.

It is well to have the bowels thoroughly moved on the morning of *the third day;* some operators, indeed, employ an earlier catharsis, giving medicine (*e.g.* 2 grains of calomel, followed by fractional doses) twenty-four hours after the operation. At any rate, by the evening of the second day, or early in the morning of the third, the purgative should be administered. Many surgeons give magnesium sulphate (as Henry's solution) or citrate of magnesium, but the more old-fashioned plan of giving castor-oil should not be lightly abandoned, for it is often most satisfactory. In any case, the action of the purgative may be aided and made more complete by an enema (*e.g.* of turpentine). The passing of flatus on the second day and the thorough evacuation of the bowels on the third day are very good indications that the patient is doing well. The passage of flatus may be aided by the passage of a rectal tube of soft rubber, and the tube may be left in for a few minutes; this manœuvre will be specially valuable on the second day when distension is complained of. After the bowels have been well moved liquid food may be given more freely, and on the fourth day tea and toast, milk, beef-tea, and possibly some boiled fish may be given in such quantity as the patient desires. On this day, also, the bowels should be moved again, preferably with an enema, and, afterwards, a purgative may be given—one twenty-four hours, and an enema the next, so as to keep the intestinal functions going on smoothly. Eggs may be added to the dietary on the fifth or sixth day, and meat on the seventh or eighth.

The *wound* may be *inspected* about the sixth or seventh day, or earlier if pain in the incision or a rising temperature is noted; if through-and-through sutures have been used



One way of closing abdominal wound for Hernia by dovetailing rectus between the broad abdominal muscles.

they may be left in for ten or twelve days, unless any one of them is giving rise to irritation or inflammation, when it ought to be removed. If catgut sutures have been used throughout, and buried, they will not of course require to be removed; but if there are also surface ones they will come away with a little traction about the sixth or seventh day, leaving the buried part to be absorbed. The wound itself is best kept dry; and it is a good plan to paint with iodine when the stitches are removed. After these have been taken out the quantity of dressing material may be lessened, and it will be well to fix it by strips of adhesive plaster, which also serve to support the wound. An *abdominal belt* should be begun to be worn about the twenty-first day, and it should be continued for a year after the operation. It may not, doubtless it does not, prevent ventral hernia, but it serves to give strength to the abdominal wall in cases of sudden strain, and may also act as a sort of reminder to the patient that he or she has had a severe operation, and is not to take liberties too soon. The belt should be of light material, it should not be elastic; it should be carefully fitted to the figure, and it may be kept down for a time by thigh straps.

A great deal of the patient's comfort depends on the regular *cleansing of the skin* which the nurse gives. Regular washing of the face and hands and sponging of the body should be done; if the patient be a woman her hair will require to be combed and braided, and the vulvar and anal regions will require washing, and, possibly, vaginal douching may be beneficial. The question of early or late resumption of the erect posture has been already referred to, and, speaking generally, the twenty-first day is soon enough. During the first week no visitors should be allowed; after that time the patient may see one or two visitors a day for a few minutes, and, if everything goes well, in the third and fourth weeks more freedom may be allowed in this respect.

COMPLICATIONS of various kinds may occur during an abdominal section and during the post-operative period. Among the former (the *operative* complications) may be named injury of the bladder, intestine, tumour, etc., in opening the abdomen; these are to be avoided by remembering the anatomical relations of the bladder (especially in children and in patients with subperitoneal pelvic growths), and by noting whether the edges of the incision bleed much, and whether the preperitoneal fat is injected (indicating peritonitic adhesions). Other complications are vomiting (to be guarded against by having an experienced anæsthetist), bulging of the intestines through the wound (generally due to faulty anæsthetisation), hæmorrhage (due to the slipping of knots, the tearing of vascular adhesions, or the injury of viscera), and tears of the intestine (to be closed by the Lembert suture, or, in large losses of tissue, by intestinal anastomosis). The chief *post-operative* complications are shock (*see* SHOCK), persistent vomiting (best relieved by gastric lavage with carbonate of soda solution), abdominal distension due to intestinal atony (to be treated in different ways varying in severity from the administration of purgatives and the passage of the rectal tube to re-opening the abdomen to relieve intestinal kinks or adhesions), secondary hæmorrhage (requiring re-opening of the abdomen), general septic peritonitis (an almost hopeless complication), localised suppuration in the wound (stitch abscesses, calling for syringing with peroxide of hydrogen) or in the abdominal cavity (necessitating re-opening of the abdomen, or the incision and drainage of the abscess through the vaginal canal in women), suppression of urine indicating wounds or occlusion of the ureters (as by ligature or clamp, when, of course, the abdomen should be re-opened), or nephritis (calling for the special treatment of that morbid state), or the removal of what was the patient's only kidney or only functionating one, and femoral thrombosis (usually a late complication, calling for the treatment appropriate thereto). *See also* TETANUS.

LITERATURE.—MOYNIHAN, *Abdominal Operations*, 2nd ed., 1906.—KELLY and NOBLE, *Gynecology and Abdominal Surgery*, 2 vols., 1907.—TREVES and HUTCHINSON, *Operative Surgery*, 2 vols., 1909.—DEAVER and ASHHURST, *Surgery of the Upper Abdomen*, 1909.—GUINARD, *Affections chirurgicales de l'abdomen* (in LE DENTU and DELBET'S *Nouveau traité de chirurgie*, vol. xxiv., 1910).—CRANDON, *Surgical After-Treatment*, 1910.—MERCADE, *La période post-opératoire*, 1910.

Abiotrophy.—A term introduced by Gowers, with the meaning of premature exhaustion, degeneration and death of the tissues, *e.g.* of groups of nerve cells, not the result of any immediate irritant. The condition has been invoked to explain certain diseases of the nervous system, many of them hereditary, in which it may be supposed that some neurons become prematurely senile, the rest of the nervous system being apparently unaffected. By this theory Thomsen's disease and locomotor ataxia (of syphilitic origin) have been elucidated; abiotrophy has been used, also, to explain the effect of the X-rays upon the spermatozoa of the frog, which can still fertilise ova, but the larvæ produced from them die prematurely (Adami, *Pathology*, i. pp. 876-878, 1910).

Abortion.

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ETIOLOGY 12
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TREATMENT 14

FREQUENCY.—Since the beginning of the twentieth century there have been indications that abortions were occurring with greater frequency, at any rate among the civilised nations of the West. Indeed, this rise in the abortion-rate has formed one of the most disquieting features in the alarming phenomenon of race-suicide; and, taken in association with the falling birth-rate, threatens the supremacy of the present world-powers in the near future. The fact that it is impossible to get exact statistics of abortions (for there is no system of registration of miscarriages, and it is difficult to see how any such system could be devised and applied) hardly lessens the dismay with which one must regard the wastage of antenatal life which is taking place; the unknown is terrible to us. But, while there are no statistics *en masse* upon this subject, there have been indications which must be regarded as significant.

J. M. Doléris (*Ann. de gynéc. et d'obstet.*, Paris, 2 s. ii. pp. 206-224, 1905), for instance, has shown that in his own hospital (Maternité de l'hôpital Boucicaut) there was a marked increase in the number of abortions; in 1898 there were 43 abortions and 457 full-time labours, while in 1904 the number of abortions had increased to 130 and the full-time labours were only 497. Further, in 1898 there were 45 premature labours, and in 1904, 102. The abortions had trebled, the premature labours had more than doubled, and the full-time labours had shown only a slight increase. But Doléris discovered other facts still more disquieting. There was evidence obtained from more than 50 per cent. of the patients that the abortion had been artificially provoked, and in some cases a catheter, by means of which fluid could be injected into the uterus to induce the miscarriage, was got. These instruments, it may be remarked parenthetically, were known and asked for as "canules anglaises;" and the herbalist who sold them stated to Doléris's agent that her fee for instruction in the mode of using them was 25 francs. Whilst none of the facts elicited by Doléris were new—for such methods of inducing abortion have long been known and practised—the novelty consisted in the freedom and openness with which their employment was carried out. The physician of the hôpital Boucicaut carried his research still further, and obtained statistics of abortions from ten other institutions (Port-Royal, Baudelocque, Tarnier, Hôtel-Dieu, Pitié, Charité, Lariboisière, etc.) for the same term of years (1898-1904) as in his own Maternity. The figures for some years and in some cases were incomplete; but even if this incompleteness be admitted, they nevertheless showed an alarming percentage increase in the number of miscarriages in most of the hospitals named. The increase was least marked in the hospitals which did not, on account of rules, small number of beds, etc., admit miscarriages freely, while in five hospitals (Tenon, Beaujon, Lariboisière, Saint-Antoine, and Boucicaut) it was most pronounced. The percentage in the Tenon and Saint-Antoine had trebled in the seven years (from 5 per cent. to 15 per cent., and from 6 per cent. to 18 per cent.), it had more than doubled in the Maternité de Boucicaut (from 7·8 per cent. to 17·7 per cent.), and it had nearly doubled for the Lariboisière and the Beaujon. Adding to these hospitals the Charité, Doléris obtained the following figures:—in 1898 there were 376 abortions (5·6 per cent.), and in 1904, 1341 abortions (16 per cent.). Another disquieting fact was the increase in premature labours during the same period of seven years. To put the matter very plainly, the abortions and premature labours had steadily and largely increased, whilst the full-time labours had remained stationary, had increased only slightly, or had actually decreased.

Doléris is inclined to give to Neo-Malthusianism a large place in the etiology of these cases of abortion. In the public mind the difference between using means to prevent the occurrence of pregnancy and to bring about the early termination of an existing gestation has been obscured, while the desire to limit families to two children or to have none at all has been inflamed by the teaching and advice given in certain books and pamphlets and at certain public conferences. A slide shown on the lantern screen to an audience of five or six hundred people not far from the Boucicaut Hospital is reproduced; it gave in tabular form the means of preventing conception, and named them *physiological* (removal of ovaries, modification of uterine endometrium, extra-genital emission of semen); *mechanical* (use of condoms, sponges de Chypre, absorbent wool, pessaries); and *chemical* (douches, etc.). On this and on similar public lectures and conferences Doléris makes this scathing reflection, "La science, et quelle science! a-t-elle jamais été mise au service de pires idées?" The prevailing gloom of Doléris's article is lightened only in one direction, and that is found in the suggestion that a knowledge of the risks of induced abortion has sent more patients into hospital to receive the antiseptic treatment there obtainable, and so to get a maximum degree of security. It is cold comfort surely.

It is not from France alone that evidence is forthcoming of the increasing frequency of abortion. In 1904 L. Lewin (Berlin) published a work of 383 pages, entitled *Die Fruchtabtreibung durch Gifte und andere Mittel*, and in it he expressed his conviction that there was going on a rapid increase in the criminal production of abortion *in all countries*. He pointed out that the prevention of conception was an act which carried with it no legal punishment, and that the means of securing such immunity from

pregnancy were openly written about and described in the public prints; and he emphasised the fact that when prevention failed and conception occurred, recourse was very often had to the criminal procedure of inducing abortion. Prüsmann (*Zeitsch. f. Geburtsh. u. Gynäk.*, liv. pp. 372-377, 1905) has drawn the veil aside, and has shown to the world an instrument which a woman could herself employ to get rid of her pregnancy: he has told how women learned to feel the os with the finger of one hand, and with the other hand to introduce the nozzle of the instrument into the cervical canal, and so to inject a solution of lysol into the cavity of the pregnant uterus. Prüsmann was led to show this instrument, which was openly sold "for the treatment of discharges," because of the marked increase of cases of abortion in the Gynæcological and Obstetrical Clinics; thus in the latter there were, in the two years previous to the reading of his paper, respectively out of 3283 cases, 808 abortions, and out of 3188 patients, 951 abortions.

In England and Scotland, also, abortions would seem to be increasing. Sir A. R. Simpson (*Scot. Med. and Surg. Journ.*, xvii. pp. 481-496, 1905), in an address on "Criminal Abortion," said: "Our Transatlantic colleagues deplore the extent which the evil practice has attained in America, where the number of men and women who are known to make a business of abortioning seems to be greater than in Europe. Great Britain is in no position to cry shame on any of its neighbours." That there was some foundation for Sir A. R. Simpson's foreboding has been demonstrated by a remarkable series of articles and letters in the *British Medical Journal* on the subject of the increasing use of lead as an abortifacient (*Brit. Med. Journ.*, i. for 1905, p. 584; ii. for 1905, p. 130; i. for 1906, pp. 257, 259, 428, 456, 499, 556, 620; ii. for 1907, p. 1672, etc.). The lead was taken apparently in the form of diachylon pills (it will be remembered that diachylon contains *emplastrum plumbi*); and, although it was present only in small amount in each pill, the effect when sixty-one pills were taken in a week (as in one of Hall's cases, *Brit. Med. Journ.*, i. for 1905, p. 587) could scarcely fail to be serious. The practice was specially prevalent in the Midland Counties of England, but was evidently spreading rapidly (Hall and Ransom, *Brit. Med. Journ.*, i. for 1906, pp. 428-430). The diachylon was bought in the form of penny lumps and made up into pellets. In a fatal case, reported by J. G. Priestley (*Brit. Med. Journ.*, ii. for 1906, p. 778), the pills were found to contain from 50 to 70 per cent. of diachylon, with aloes to prevent constipation, and boric acid; but the more common practice appears to be the use of diachylon itself in irregular lumps.

Classification.—For a good many years obstetricians have been satisfied with the arrangement of the causes of abortion into the three groups of *paternal*, *maternal*, and *ovular*; but, obviously, this is far from being a perfect classification, for *paternal* causes are dubious, and *ovular* ones can only be recognised after the miscarriage has taken place, and after the contents of the uterus have been submitted to examination. F. J. Taussig (*Amer. Journ. Obstet.*, lviii. pp. 654-662, 1908) has tried to make a more scientific etiological arrangement of miscarriages, although he admits that "what we do not know concerning the causes of abortion is far greater than what we do know." There are two subdivisions, the *predisposing* and the *exciting*. The former he divides into three groups: (1) *increased sensitiveness to nerve irritation*, arising from (*a*) temperament; (*b*) frequent abortions in quick succession; (*c*) or the incidence of a menstrual date: (2) *greater tendency to placental thrombosis*, due to (*a*) endometritis; (*b*) uterine congestion from constipation or sexual connection: and (3) *lessened resistance to expulsion of the uterine contents* from (*a*) the presence of cervical lacerations; or (*b*) the antecedent amputation of the cervix. The latter (the exciting) causes are placed in five groups. There is (1) *mechanical irritation*, which may be either (*a*) *transmitted*, as in the occurrence of a blow or fall, or of prolonged jarring (as in railway travelling, dancing, etc.), or of straining (as in constipation); or (*b*) *direct*, when the irritation may be applied to the outside of the uterus, as in the case of adhesions dragging or pushing the organ out of place, or from its manipulation during the bimanual examination or in a laparotomy, or to the inside of the uterus, as in the introduction of foreign bodies (sound, bougie, etc.), or in the presence of an excessive quantity of liquor amnii, or of intra-uterine tumours, or of exudates or clots. There is (2) *thermic irritation*, which may affect the whole body as in cold sea-bathing, or only the pelvic region as in the use of hot vaginal douching or the hot sitz-bath. There is (3) the important group of cases produced by *toxic irritation*, due to chemical, bacterial, or placental toxines: among the chemical agents may be named all emmenagogues (*e.g.* ergot), lead-poisoning, and carbon dioxide; among the bacterial, the various infectious diseases of the mother; and among the placental, the poisons arising in the course of eclampsia, hyperemesis, chorea, and acute yellow atrophy of the liver. There is (4) *nerve irritation*, which may be psychic (including emotion, fright, severe pain) or reflex (operations on external genitals, irritation of the breasts, etc.). Then the last group (5) is that in which the exciting cause is *death of the fœtus*, and this may be due to congenital inanition (alcoholism or illness of parents), congenital de-

formities, interference with nutrition (maternal anæmia, placental thrombosis, or umbilical torsion or knotting), infectious diseases of the fœtus, or, simply, hyperpyrexia. Taussig's classification is pathogenetic rather than etiological; it has the advantage of leading the obstetrician to form a more scientific conception of the mechanism at work in the production of each case of miscarriage; but it has the disadvantage of overlapping, for it is quite conceivable that one and the same case might require to be placed in two or even three of the subdivisions which are enumerated. Still there can be no doubt that some classification such as this will be required if our knowledge of the intimate causation of abortion is to be advanced.

ETIOLOGY.—Any advance which has taken place in our knowledge of the causation of abortion during the past five or six years has been rather in the direction of a more exact acquaintance with the means which were being illicitly employed to provoke the premature emptying of uterus than in that of the investigation of the pathological causes of abortion or their mode of action. In a word, our increased knowledge refers to criminal rather than to natural or unprovoked abortion. At the same time a few facts regarding ordinary abortions have been noted or emphasised. J. W. Ballantyne (*Internat. Clinics*, 11 s. ii. p. 231, 1901) insists upon the recognition of the clinical fact that there exists a great difference between what he terms the "uterine irritability" of one patient and that of another, the most directly abortifacient measures failing to induce a miscarriage in one woman, the slightest cause (a slip of the foot on a polished floor, etc.) at once sufficing to do so in another woman. Munro Kerr (*Operative Midwifery*, p. 518, 1908) associates this "irritability" with the habit of aborting, admitting, however, that the latter is more usually the result of special diseased conditions, which, if carefully searched for, will be discovered. "Still, in spite of the most careful examination, there are cases where a peculiar irritability of the uterus seems to be the only cause." It may be noted, in passing, that J. W. Taylor (*Brit. Med. Journ.*, i. for 1903, pp. 835-838) prefers the term "recurrent" to the more commonly used "habitual abortion;" he would limit the use of either term solely to the cases in which from the beginning of married life or from a definite period in it every pregnancy has ended prematurely; and he is of opinion that a "strumous" family history is as important as syphilis in the causation of recurrent miscarriages, the low vitality of one or both parents accounting in both groups of cases for the premature emptying of the uterus. One novel cause of abortion may be referred to—the Röntgen rays. M. Fraenkel (*Zentralbl. f. Gynäk.*, xxxi. p. 953 1907), at any rate, used them to induce therapeutic abortion in the case of a tuberculous woman who was three months pregnant; twenty-five sittings, lasting from five to ten minutes each, were needed before the contents of the uterus were discharged; and, since Fraenkel believes that the abortifacient action of the rays is due to the degenerative changes set up by them in the ovaries and the thyroid gland, he recommends their use (in place of oophorectomy) in cases of osteo-malacia.

But, as has been said, it is along the line of the investigation of the means of provoking abortion among the laity that there has been progress during the past five years. We now are better able to define the measures which abortion-mongers (not always outside the medical profession, it must be reluctantly confessed) employ to bring about the emptying of the gravid uterus. The *British Medical Journal* (ii. for 1907, pp. 1657, 1672) has thrown a sudden light into this dark place in professional and non-professional practice. In a leading article on "Emmenagogues in the Newspapers" the following passage occurs:—"Complaints peculiar to the female sex furnish a rich hunting-ground for these unscrupulous quacks. It is unnecessary for their purpose to employ the large and detailed newspaper advertisements familiar in other cases; a small paragraph, with some heading that will catch the eye, announcing a remedy for 'all irregularities so prevalent with the sex,' or, in many cases, merely implying the purposes for which it is put forward, appears to suffice. . . . If the bait is taken the game begins in earnest; the sufferer is supplied with printed matter, often with the addition of personal letters, setting forth the virtues of the article in question, but nearly always with the reservation that in certain obstinate cases a more powerful medicine is required, which can be supplied at a much higher price. . . . The most serious consequences, however, are quite apart from the swindling of the purchaser of these nostrums. A considerable number of them are recommended in such a way that the suggestion that they can be used as abortifacients is very thinly veiled. . . . The purpose for which these preparations are expected to be taken is plainly shown by their being accompanied in so many cases with advertisements of quinine pessaries and various appliances for preventing conception." That the language used in this quotation is not exaggerated is fully proved by a perusal of the results of the investigation of "secret remedies" carried out by the *British Medical Journal* (see, for instance, pp. 1657, 1658, *Brit. Med. Journ.*, ii. for 1907).

Of the part that is being played by the medical profession in the production of abor-

tion we would fain hope that estimates are exaggerated; but a few lines may be quoted from Frank H. Jackson's article (*Amer. Journ. Obstet.*, lviii. pp. 662-670, 1908) indicating the opinion formed therein on this matter. "To our disgrace, the men who are performing most of the abortions in this State (Maine) are not outcasts from their profession; some of them are members of this State society and its county branches . . . they are often pointed out as honest, hard-working physicians, yet some of them will kill a baby in its mother's womb with as much compassion as the butcher in the abattoir performs his daily work. Putting it at a conservative estimate, I believe that there are performed fifty thousand abortions annually in this State." It is to be hoped that Jackson's estimate is excessive; but if it be at all near the mark, then it is high time for the adoption of such a clause in the statutes of the State of Maine as is suggested, viz. "Whosoever shall by any means whatsoever bring about, commit or attempt to commit an unlawful abortion, or whosoever may aid or abet in such abortion or the bringing about of such abortion, shall be guilty of a felony."

Elsewhere (p. 11) we have taken notice of the evidence regarding lead-poisoning in the artificial production of abortion; and it seems to be undeniable that diachylon in the form of pills is being largely used to terminate pregnancies (*Brit. Med. Journ.*, i. for 1906, p. 428; and *Lancet*, ii. for 1907, p. 83). Reference may here be made to the belief that lead-poisoning in the case of the husband may have an abortifacient effect upon the wife. Professor Oui (*Compt. rend. Soc. d'obstet., de gynéc., et de pédiat. de Paris*, ix. pp. 33-36, 1907) relates the case of a woman—the wife of a stereotyper—who gave birth first to three infants who died in early infancy, then after her husband had suffered from lead colic she bore seven dead and macerated fœtuses; but, further, the man had been married before, and had had a living child by his first wife, and he had also had a living child by this woman, but these two births were before he became a stereotyper. Professor Oui refers also to Brouardel's statement regarding the wife of a house-painter who had five miscarriages in succession and who then gave birth to a healthy full-time child; when she was questioned, she admitted that she had grown tired of aborting, and had on this occasion chosen a healthy man to be the father of her offspring. It is difficult to explain exactly the manner in which lead-poisoning in the husband causes abortion in the wife, for it is difficult to imagine that a spermatozoon can carry sufficient life to impregnate an ovum, and yet, at the same time, sufficient death (so to speak) to bring to an end the gestation it has thus initiated: one wonders whether the wife has not been poisoned by the lead in some other way than through the ovum. But, of course, the same difficulties arise in connection with paternal syphilis. (See Clement Lucas, *Lancet*, i. for 1908, p. 277.)

There is a question which may be asked here—which is asked sometimes by the patient herself: If the actual abortion be prevented, more especially if it threaten on several occasions and be finally averted, will the infant suffer in any way from the early dangers through which it passed? No answer to this question can as yet be formulated; on *à priori* grounds it is reasonable to fear evil results for the child, but, as a matter of fact, many threatened abortions go on to the full time and end in the birth of perfectly normal and living infants. At the same time, it is interesting to note that lead-poisoning in the parents has been followed by the presence in their offspring of idiocy, imbecility, epilepsy, and of macrocephaly with convulsions (Ballantyne, *Antenatal Pathology*, i. p. 262, 1902); and in a case reported by Heelis, Jacob and Trotman (*Brit. Med. Journ.*, i. for 1906, p. 257), a hydrocephalic fœtus was borne by a patient who confessed to taking three or four diachylon pills daily for a week with the hope of producing abortion; the child survived its birth for a few hours, and after the post-mortem examination the liver was found to show traces of lead. Now, it is well known that lead in the mother's circulation may reach the fœtal tissues; it is also a well-known peculiarity of lead to attack the nervous tissues by preference; and it is therefore not improbable that the lead which this mother took to induce abortion while failing as an abortifacient may have succeeded in causing structural defects in the nervous system of the fœtus.

Diagnosis.—No great advance in the means of diagnosing abortion falls to be recorded. The first step must always be the diagnosis of pregnancy, for of course there can be no miscarriage from a non-pregnant uterus; and every means of recognising early pregnancy which may be discovered will aid us in the recognition of the interruption of pregnancy. Further, the great advances which have been made in our knowledge of ectopic pregnancy (*vide* Ectopic Pregnancy) must ultimately help us more clearly to differentiate between this morbid state and abortion; in the meantime, it must be confessed that the two are very often confused. Sittner (*Deutsch. med. Wochenschr.*, xxix. pp. 743, 759, 787, 1903), Rudaux (*Clinique*, i. p. 246, 1906) and many others have pointed out the frequency with which an ectopic gestation has been regarded as a threatened abortion, and, conversely, a miscarriage has sometimes been taken for an extra-uterine pregnancy. In the former case the expulsion of a uterine cast may lead the medical attendant to the conclusion that the threatened has become a complete or an incomplete abortion, while all the

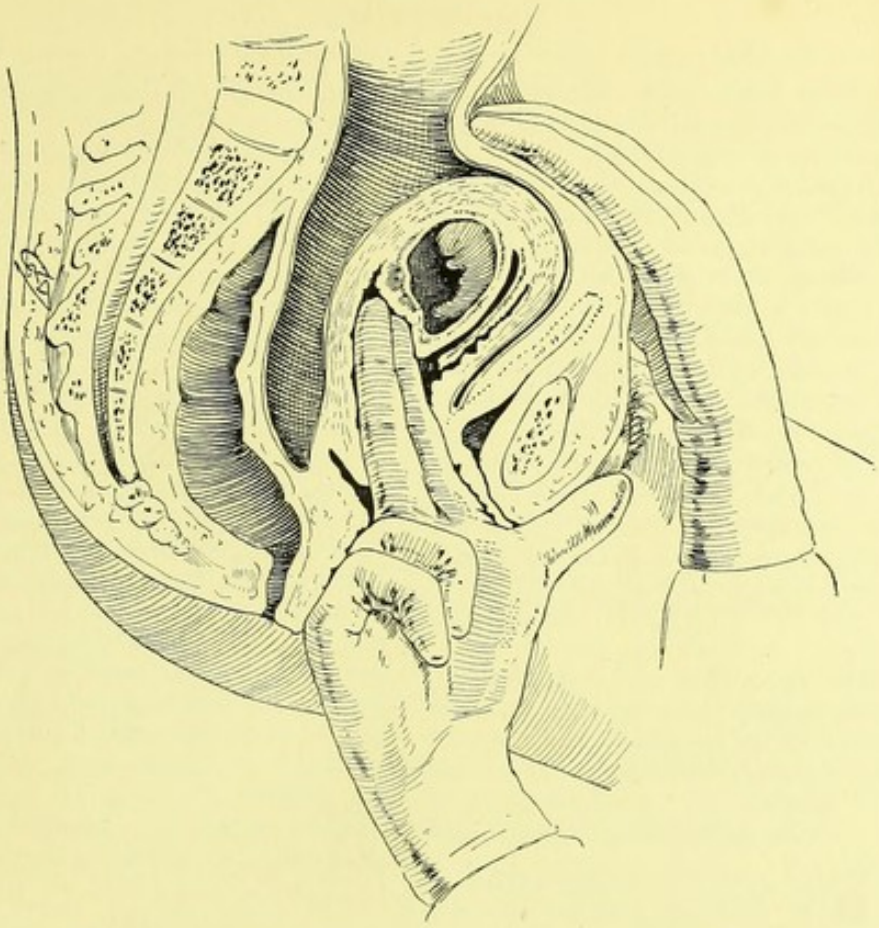
time there may be a tubal pregnancy. In such cases reliance must be placed on the bimanual examination carefully carried out, and the detection by this means of a tumour at the side of or behind the uterus when it is an ectopic gestation, and the absence of this swelling when it is an uncomplicated abortion. The difficult cases are the retroversions of the gravid uterus and the interstitial and cornual pregnancies. It has sometimes been maintained that the cervix uteri does not soften in ectopic pregnancy, and that this negative sign may be used in diagnosis; but Pinard (*Compt. rend. Soc. d'obstet., de gynéc., et de pédiat. de Paris*, v. p. 108, 1903) insists that softening occurs whether the gestation be extra-uterine or intra-uterine, and that the firmness which is sometimes observed is due to the death of the ovum. It is easy to mistake an "angular pregnancy," *i.e.* a case in which the ovum is implanted in the corner of the uterus over the tubal ostium, for an extra-uterine gestation; and it is difficult to imagine a means of differentiating the one from the other, especially if the latter be of the tubo-uterine variety (Munro Kerr, *Trans. Edin. Obstet. Soc.*, xxxiii. p. 185, 1908).

Treatment.—In the management of abortion there are several questions which must still be left unsettled; but, on the whole, there is a more marked tendency for operators and teachers to come into line upon all the more important matters. Nothing can be added to the various precautions which have been recommended in cases of *recurrent* abortion; but no obstetrician must omit the searching examination of the local and systemic organs of any woman who has repeatedly aborted, every care must be taken to remove or modify any causal state (uterine displacements, endometritis, syphilitic poisoning of one or other parent, etc.), and no rules can be too rigid for the hygiene, week by week, and even day by day, of any patient who has had several miscarriages.

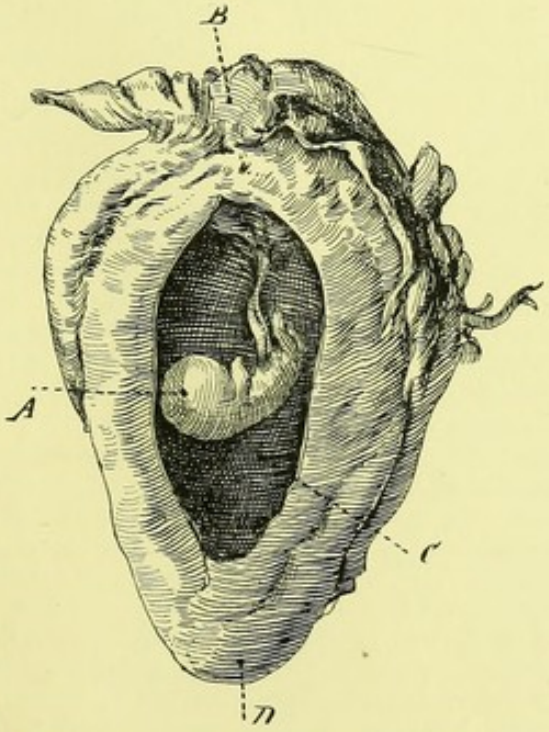
In the case of a *threatened* or *evitable* abortion there is an increasing tendency to exhaust every means of prevention before labelling the case (even in one's mind) as unavoidable. With a falling birth-rate it has become of the greatest importance to conserve antenatal life (Ballantyne, *Trans. Edin. Obstet. Soc.*, xxxii. p. 23, 1906-7), and medical men are beginning to find that many threatened miscarriages may be averted if prolonged and rigorous care be taken. There is no noteworthy addition to our means of combating the tendency to abort: most practitioners rely on clearing out the rectum with an enema, on the insertion of a morphia suppository, and on strict maintenance of the horizontal posture, with absence of all mental excitement and emotional disturbance. Medicines other than opium cannot be said to have established themselves as better uterine sedatives than morphia. There has been no increase in the means of preventing the emptying of the uterus; but there has been increased rigour in the use made of the means already known and tested. So long as the uterus continues to grow, even if hæmorrhage also continue to some extent, so long may the hope of the continuance of the pregnancy be retained.

When, however, it has become evident that the abortion is *inevitable*, it is an almost universal practice to endeavour to obtain the complete emptying of the uterus as quickly as possible. While there are still some practitioners who prefer to trust to vaginal douching, followed by vaginal plugging and the administration of an oxytocic drug (*e.g.* ergot or quinine), there is an increasing tendency to evacuate the uterus with greater rapidity and completeness by means of the finger or the ovum forceps. If the os be dilated to the extent of allowing two fingers to pass in, it is difficult to understand why there should be any delay in emptying the uterus digitally, unless indeed it be the fact that by so doing the interference comes to be regarded as an "operation," and is necessarily accompanied by the administration of an anæsthetic. The advantages of this rapid evacuation are the thoroughness with which it can be carried out (the operator's left hand pressing down the uterus so as to bring its whole interior under the influence of the curetting fingers), the diminution of the probability of any fragments of the sac being left behind, and the shorter convalescence which follows. Of course the vulva should be thoroughly cleansed and the vagina douched (before and after the scraping out of the uterus); the cavity of the uterus should also be washed out with a two-way tube, sterilised water at 118° F. being used, and the douche not being held high; and the uterus and vagina should be packed with gauze (iodoform, nosophen, or simple sterilised). Whilst this plan of procedure is being more generally adopted in cases of inevitable abortion, there are still many men (*e.g.* H. J. Boldt, *Journ. Amer. Med. Assoc.*, xlvi. p. 791, 1906) who would trust to vaginal packing and the use of an oxytocic if the cervix be not dilated. Undoubtedly the closure of the cervix causes a difficulty which can only be got over by dilatation with metal or rubber cones or with the more slowly acting tents; a risk is thus introduced, but it must be remembered that an inevitable abortion with a closed cervix is always a dangerous case, and it is maintained by some that the dilatation of the cervical canal (with a carefully prepared tent) and the rapid emptying of the uterine cavity do not increase but diminish the consequent risk. Of course the dilatation must be carried out with care, and the aseptic precautions must be complete.

In *incomplete* abortions nothing is to be gained by waiting, for the use of oxytocic drugs (such as ergot) cannot be trusted to cause complete



Detachment and removal of an ovum with the fingers.



An expelled ovum embedded in thickened decidua.

A. Foetus.
B. Portion of decidua.
C. Amniotic cavity.
D. Cervical pole.

emptying of the uterine cavity. If necessary, the cervix must be dilated and the interior scraped out with the finger (rubber gloves being worn), or the curette; but if the case is already septic, it will be safer to trust to the finger than to the curette (Lepage, *Ann. de gynéc. et d'obstet.*, 2 s. iii. p. 321, 1906), for pelvic cellulitis is apt to follow the use of the latter under such circumstances (Munro Kerr, *Operative Midwifery*, p. 530, 1908).

No great change has been made in the treatment usually given to a *missed* abortion. If it is causing no rise of temperature or other symptoms, it is generally left to be expelled, as it often is, at the date corresponding to the full term of labour. It ought, however, to be carefully watched, for any signs of intra-uterine sepsis should make the attendant at once adopt the treatment for incomplete abortion. At the same time, it is felt by some obstetricians that it is hardly scientific treatment to allow a dead gestation sac to remain in the uterus till danger arise; but, on the other hand, it must be remembered that it is usually an aseptic sac lying in a germ-free cavity with which one has to do, and that there is always some doubt as to the exact diagnosis.

Abrams' Heart Reflex.—A. Abrams has investigated the mode of action of *Kuatsu*, the method employed by the Japanese for restoring consciousness in individuals rendered unconscious for the time by a "knock-out" movement in jiu-jitsu, as well as in cases of unconsciousness from other things, in sunstroke, and in apparent drowning. Kuatsu may be carried out in various ways, but that sanctioned by the Japanese Government is "to lay the patient prone, with arms extended at right angles to the body, and for the operator to kneel over him and rhythmically strike his seventh cervical spine with the butt of his palm, wrist extended, until consciousness returns; he is then propped up, and his arms worked in a circle, after which he is helped on his feet, and induced, with help, to walk about in order to restore respiration and circulation." Abrams claims that the plan employed acts by stimulating the heart reflex to which his name has been attached, viz. "a contraction of the myocardium of varying duration which results when the skin in the precordial region is irritated by stroking, tapping, or friction." Abrams has found that the reflex can be excited from various surfaces of the body, and that the most satisfactory method was by percussion over the seventh cervical spine. There is another heart reflex, that of dilatation, which can be got by concussing the 9th, 10th, 11th, and 12th dorsal vertebræ rapidly and successively. The cardiac contraction which follows concussion over the seventh cervical spine can be seen by means of the Röntgen rays; it involves both ventricles, and it persists for some time after the stimulus ceases to act. It is a curious fact that previous injection of pilocarpine increases the sensitiveness of the reflex. Abrams attributes the success of the Schott treatment (exercises and baths) to the eliciting of this reflex, but thinks the "Kuatsu" plan acts more quickly and better. In heart failure with cyanosis he has found concussion of the seventh cervical spine beneficial. The physiological explanation would seem to be stimulation of the third dorsal nerve, which sends a large branch to the inferior cervical ganglion, from which come the augmentor fibres of the cardiac plexus. The whole subject, however, requires more investigation.

LITERATURE.—A. Abrams, *New York Med. Journ.*, xcii. p. 850, 1910.—*Lancet*, ii. for 1910, p. 1501; also Abrams' Work, *Spondylotherapy*, San Francisco, 1910.

Abrin.—The active principle of *Abrus precatorius*, an intensely poisonous body, against whose effects, however, animals can be immunised by repeated sublethal doses; the abrin acts as a hæmolytic or hæmoclastic (Adami, *Pathology*, i. pp. 122, 306, etc., 1910).

Acariasis.—Scabies, or rather mange, as affecting animals, and due to various kinds of *Acarus*.

Acconci's Method. *See* Accouchement Forcé.

Accouchement Forcé.

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(*e*) *Vaginal Cæsarean Section* . . . 19

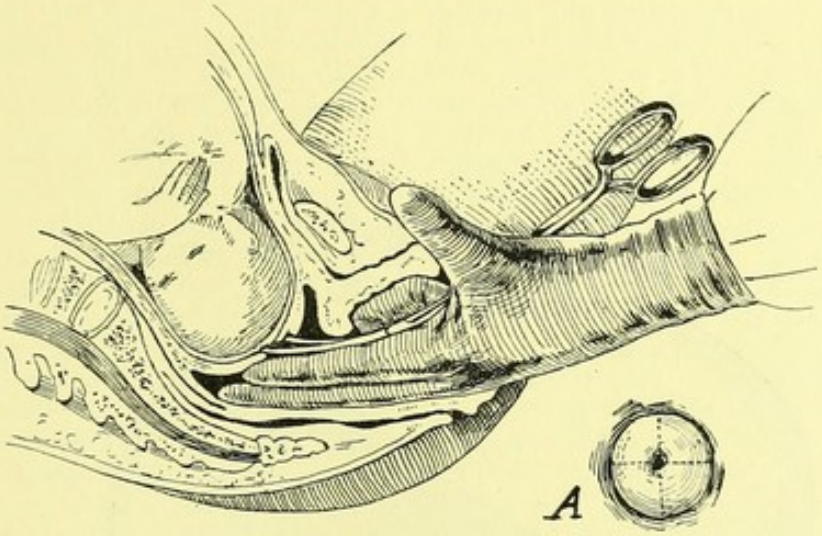
It is convenient to group together under the name *accouchement forcé* all the operations which have as their purpose the rapid and forcible enlargement of the cervical canal and the immediate extraction of the child. In this way —the plan adopted by Munro Kerr in his *Operative Midwifery* (pp. 454-476, 1908)—there are brought together under one heading the operations of manual dilatation of the cervix, of dilatation by hydrostatic dilators (metreurynters), tents, or expanding metal instruments, of enlarging the canal by means of incisions, and of vaginal Cæsarean section. The essential feature of the operation is the enlargement of the cervical canal, and this can be carried out, as above indicated, by one of two methods—stretching or cutting, dilatation or section; thereafter the choice is between forceps and version, for the extraction of the infant.

The Indications for this operative procedure cannot as yet be clearly defined. A discussion, which had the delimitation of these various

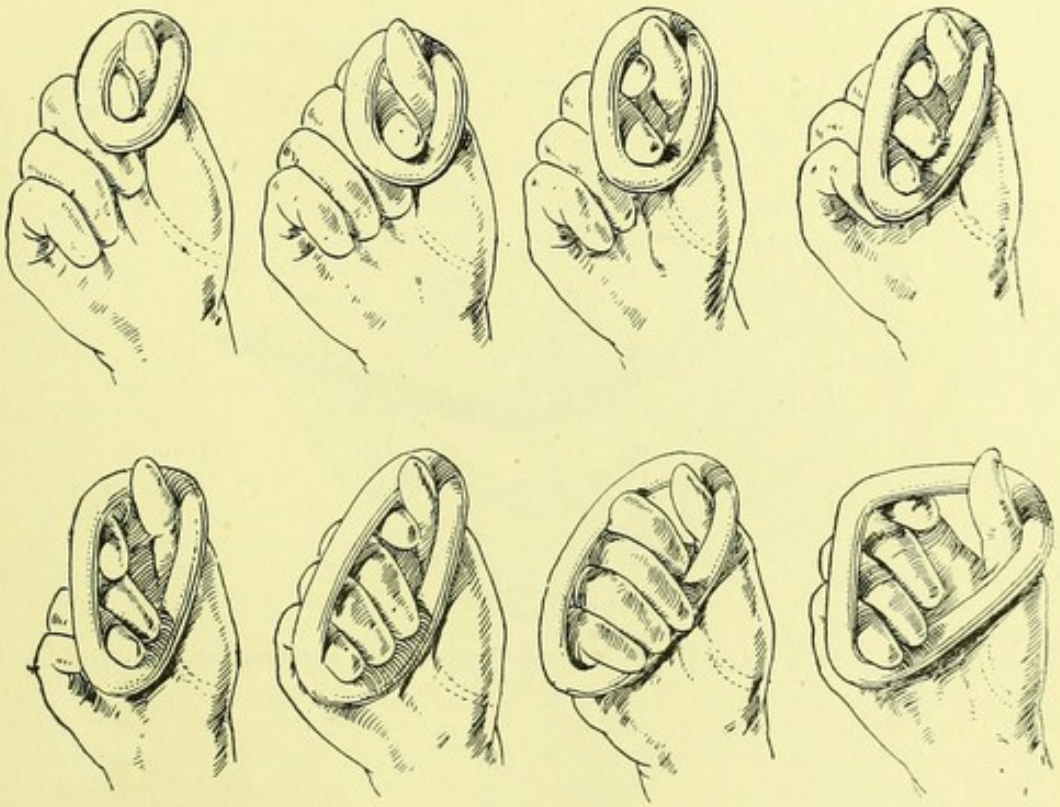
plans of artificially enlarging the cervix in labour as its object, took place in 1907 (*Brit. Med. Journ.*, ii. for 1907, pp. 426-431); but although many contributions of considerable value were made to the subject on this occasion, it cannot be said that the indications for accouchement forcé were then agreed upon, nor are they now. There is, however, a general feeling that certain grave cases of eclampsia justify the operation. When the cervix is taken up and the os somewhat open the manual and bimanual methods, the use of hydrostatic bags, and even the employment of the Bossi or other metallic dilator are to be recommended; but when the cervix is not taken up and the os is closed, vaginal Cæsarean section ought to be the operation of election. Grave eclampsia at the sixth month, therefore, may perhaps be regarded as the most undoubted indication for vaginal Cæsarean section, while the same disease coming on near to full term or in the early stages of labour will call for one or other of the dilating methods. In addition to eclampsia in being, some obstetricians regard the threatening of convulsions as a sufficient indication for accouchement forcé; but the success of preventive means ought to be taken into consideration, and such measures ought at any rate to get a fair trial. Other indications, about which, however, there is no strong consensus of opinion, are accidental hæmorrhage (especially the concealed variety), some cases of placenta prævia (when the hydrostatic bags are generally chosen), hyperemesis gravidarum (although the prognosis is very grave), and serious cases of heart disease and of acute œdema of the lungs, which are not beneficially affected by medicinal means. Not only are there marked differences of opinion regarding the justifiability of the operation in these morbid states, but there are also divergent views regarding the methods to be adopted—some obstetricians, for instance, preferring the knife, others always using the fingers, and others favouring the bag or the Bossi dilator. On the whole, the tendency appears to be to restrict accouchement forcé more and more, and to limit especially the use of metallic dilators of the Bossi type.

Of the various METHODS proposed for the performance of accouchement forcé, we may refer first to *manual* or *bimanual dilatation* of the cervix. Harris (*Surg. Gynec. and Obstet.*, iii. p. 79, 1906) strongly supports the manual method, but points out that it is not suitable in cases of cervical cancer or when there is much cicatricial tissue in the cervix (previous lacerations). The patient is put under an anæsthetic, the rectum having been thoroughly emptied. The operator wears rubber gloves, and the patient's external parts are carefully cleansed. If the cervical canal will admit the index finger up to the metacarpo-phalangeal joint, then dilatation may be at once begun; if not, a metallic dilator must be used until the finger passes in. At first the under finger (flexed) and the tip of the thumb are pushed in; in from five to twenty-five minutes two fingers and the thumb can be got in; with these the cervix is gradually stretched, by expanding the fingers till three fingers and the thumb are within the canal; finally, four fingers and the thumb are introduced, first close together and later expanded, and so the canal is fully dilated in about forty-five minutes. When one hand tires, the other is employed; and great care is taken to keep the gloves aseptic. The bimanual method, as used by Edgar (*Practice of Obstetrics*, p. 925, 1903), is in some respects preferable to the unimanual. It also presupposes sufficient dilatation to admit one finger; and if this is not present, a metallic dilator or a plug of gauze must be inserted. The index finger of one hand is pushed in, then the corresponding finger of the other hand is introduced, and with the two back to back the cervix is stretched. "The pressure is continued as a sort of eccentric massage, the fingers of the opposite hands always making gentle and steady pressure outward and downward, and in opposite directions." The direction of the stretching force should be first antero-posterior, then lateral, and then oblique. When a second finger of each hand can be inserted, the dilatation is further effected until it is complete. The hands should even then be retained for some minutes in the cervix till complete relaxation is obtained. It is claimed for this method that it more closely resembles the natural process, that it keeps the membranes intact and does not interfere with the existing presentation and position of the fœtus, that the sense of touch is retained, and that therefore the force used can be better estimated and laceration made less likely, and that, since the manipulation is intra-cervical only, there is less risk of sepsis. Lewis (*Surg. Gynec. and Obstet.* iii. p. 756, 1906) thinks that this method, when performed under due precautions with educated fingers and without undue roughness or care, should be very useful; and is of opinion that, even if it be performed by one who is inexpert, there will be less risk than if metallic dilators were employed. It does not, however, seem to have been much used; possibly the long and tiring manipulation and the comparative slowness of the manual method have discouraged operators and driven them to instrumental methods.

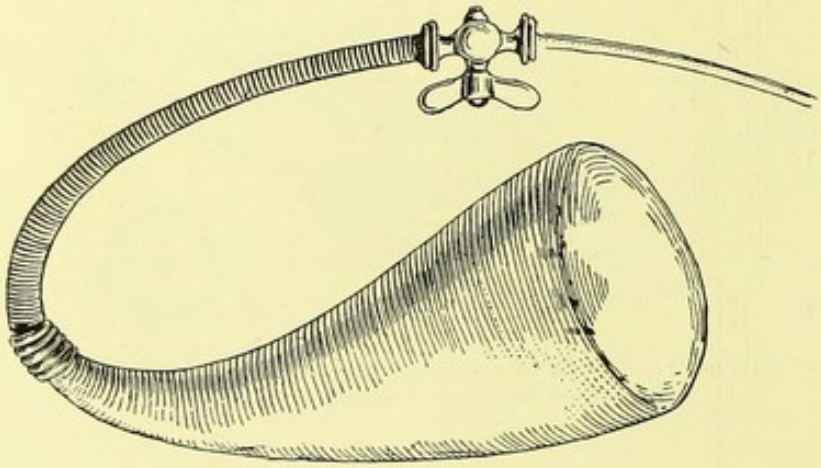
Another plan is by means of *hydrostatic bags*. The introduction of the inelastic conical bag of Champetier de Ribes and of Pomeroy's new hydrostatic dilator (*Surg. Gynec. and Obstet.*, iii. p. 542, 1906) and others has stimulated fresh interest in this method (originally introduced many years ago by Keiller (1859) and R. Barnes. When the bag is placed in the vagina it is



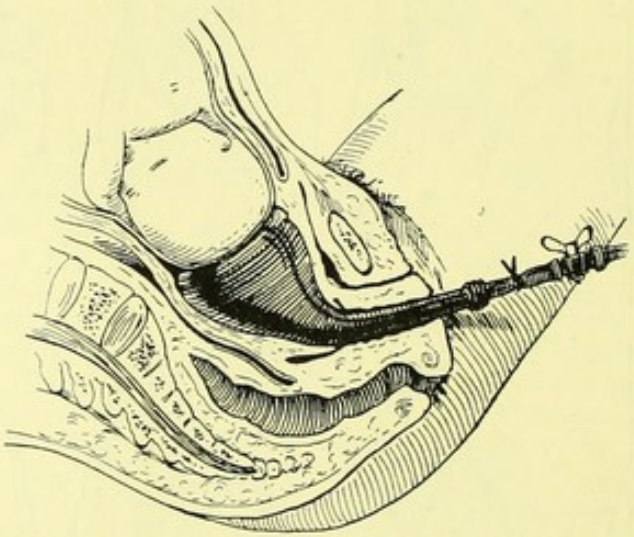
Incision of the cervix by the Dührssen's method. (*After* Jellett.)
A. Dotted lines show the proposed incisions.



Harris' method of manual dilatation of the cervix. (*After* Harris.)



Champetier de Ribes' hydrostatic dilator.



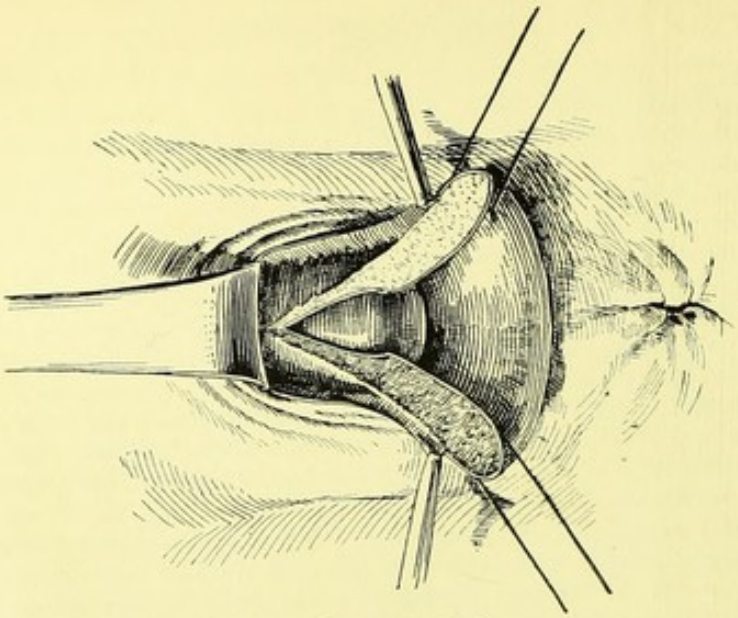
Dilatation of the cervix, with Champetier de Ribes' hydrostatic dilator.

rightly called a kolpeurynter (*e.g.* Carl Braun's instrument), but when it is placed in and exercises pressure on the cervix it ought to be termed a metreurynter. A certain amount of cervical dilatation is presupposed. The bag is thoroughly disinfected, and is introduced (in the case of the Champetier de Ribes's instrument) folded together closely in the grasp of a special pair of forceps into the cervical canal; it is then partly distended by pumping water (lysol solution) into it by means of a syringe, and the forceps is unlocked and withdrawn. Since the broad end of the cone is uppermost, there is little tendency for the bag to slip out; it is now further distended with water and left to dilate the canal, although some operators recommend that traction (continuous or intermittent) be made on it to hasten the dilatation. It is not so rapid a method as manual dilatation, and of course it is much slower than vaginal Cæsarean section or Bossi's plan; but it is claimed for it that, forming as the bag does a fluid dilating wedge, it more closely resembles the natural process. J. B. De Lee (*Internat. Clinics*, 16 s. i. p. 147, 1906) states that the hydrostatic bag is, without question, the safest method of opening the cervix, and recommends the Voorhees bag, an American modification of the French style; he admits that if care is not used the uterus may be ruptured. The general opinion would seem to be that hydrostatic bags are finding their special sphere of usefulness in the modified accouchement forcé which is employed in the treatment of placenta prævia.

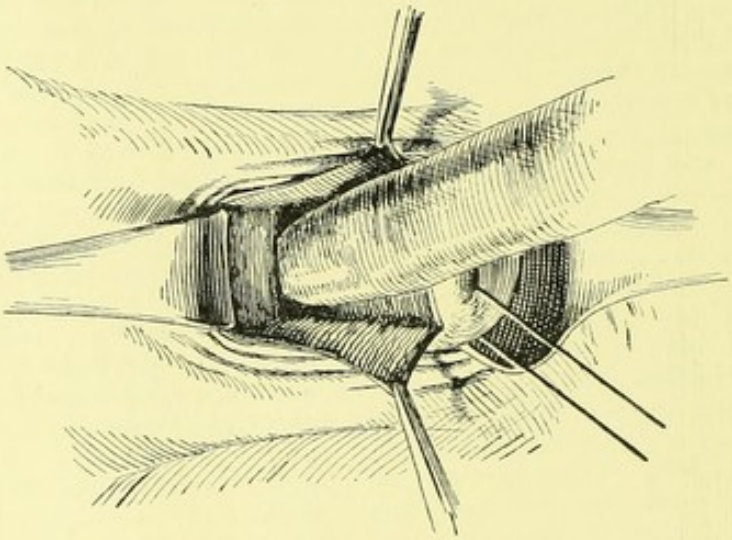
Had this summary been written two or three years ago considerable space would necessarily have been given to the discussion of Bossi's *metallic dilators* and of the somewhat similar instruments of Frommer, Tarnier, and De Seigneux (*Zentralbl. f. Gynäk.*, xxix. p. 717, 1905); but less attention need now be given to this method of performing accouchement forcé, for it has been abandoned by many obstetricians. Bossi's invention of a branched metallic dilator consisting of three or four rods ending in blunt points, which could be accurately and equally separated by a registering screw apparatus at the bases of the rods, had much to do with the temporary popularity of this form of rapid dilatation (viz. 30 to 35 min.) of the cervix; and Leopold's strong recommendation (*Arch. f. Gynaek.*, lxvi. p. 198, 1902) quickly spread its fame abroad. Soon after the appearance of Leopold's article the instrument of Bossi was successfully employed in Edinburgh by Sir. A. R. Simpson (*Trans. Edin. Obstet. Soc.*, xxviii. p. 21, 1902), by Frost (*ibid.*, p. 15, 1902), and by Ballantyne (*ibid.*, xxix. p. 76, 1903-4), generally in cases of eclampsia; Gairdner used either the Bossi or the Bossi-Frommer dilator in fourteen cases in Glasgow (*Journ. Obstet. and Gynæc. Brit. Empire*, iv. p. 384, 1903); De Paoli (*Arch. f. Gynaek.*, lxix. p. 12, 1903) treated nineteen cases of placenta prævia thus, with one maternal death; and Schürmann (*Monatsch. f. Geburtsh. u. Gynaek.*, xviii. p. 513, 1903) reported ten cases in which Preiss's modification of the Bossi was used, and thought that for abortions between the fourth and sixth month, and for labours at term, Bossi's plan was a great addition and a safe method. Ehrlich's lengthy article (*Arch. f. Gynaek.*, lxxiii. pp. 439 543, 1904) was more critical than any of the preceding contributions; this writer, from an experience of forty-seven cases in Leopold's clinique, thought that rapid mechanical dilatation of the cervix should be employed only when the life of the mother or of the infant was seriously threatened, that the earlier in pregnancy the plan was resorted to the greater was the care and foresight necessary, and that special precautions were needed for primiparæ and patients in whom the cervix was not taken up. The critical period thus ushered in was continued throughout 1905 and 1906, till Runge (*Berl. klin. Wochenschr.*, xliii. p. 1190, 1906) gave it as his opinion that in skilled hands the instrument could yield good results, but that very few practitioners should use it, and that it should never be employed when the cervical canal still existed. Dührssen's method (deep cervical incisions) and Bossi's plan were brought into sharp contrast and conflict in a series of articles which appeared in 1905 and 1906 (*Arch. f. Gynaek.*, lxxv. p. 247, 1905; *Zentralbl. f. Gynäk.*, xxx. pp. 289, 417, 509, 748, 811); and within the past two years little has been heard in favour of the latter method, while the former has been strongly pressed. Bossi himself, however (*Gynaek. Rundschau*, i. p. 789, 1907), defends forcible dilatation of the cervical canal, and states that he has in no way altered his views during the past seventeen years since he first introduced the instrument that bears his name. Cortiguera also (*Journ. de med. Paris*, 2 s. xix. p. 400, 1907) maintains that Bossi's method is far the best at our disposal at the present time; the dilator is easy to sterilise and to use; it acts quickly and dilates sufficiently; it is applicable even before the cervix is taken up; it causes no lacerations of any account; the hæmorrhage is scarcely more than in normal labour; and it is as quick and less dangerous than Cæsarean section. Yet, whilst these voices are heard in favour of Bossi's method, it can hardly be denied that general obstetric opinion is against it. The risks of serious cervical lacerations are real, even when cases are chosen with care and a proper interval of time allowed for the process of dilatation, and there are certain so-called indications for its use, *e.g.* placenta prævia, and the ordinary induction of labour where haste is not needed, which are regarded by nearly everyone as indefensible. Whether or not a small field of usefulness remains for the Bossi dilator the future must decide. Grave cases of eclampsia

in which the cervix has been taken up, but in which the convulsions cannot be controlled in other ways, may possibly continue with advantage to be treated by emptying the uterus by this method. But, as Ballantyne (*Trans. Edin. Obstet. Soc.*, xxix. p. 99, 1903-4) pointed out, it is an "exceptional remedy for exceptional conditions." Its distal end is a powerful dilator; at its proximal end, therefore, must be a sensitive hand, an observant eye fixed on the indicator, and a brain alert to note the degree of resistance which experience has found to warrant continued dilatation. "It is an instrument to be worked with the head rather than the hand."

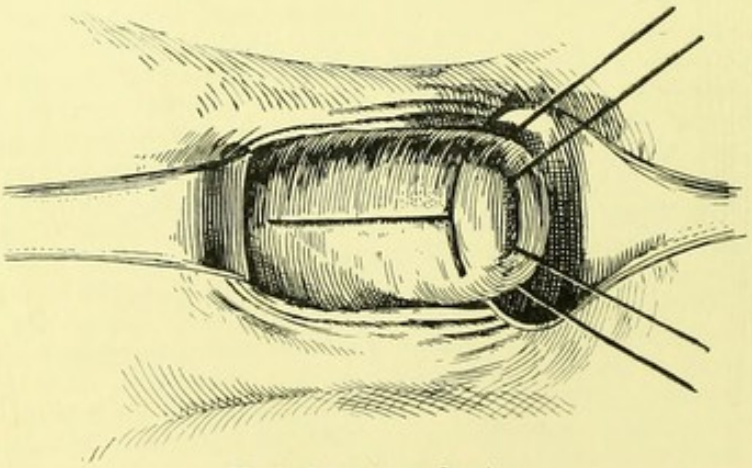
The performance of accouchement forcé by the knife may take the form of *multiple deep cervical incisions*, or that of *vaginal Cæsarean section*. For both these methods obstetricians are indebted to Dührssen (see Winckel's *Handbuch der Geburtshülfe*, B. iii. t. i. p. 609, 1906), although Acconci's claim of priority has been accepted by some. Superficial cervical incisions are no novelty in obstetric practice; but *deep* incisions were first practised in a systematic way by Dührssen in 1890 (*Arch. f. Gynaek.*, xxxvii. p. 27). They were four in number—an anterior, a posterior, and two lateral, and they ran from the margin of the os to the utero-vaginal junction; they were made with a pair of angular scissors, and it was found to be advantageous to clamp the cervix with long catch-forceps on each side of the incision (De Lee, *Internat. Clinics*, 16 s. i. p. 147, 1906). The operation thus introduced has been frequently practised, more especially in cases of eclampsia and accidental hæmorrhage; it should be restricted to the cases in which effacement of the cervix has already been secured, and the incision should be closed with sutures immediately after the birth is completed. The danger is extension of the cuts during extraction, with consequent conversion of a cervical incision into a uterine rupture. Partly on this account, and partly for other reasons, Dührssen in 1895 described and recommended the operation of *vaginal Cæsarean section* or *vaginal hysterotomy* (to use a less ambiguous designation), and in 1896 published his work on the subject (*Der Vaginale Kaiserschnitt*, Karger, Berlin). Several years, however, elapsed before the operation was received with any favour; indeed, it was hardly known among English-speaking obstetricians till Stamm, in November 1903 (*Amer. Journ. Obstet.*, xlviii. p. 595, 1903), and Munro Kerr, in January 1904 (*Trans. Edin. Obstet. Soc.*, xxix. p. 68, 1903-4), introduced it to American and British practice respectively. But during the preceding years there had been several Continental contributions to the discussion regarding the value of and indications for this new obstetric procedure. Recommended at first in cases of cancer of the cervix uteri in pregnancy (Dührssen, *Zentralbl. f. Gynäk.*, xxi. p. 942, 1897; Mittermaier, *ibid.*, xxii. p. 5, 1898; Seiffart, *ibid.*, xxii. p. 121, 1898; and others, *ibid.*, xxiii. pp. 572, 670, 816, 856, 1287; xxiv. pp. 69, 933, 1357, etc.), it was ere long extended to other morbid states, such as eclampsia, hyperemesis gravidarum, serious heart disease in pregnancy, and indeed to all those states in which rapid emptying of the gravid uterus was called for, and in which the cervix was undilated and not easily dilatable. In 1901, for instance, Dührssen (*Zentralbl. f. Gynäk.*, xxv. p. 33, 1901) was using the vaginal Cæsarean section in eclampsia; in 1902 Jahreiss (*ibid.*, xxvi. p. 919) employed it in two cases of eclampsia; whilst Bumm (*ibid.*, xxvi. p. 1417, 1902) used it in chorea, nephritis, heart disease, eclampsia, cancer of the cervix, and for the induction of premature labour in thirteen cases, with one maternal death. Ehrendorfer (*Zentralbl. f. Gynäk.*, xxvii. p. 483, 1903) employed it in hyperemesis gravidarum; Rühl (*ibid.*, xxvii. p. 1044, 1903) brought it into action in marked rigidity of the cervix; and further cases of eclampsia treated in this way were reported (*ibid.*, xxvii. pp. 488, 1367, 1903). It would, perhaps, more quickly have attracted the attention of obstetricians had it not been that about this time (1903) accouchement forcé by means of the Bossi dilator was highly favoured; perhaps, also, Dührssen did not practise moderation in the way he stated his arguments. But since 1903 no obstetric operation has been more extensively discussed. Thus the *Zentralblatt für Gynäkologie* for 1904 contained fourteen original articles by Rühl, Westphal, Ahlfeld, Dührssen, Kroemer, Steffeck, Maly, Kermauner, Hammerschlag, Krönig, and Wanner; and its sphere was extended so as to include placenta prævia. Uthmöller (*ibid.*, xxx. p. 306, 1906) performed the operation in private practice for eclampsia; and Zárate (*ibid.*, xxxi. p. 1625, 1907) did it for the first time in South America, the indication being laryngeal stenosis. In other countries contributions appeared from the pens of Webster (*Amer. Journ. Obstet.*, xlix. p. 810, 1904), Bacon (*ibid.*, l. p. 488, 1904), Jerie (*Casop. lek. cesk.*, xliii. p. 1168, etc., 1904), Miller (*New Orl. Med. and Surg. Journ.*, lvii. p. 551, 1904-5), Mainzer (*Deutsch. med. Wochenschr.*, xxxi. p. 266, 1905), Strauss (*Med. Rec.* (New York), lxvii. p. 417, 1905), C. Van de Poll (*Med. Weekbl.*, xi. p. 575, 1904-5), H. D. Fry (*Surg. Gynec. and Obstet.*, i. p. 58, 1905), Fabre (*Lyon méd.*, cvii. p. 604, 1906), Bar (*Rev. gén. de clin. et de thérap.*, xxi. p. 769, 1907), Brewis (*Scot. Med. and Surg. Journ.*, xxi. p. 226, 1907), Karnicki (*Przegl. lek.*, xlvi. p. 471, 1907), Saks (*Medycyna*, xxxv. p. 644, 1907), and H. D. Fry (*Amer. Journ. Obstet.*, lix. p. 202, 1902). Indeed, had it not been for the discussion which arose in regard to pubiotomy, and which diverted obstetric interest in another direction, the operation of vaginal Cæsarean section might still have been the



Vaginal Cæsarean Section.
Bladder pushed up and anterior cervical and uterine wall incised, and sac showing.



Vaginal Cæsarean Section.
Separating bladder from anterior vaginal wall.



Vaginal Cæsarean Section.
Incisions in the anterior vaginal wall.

cause of much writing; as it is, it may be said that the sphere of its usefulness has now been marked out with a certain degree of definiteness. In early pregnancy, when for any reason the uterus requires to be emptied quickly, Dührssen's operation is by many regarded as the best means of so doing, for it is founded on sound surgical principles; but it requires considerable technical skill, and is emphatically the operation of the obstetric specialist (calling, as it does, for qualified assistants and the equipment of a hospital). Munro Kerr (*Operative Midwifery*, p. 476, 1908) is of opinion that up to the twenty-eighth week of gestation it is the best way of rapidly emptying the uterus; and there is much to be said in support of this conclusion if it be added that a skilled operator accustomed to vaginal surgery is available to carry it out. The indications for its performance would therefore be such morbid states as hyperemesis gravidarum, chorea gravidarum, and eclampsia before the seventh month. In the later months of pregnancy the vaginal operation does not seem so applicable, for the extraction of a full-sized child through the opening made for it by this route can hardly be safely accomplished, and damage to the lower uterine segment is to be anticipated. Munro Kerr, therefore (*op. cit.* p. 476), would prefer the ordinary abdominal Cæsarean section for the cases in which Dührssen and his followers recommend the vaginal operation. It would appear also that the latter procedure is not suitable in placenta prævia; but it may be favourably considered in cases of cancer, and perhaps of myoma of the cervix and lower part of the uterus.

With regard to the details of the operation of vaginal Cæsarean section there have been some differences of opinion. As originally performed by Dührssen, it was customary to incise both the anterior and posterior walls of the vagina, and some operators still pursue this method; but it is now more usual (especially in the early months of pregnancy) for the incision to affect only the anterior wall, *i.e.* anterior hysterotomy. Further, Dührssen himself (*Berl. klin. Wochenschr.*, xlvi. p. 194, 1909) has recently given his approbation to a new method devised by his assistant, Solms; this consists in a combination of gastro-elytrotomy (Ritgen) and vaginal Cæsarean section (laparo-colpohysterotomy), and really differs so much that it ought rather to be regarded as a new procedure altogether (Solms, *Berl. klin. Wochenschr.*, xlvi. p. 199, 1909). Vaginal Cæsarean section, as usually performed, differs somewhat according to the age of pregnancy when it is carried out. If it be indicated in early pregnancy, then the following method may be used (De Lee, 1906; Munro Kerr, 1908; Whitridge Williams, 1908):—The patient is placed in the lithotomy position, and the usual thorough cleansing of the vulva is carried out. One skilled assistant gives the anæsthetic and another helps the operator; it is well to have a third, if possible, to prepare and hand ligatures, etc. A good light is essential, and a large speculum or retractor is needed to expose the cervix by pulling back the posterior vaginal wall. The cervix is then seized with two pairs of volsellæ and dragged down towards the vulva; strong heavy traction sutures (silk or gut) are then passed through the cervix on both sides to replace the volsellæ and maintain the uterus at its low level, thus giving more space for manipulation. A transverse incision is made across the cervix immediately below the reflection of the bladder, encircling the cervix in one-third of its circumference, and a longitudinal cut is next made, passing up to about 1 cm. from the urethra; both these incisions divide only the mucous membrane. The finger is then introduced through these incisions and the bladder pushed out of the way, and it is very important that this be done thoroughly; thus the pouch of peritoneum is displaced upwards and the anterior cervical wall is laid bare. The next step is the division of the anterior wall of the cervix with scissors and in the middle line; further traction is made and the lower uterine segment comes into view; this also is incised; and then, as a rule, the bag of membrane bulges through, is ruptured, and the child extracted by turning. The placenta and membranes are next stripped off and removed. A hypodermic injection of ergotine may have been given at the beginning of the operation; if not, it should be administered now. An intra-uterine douche (at a temperature of 116° or 118° F.) will now be found to be useful in making the uterus retract. The uterine wound is closed by a continuous catgut suture, beginning at the upper end of the incision and having the stitches close together. If the uterine cavity has been previously plugged with gauze, care will have to be taken that the stitches do not catch upon the packing. The vaginal incisions are next closed with catgut, but a thin strip of gauze may be placed in the vesico-uterine space (in front of the cervix) and withdrawn (along with the uterine plug) twenty-four hours later. It should be added that after the extraction of the child and placenta the re-insertion of the vaginal speculum and the making of traction upon the cervix will bring the field of operation fully into view and greatly facilitate the later stages of the operation. It may be necessary, according to Munro Kerr, to pull the uterus back and tack it into position before closing the vaginal incision. The whole operation is, as will have been noted, an extra-peritoneal one: the reflection of peritoneum in front of the uterus is pushed upwards and out of the way so as to give access to the anterior aspect

of the supravaginal portion of the cervix and to the lower segment of the body of the uterus. If the operation is carried out in the later weeks of pregnancy it is generally recognised that some modification of the details is necessary. It is then necessary to incise the posterior wall of the uterus as well as the anterior. Thus Bar (*Rev. gén. de clin. et de thérap.*, xxi. p. 769, 1907) makes an incision in the middle line in the posterior lip of the cervix, reaching the length of the vaginal *cul-de-sac* and extending for 4 cm. on to the vaginal wall; the peritoneum can be stripped off the posterior aspect of the cervix through this incision. Dührssen makes a vertical incision in the posterior lip of the cervix and a transverse one in the posterior vaginal vault. Then the anterior incision is made. By this means both the anterior and posterior aspects of the lower uterine segment are exposed. Regnoli (*Policlin.*, xi. sez. chir., p. 49, 1904) makes the posterior incision, and limits the anterior one to the cervix. Döderlein (*Zentralbl. f. Gynäk.*, xxxi. p. 1027, 1908) does not divide the vaginal fornix from the cervix and push up the bladder; he simply divides the uterine wall higher and higher, applies his forceps further and further up, and draws the uterus more and more downwards; the bladder and other structures separate themselves. The other stages of the operation are much the same as when the section is performed earlier; but it has been found, more especially if the patient be a primipara, that it is very helpful to do a preliminary episiotomy to give more room in the vagina for manipulation. Dührssen makes a right-sided vaginal and perineal incision, and if the levator ani be divided he is thus able to pass his whole fist into the vaginal canal and vault, pull the cervix down into view, and limit the hæmorrhage. After the extraction of the child and placenta, the posterior incision is closed first, preferably by through-and-through catgut sutures tied on the cervical mucous membrane; then the vagina is closed by a continuous catgut suture tied on the vaginal mucous membrane; next the anterior wound is sutured; and finally the perineal wound is secured. Of course the operation of vaginal Cæsarean section is not without its risks. The peritoneum may be opened into or the bladder may be wounded by extension of the incisions during extraction of the child, although some operators have never met with this (Bumm). There is danger of hæmorrhage from the incisions and from the placental site; but the head of the child acts as a plug during the operation, and the uterus can be packed with gauze afterwards. The downward traction which can be made upon the cervix also helps to check the bleeding. The danger of rupture of the uterus in subsequent labours would seem to be exaggerated. It may be stated, in conclusion, that vaginal Cæsarean section, in the hands of specialists, offers a rapid and reasonably safe method of opening into and emptying the uterus at any date in pregnancy, whatever be the state of the cervix; it may be anticipated that it will continue to be employed in a limited number of cases which can otherwise hardly be satisfactorily dealt with.

Acetomorphine. *See* DRUGS, RECENT (*Heroin*).

Achilles Jerk. *See* REFLEXES.

Acholuric Jaundice. *See* JAUNDICE.

Achylia Gastrica.—A condition of permanent anacidity of the stomach described by Einhorn, in which the secretion of hydrochloric acid is in abeyance: according to some writers pepsin is also absent. The symptoms are variable; lienteric diarrhœa is the most characteristic. Gastric achylia occurs in many cases of carcinoma: apart from this, it is chiefly a disease of the senile period, and is probably often a complication of some underlying condition—cirrhosis, etc. The diagnosis of gastric achylia rests on an examination of the stomach contents. 1. During fasting the stomach is empty, and after an Ewald's test breakfast only a little undigested bread can be recovered—*i.e.* there is no stagnation of food in the stomach. 2. Gastric contents neutral, or faintly acid; no pepsin. 3. No gastric mucus after Ewald's test breakfast. 4. The gastric mucosa is fragile, and bleeds readily when a tube is passed.

LITERATURE.—LIEFSCHUTZ, *Arch. f. Verdauungsk.*, 27th October 1906.

"Acid Control." *See* DIGESTION (*Movements of Alimentary Tract*).

Acidosis.

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THE condition known as acid intoxication, or acidosis, has assumed considerable importance during the past few years. While there is a belief, apparently well founded, that acid intoxication exists under a variety of different circumstances, and that it is at the root of several clinical groups of symptoms, it must be admitted that the only condition which has been definitely proved to be due to acidosis is diabetic coma. Next in importance and probability as clinical manifestations of acidosis, come the cyclic vomiting of children and delayed chloroform poisoning, while it is also possible that some forms of infantile atrophy are

due to the same cause. Before, however, considering the symptomatology of the condition, it is necessary to discuss the general nature of acidosis.

We may define acidosis as a diminution of the normal alkalinity of the tissue juices from the presence of fatty acids and their derivatives, which are ultimately excreted in the urine as acetone, diacetic acid, and oxybutyric acid (*ketonuria*). Since, however, it is the retention, and not the elimination, of these bodies which causes intoxication, acidosis may occur without ketonuria, and *vice versâ*.

Source of the Acetone Bodies (Ketones). —Of these, oxybutyric acid is that which is primarily produced in the body; by its oxidation diacetic acid is formed, and from this again acetone is derived. The acetone bodies are directly derived from fat — particularly the lower fatty acids, such as butyric acid. Carbohydrates and proteids give rise to them indirectly only in so far as they lead to the formation of body fat. The question then arises, are the acetone bodies normal intermediate products of fat metabolism, and is their development in the tissues in excessive amount due to a defect of secondary oxidation, or, are they due to abnormal metabolism of fat? The latter alternative seems the more probable. The immediate cause of the fat metabolism going astray seems in all cases connected with default of carbohydrate metabolism. It may be that the carbohydrate element of the food is insufficient (as in starvation), or that, as in diabetes and possibly other conditions, the body is unable to utilise what is eaten. In any case it is certain that for the complete oxidation of fat, carbohydrate must be burnt up in the body. This is perhaps one of the chief facts demonstrated concerning acidosis—that its immediate cause has to do with deficiency of carbohydrate. The acetone bodies are produced in the tissues of the body, particularly in the liver and muscles, not in the intestine, but further than this their seat of origin is unknown.

Excretion of the Acetone Bodies.—In health the only member of the group which is eliminated is acetone, which is excreted in the expired air (·03 gram to ·08 gram per twenty-four hours) and in the urine (·1 gram to ·3 gram per twenty-four hours). Only when the urine contains larger quantities than this do we speak of a pathological "acetonuria." As the amount of acetone in the urine rises, diacetic acid and oxybutyric acid also appear, but there is no constant ratio between them. The quantity of oxybutyric acid excreted often greatly exceeds that of the acetone. The excretion of the acetone bodies is greatly influenced by the administration of alkalies; large doses of sodium bicarbonate wash the diacetic and oxybutyric acid out of the tissues.

Relation of Urinary Ammonia to Acetone Bodies.—An important connection exists between the excretion of ammonia and the acetone bodies. In man the greater part of the ammonia produced in the body is converted into urea, but a small proportion evades this transformation, and is eliminated in the urine in combination with the mineral acids set free from the food. The ammonia nitrogen normally forms only from 3 to 5 per cent. of the total urinary nitrogen. The object of this mechanism is to spare the fixed bases of the body. An increase in the mineral acids of the food increases the output of urinary nitrogen; organic acids, with the exceptions undernoted, have no such effect, as they are eliminated as carbonic acid. Lactic acid and the acetone bodies, however, behave like mineral acids in this respect, hence the amount of ammonia nitrogen in the urine is an index of the quantity of these substances (and therefore of acidosis) in the body. Each gram of ammonia excreted in excess of that present in the food is equivalent to 6 grams of oxybutyric acid. The administration of alkalies diminishes, and their withdrawal increases, the output of ammonia. While increase of ammonia nitrogen in the urine is most commonly brought about in this way, it may also arise from interference with the urea synthesis, such as occurs in liver diseases.

Tests for the Acetone Bodies. — No simple clinical method for the quantitative estimation of acetone and oxybutyric acid is available. For the ordinary quantitative reactions of these bodies, see Urine, Pathological Changes in. The most generally useful test for the presence of the acetone bodies is ferric chloride, which gives a port-wine colour with diacetic acid (not acetone). In slight degrees of aceotnuria, therefore, when acetone alone is present, the reaction is negative. The test is not available when the patient is taking salicylate, as the urine then gives the same port-wine colour with ferric chloride.

Clinical.—Clinically, we must distinguish between acidosis and acid intoxication. An individual may suffer from acidosis for years, without any special symptoms arising. This occurs especially in diabetes. The main symptoms ascribed to acid intoxication in man are—dulness and apathy, increasing to drowsiness and coma; sometimes, however, these are preceded by restlessness, irritability, insomnia, and delirium. Vomiting, which may be uncontrollable, and is sometimes hæmorrhagic, associated either with diarrhœa or constipation, is a fairly constant symptom. The abdomen is sunken; thirst and epigastric pain are sometimes complained of. Icterus is not uncommon. There is every appearance of the gravest illness. The face has a dusky flush, the tongue becomes dry, the abdomen sinks, the pulse becomes feeble, and the patient is collapsed. A peculiar form of breathing, known as "air hunger," characterised by deep, laboured respiration, is common. The breath smells

strongly of acetone, and the urine generally gives a marked ferric chloride reaction. Not all these symptoms, however, necessarily occur in any one case. They may be grouped around five heads—nervous, gastric, respiratory, collapse, and excretion of ketones, and sometimes one, sometimes another series predominates.

It will be seen that in this varied symptomatology the clinical picture of acid intoxication departs to some extent from that produced experimentally in animals, and it is not quite certain that all the above symptoms are due exclusively to acidosis. The purest type of the condition exists in diabetic coma, which responds, moreover, temporarily at least, to alkaline injections much more rapidly than do any of the others.

Types of Acidosis and Acid Intoxication.—From a clinical point of view, we may group cases as follows:—1. Symptomatic acidosis. 2. Acid intoxication from drugs. 3. Diabetic acidosis. 4. Cyclic vomiting. 5. Delayed chloroform poisoning. 6. Acidosis in infancy. The different groups overlap to some extent, but in their leading features they are sufficiently distinct from one another.

1. *Symptomatic Acidosis.*—Acetonuria, accompanied or not by an odour of acetone in the breath, but not associated with any other symptoms which at present can be referred to acidosis, occurs in a great variety of conditions. It is met with in sepsis, acute pneumonia, fevers of all kinds, appendicitis, peritonitis, gastric ulcer, diphtheria, toxic gastro-intestinal disorders, starvation, and indigestion, especially in children. Its occurrence in these cases has been ascribed to organismal toxæmia and auto-intoxication, but the view held by most of those who have paid particular attention to the subject, is that in these, as in other cases, defect in the oxidation of carbohydrates is to blame.

2. *Acid Intoxication from Drugs.*—Among drugs which cause acidosis, phloridzin, morphine, and phosphorus may be mentioned. By far the greatest practical interest, however, attaches to the acid intoxication which may result from the administration of sodium salicylate, especially when the drug is given in very large doses. Air hunger is the first danger signal; it indicates a cessation of the salicylate and the free administration of sodium bicarbonate. Dr. Lees advises that twice as much sodium bicarbonate as salicylate should be given when the latter drug is being freely used, and that constipation should be treated. If these precautions are taken, serious intoxication is unlikely to occur.

3. *Diabetic Acidosis.*—The clinical features of diabetic coma are described elsewhere. It is easy to understand why a diabetic is specially liable to acidosis. He takes little carbohydrate, and cannot utilise what little he does take. The greater his intolerance of carbohydrate, the more certain is he to suffer from ketonuria; if, however, he can assimilate as much as 80-100 grams of carbohydrate per day, ketonuria will probably remain absent. The inhibition of ketonuria by carbohydrate depends, of course, not on the amount eaten, but on the amount catabolised. When the acetone in the urine amounts to about ·5 grams per day, diacetic acid (shown by ferric chloride test) is generally also present. The ketonuria of diabetes, though on the whole similar to that of inanition, differs from it in the following particulars (Noorden):—1. A diabetic patient may tolerate starches in quantities which, in a normal person, would be enough to prevent ketonuria; yet, notwithstanding this, he may develop ketonuria. 2. In a diabetic a change from a mixed to a carbohydrate-free diet may cause ketonuria, which does not disappear when carbohydrates are again added to the food. 3. In other cases ketonuria disappears on a strict diet, on account of the improvement in the general condition. 4. Diabetic ketonuria varies, though the diet and catabolism of sugar remain constant; and different persons, on the same diets, and having identical powers of catabolising sugar, exhibit differences in the amount of ketones they eliminate.

4. *Cyclic Vomiting.*—This has only been recognised as a definite clinical entity within recent years. It is also known as periodic vomiting, vomiting with acetonæmia, and food fever with recurrent gastric catarrh (Eustace Smith). It usually occurs in childhood, from the second or third year and onwards; it tends to cease spontaneously at puberty, when, it is said, it may be replaced by migraine. The attacks recur at irregular intervals of a few weeks or months. The vomiting, which is the outstanding feature, sets in suddenly, usually in the midst of perfect health. It is projectile, extremely severe and uncontrollable, the smallest quantity of fluid being at once rejected. With this vomiting the child looks extremely ill; he is at once prostrated, the eyes become hollow, the face has a dusky flush, the tongue is dry, and there is great thirst. The fruity odour of acetone is very evident in the breath, and there is usually also acetonuria. The attacks generally last for five or six days—rarely much longer; they are accompanied by very apparent wasting. The vomiting ceases as suddenly as it began, and there is, simultaneously, rapid improvement in the general condition. The appetite returns immediately, there is no sign of indigestion, and recovery is very rapid.

In another group of cases the clinical features are somewhat different. The patients are children who suffer from chronic indigestion, and are particularly intolerant of carbohydrates. They are liable to attacks of pyrexia, to urticaria, and to paroxysmal vomiting with

acetonuria. Marked irritability of temper sometimes characterises the onset of a vomiting bout, or an attack of pyrexia. The parents of such children are often "gouty," and the patients themselves often suffer from gravel.

Cyclic vomiting may easily give rise to errors in diagnosis. It has often been mistaken for obstruction, and even operated on in that belief. The history, the odour of acetone, and the hollowed-out abdomen should prevent this error. The persistent vomiting and the retracted abdomen may also lead to a diagnosis of meningitis; here the history, the acetonuria, the absence of irregularity of the pulse, should lead us aright.

Cyclic vomiting is seldom fatal, hence there are few pathological records. It is, however, a curious fact that a relatively large number of deaths have occurred during a first attack of vomiting. However desperately ill the patient may appear, there is always room to hope that the vomiting will suddenly cease. Langmead describes the pathological appearances in four cases. The principal lesion found was well-marked fatty infiltration of the liver, and cloudy swelling, with some fatty change, in the kidneys.

5. *Delayed Chloroform Poisoning.*—Although this is described elsewhere (p. 28), it must be shortly referred to here. It is more commonly seen in children than in adults, and is especially liable to occur after laparotomy for any acute abdominal infection. The symptoms closely resemble those described above as characteristic of acidosis, and the post-mortem appearances, according to Guthrie and Langmead, are identical with what are found in cyclic vomiting.

6. *Acidosis in Infancy.*—In many infants suffering from gastro-intestinal disorder, the urine contains a relatively large amount of ammonia nitrogen. Keller associates this fact with an excess of fat in the diet. As we have seen, increase in the output of ammonia nitrogen is a measure of acidosis. The excess of fat may lead to an increased absorption of fatty acids from the intestine—"absolute acidosis," or it may operate in another direction. According to Keller, the fatty acids in the intestine are neutralised by the fixed bases of the tissues, which are found in the stools. The body is therefore despoiled of its alkali, and "relative acidosis" results.

It must not be supposed that the theory of acid intoxication is free from difficulties. Guthrie sums up the alternative hypotheses as follows:—

"1. That so-called fatty acid intoxication is due to deficiency of bases in the body to neutralise the acids formed, rather than to excess of the acids themselves.

"2. That diabetic coma, and therefore other cases attributed to fatty acid intoxication, are really instances of CO_2 poisoning.

"3. That the toxic symptoms following anæsthetics are due to the anæsthetic remaining in combination with certain tissues of the body, or, in the case of chloroform, to its administration in too concentrated a form.

"4. That idiosyncrasy explains post-anæsthetic poisoning.

"5. That the symptoms are merely those of carbohydrate starvation (Beddard).

"6. That they are due to disturbance, not merely of fat metabolism, but also of the proteolytic, antitoxic, and glycogenic function of the liver (Hunter)."

At the present time, however, the acid intoxication theory, as outlined above, is both the best explanation of the phenomena and the best working hypothesis.

Therapeutic Considerations.—The chief indications would seem to be to administer alkalies and carbohydrates. Alkalies have been extensively employed—on the whole with good results In diabetic coma the manner in which intravenous injections of sodium bicarbonate sometimes restore consciousness is as striking a proof as could be desired of the essential nature of the condition; the improvement, unfortunately, is always merely temporary. In all cases of acid intoxication the attempt should be made to introduce large quantities of alkalies into the system—by the mouth, the bowel, or subcutaneously. When the stomach will retain it, sodium bicarbonate should be given in doses of 30 grs. or more at frequent intervals. For subcutaneous or (preferably) intravenous injection a 3-5 per cent. solution of the salt is used; when the drug is given by the rectum, from 120 to 480 grs. may be given in the day. If there is reason to suppose that chronic acidosis short of intoxication exists, alkalies should also be given regularly. Their effect in promoting elimination of the acetone bodies has already been mentioned. Joslin has recently suggested that since acidosis means a loss to the body of all the fixed bases, it is not enough to introduce sodium alone, and recommends the use of alkaline salts of potash, soda, lime, and magnesia.

Theoretically it would seem a simple matter to treat acidosis by giving carbohydrate. In acidosis from inanition or starvation the use of a starchy food undoubtedly brings about a cessation of the acetonuria. Except in diabetes, however, carbohydrates have not been much used in actual or threatening acid intoxication. Hunter suggests giving to patients about to be anæsthetised a well-sweetened meal three hours prior to operation. In acute acid intoxication, whether cyclic vomiting or delayed chloroform poisoning, the use of sugar or lactose does not appear to afford much benefit, but it seems reasonable to give them a trial, along with alkalies. Possibly levulose, which is more

readily catabolised by diabetes than other forms of carbohydrate, might prove useful in such cases. In the class of case described by Eustace Smith as "food fever," the line of treatment which has been found most satisfactory has been the limitation of the carbohydrate elements in the diet. This seems to point to such patients being unable to deal with carbohydrates in a normal fashion, and perhaps some inability of this kind is the factor which determines the occurrence of acidosis. Noorden points out that many diabetics can assimilate more starch when only one variety is given than when the diet contains mixed carbohydrates, and has introduced an "oatmeal cure" based on this fact (see DIABETES). A similar line of treatment seems worthy of trial in children with defective power of dealing with carbohydrates. Among "antiketogenous" substances which may, to some extent, replace ordinary sugars and starches, Noorden enumerates albuminates, pentoses, glyconic acid, glycerin, citric acid.

FATS.—Seeing that the acetone bodies are derived from fats, should these not be withdrawn from the food where acidosis is feared? Apparently little is gained by doing this. The giving of fats does not increase fat catabolism; it only leads to the food fat being catabolised instead of the body fat. Only the lower fatty acids, especially butyric acid, have a marked effect in increasing ketones, so that practically the chief matter is to restrict the intake of butter and cream. In the acidosis of infants the indication is to reduce the ration of milk greatly, and to give malted and unmalted starchy foods.

In addition to these causal indications, the symptoms of acid intoxication require treatment on the ordinary lines.

LITERATURE.—VAN NOORDEN, *Metabolism and Practical Medicine*, English edition, edited by Walker Hall, London, vol. i. p. 169; vol. iii. pp. 586, 882, 1907.—JOSLIN, *Trans. Assoc. Amer. Phys.*, xxii. p. 246, 1907.—FOLIN, *idem*, p. 256.—GUTHRIE, SPRIGGS, *Brit. Med. Journ.*, ii., 1908.—LANGMEAD, *Brit. Med. Journ.*, ii. p. 820, 1907.—BEESLY, *Brit. Med. Journ.*, May 19, 1906.

Acromegaly.—SURGICAL TREATMENT.—There are now on record a number of cases where acromegaly is said to have been cured by surgical means. The procedure adopted has been to remove the tumour of the pituitary gland, which is so constantly present in this disease. The function of the pituitary gland has been carefully investigated in recent years by Schaeffer, Herring, and others. The function which its secretion subserves is not yet understood, but it would appear that it is intimately concerned with growth and development. When this is the case it is not surprising that disease of the pituitary gland should so frequently be associated with gross malformation of the osseous and other tissues. The successful removal of tumours of the pituitary gland by surgical operation in cases of acromegaly has been attended by so pronounced an improvement in the patient's condition that it can now be considered as definitely proven that in many, if not all, cases of acromegaly the cause is to be found in an aberrant function of the pituitary gland.

Von Eiselsberg, of Vienna, was one of the first to obtain a successful result after operation in cases of acromegaly. One of his cases was that of a patient of thirty-three years of age. It showed the typical features of acromegaly. Eight years prior to operation she noticed, while pregnant, enlargement of the hands, feet, and face. She had previously suffered from headaches and visual disturbances. X-ray examination revealed a considerable enlargement of the sella turcica. An operation for the removal of the tumour was undertaken at the patient's request. A solid growth was found involving the pituitary, which proved on examination to be of the nature of a sarcoma. The patient died two days after operation, from meningitis.

The method adopted by von Eiselsberg for obtaining access to the pituitary gland is one where a nasal flap is made, and access gained by the removal of the wall of the frontal sinus.

Hochenegg, of Vienna, has recently operated on a patient who was thirty years of age, and in whom the diagnosis of acromegaly had been made. The Röntgen-ray photograph of the skull showed a tumour of the pituitary to be present. The disease first appeared when the patient was aged fifteen years. At first, intense headache and periodic attacks of perspiration and epistaxis were complained of. This was followed by defective vision. At twenty-five years of age a marked improvement took place in the patient's condition. This was, however, followed later by a return of the disease in a more aggravated form. Enlargement of the hands and feet now developed, and marked thickening of the lips and face appeared. She was operated upon after the method of von Eiselsberg. A nasal flap was made, the nose turned back, and the hypophysis by this means exposed on chiselling through the sella turcica. The neoplasm was removed by means of the curette. It was found to be, on examination, an adenoma. The patient made an excellent recovery; the headaches disappeared, the eyesight became much improved, the hands and feet are said to have become much reduced in size.

The pronounced improvement that followed the removal of the pituitary tumour in this case is strong evidence in support of the growth having been responsible for the acromegalic condition.

Acroteric.—Belonging to the outermost points (Gr. ἄκρος, at the end)—a term used by

Sir Jonathan Hutchinson (*Brit. Med. Journ.*, i. for 1910, p. 1497) to denote the white marks found on animals' (*e.g.* horses') feet, the tip of the tail, the forehead, and the ears; these marks are believed by him to find their representatives in the human subject in such abnormalities as the "piebald negro."

"Acute Abdomen."—A general term indicating all the acute conditions developing in the abdomen and calling for immediate (emergency) operation. Among such are acute appendicitis, acute intussusception, general peritonitis, strangulated hernia, twisting of the pedicle of an ovarian cyst, etc. See Spencer, W. G., *Brit. Med. Journ.*, ii. for 1909, pp. 1789-1792; and Carmichael, E. S., *International Clinics*, s. 20, vol. iv. p. 98, 1910.

Adams-Stokes' Disease or Syndrome.—Slow heart's action (bradycardia) associated with fainting or epileptoid attacks, and occurring as a complication of heart-block. *See* Heart, Diseases of (*Irregular Action*).

Addiment.—A term used in bacteriology, synonymous with *complement*. *See* Immunity.

Adenomyoma.—A myoma (or "fibroid") containing scattered gland tubules, which have been regarded as cell-rests of parts of the Wolffian body (paroophoron) or duct, but they may be simply inclusions of uterine glandular tissue in the developing myoma (Adami, *Pathology*, i. pp. 748, 749, 1910).

Adrenal Glands.—Hutchison (*Quarterly Journ. of Med.*, Oct. 1907) directs attention to the existence of a definite clinical syndrome occasionally met with in children, viz. suprarenal sarcoma with metastases to the skull. He gives the following epitome of the symptoms, based on ten cases:—The ages of the patients varied from nine months to nine years. In most cases the first thing noticed was swelling of the bones of the skull, with proptosis, and sometimes ecchymosis of the eyelids. Anæmia is a striking feature, the blood picture being that of secondary anæmia, without leucocytosis. An abdominal tumour in one or other loin was felt in five cases. The progress of the disease is rapid—one to six months—and is marked by advancing exhaustion and anæmia, signs of increased intracranial pressure, optic neuritis, and blindness. The tumours of the skull increase in size, fill up the temporal fossæ, and give a very characteristic appearance. Post mortem, there was found in all cases a sarcoma of one or other suprarenal with metastases to the skull bones, ribs, and vertebræ, but not, as a rule, in the long bones, and only exceptionally in the viscera. The disease simulates scorbutus with orbital hæmorrhage, and chloroma (*q.v.*). In either case the differential diagnosis is easy—failure of antiscorbutic diet, and absence of lymphocytosis. While the condition is usually described as a sarcoma, it is possible that some cases are really malignant hypernephromata, which are more closely allied to carcinomata.

Precocious obesity, with premature development of the sexual organs, has been described by Bulloch and Sequeira, Guthrie, and others, as an accompaniment of hypernephroma (*Trans. Path. Soc. Lond.*, 1905; *Rep. Soc. Study Dis. in Children*, vol. vi. 1906; vol. vii. 1907).

Tilerton and Wolbach (*Amer. Journ. Med. Sci.*, June 1908) divide cases of suprarenal sarcoma into four categories:—(1) Those with metastases to the skull (Hutchison's type). (2) Simultaneous of liver and adrenals. (3) Those associated with precocious maturity. (4) Those not falling under any of the preceding heads. *See* also Frew, *Quart. Journ. Med.*, Jan. 1911.

Adrenalin.—The extract of the suprarenal gland; a proprietary preparation.

Adrenin.—The extract of the medulla of the adrenal gland (*Schäfer*).

Aeropathy.—A comprehensive term (Gr. ἀήρ, the air, πάθος, suffering) suggested (by Seward Erdman, *Journ. Amer. Med. Assoc.*, xlix. p. 1665, 1907) for the various symptoms due to greatly altered barometric pressure; it includes, therefore, caisson disease, balloon sickness, divers' paralysis, compressed air illness, and "bends."

Agglutinogens. *See* Immunity (*Agglutination*).

Aggressins.—A term used in bacteriology to signify bodies or substances, not toxines proper, which are excreted or discharged from virulent microbes, which have an inhibitive action upon the cells of the organism, and which either neutralise the action of the opsonins or directly repel the body cells; they have been regarded as new undescribed substances, or as free bacterial receptors, and it has been suggested that they are to the bacterial organism what the opsonins are to the animal (Adami, *Pathology*, i. p. 557, 1910).

Air Hunger. *See* Acidosis (*Clinical*).

Alanin.—Amino-propionic acid ($C_3H_7NO_2$).

"Albulactin."—A soluble salt of lact-albumen which is intended to be added to diluted cows' milk (for infants' use) in order to make its protein constituents similar to those in human milk, *i.e.* about equal amounts of casein and albumen. The *British Medical Journal* report (vol. i. for 1910, p. 1242) states that it is a fine dry powder, containing 12·71 per cent. of nitrogen and 5·22 per cent. of mineral constituents, and that on the addition of acid to a solution of it no clots are formed, but the albumen is precipitated in finely divided form. It is to

be added to diluted milk in the proportion of 1 to 100, with milk sugar in addition. It is claimed that a soft, finely subdivided curd forms in the stomach resembling that resulting from the ingestion of human milk.

Alcoholism. — QUINQUAUD'S SIGN. — This is a phenomenon which, particularly in Germany, has been the object of study to a greater extent than its importance merits. It was originally described by Maridort in 1900; his attention had been drawn to it by Quinquaud seven years earlier. Quinquaud's sign, which was at one time expected to afford a means of detecting alcoholism, is elicited thus:—The patient allows his outstretched fingers to rest lightly on the palm of the observer's hand at an angle of about 45°—in the position assumed in playing the piano. After a few seconds the observer can feel a sort of crepitation, as if the phalanges of the patient were knocking against one another. The crepitations can be heard if the patient's fingers rest on a small resonator—a box made of thin wood—to which the chest-piece of the observer's stethoscope is applied. Unfortunately, Quinquaud's sign is not pathognomonic of alcoholism: it is common in alcoholics, fairly frequent in moderate drinkers, rare in abstainers. Fürbinger states that if it is well marked the patient is probably a drunkard; if absent, alcoholism is excluded. According to Minor, it is very common in tabes—a "hypotonic phenomenon." Lautscher looks on the sign as evidence of general nerve instability, and common in alcoholism. The mechanism of the sign is unsettled; some have regarded it as a crepitation of osseous surfaces on one another from fibrillary contractions of the interossei; others think it is produced in the tendon sheaths. Statements as to its relation to tremor vary; some assent, and some deny, an association between the two.

LITERATURE. — FURBINGER, *Deutsch. med. Wochenschr.*, No. 27, 1904; *Berl. klin. Wochenschr.*, May 22, 1905.—MINOR, *ibid.*, Nos. 18, 19, 20, 21, 1907.—LAUTSCHER, *ibid.*, Nos. 34, 35, 1906.

KORSAKOFF'S PSYCHOSIS.—This is a peculiar symptom-complex which is most commonly associated with alcoholic peripheral neuritis, but may occur apart from neuritis, and may also result from other intoxications, *e.g.* chronic lead and arsenic poisoning, infectious diseases, or from senile arterial changes. It may be preceded by delirium tremens, or by alcoholic stupor. The four cardinal mental symptoms are (1) poor retention—inability to impress passing experiences on the memory; (2) defective memory for recent events; (3) disorientation in time and space; (4) and confabulation. Owing to the memory defect actual events are hopelessly mixed up and described in erroneous sequence and connection, leading to rather fantastic stories. The patient's memory has awkward gaps in it, and he advances ingenious fabrications to bridge over these, and to supplement the defects (confabulation). Notwithstanding the disorientation in time and space, the patient reacts fairly well to the immediate surroundings. Korsakoff's psychosis is much more common in women than in men.

LITERATURE.—CHAPIN, *Rev. Neur and Psych.*, vol. v. p. 172, 1907.—BONHOEFFER, *Allg. Zeitsch. f. Psych.*, Sept. 2, 1904.

Aleukæmic Leukæmia. *See* LEUKÆMIA (*Atypical Forms*).

Allelomorphism. *See* HEREDITY (*Mendel's Law*).

Allergia (Gr. ἀλλά, in another way, and ἔργω, I do work).—A synonym of anaphylaxis (*q.v.*), introduced by von Pirquet.

Alloæsthesia. *See* ALLOCHIRIA.

Allochiria or Allocheiria.—Dr. Ernest Jones believes that under the term allochiria (the false reference of a point stimulated to a corresponding point on the opposite side of the body) two quite different conditions have been placed. There may be a general defect in the localisation of cutaneous stimuli, and to this state the name of *alloœsthesia* is to be given; or there may be a specific defect, independent of any error in localisation—*dyschiria*—a state in which, independent of any defect in sensorial acuity or in the power of localisation, there is constantly ignorance or error in the patient's mind as to the side of given stimuli. Jones regards dyschiria as divisible into three stages, of which the first and third are quite temporary and transitional: *achiria*, in which there is no knowledge of the side of the stimulus; *allochiria*, in which it is referred to the corresponding point on the opposite side; and *synchiria*, in which it is referred to both sides. Dyschiria is looked upon as characteristic of hysteria, being a form of psychical dissociation or disaggregation, the cleavage of certain normally associated mental processes.

LITERATURE.—*Rev. Neurol. and Psychiat.*, Aug. and Sept., 1909.

Allomorphism (Gr. ἄλλος, another, μορφή, form).—A term introduced by Orth to signify a simple morphological change of cells due to mechanical action, as seen in the flattening of cylindrical cells in cysts from the pressure of the cyst contents (Adami, *Pathology*, i. p. 641, 1910).

Aloin Reaction. *See* DIGESTIVE FUNCTIONS, TESTS FOR.

Altmann's Granules. — Altmann's granules, also known as plasmasomes or fuchsinophile granules, are found in most kinds of normal cells, and it is stated that their pres-

ence is noted in inflammatory conditions and in innocent neoplasms, but that in malignant new growths they tend to disappear or are altogether absent from the particular type of cell involved. It has been maintained that there thus exists a "granularity" test for malignant disease, and Beckton's conclusions are (1) excluding new growths originating in cells not normally containing Altmann's granules, absence of granules from all or nearly all the essential cells of a new growth indicates malignancy; (2) presence of Altmann's granules in all or nearly all the essential cells of a new growth is usually associated with non-malignancy, or only with malignancy of a special kind or limited degree (*cf.* thyroid, ovary); and (3) in a tumour the diagnosis of which lies between inflammation and sarcoma, presence of Altmann's granules indicates the former, absence the latter. *See* H. Becton, *Brit. Med. Journ.*, ii. for 1909, pp. 859-861; ii. for 1910, pp. 1422-1425.

Amphimixis or Amphimyxia.—The fusion and intermixture of the germ plasm contained in the nuclei of the spermatozoon and ovum (pronuclei) taking place in the fertilised ovum; it is a factor in variation. (Gr. *ἀμφί*, on both sides, *μῖξις*, a mixing.)

Amyloidosis.—General amyloid (waxy) or "chondroid" infiltration of an organ, such as the liver or spleen.

Anæmia, Pernicious. — (*See also* LEUKÆMIA, LEUKANÆMIA).—Hunter has elaborated his theory of the toxic nature of pernicious anæmia, and has described as characteristic of the disease a peculiar condition of glossitis. He regards this as one of the initial lesions, and associates it with exposure to drain infection. Hunter's observations have not, however, been generally confirmed. From a careful study of the morbid changes in a large series of cases Gulland and Goodall have arrived at the following general conclusion:—Pernicious anæmia is essentially a megaloblastic anæmia. The evidences of blood destruction throughout the body are so widely spread as to indicate rather a generally increased vulnerability of the blood-cells than a pathologically excessive hæmolytic action on the part of so many tissues. In some part of the body, not necessarily the intestine, a toxin is produced which acts directly on the marrow, interfering with normoblastic blood formation, leading to megaloblastic formation, and exerting negative chemotactic influences on the leucocytes. The megaloblastic degeneration is a reversion to the fœtal type.

TREATMENT. — The X-rays having proved useful as a palliative remedy in leukæmia, have also been employed in pernicious anæmia. The reports which have been published are by no means encouraging, and it seems probable that the rays are as likely to do harm as good in pernicious anæmia. Byrom Bramwell advises that in the event of arsenic arresting the disease and producing a certain degree of improvement, a course of iron should be given. He records ten striking cases in which the administration of iron after arsenic was attended with marked improvement.

APLASTIC ANÆMIA.—Although this form of anæmia was described by Ehrlich in 1888, little attention has been paid to it until recently. It may be defined clinically as a severe form of pernicious anæmia which progresses steadily downwards without any of the remissions which are so characteristic of the ordinary type of the disease.

The individual symptoms differ in no respect from those of any severe anæmia, but the blood picture diverges more or less from what is generally considered characteristic of pernicious anæmia. There is a marked fall in hæmoglobin, red corpuscles, and leucocytes; the red corpuscles show the ordinary deformation, but megalocytes and nucleated red corpuscles are entirely, or almost entirely, absent, and the colour index is low. There is leucopenia, with relative lymphocytosis. When the absolute number of the different varieties of white cells is counted it is found that the diminution in the total is due to the small number of polynuclears. From the absence of nucleated reds and the diminution of polynuclears, it may be inferred that the marrow is inactive, and, in fact, such is the case. Instead of the red jelly-like marrow which is characteristic of pernicious anæmia, the marrow in aplastic anæmia is pale yellow and shows no sign of regeneration.

The cause of aplastic anæmia is unknown; for the present it seems best to classify it as a variety of pernicious anæmia. The recognition of the existence of such a group of cases is practically important, because the prognosis is much worse as regards the duration of life than in pernicious anæmia, and a case in which the above blood picture is observed must always be looked upon with anxiety.

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Anæsthesia and Anæsthetics.

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IN recent years there has been witnessed a profound alteration in the methods of inducing anæsthesia during surgical operations. The reason of this lies in the perfection which has been obtained in the practice of methods of local and regional anæsthesia.

GENERAL ANÆSTHETICS.

Under this category chloroform and ether still maintain their position as the anæsthetics of choice in major surgical operations, and nitrous oxide and ethyl chloride are the drugs most depended upon when anæsthesia of short duration is required. The trend of popular opinion as to the relative merits of chloroform and ether has altered considerably of late in favour of the use of the latter, and this is especially to be noted in the home of chloroform, the Edinburgh Medical School. In spite of much advice from without, and of occasional alarming experiences within, the graduate of that School held to the opinion expressed by Lister in 1870, "that the danger of chloroform may be compared not inaptly to that of railway travelling. In both cases the risk incurred by any individual is so small that it does not enter seriously into our calculations, and just as railway accidents are generally occasioned by culpable mismanagement, so death from chloroform is *almost invariably* due to faulty administration." The explanation of the alteration lies, not in the discovery of new dangers during the actual administration of the drug, but in the revelation of risks more remote, and to which the term "delayed chloroform poisoning" has been given.

Delayed Anæsthetic Poisoning—Delayed Chloroform Poisoning.—Up to within a few years ago it was generally considered that, though the use of chloroform might give rise to a certain increased degree of responsibility to the operating surgeon during its administration, he was compensated for this by the knowledge that the complications to which it might give rise at a later date were less serious than was the case when ether was the anæsthetic. According to certain observers, however, this appears not to be correct, and especially in those cases where sepsis is present, the use of chloroform is attended with an increased amount of danger.

Delayed chloroform poisoning has been investigated in this country, more especially by Guthrie, Stiles, and M'Donald. In 1894 Guthrie published an article on "Some Fatal After-Effects of Chloroform on Children," and in it he drew attention to a class of case, the clinical characteristics of which were usually pronounced and the pathological features distinct, but the actual cause of death somewhat obscure. The cases all possessed the factor in common that operations under chloroform had been performed. In the majority the operation had been one of no undue severity, but instead of making a rapid recovery the child developed acute delirious mania, uttering shrill, piercing screams at short intervals. Its eyes were dry, the pupils often dilated; its face usually was flushed, but in some cases pronounced pallor was noticeable. In certain of the cases these symptoms came on directly after the child had been returned to bed; in most they were not noticeable until the evening, and the child was observed to be restless and sleepless and often in a state of wild terror and anxiety. The temperature, which had been subnormal after the operation, had usually now risen to from 101° to 103° Fahrenheit. Consciousness was lost early, and at intervals the child was dull and apathetic. Grating of the teeth was present in some cases. A salient feature of the condition was the occurrence of extremely violent, persistent, and copious vomiting. This vomiting occurred even when the child was fed by the rectum. At first, food was returned from the stomach, and thereafter a clear or yellowish fluid, and this in most cases was succeeded by a vomit having the appearance of the dregs of beef-tea. This last Guthrie considered to be specially characteristic of this disease. Only in a very occasional case could it be described as having a "coffee ground" appearance. Death, preceded by coma and exhaustion, usually occurred within from one to nine hours. The type of breathing was like that which is common in cases of death from gradual respiratory failure. The inspiration was spasmodic, irregular, and gasping, with gradually increasing intervals between the acts, until the last breath was drawn; while expiration throughout was ineffective and attended by little or no action of the extra expiratory muscles. The pathological examination of the organs after death in these cases showed evidences of the widespread operation of an intense poison, as manifested by the degeneration of the parenchymatous tissue in many organs. This was especially observed in the liver, where an extreme degree of fatty degeneration was constantly present. The kidneys usually showed a similar appearance, but less pronounced in degree. The heart in certain of the cases showed fatty degeneration of its muscle fibres. No other pathological finding was at all constant. The most careful examination failed to detect the presence of sepsis or fat embolism. There was also no evidence that death had been caused by the absorption of any of the various antiseptics used during the treatment, such as carbolic acid or iodoform.

The ultimate conclusion to which Guthrie was driven as to the cause of death in these cases was that it was due to the after-effects

of the chloroform. He was unable to account otherwise for the fatalities than by supposing that the deaths were due to auto-intoxication, that the fatty degeneration of the liver existed before the operation, that chloroform and operation shock combined aggravated the functional disturbance already present, and thus loaded the system with toxic alkaloids, which the kidneys in certain cases were unable to eliminate. Guthrie, therefore, advised that in no case should chloroform be given to a patient suffering from fatty liver, and, as it is impossible, from physical signs and symptoms, to do more than surmise the existence of the same, we must rely on signs of functional inactivity of the liver as indicated by the excess of alkaloidal substances present in the urine. The precise nature of such alkaloidal substances, and the best method of detecting them, must be left for further investigation.

Little has been added to the clinical picture as described by Guthrie. It is now known that the disease is virtually associated constantly with the presence of acetone in the urine, and cases have been observed where the onset has been more gradual and the progress slower. All observers confirm the constancy with which the characteristic "beef-tea" vomiting occurs. Stiles and M'Donald lay special emphasis on this, and suggest that the persistent chloroform sickness present after operation in certain cases may be a minor manifestation of the same condition. "Every surgeon who has closely watched patients after operations in cases of acute appendicitis, and occasionally after operations performed during the quiescent period, must have observed the critical condition in which he occasionally finds his patient about forty-eight hours or so after the operation. The chloroform sickness has persisted, the vomited matter is of the dark hæmorrhagic type already referred to, the patient has become rapidly emaciated, the pulse is small, rapid, and often irregular. There is sleeplessness, often extreme restlessness, and the patient is threatened with death from collapse. The urine contains a trace of albumen. There is no complication indicated with the wound, no pain, no increase of tenderness, and no distension. Nevertheless the patient is in a very critical condition, and the surgeon fears either general toxæmia or the commencement of a spreading peritonitis. Should no improvement set in, the surgeon will probably deem it necessary to open up the wound and investigate the deeper parts. He may find nothing wrong at the site of operation, and after adopting certain therapeutic measures he is relieved to find that, during the next twenty-four hours, the patient's condition may have improved to such an extent as to call for no further anxiety. What is the exact cause of the symptoms in these cases? Are we dealing, though in a milder degree, with the same acute fatty degeneration changes that we can demonstrate as having occurred in the fatal cases, and if so, what share has the chloroform taken in bringing them about?" If it can be proved that in infective conditions, such as that above referred to, chloroform may so supplement the harmful action of the bacterial toxine as to be responsible for death, the question of substituting some other anæsthetic is obviously indicated. Beesly, when resident surgeon under Mr. Stiles, carried out certain most valuable observations on post-anæsthetic acetonuria. He confirmed the occurrence of the presence of acetone in many different diseases. A certain degree of acid intoxication occurs after every surgical operation in which a general anæsthetic is administered. With chloroform, varying degrees of poisoning are met with, from the slightest manifestation to the case of death from delayed anæsthetic poisoning. Acetone may be looked upon as being virtually constantly present in cases where sepsis has occurred; the administration of an anæsthetic may alter the normal elimination of this, and aggravate the clinical symptoms of intoxication. When ether was substituted for chloroform as the anæsthetic in cases where acute suppuration was present, the result of the change was claimed to prove that the previous mortality had, to a certain extent, been dependent upon the use of chloroform. Out of nineteen cases of acute appendicitis operated on under chloroform, fourteen died. Out of twenty-four cases operated on under ether, only two died.

Experimental evidence of the damage done by chloroform when administered as a general anæsthetic was first clearly demonstrated by Ungar and Junkers in 1883. They were the first to demonstrate that fatty degeneration can be produced by chloroform when administered by inhalation. Since then numerous other investigators have confirmed this observation. It has been found impossible, however, to reproduce with any degree of constancy the same clinical features and pathological appearances with which delayed chloroform poisoning in man is associated. The reason of this, according to Stiles and M'Donald, is to be found in the fact that the fundamental cause of the death lies in a personal idiosyncrasy to the drug which is possessed by the patient. Guthrie, in his most recent article, emphasises the fact that the symptoms of so-called delayed poisoning by chloroform, ether, or ethyl chloride are those of acute fatty acid intoxication. The fatty acids which produce symptoms, viz. B. oxybutyric and diacetic acid, which are the poisonous precursors of acetone, are themselves the result of insufficient oxidation or imperfect metabolism of fat. Fat in excess must be present somewhere, in order

to give rise by its imperfect metabolism to fatty acid intoxication. The liver, being the chief seat of metabolism of fat, must naturally be the chief organ suspected. All, or nearly all, the diseases and conditions under which operations followed by fatal symptoms of acetone poisoning have been performed are those which are known to be associated with fatty liver. Causeless vomiting in a child would, according to him, justify postponing an operation. When the patient is suspected to possess a fatty liver, diet restricted in fat should be given for some days. Such fatty acids as may be present are best neutralised by the administration of bicarbonate or citrate of soda. Mild purgation is also beneficial. As starvation will give rise to acute acetonuria, nutrient enemata should be given two hours before and immediately after an operation. (*See also* ACIDOSIS.)

The treatment of post-operative intoxication should be, according to Guthrie, by venesection, saline transfusion, and the administration of bicarbonate of soda. This may be given either by rectal injection or subcutaneous infusion.

Narcosis Anæsthesia. — The most convincing proof that can be obtained of the advantages of the induction of narcosis prior to the administration of a general anæsthetic can be observed when chloroform or ether, especially the former, is given to an animal, such as the dog. When endeavour is made to anæsthetise the unnarcotised dog, a dangerous and most unpleasant performance is witnessed, for when the violent struggling of the animal is past, frequently it is found that a state of suspended animation culminating in death follows. When, on the other hand, a hypodermic of morphia is given, one hour prior to the giving of the anæsthetic, the animal is found to pass quietly under the influence of the drug, and even chloroform proves with such animals the safest of anæsthetics.

The induction of narcosis by the hypodermic administration of morphia prior to the giving of an anæsthetic has been practised for long, especially in cranial surgery. Recently this method has been more widely used, and with morphia there has been associated another drug —scopolamine—which antagonises certain of the more harmful effects of morphia, and at the same time augments its beneficial action.

Scopolamine - Morphine Anæsthesia. — Scopolamine is a drug that belongs to the atropine tropene group. The greatest drawback to its use is the inconstancy of the purity of the drug, and its liability to undergo decomposition. Kobert found that scopolamine, when applied to the cortex of the brain, diminished its electric irritability. It was in cases where pronounced cerebral irritability was present that it was first used in surgical operations by Schneiderling, the originator of this form of narcosis. The value of the combination of scopolamine and morphine consists in the cumulative hypnotic action on the cerebral centres. They thus possess in combination a pronounced hypnotic action, but in other respects they are antagonistic in their action.

Scopolamine - morphine anæsthesia has now been practised for some years. It is usually given in combination with a general anæsthetic, and has proved eminently safe and satisfactory. Thus Grim reports 2850 cases in which they were given prior to the administration of chloroform and ether, without any bad effects following. He found the number of cases of pneumonia following operation was reduced to one-third of what had previously been his experience.

Method.—The method of administration may be carried out as follows :—As the drug rapidly deteriorates, it is advisable that the mixture be freshly prepared prior to administration. Where cases in which this form of anæsthesia is to be practised are often coming under treatment, a stock solution may be prepared and kept for four or five days. In order to prepare this stock solution, it is advisable that some preparation, such as Merck's Scopolamine, be used. A half grain of the alkaloid should be dissolved in 100 c.c. of sterilised water. From this 4 c.c. is placed in a sterile ampoule, and to this is added ·033 grams, that is $\frac{1}{2}$ grain, of sulphate of morphia. Each bottle thus contains $\frac{1}{150}$th grain of scopolamine and $\frac{1}{2}$ grain of morphine. Two and a half hours before the operation one-third of the contents of the phial is given hypodermically. A like amount is given one and a half hours before the operation. In the meantime, the state of the patient is carefully watched. If the pulse is regular, the respiration rate not unduly reduced, and the patient soundly asleep, the second dose may be omitted. In many cases, however, it is found advisable to administer the third portion half an hour before the time of operating. The patient is thus admitted to the operating theatre in an unconscious or semi-conscious condition. The preparation of the skin can usually be done without rousing the patient. If this should cause restlessness, the general anæsthetic is commenced at once. In administering the anæsthetic the pupil is found usually to remain contracted. The amount of anæsthetic required is very much less than would be the case in the unnarcotised individual. Among the other advantages of this form of anæsthesia there may be mentioned the obvious benefit of admitting the patient to the operating theatre in an unconscious state. Mental and physical excitement are thus absent. The patient also, when returned to bed, usually sleeps for an hour or more. Post-operative vomiting occurs less frequently. The drugs have also this advantage, that, when ether is administered, there is no hypersecretion of mucus to obstruct the air-passages. In many

cases this method of inducing anæsthesia is found to be simple and satisfactory, but occasionally a case occurs where, probably from some personal idiosyncrasy to the drug, difficulty is experienced in bringing the patient under its influence.

The Psychical Effect of Anæsthetics.—Mention has already been made of the value of administering a narcotic prior to giving a general anæsthetic. The value of quieting the state of mental perturbation into which many patients are thrown can be easily realised and appreciated, but it is difficult to bring forward definite proof of this fact. Crile, in an article upon the "Psychic Factor in Graves' Disease," provides such a proof very clearly. From facts observed clinically, and from evidence obtained from experimental investigation, he submits the hypothesis that in Graves' disease the most powerful factor producing hyperthyroidism is psychic excitement. In some way, either directly or indirectly, this leads to the discharge into the circulation of an excessive amount of thyroid secretion, which in itself may cause death. According to him, the greatest factor in the mortality, when such cases are treated surgically, is not the operation, but what has occurred prior to this. In other words, at the time the surgeon makes his first incision the fate of the patient has been already decided. When Graves' disease is to be treated by surgical operation, this should be performed virtually without the patient's knowledge. The gland should be "stolen." In order to do this, Crile has devised a procedure which consists of a deliberate deception of the patient as regards the nature of the treatment to be undergone. On the evening prior to the operation bromides are given; in the early morning, if the conditions are favourable for operation, a hypodermic of morphia is administered. When under its influence ether is administered, the patient having been previously trained to believe that this procedure is part of a medical treatment. The operation of removing a part of the gland is then carried out. As a result of eliminating the psychic factor from the risks incidental to the surgical treatment of this disease, the author claims to have obtained a much higher percentage of recoveries.

Regional Anæsthesia.

Local Anæsthesia.—Local anæsthesia is now very widely practised, and the results obtained are found to be almost uniformly successful. It is an extremely safe method of inducing analgesia, and can be used in a wide variety of surgical operations. The uniform success which now attends its use is due to a variety of factors. The most important of these is the addition of the active principle of the suprarenal gland to the fluid infiltrated into the tissues. Braun was the first to use this substance in combination with cocaine as a local anæsthetic. Its presence causes contraction of the blood-vessels, and thus a smaller dose is required, the drug being localised, and its action intensified and prolonged in consequence. There would also appear to be evidence that, when it is ultimately absorbed into the general circulation, it has been changed into an innocuous compound. The result is that the amount of the anæsthetic required is considerably less when adrenalin is used, and the amount that can be given with safety is much greater. Another factor which has contributed to the success which has attended the practice of local anæsthesia in recent times is the much greater degree of dilution in which the fluid is used. As early as 1891 Schleich pointed out that it was possible to produce a very complete degree of analgesia if the tissues were thoroughly infiltrated with a cold, neutral, salt solution, and when given in such a manner the anæsthetic properties of such drugs as cocaine were greatly intensified. It is now customary to administer the anæsthetic dissolved in physiological salt solution. The advantage of injecting an isotonic fluid is that no irritation is caused, and the process is usually rendered absolutely painless. Braun has demonstrated that, when fluid such as distilled water is injected, this may be accompanied by a marked irritation of the part, even resulting in local necrosis. Probably also, to a certain extent, the increased success with which anæsthesia can now be induced locally is to be attributed to the use of certain drugs, such as novocaine, which are less toxic than cocaine. Novocaine is one of the more recent substitutes for cocaine which have been introduced as a local anæsthetic. It is obtained in the form of a crystalline powder, which may be heated to a temperature of 120° C. without decomposition, and melts only at 155° C. It is soluble in its own weight of cold water, and the aqueous solution is isotonic with human fluids, and in more dilute solutions it can be made up in normal saline solution. Novocaine is said to possess as great anæsthetic potency as cocaine, whereas the toxicity of it is extremely slight. It also would appear to be almost devoid of any irritating action on the tissues.

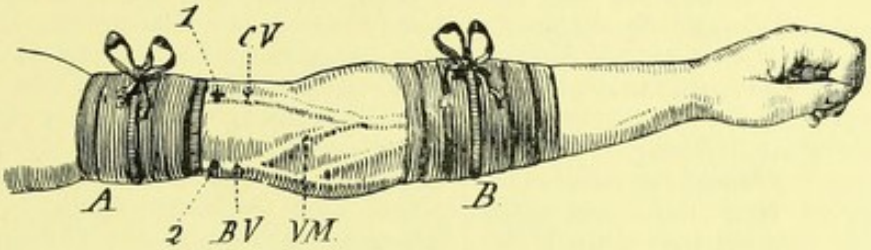
Local anæsthesia may be practised either by (1) directly infiltrating the drug into the part to be operated upon, or (2) by investing completely the area to be operated on by peripheral infiltration. Both of these methods give very satisfactory results. The latter is now being very widely practised, and by means of it many operations can be most successfully performed. Thus large skin grafts may be removed from the front of the thigh, a finger may be amputated by infiltrating the base of the digit, and so on. It possesses the advantage that there is no risk of disseminating infection by it, or of devitalising the site of the wound.

Technique.—If novocaine be the local anæsthetic to be used, this may be obtained either in powder or tablet form. In the case of the surgeon who is practising local anæsthesia at all frequently, it is advised that he obtain it in the form of a powder, and make up his own stock solutions from that. The stock solutions necessary are (1) a 1 per cent. solution of novocaine, made by dissolving 1 gram of the powder in 100 c.c. of normal saline solution; (2) a solution of sterile physiological salt solution, made by dissolving ·9 gram of sodium chloride in 100 c.c. of distilled water; (3) a bottle of adrenalin chloride (1 in 1000). The two former solutions should be prepared and preserved in a flask stoppered with sterile cotton-wool. Immediately prior to the performance of the operation the anæsthetic solution is made up by mixing equal parts of 1 per cent. novocaine and salt solution, and to this four or five drops of the adrenalin chloride should be added. It will be found that for most purposes the ½ per cent. solution prepared is eminently satisfactory, but where a wide area has to be infiltrated a ¼ or ⅛ per cent. solution may be used with perfect success. The amount which may be infiltrated with safety when the drug is prepared in the dilute forms described is really so great that there is no fear of inducing toxic phenomena. It is essential that, if anæsthesia is to be induced with the least amount of discomfort to the patient and annoyance to the surgeon, a satisfactory syringe should be used. There are many of these in the market, and with most of them, if care is taken to keep them in proper working order, no trouble will be found in their use. If care is taken of it, the "Record" syringe is very useful, or an "all metal" one may be employed. The syringe should be fitted so as to carry Schimmel's aseptic needles, and have a piece of bent tubing to allow of the point of the needle being introduced into the tissues obliquely. Hypodermic injection is found to give the most satisfactory results, and this is carried out in a manner that will render the subcutaneous tissue extremely œdematous. After the fluid has been introduced the surgeon should allow at least ten minutes before commencing his operation, so that the anæsthesia may be absolute.

The disadvantages attending the use of local anæsthesia are few. The addition of adrenalin, although it confers a markedly increased degree of potency to the drug, and renders the anæsthesia much more complete, has this disadvantage, that, when its action has passed away, and the contracted vessels dilate, slight hæmorrhage may occur. In most situations this is a matter of trifling moment, but occasionally, when operating in loose cellular tissue, such as the scrotum, troublesome bleeding may ensue. The use of the local anæsthetic has also this disadvantage, that it must of necessity to a certain extent lower the vitality of the tissue, and by this means possibly lead to the further dissemination of a septic focus.

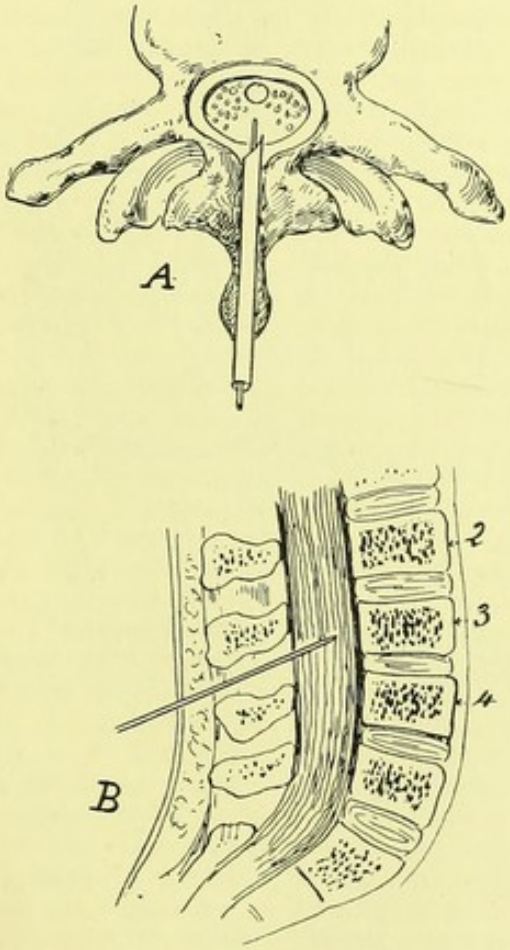
Venous Anæsthesia.—This form of anæsthesia has only recently been introduced by Professor Bier, of Berlin. He was led to devise the method by observing how small an amount of the drug was required to induce very widespread anæsthesia when it was introduced into the lumber sac, in contrast to the large amount necessary to penetrate a nerve trunk by hypodermic injection. It appeared to him that the natural channel in which the anæsthetic should be conveyed to the nerve was the blood-stream, and in order to do this he has devised a technique whereby the area to be operated on is emptied of blood. A vein is exposed, and into it the anæsthetic fluid is introduced. The method is carried out as follows:—The region to be operated on is rendered bloodless by the application of an Esmarch's bandage from below upwards. A sterile, soft, thin rubber bandage is then wound round the upper and lower limit of this bloodless area, a vein is then selected, as, for example, the basilic, when the elbow joint is to be operated upon. This channel is opened into as near to the upper bandage as possible, and its proximal end ligatured. There is then transfused into the lower portion of the vein a solution of ½ per cent. novocaine, without the addition of adrenalin. The amount which can be introduced, according to Bier, is from 40 c.c. to 80 c.c., or (if a solution of one-half the strength is injected) from 100 c.c. to 150 c.c. A considerable amount of pressure may be required to overcome the venous valves. The effect upon the part is, that it becomes blanched and swollen, and is rendered soon completely anæsthetic. The portion of the limb beyond the bandage is also rendered "indirectly" anæsthetic. The former anæsthesia is almost immediate in onset. When the operation is completed, it is found advisable to wash out a certain amount of the anæsthetic from the vessels, by allowing slight bleeding to occur. This form of anæsthesia has not yet stood the test of time, but it will probably prove to be of very considerable use in cases where such operations as excision of joints are being practised.

Spinal Anæsthesia.—The rapid perfection which this form of anæsthesia has reached is one of the triumphs of modern surgery. A method which will allow of such scenes being witnessed as a patient lying quietly on the operating-table, and discussing topics of popular interest with the surgeon who is engaged in removing his rectum, or prostate, must command respect. When the same patient is seen an hour later lying in bed and reading a newspaper, obviously suffering little if any pain, profound admiration for the practice responsible for such a state of affairs cannot be withheld.



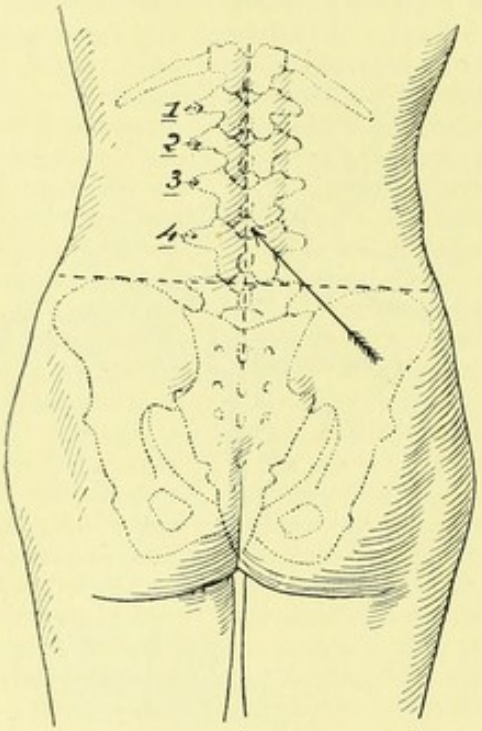
Venous Anæsthesia.

A. Proximal. *B*. Distal bandages.
C.V. Cephalic vein.
B.V. Basilic vein.
V.M. Vena media.
1 and 2. Places where the injections may be made.



Lumbar Puncture.

A. Inner cannula for injection into the subarachnoid space. (*After* Barker.)
B. Side view of the same, showing slanting position of cannula between third and fourth lumbar vertebræ.



The point for Lumbar Puncture.
Between the third and fourth lumbar vertebræ, one centimetre from the median line and in the direction of the arrow.

A lucid conception of what the patient undergoes is given in a short article by "T. H. S.," in the *Journal of the Royal Army Medical Corps for* 1908.

"A slight prick in the small of the back, a sharp blow as the needle was driven home through the tissues, and a faint dragging pain as it felt its way into the spinal canal. That was all, and the entire process of anæsthetising, so dreaded by the patient, and so troublesome to the operator, was over. In two minutes a warm glow spread slowly up both limbs, quickly followed by a tingling sensation in the feet. In another half-minute a heavy leaden feeling spread up both legs, and only the very slightest movement of the toes could be performed. The feeling of numbness gradually increased, with loss of sensation, and in three-and-a-half minutes there was a complete anæsthesia up to the umbilicus, and I was experiencing the curious condition that, with complete control of all my faculties, I was, for all practical purposes, dead from the waist downwards.

"During the whole operation, which was in the region of the right hip and the muscles of the thigh, not a single twinge of pain was felt until fifty minutes after the insertion of the needle, when cutaneous sensibility began to return, and the last few stitches were slightly painful. The spinal anæsthesia was produced whilst lying on the left side, and during the operation I found that there was not complete loss of sensation in the left leg, and that there was slight power of movement in the left foot. Slowly sensation began to return to the limbs, with the same tingling in the feet. I felt no nausea or unpleasant symptoms of any kind, and half an hour after leaving the theatre I was enjoying a cup of hot coffee and a cigarette, feeling very comfortable, and thoroughly convinced of the tremendous advantages of stovaine over chloroform.

"But four hours later I was not so sure about it, for I developed the most appalling headache, which lasted without a break for thirty-six hours, in spite of all treatment. Never have I experienced such a splitting headache, and I hope I never may again. To vary the monotony, I had attacks of agonising cramps in both legs, which lasted for an hour or so, and then gradually subsided, to be followed by another attack in a few hours. The cramps became less frequent, the headache wore away, and forty-eight hours after the injection I was my normal self once more.

"My experience of stovaine may be exceptional, and as far as I can gather, is so; but if the after-effects of spinal anæsthesia are likely to be as painful and prolonged as they were in my case, then it has no advantages over chloroform. Nothing would induce me to undergo the tortures of that reactionary period again, unless the administration of chloroform was out of the question. I have now tried both, and my experiences may be of some interest."

The introduction of spinal anæsthesia stands to the credit of Professor Bier, of Berlin. His was the pioneer work. He studied the effects of introducing a solution of cocaine and adrenalin into the lumbar sac. In fact he had the operation performed on his own person to enable him to observe the effects. The result of his researches was such as to lead him to discontinue the practice with such a drug as cocaine. Some five years later or so, Fourneau introduced the practice of using stovaine. This drug has been found to possess very many advantages over cocaine, and with it many cases have been operated on in which perfect anæsthesia was obtained. As will have been seen, however, from the description of the personal experiences of one upon whom it was used, it has certain disadvantages, and many now prefer to use a newer drug—tropococaine. This latter drug is said to act more upon the sensory fibres than does stovaine, and it would appear to be responsible for fewer serious after-effects.

Cases suitable for Spinal Anæsthesia.—Spinal anæsthesia may be practised on any rational-minded adult, where the operation is one involving structures below the iliac crests. The method has been used on children, but obviously this is attended with many disadvantages. It may be used in abdominal surgery, or even where the thorax is being operated on, if means are adopted to raise the level of the anæsthetic zone, but to be certain of doing so is difficult, and attended with increased danger. The class of case in which it is found to be especially useful is the one where some contra-indication to the use of a general anæsthetic exists, such as a patient with a senile heart. In no case should it be used where there is an infective focus, from which micro-organisms may escape into the general circulation, as the spinal anæsthetic might so lower the resistance of the cord and its membranes as to determine the circulating virus to that region, and thus set up a meningeal infection or myelitis.

The Method of Inducing Spinal Anæsthesia.—The preparation of the patient for spinal anæsthesia should be as careful and as thorough as for a general anæsthetic, because it is never absolutely certain that general anæsthesia may not ultimately be required. The skin of the lower part of the back is prepared as for an aseptic operation. In the adult man the spinal cord terminates beside the lower part of the first lumbar vertebra, and the subarachnoid space extends down to the second or third sacral vertebra. Into this space, containing the cauda equina, it is proposed to introduce the anæsthetic. The cauda equina is separated into two lateral portions by the cysterna terminalis, containing the conus medullaris and filum terminale, and it is especially into this cistern that endeavour will be made to plunge the needle. The safest and the easiest means of gaining access to this area is by median puncture in the second or third

lumbar interspace. When the anæsthetic is introduced into the area above mentioned, it mixes freely with the cerebro-spinal fluid, and complete bi-lateral anæsthesia is induced.

Immediately prior to the patient being sent to the operating-theatre it will be found a useful procedure, especially in the case of the surgeon new to this form of anæsthesia, to introduce under the skin to be punctured a few drops of a local anæsthetic, such as ½ per cent. novocaine with adrenalin. This will get rid of the slight pain arising from the introduction of the spinal needle, and enable the surgeon to withdraw the needle and introduce it at another level, should he fail in his first attempt. When the patient is admitted to the theatre, there is found ready for use a Bier's Spinal Anæsthetic syringe. This consists of a trocar and cannula, the former with its point ground accurately to fit the oblique mouth of the cannula. A pair of these are provided in the case along with a 2 c.cm. "Record" syringe. All have been tested and have been found to be working smoothly, with the needle point sharp, and have been sterilised by boiling in distilled water. The presence of any such substance as soda in the water is liable to render the anæsthetic fluid inert. The most convenient form in which the tropococaine can be obtained is in ampoules, containing ·06 grams of the drug, made up in a 5 per cent. sterilised solution, with ·6 per cent. common salt. Prior to use, the outer surface of the ampoule is sterilised by immersing it in a solution of spirit and biniodide of mercury (1 in 500), or any other suitable antiseptic. This is washed off with sterilised water. The neck of the small flask is broken, and the contents of it aspirated into the syringe, through one of the cannulæ, which has been fitted to it. All air is then carefully expelled from the syringe, and it is laid aside on a sterile towel or, what is better, held by an assistant in a sterile swab.

The patient having been placed on the operating-table, he is made to sit up with his knees drawn up and his head bent to its extreme limit on his chest, so as to produce the greatest degree of posterior spinal convexity. The advantage of this attitude over that where he sits with his legs over the side of the table is that he is unable to straighten his back and so displace the point of it if a hand is placed lightly on the nape of his neck when the needle is introduced. The skin of the back is again carefully cleansed by an assistant, the surgeon occupying the time in cleansing his own hands and putting on sterilised rubber gloves and the usual sterilised clothing. All being ready for the introduction of the needle, the surgeon locates the third lumbar interspace by first finding the fourth lumbar spine, which is situated at the level of a line connecting the highest points of the iliac crests. With the thumb of one hand he presses firmly against the third lumbar spine, and, taking the unused trocar and cannula from the basin of sterilised water in which it lies, he thrusts it steadily through the skin over the third interspace. He takes care to rigidly adhere to the mid line, and to carry the needle with its point at right angles to the vertebral column. In many cases no difficulty will be experienced in puncturing the lumbar sac, but in some the needle will be found to immediately impinge on bone. If such is the case, the needle should be withdrawn slightly, and its direction altered in a vertical plane. Sometimes it will be found that the laminæ are struck when the point of the needle is deeper in the tissues. Should this occur, the point should again be withdrawn slightly, and a new channel sought for. When failure follows a second attempt, it is advisable to withdraw the needle entirely and commence from the beginning again at a different level. There is no difficulty in recognising when the needle has pierced the membranes covering the lumbar sac. An absence of resistance is felt, and perhaps the patient feels a twinge of discomfort. When this is accomplished, the stillette is withdrawn, and cerebro-spinal fluid flows out freely. This free escape of cerebro-spinal fluid is the only certain indication that the lumbar sac has been pierced. It is further essential that it should be seen to flow freely before proceeding with the next stage of the operation. It is not sufficient to observe a mere wetting of the needle, or to obtain fluid with difficulty on aspirating with a syringe. It is advisable to allow only a small quantity of the cerebro-spinal fluid to escape. Therefore, when the stream is seen to flow freely, the syringe is taken from the hand of the assistant, the cannula which still protects its point is removed, and the nozzle of the syringe is introduced into the second cannula, which projects from the skin of the back. The piston of the syringe is then steadily withdrawn, to allow a certain amount of the cerebro-spinal fluid to mix with the tropococaine solution in the syringe. The piston is then pressed slowly home, until all the anæsthetic fluid is driven into the lumbar sac. When this is accomplished the needle is withdrawn and the puncture wound of the skin dressed with sterilised celloidin or collodion. The patient is now allowed to lie recumbent in the dorsal position, his head raised on the pillow. Should an especially high degree of anæsthesia be desired, the table should be tilted into the Trendelenburg position for two minutes. In a few minutes the patient complains of numbness and tingling in his lower limbs. This gradually progresses, until complete anæsthesia to pain supervenes, in from seven to ten minutes. Three-quarters of an hour's anæsthesia is easily obtained by this means. After-effects are usually slight. Occasionally cramps are felt in the limbs, or sickness

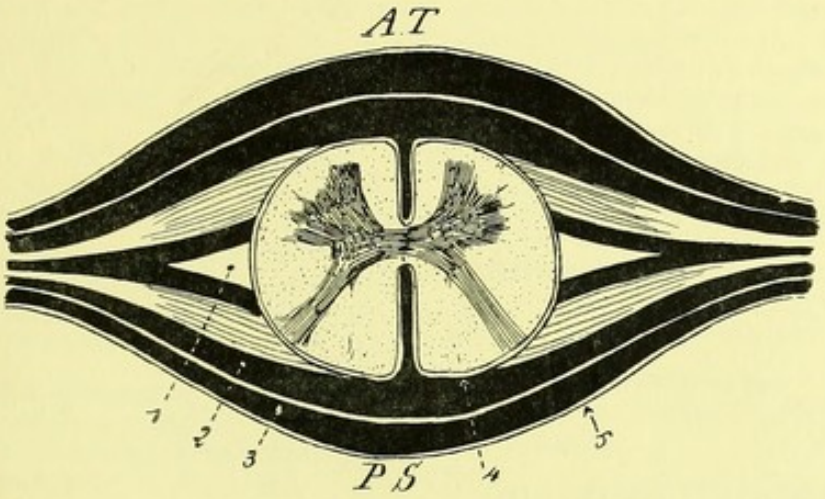
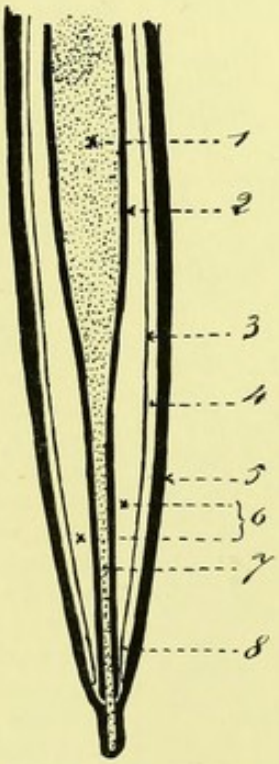


Diagram of the transverse section of the spinal cord and its membranes.

1. Lig. denticulata.
2. Subarachnoid space.
3. Sub-dorsal space.
4. Pia mater.
5. Dura mater.

A.T. Anterior surface. *P.S.* Posterior surface.



Schematic longitudinal section of spinal cord showing the arachnoid.

1. Conus medullaris.
2. Pia mater.
3. Arach. visc.
4. Sub-dorsal space.
5. Dura mater.
6. Sub-arachnoid space.
7. Filum terminale.
8. Reflex of arachnoid.

and vomiting may occur. Rise of temperature on the night following the operation is not at all unusual. Where high anæsthesia has been obtained by tilting the table, there have been cases where temporary paralysis of the diaphragm occurred, and artificial respiration was required. This is, however, an avoidable complication.

The mortality from spinal anæsthesia is already as low as that from chloroform ; it will undoubtedly get still lower. When the possibilities it opens up to the medical man who is so placed that to obtain assistance is difficult, it must be realised how great a boon to modern surgical practice this will ultimately prove to be.

Anaphase.—A stage in mitosis (following upon the prophase and the metaphase) during which the daughter chromosomes (produced in the metaphase) diverge, one of each pair going to the one pole and the other to the other pole of the spindle.

Anaphylaxis. *See also* IMMUNITY.—This term, introduced in 1902 by Charles Richet, is derived from ἀνά, back, and φυλάσσειν, to be on one's guard against. It has been used to describe that state[1] of special vulnerability (sensitisation or supersensitisation) which the organism may acquire on account of a second inoculation of certain organic substances which at the time of a first injection are indifferent or little toxic for it (the organism). It is, therefore, an inverted immunity, and may be regarded as opposed to prophylaxis. A considerable literature and not a few new scientific terms (thalassin, congestin, mytilocongestin, toxogenin (anaphylactin), apotoxin, Theobald Smith phenomenon, phenomenon of Arthus, etc.) have come into existence in connection with anaphylaxis.[2] Richet, experimenting with venins got from certain sea anemones, found that one of them (thalassin) acted prophylactically, and the other (congestin) anaphylactically. A second injection of congestin into dogs found them from five to twenty-five times as sensitive as they were to the first injection, an effect which Richet explained as due to the formation of a third substance, a toxogenin, which, combining with the small dose of toxin introduced in the second injection, produced a very active poison (apotoxin). Anaphylaxis was temporary, disappearing after forty days, and being replaced by prophylaxis, or acquired active immunity, and Richet regarded anaphylaxis as Nature's method of accelerating the reaction of the organism to the toxins, and securing the rapid production of antitoxins. Richet's views, however, have not been accepted by all. The practical outcome is that in serum treatment a second injection should be made with caution.

[1] Armand-Delille, P. F., *L'Anaphylaxie*, Paris, 1910.
[2] Editorial, *Brit. Med. Journ.*, i. for 1910, p. 1254.

Anaplasia.—A term introduced by von Hansemann to express a loss of power of full development in a cell (*e.g.* a tumour cell), due to an alteration in the distribution of the nuclear matter (atypical mitosis). These cells cannot attain their perfect structure and function, but they may possess abnormal powers of vegetative activity, and they have been regarded by some as giving an explanation of malignancy in tumours—reversionary atrophy (Adami, *Pathology*, i. pp. 641, 709, 841, 1910).

Anarthria. *See* APHASIA.—The condition in which speech alone is lost, the patient being able to read, hear, and understand.

Anastomosis. *See* INTESTINES, SURGERY OF ; ARTERIES, SUTURE OF ; NERVES, SURGERY OF.

Aneurism, Surgical Treatment of.—*Matas's Operation.*—An operation for the radical cure of aneurism has been introduced by Matas (*Journ. of the Amer. Med. Assoc.*, 1906, Mar. 31, Sept. 29). In its most elaborate form the operation aims at reconstructing the artery out of its sac walls, but this is not, as many have thought, its main object, and can, indeed, only be attained in a limited number of cases. Fundamentally the Matas operation consists in—(1) The obliteration by suture of the vascular orifices opening into the aneurismal sac, and (2) the obliteration of the sac by suture, which brings its inner surfaces into apposition, or by methods of obliteration which leave the sac undisturbed and tend to secure healing by plastic union. The circulation being controlled, the sac is exposed and opened, and the arterial openings into it are sutured. Matas lays stress on the need for closing not only the parent artery, but also the collaterals, if permanent freedom from recurrence is to be ensured. The sac is then obliterated by approximating its walls with buried sutures. In this, *obliterative endo-aneurysmorrhaphy*, the continuity of the artery is not restored. *Restorative endo-aneurysmorrhaphy* may be performed in saccular aneurisms provided that the main trunk retains its continuity and normal outline, the sac being simply grafted on to the vessel. The sac is opened freely and the arterial opening exposed. This opening is then closed by a continuous suture passing through all the coats of the vessel. The sac is then obliterated by bringing its endothelial surfaces together with buried sutures. The communication between the artery and the sac is thus arrested, but the artery remains patent, and the blood supply to peripheral parts is not checked. *Arterioplasty*, or *reconstructive endo-aneurysmorrhaphy*, can only be done in fusiform aneurisms in which the arterial walls are healthy and the two openings of the parent artery are on the same level. It is especially applicable in traumatic aneurisms, which most

frequently fulfil these requirements. After opening the sac, and, if necessary, suturing the orifices of any collateral vessels which may exist, a drainage tube of appropriate calibre is placed along the bottom of the sac, continuous with the openings of the main artery. Using this as a guide, the operator makes a new channel by suturing the walls of the sac over it, the tube being withdrawn before the last few stitches are tied. The sac is then obliterated by folding down its walls and placing the layers over the new channel so as to strengthen it; the folds are united by buried sutures.

Matas (*Journ. of the Amer. Med. Assoc.*, Nov. 14, 1908) gives the following statistics showing the results of his method of intra-saccular radical cure of aneurism :—

Total number of cases (arterio-venous aneurism excluded)	85
Total number of operators	52
Typical operations	77
Atypical operations	8
American operators	49
Foreign operators	3

Anatomical Distribution of Aneurisms.

Abdominal aorta	2	External carotid	1
External iliac	1	Posterior tibial	1
Gluteal	1	Subclavian	1
Ilio-femoral	1	Axillary	1
Femoral	18	Subclavio-axillary	2
Popliteal	50	Brachial	2

Results.—Total, 86 cases ; 78 recoveries and 8 post-operative deaths. Secondary hæmorrhage, 2 ; gangrene, 4 ; relapses, 4—all in reconstructive cases.

Angular Pregnancy. *See* ABORTION (*Diagnosis*).

Anisogamy. — Union of dissimilar gametes (Gr. ἄνισος, unequal, γάμος, marriage). *See* PROTOZOA.

Anophelesis.—New name for malaria proposed by E. W. Robertson (*Virginia Med. Semi-Monthly*, Sept. 10, 1909).

Antenatal Pathology.

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DEFINITION.—The term *Antenatal Pathology* seems to have been first employed in its present sense by Ballantyne in his work (of which only two volumes appeared) entitled *Diseases and Deformities of the Fœtus: an Attempt towards a System of Antenatal Pathology* (1892, 1895) ; and this writer adopted the name as the title of his large work, which was published some ten years later (*Manual of Antenatal Pathology and Hygiene*, vol. i. "The Fœtus," 1902 ; vol. ii. "The Embryo," 1904). As defined in the last-named work (*op. cit.*, i. p. 2) antenatal pathology is concerned with all the morbid processes which act upon the organism before birth, and with the effects which they produce by their action ; it deals with the pathology of the individual during his fœtal and embryonic existence, and for this reason it might be named intra-uterine pathology ; but it includes also the consideration of the morbid agencies which influence the germ (ovum or sperm) in the period which precedes the beginning of embryonic life, and it therefore embraces also the study of morbid heredity or of pre-embryonic or germinal pathology.

SUBDIVISIONS AND CLASSIFICATION.—With the scope given to it by this definition, antenatal pathology requires to be subdivided in order to be conveniently studied. Beginning at the point nearest to birth and working backwards towards conception and the events which precede it, Ballantyne names three large subdivisions of the subject, viz. fœtal pathology, embryonic pathology, and germinal pathology, corresponding to the fœtal, embryonic, and germinal periods of antenatal life. The fœtal period occupies by far the largest part of the mother's pregnancy ; it may be said to extend from the eighth to the fortieth week, or thirty-two weeks in all (seven calendar months roughly) ; the embryonic period lasts from the end of the first week to the eighth week of antenatal life, although Ballantyne gives to the last fortnight (seventh and eighth weeks) the special name of the neofœtal period (a transition time) ; and the germinal epoch is that time in life which precedes the first appearance of the embryonic rudiments, which corresponds, therefore, to the first week of antenatal life (that immediately following conception), and to the long time before that event when the germ-cells (ovum and sperm) were lying in the parent organisms and were being prepared for their great culminating function of forming a new being. Sharply defined in its terminal period by birth, antenatal life stretches away back almost indefinitely in the other direction into the shadowy vitalities of the reproductive cells of the parents and their ancestors, till, theoretically at least, it reaches the ovum and spermatozoon of the primitive pair. Each of these periods of antenatal life has its own characteristic pathological developments, in a certain sense each of them has its own form of death ; and in each of them the special physiology of the time has its effect upon its pathology and death. Speaking generally, the fœtal period is characterised by the occurrence of diseases, the embryonic by monstrosities and malformations, and the germinal by the coming into action of pathological tendencies and predispositions. The morbid developments of the fœtal period are the diseases of the fœtus,

those of the embryonic period are the malformations of the embryo (corresponding to a large part of teratology), and those of the germinal period are morbid heredity showing itself in various ways. Such is a generalisation of the multiform morbid states grouped together in antenatal pathology; if an attempt be made to particularise, it is found that there are no clear-cut lines of demarcation, and that the pathological developments of one time cannot be separated with mathematical precision from those of another, but overlap to a great or small extent. Keeping this modifying circumstance in mind we may try to form some idea of the scope and contents of each of the three periods.

Fœtal Pathology.—During the fœtal period of life the organism (the fœtus) shows its vitality chiefly by growth along lines which have been already definitely laid down. In this respect it resembles the subsequent postnatal period of infancy rather than the precedent antenatal one of embryonic existence. It is growth rather than development that is its distinguishing mark. It is true that the intra-uterine environment has very distinctive and peculiar characters—the unborn infant exists in a fluid medium of practically constant temperature, it is protected from traumatism by the maternal structures, and it is shut in from the light; further, the fœtus has several of its organs almost inactive, and its most important and most active organ, the placenta, is extra-corporeal. Nevertheless, the chief phenomenon of fœtal life is growth, rapid and continuous, along lines already indicated; within seven months the organism increases from a structure 1 inch in length to one measuring 20 inches, and its increase in weight is from 1 ounce to 7 or 8 pounds. In these facts is found the explanation of much that is puzzling in fœtal pathology; the more clearly we recognise the physiological characters of fœtal existence, the more easily shall we solve the riddle of the peculiarities of the diseases which affect the unborn infant. At the basis of the understanding of fœtal morbid states is the knowledge of the anatomy and physiology of the fœtus. In his work referred to above (*Manual of Antenatal Pathology*, i. pp. 172, 429), Ballantyne applies these principles to the study of the transmitted and idiopathic diseases of the fœtus and of fœtal death. Thus, in connection with infection of the unborn infant with *typhoid fever*, he points out that the characteristic intestinal lesions are seldom met with, and he explains this by the fact that the intestinal functions are almost quiescent during antenatal life, and by the avenue of entrance of the infecting agent in the case of the fœtus. The latter fact is one of considerable interest and importance. Since the maternal blood comes into close relationship with the fœtal only in the placenta, it follows that germs can pass from the former to the latter only through that organ; fœtal infection, therefore, is by way of the placenta, the umbilical vein, and the umbilicus, and the unborn infant has diseases transmitted to it, not through the buccal, pharyngeal, pulmonary, or intestinal mucous membranes, but through the blood which reaches it at the umbilicus. The lesions which this infection will cause will therefore have a localisation different from that which is found in the adult; they will have the umbilicus as a centre, and will be most likely to be discovered in the organs nearly related by vascular connections to the umbilicus. Consequently, in fœtal typhoid the typical bacillus is found commonly in the placenta, the blood, the brain, the spleen, and other organs, but intestinal lesions are very uncommon. In such cases the fœtal blood has shown Widal's test, proving that agglutinins also are transmitted from the mother to the fœtus, or are developed independently in the latter. Fœtal *tuberculosis* is another malady which is affected by the antenatal environment, and the fœtal method of acquiring a microbic morbid state: the lungs of the unborn infant suffering from tubercle usually show only scattered bacilli, whilst the liver (which is the first organ to receive the infected blood of the umbilical vein) contains, as a rule, great numbers of them and exhibits tubercular lesions; the spleen likewise is affected, and bacilli are to be found in the placenta and in the blood of the umbilical vein; and, on the other hand, tubercular lesions of the intestine are very rare. The same general system of distribution may be traced in other transmitted diseases of the fœtus, such as smallpox, syphilis, and malaria; and in transmitted toxicological states, such as lead-poisoning, the same rule applies, the metal being discovered in the liver, spleen, and brain, as well as in the placenta. The idiopathic diseases of the fœtus, such as general dropsy, ichthyosis, elephantiasis, etc., do not indeed show any peculiarity in the matter of the localisation of the characteristic lesions of these maladies, but they do exhibit the effects of the intra-uterine environment and the preponderating influence of the placenta in antenatal life. Fœtal ichthyosis, for instance, reaches a stage and a degree never seen in postnatal life; and the explanation is to be found doubtless in the fluid medium in which the fœtus lies, which, on the one hand, prevents the action of friction, and on the other, encourages an extraordinary proliferation of the epidermic layers of the skin. General fœtal dropsy, also, attains a degree never seen in œdema of the adult; and the reason is to be found in the placenta, which can keep even a seriously diseased fœtus in life, the latter being a semi-parasite upon its mother through the placenta. The proof of this statement is found in the fact that such a fœtus is incapable of an

independent existence when removed from the intra-uterine economy, as occurs at the moment of birth; by the help of the placenta the fœtus can live on in utero with every one of its organs waterlogged and physiologically useless, but at birth conditions are altered, and the newborn infant is either stillborn or rapidly dies. There are some morbid states of the fœtus, however, which have peculiarities not to be satisfactorily explained either by the environment, the mode of microbic invasion, or the predominance of the placenta; such are the bone diseases (achondroplasia, fœtal rickets, etc.), some of the skin diseases (hypertrichosis congenita, tylosis palmæ, etc.), and certain maladies of the bladder, heart, kidneys, and bile-ducts. In these curious pathological conditions we have to look elsewhere for an explanation of their characters; and Ballantyne finds it in the fact that all parts of the new organism do not pass into the fœtal period at the same time, some remain in the embryonic stage whilst the others, having developed fully, go on into the fœtal. Some of these so-called maladies are really malformations, at least they occupy a place midway between the diseases and the teratological states; their peculiarities, therefore, are the result of morbid agents acting upon tissues still in the formative or evolutionary state.

Embryonic Pathology.—During embryonic life (which lasts, roughly speaking, from the end of the first week to the end of the sixth, from the appearance of the first embryonic rudiments in the embryonic area of the blastodermic vesicle to the completion of the development of the new organism and its revelation as a recognisable human embryo) it is development, not growth, which is the characteristic feature. There is growth undoubtedly, but so marked, so arresting are the phenomena of development which are going on that they mask all else, and it is impossible to avoid coming to the conclusion that the physiology of the embryo is typically embryology. Embryology is, so to speak, almost the only function of embryonic life; to gain a clear idea of this stage in antenatal existence it is necessary to think, not of organs performing functions, but of organs being formed; embryonic physiology has to do, not with organs and their special activities, but with the special activity which produces, builds up, and perfects the organs themselves. The great, almost the only, function of the embryo is to form tissues and organs, or, in one word, organogenesis. We have to imagine an aggregate of cells arranging themselves, apparently in a disorderly fashion or in a fashion of which the order is but dimly decerned, first, into the three layers of the blastoderm, and then, after many intermediate stages and phases, into the organs which take on the particular functions of fœtal and postnatal life. There is no anatomy of the embryo apart from its physiology; the two are united together in the subject of embryology, which, as it were, contains them. It is only in fœtal life that the distinction between matters anatomical and matters physiological begins to become apparent; after birth it is, of course, quite evident. For the sake of strict accuracy, however, it must be added that the latter part of embryonic life is not without indications of functional activity, in the ordinary sense of the term, and some of the organs, *e.g.* the heart, are performing other acts than those of formation or construction merely. There is no sharply marked boundary between embryonic and fœtal life in this respect, but rather a gradual passage; still, the fact remains that the principal manifestation of embryonic life stands out prominently as organogenesis.

The existence of so fundamental a dissimilarity between the physiology of the embryo and that of the fœtus prepares us for the statement that the pathology of the embryo is startlingly unlike that of the fœtus; it is a pathology *sui generis*. To state the matter concisely, the pathology of the embryo is teratology. Since the chief result of the physiological activity of the embryo is the formation of parts and organs, so the chief result of pathological processes in the embryo is the malformation of its parts and organs; the one leads to normal formation, the other to abnormal formation. Monstrosities and structural anomalies are the results of morbid agents acting upon the organism in the embryonic period of its existence, or, to write more exactly, upon such parts of the organism as are in the embryonic or formative stage. Experimental teratogenesis would seem to show that the morbid agents are in no way peculiar to the embryonic period, but are, in fact, the causes (microbic, toxinic, toxicological, traumatic) which produce diseases by their action upon the fœtus and adult. In the case of the embryo they are called teratogenic, and in that of the fœtus or adult they are named pathogenic; but there is no sufficient reason for supposing that in their essential nature they differ one whit. It is the result which is dissimilar, strangely and strikingly dissimilar, being in the one instance teratological and in the other pathological. The mode of action of the cause is no doubt different, and the organism upon which it acts and its surroundings are indeed widely different; and it is in this manner that the vast difference between the results—a monstrosity and a disease—is produced. The pathology of the embryo, then, has to do with monstrosities and malformations, with, in other words, the teratological states. At the same time Ballantyne suggests (*Manual of Antenatal Pathology*, ii. p. 6) that all that is teratological does not of necessity belong to the embryonic period; some organs are still in the embryonic phase when, as far as time goes, they are in the fœtal period, and they

may develop malformations at this later epoch. Again, there is reason to believe that some teratological states are determined in the germinal period; united twins, for instance, may originate then. Ballantyne's main thesis, however, is that embryology is the key to the understanding of teratology; the latter is a disturbance of the former, teratological results being produced by irregularities in embryological processes. Normally the embryology of the facial region, although, indeed, most complex, results in the formation of the facial features without let or flaw; but if the organogenetic processes be interfered with, if one fissure closes too soon or too late, or if one process projects too far or not enough, facial deformities, such as hare lip or genal fissure, are produced. Embryology in disorder, then, is teratology. Further, when we come to ask how the embryological disorder is brought about, we find an answer to our question in the immediate environment of the embryo. Normally the embryo floats free in the liquor amnii; but if, from scarceness of the liquor or from adhesiveness of the embryo or of the walls of the embryonic sac, the amnion comes in contact with and becomes united to the embryo, then that part of the embryo so affected is arrested or distorted in its development, and a malformation results. At a later stage the embryo, now grown into a fœtus, may separate from the amniotic wall, and so the demonstration of the causation of its deformed condition may no longer be made patent. Amniotic pressure, for instance, can be made to account for such an apparently inexplicable teratological state as sympodia; the lower limbs at the early stage of development, when they are bud-like rudiments, get pressed together, and at the same time rotated in such a fashion as to produce the characteristic sireniform monstrosity. Some monstrosities, it is true, more especially those in which two embryos are concerned (placental parasites, united twins, etc.), cannot be entirely explained by a reference to embryological states and the arresting amniotic factor; for their elucidation it is necessary to consider conditions prior to embryonic life, germinal anomalies in fact; but the great majority of the deformities which affect the unborn infant have an embryological and amniotic explanation. There is also reason to believe that the teratogenic pressure is not always amniotic in nature: it may sometimes be caused by pelvic or abdominal tumours, by deformities of the uterus or narrowness of a tubal gestation sac, by the umbilical cord, or even by one part of the embryo compressing another. Experimental teratogeny, however, seems to demonstrate that amniotic narrowness is the most frequent factor in the production of monstrosities.

Germinal Pathology.—"The pathology of the germ," writes Ballantyne (*op. cit.*, ii. p. 607), "is the Hinterland of Antenatal Pathology," and it is true that of its characters we know extraordinarily little; it is almost wholly an unexplored territory. To begin with, we have very little information of the life of the human germ before the appearance of the first rudiments of the embryo in the embryonic area of the blastocyst. This is the *terminus ad quem* of germinal life, and corresponds, roughly speaking, to the end of the first week after the occurrence of impregnation. The *terminus a quo* is much more difficult of definition: for the individual life it may be regarded as the conjunction of ovum and spermatozoon in fertilisation, but it really begins much further back, when the reproductive cells of the parents become specialised from the cells of the genital ridge. Germinal life then consists of a short period (a week) of single existence, and of a long precedent period of dual existence, when the germ cell and the sperm cell are lying apparently dormant in the tissues of the parent organism. Further, inasmuch as the germ cell is believed to contain a particle of the structural elements of the germ of the preceding generation, and that a particle of the generation before, and so on, it becomes impossible to fix a starting-point. In this sense germinal life is without beginning, an idea which plays a large part in the modern theories of heredity; but, for practical purposes, we may regard the germinal life of the individual as beginning in the vital activities of the two reproductive cells of his parents, in the ovum and the spermatozoon which by their union cause him to come into being. After a long period of what may be termed latency in the Graafian follicle of the ovary, the ovum undergoes the process of maturation, is expelled from its ovarian habitation, is transmitted through the Fallopian tube, and reaches the uterus. Either in the tube or in the uterus the ovum is fertilised by a spermatozoon, an event which marks the commencement of a unified germinal life; intricate changes are thus occasioned which lead to the formation of the morula mass and to the appearance, first of the extra-embryonic structures of the blastocyst (umbilical vesicle, chorion, amnion, etc.) and later of the embryonic rudiments in the specialised part of the blastocyst known as the embryonic area. The spermatozoon which plays so large a part in initiating this unified germinal life has also a past history, about which less even is known than about that of the ovum, during which it is subject to influences which no doubt deeply impress themselves upon the future development of the embryo.

Now, if the same principle of study be applied to the pathology of germinal life as was brought to bear upon embryonic pathology (*vide ante*), that, namely, of looking for an explanation of characteristic morbid developments along the line of physiological peculiarities, it will at

once become apparent that, theoretically, the pathology of germinal life ought to consist of anomalies in the formation of the first rudiments of the embryo, of malformation of the blastocyst and its contained parts (amniotic sac, umbilical vesicle, trophoblast), of unusual modes of segmentation, of errors in the details of the impregnation of the ovum by the spermatozoa, of imperfect maturation of the ovum, of imperfect formation of spermatoblasts and spermatozoa, of irregularities in the site of fertilisation (ovarian or tubal instead of intra-uterine), and of the incidence of morbid influences upon the germ cells during the long time when these structures are lying in the genital glands of parents and ancestors. Germinal pathology may be expected to be made up of the pathology of the blastocyst, of that of the morula mass, of that of fertilisation, of that of maturation, and of all the effects of the subjection of the germ cells to abnormal influences in earlier periods of the life of the individual while in the dual stage of existence (*i.e.* morbid heredity). A theory constructed along these lines does, as a matter of fact, form a working hypothesis which serves to explain the diverse phenomena of germinal pathology; anomalies of segmentation may be the causes of the hydatid mole and of the "rests" (themselves hypothetical) which many believe to have much to do with the etiology of tumours; irregularities in the place of fertilisation may have something to do with ectopic pregnancy; irregularities in the mode of impregnation (*e.g.* polyspermy) may be the root causes of double monsters; defects in maturation may underlie and explain the development of dermoid cysts and of the rare cases of fœtus in fœtu; and unusual chemical and physical agencies acting upon the germ cells in their long period of latency may be, in part at least, the determining factors in the production of "hereditary" anomalies. Ballantyne suggests further (*op. cit.*, ii. p. 617) that the same ultimate agencies are the causes alike of the pathological developments of germinal life, of the more strictly teratological states of embryonic life, and of the diseases of fœtal existence; he believes these agencies to be toxinic, microbic, toxicological, and traumatic; and he regards the diversity of results as due to the very different conditions under which the causes are acting, and to the very dissimilar character of the organism (germ, embryo, fœtus) upon which they exert their morbid influence. He is of opinion, therefore, that there are no *special* causes of germinal deviations, of embryonic malformations, and of fœtal diseases; the *special* characters of these morbid manifestations are to be explained in another fashion, they are to be looked upon as due to peculiarities of environment and to the characteristics of the life of the antenatal period of existence in question.

Etiology. — From what has been already stated regarding fœtal, embryonic, and germinal pathology it will be evident that Ballantyne (*Antenatal Pathology*, vols. i. and ii., 1902, 1904) advocates the theory of the identity of morbid agency. He regards the morbid phenomena of antenatal life as due to the same causes as produce diseases in postnatal existence, viz. microbes, toxines, and toxinic products, toxicological agents (chemical and vegetable poisons), and traumatism; and he explains the extraordinary difference in the results produced as brought about by the peculiarities of the life of the period dealt with and of the environment which is characteristic of this or that epoch of antenatal existence. The fœtus, so to say, lives under the influence of the placenta, and this fact alone determines to a large extent the character of its morbid developments; the embryo is dominated by the amniotic environment, a circumstance which, taken along with the evolutionary and constructive nature of its vital activities, has much to do with the peculiar teratological nature of its pathology; and the germ has a life which is so extraordinarily different, both in its unified and in its dual existence, from anything else that it is not to be wondered at if its deviations from the physiological standard are also of their own kind, in a very special way. This theory is supported by the results of experimental teratogeny, or the artificial production of monstrosities, as carried out by Dareste, but more especially by the experiments of Féré, who injected toxic and toxinic substances into developing hens' eggs with teratological effects. Franklin P. Mall (*Study of the Causes Underlying the Origin of Human Monsters*, 1908) has recently brought forward strong evidence in favour of the view that pathological embryos and small monsters are identical and are developed from normal ova due to external influences ("faulty implantation"); and these conclusions support to a large extent the view which has been advanced that teratology is simply disordered embryology, and that the cause of the disorder is some influence acting upon the embryo from without. Schwalbe's fine work, now in process of publication, also contains many observations on teratogenesis which go to prove the teratogenic effect of external agents upon the organism in the embryonic stage of its existence (*Die Morphologie der Missbildungen des Menschen und der Thiere*, parts i., ii. and iii., 1906, 1907, 1909). There is still, however, a tendency among writers on these subjects to separate the monstrosities and malformations from the other results of the action of morbid agencies upon the organism before birth; teratology has for so long a time stood by itself that there is little likelihood of its being considered as nothing more than one subdivision of antenatal pathology. At the same time, evidence is accumu-

lating which seems to show that morbid agents are the same at all periods of life, antenatal as well as postnatal, and that the differences in the pathological results produced at the different periods are due rather to the environment of the organism and to the special characters of its life than to any difference in the pathological causes.

DIAGNOSIS.—The diagnosis of antenatal states after birth calls for no special comment; its success or failure will depend upon the knowledge or the ignorance of the practitioner; and its performance requires no further skill than that which is necessary for the distinction and recognition of ordinary postnatal, medical, and surgical morbid conditions. But the difficulties of diagnosing pathological states while the subject of them is still in utero are many and serious, and the art of antenatal diagnosis has as yet made very little progress. Ballantyne gives a chapter of his book (*Manual of Antenatal Pathology*, i. pp. 430-450) to this subject; in it he claims that a careful scrutiny of the history of the parents before and about the time of conception, and, more particularly, of the mother during the months of pregnancy which have already elapsed, will often enable the medical man to form a strong suspicion that the unborn infant will be diseased or malformed. The physical examination of the abdomen in the later months of gestation will sometimes be successful in detecting gross enlargement of one or more parts of the fœtus, and it may, in the hands of an expert, yield further information. The use of cephalometers and the employment of the Röntgen rays may in time serve as important adjuvants in the acquisition of knowledge regarding the state of health or disease of the unborn infant. It has to be borne in mind that hydramnios frequently means some anomaly or abnormality of the fœtus; and, since the diagnosis of hydramnios can usually be easily made, its presence ought to make the obstetrician suspect a fœtal morbid state. Fœtal heart murmurs have been detected by auscultation during the later months of pregnancy, and there are signs and symptoms of fœtal death which make it possible to diagnose this antenatal catastrophe before the child is expelled. If the attention of the medical man were more systematically turned to the subject of antenatal diagnosis, there would doubtless be a rapid increase in his knowledge of the matter and in his skill in applying it. Meantime the difficulty is to get the patient to allow, and the obstetrician to make, a routine examination during pregnancy; many pregnant patients are never examined even with a view to determining the relative size of the mother's pelvis and of the fœtal head until the incidence of labour pains.

TREATMENT. — Antenatal treatment waits upon antenatal diagnosis, and in the absence of exact methods in the latter sphere of practice the former is arrested nearly altogether. What little treatment is possible is largely empiric, *e.g.* the giving of chlorate of potash to the mother in cases of recurrent abortion or repeated fœtal death; but some definiteness has been introduced into the subject by the topical administration of mercury when the mother is syphilitic. There has indeed been an advance in the treatment of antenatal morbid states within the past ten or twelve years, but it has been in the sphere of reparative surgery applied after the birth of the infant; partially successful attempts have, for instance, been made to separate united twins, and some of the grave malformations of the cranium and its contents have been attacked with at least a cosmetic advantage. Extroversion of the bladder, absence of bones of the leg or arm, and exomphalos have been dealt with in new ways which augur greater success than in the past. We are still, however, standing on the threshold of preventive medicine as applied to antenatal morbid states.

Antiarachnolysin. — An antivenin acting against the poison of the spider (*Epeira diadema*).

Antigen.—A term used in bacteriology and immunity to signify any body against which, after it has been injected into the organism, an antibody is produced (Gr. ἀντί, against, and γίγνομαι, I am born).

Antiketogenous. *See* ACIDOSIS (*Therapeutics*).

Antilactase.—An enzyme capable of splitting up milk sugar.

Antipepsin. — An enzyme capable of splitting pepsin.

Antiphrynolysin. — An antivenin acting against the poison of the toad (*Bombinator bufo*).

Antisteapsin.—An enzyme capable of splitting fat.

Antitryptic Index. *See also* CANCER. —This "index," which is a means of ascertaining the immunisation response, depends on the following circumstances:—When a viscous solution of casein is incubated with trypsin it is digested and loses its viscosity, and the rate of the loss may be measured with a viscosimeter (pipette and fine capillary tube); further, the rate of loss of viscosity is retarded by the addition of a drop of blood serum, and the degree of retardation depends on the health of the patient (the blood of one who is suffering from cancer, tuberculosis, etc., retarding more markedly). Two blood serums (one normal and one pathological) can thus be compared, the rate at which the casein solution drips through the capillary tube giving the index;

thus with the normal serum the solution may drip through in 100 seconds, and with the abnormal in 103½ seconds, when the antitryptic index is 3½. See F. C. Eve's article in the *Brit. Med. Journ.*, i. for 1910, p. 1540.

Aphasia. *See also* APRAXIA. — In a series of essays which appeared in the *Semaine médicale* during 1906, Pierre Marie, one of the most eminent of living neurologists, has severely criticised the current doctrine of aphasia. The views he expressed have neither received general acceptance, nor have they been effectively controverted, and, pending further research, all that is necessary is to summarise Marie's leading contentions.

His criticisms are based on clinical observations, and on more than fifty autopsies on aphasic patients. He is peculiarly fortunate in having so much material at his disposal, and it is not unnatural that he should urge that the best way to study aphasia is from a clinico-pathological standpoint pure and simple, in preference to being influenced by theory and graphic representations of the speech mechanism. The leading features of Marie's conception of aphasia are that there is always (1) more or less difficulty in comprehending spoken language, and (2) a marked diminution in the general mental capacity.

The failure to understand speech which all aphasics manifest has escaped recognition because of the simple nature of the ordinary test questions. A patient may be able to show his tongue at request, but cannot execute a more complicated order. A clinical test employed by Marie is as follows:—"There are three pieces of paper; give me the biggest, crumple up the second one and throw it on the floor, put the smallest in your pocket." No aphasic, he says, can do this correctly. A further reason why mental impairment has evaded notice is that the affective faculties are less affected than the intellect. Thus, a patient continues to act normally in his family and social relations, but he loses the accomplishments which he has gradually acquired—the musician can no longer compose, the cook produces uneatable dishes, the business man forgets simple arithmetic, and so on.

Marie subdivides aphasia into one subordinate and two main symptom groups:—1. *Anarthria*, in which speech alone is lost, but the patient can read, hear, and understand. 2. *Wernicke's aphasia*, in which the patient can speak, though badly, understands badly, and cannot read or write. The inability to read and write is not word deafness or blindness, but arises from mental impairment. 3. *Broca's aphasia*, in which the patients can neither read nor write, understand badly, and have lost the power of speech. Obviously, the only difference between (2) and (3) is the retention or loss of the power of speech, and Marie regards this as the essential distinction between them.

From a pathological point of view, his classification is even simpler. Broca's aphasia is simply (1) plus (2) — Wernicke's aphasia with anarthria. Anarthria is caused by lesions of the lenticular region on either side; there is failure of co-ordination of the movements required for speech, but no paralysis. The lesion causing Wernicke's aphasia is in the "association centre" of Flechsig — the left supra-marginal and angular gyrus and first and second temporal convolutions. Lesions in this region are generally due to obstruction of the sylvian artery. The larger the area of softening produced, the more severe is the aphasia, and the more likely is the lenticular region to be jointly affected. Individual variations in the distribution of the vessels play an important part in producing variations in the clinical picture. Mental deterioration is on the whole less in motor than in sensory aphasia, because the lesion causing the former is generally farther removed from the cortex.

Marie admits that pure, or almost pure, word blindness also exists. He looks on it as due to softening in the domain of the posterior cerebral artery, and localises the lesion in the left lingual and fusiform lobes on the inferior aspect of the cerebrum, impairing the integrity of the optic radiation.

Marie's destructive criticism must now be referred to. His chief contentions are:—(1) Broca's (the third left frontal) convolution has nothing to do with aphasia, because (*a*) in some right-handed persons its destruction has not caused aphasia; (*b*) it has been found intact in some well-marked cases of Broca's aphasia; and (*c*) its frequent involvement in cases of aphasia is merely a coincidence, and arises from the fact that the blocking of the sylvian artery which causes softening often occurs proximally to the vessel supplying the third left frontal, and hence affects that along with Wernicke's area. (2) Pure word deafness does not exist. Alleged instances arise from mal-observation and failure to recognise minor degrees of labyrinthine deafness. The first left temporal convolution is not a centre for the memory of words. (3) Pure motor aphasia is nothing but anarthria. (4) No distinction exists between cortical and subcortical aphasia, for no aphasia due to a focal lesion is ever purely cortical.

Marie's positive teaching may be summed up thus:—Aphasia is either intrinsic (Wernicke and Broca—language area involved), or extrinsic (anarthria—language area not involved). Wernicke's area contains the true speech centre; it is an intellectual rather than a sensory centre. There is always intellectual defect in aphasia. The degree of speech disturbance depends on the size of the lesion. Pure word blindness differs from the other forms in being due to

lesions in the domain of the posterior cerebral, not the sylvian artery.

LITERATURE.—Marie. *Sem. méd.* (Paris), Nos. 21, 42, 48, 1906; *Presse méd.* (Paris), No. 4, 1907.—Dejerine. *Presse méd.* (Paris), pp. 437, 453, 742.—Blassberg. *Wien. klin. Wochenschr.*, Aug. 13, 1908.—Mayendorf. *Berl. klin. Wochenschr.*, Aug. 10, 1908. A valuable *résumé* of the subject is contained in an article by Collier, *Brain*, xxxi. p. 523, 1908.

Apinol. — A product of the destructive distillation of pine wood, stated to be an antiseptic, a local anæsthetic, and an expectorant.

Aplastic Anæmia.—Anæmia in which there is a diminution of the granular leucocytes as well as of the red blood corpuscles, with a relative increase of the lymphocytes, indicating absence of a compensatory reaction of the bone marrow. It was described by Ehrlich in 1888, and recently by Cabot in 1908 (Osler and M'Crae's *System of Medicine*, iv. p. 637). It has been regarded by some as distinct from pernicious anæmia and by others as differing only in degree. See also Lavenson, *Amer. Journ. Med. Sci.*, cxxxiii. p. 100, 1907.

"Appetite Juice." *See* Digestion (*Gastric*).

Apraxia. — In connection with Marie's theory of aphasia, according to which the third left frontal convolution is deposed from its position as a centre for the memory of words, it is of interest to remember that recent work on apraxia (a subject brought into notice by Liepmann) tends to show that certain functions, comparable to that of speech, are localised in the first and second frontal convolutions, and therefore in so far supports the older hypothesis as opposed to Marie's views. By apraxia is meant a condition of inability to execute skilled movements with the limbs, apart from paralysis, disturbance of sensation, defect in co-ordination, or intellectual impairment. The ability to perform purposive movements of the limbs, either right or left, is supposed to depend on the integrity of the posterior part of the first and second left frontal convolutions, which are probably connected with the left side of the body by the anterior fibres of the corpus callosum. It is obvious that "motor aphasia bears the same relation to the movements of the muscles concerned in speech as does apraxia to the movements of the limbs. Motor aphasia, pure or cortical, is clearly synonymous with apraxia, pure or cortical, of the movements concerned in speech, and motor agraphia is apraxia pure and simple. According to this view a series of higher motor centres concerned with certain subjectively purposive movements are situated in the posterior parts of the three frontal gyri and immediately in front of the Rolandic centres (lower motor centres) for the corresponding regions of the body. Lesion of these centres is productive of phenomena of a similar order in the corresponding region of the body—namely, motor aphasia, motor agraphia, and apraxia. At a time, then, when the most determined efforts are being made, and upon grounds which are at least logical, to dismiss the left third frontal gyrus from our conception of the essential speech mechanism, evidence of a very strong nature is increasingly coming to hand which calls for the retention of Broca's area as a speech centre, entirely apart from the consideration of local lesions of the brain causing speech-defect." (Collier, *Brain*, xxxi. p. 529, 1908.)

[For a general review of apraxia, see Wilson, *Brain*, xxxi. p. 164, 1908.]

Arsacetin. — Sodium acetyl arsanilate, a crystalline substance without taste or odour, free from arsenious or arsenic acid, soluble to 10 per cent. in cold water, claimed to be less toxic than sodium arsanilite, and recommended in syphilis and trypanosomiasis (dose, from 1½ to 7½ grains hypodermically).

Arterial Hypertonus.—This term was introduced by Russell to denote a condition of the arterial wall characterised by tightening up of its muscular fibres. His recent work on the subject is extremely suggestive, and has attracted a great deal of attention. The pathological changes in the arterial wall which are of importance clinically are atheroma, obliterative endarteritis, calcareous infiltration of the tunica media, and arterio-sclerosis. Russell has been one of the first to show that a clear distinction must be drawn between atheroma (a focal lesion, chiefly of the intima, progressing to degenerative changes) on the one hand, and arterio-sclerosis on the other. Moreover, he has shown that in the production of what is clinically known as arterio-sclerosis two factors are operative; one a permanent one — a thickening chiefly of the media, the other temporary, or often so—a hypertonic contraction of the vessel wall. A further point is that hypertonus in this sense may affect normal, or atheromatous, as well as sclerosed vessels.

Russell was led to his conception of the morbid anatomy of arterio-sclerosis by examining radial arteries which had shown marked thickening during life. He found that the thickening was due to hypertrophy of the muscular fibres of the tunica media, hyperplasia without degeneration of the subendothelial tissue of the tunica intima, and sometimes fibrous hyperplasia of the tunica adventitia. These changes obviously differ essentially from atheroma; moreover, they are not confined to a limited area of the vessel wall, but are widely distributed throughout the body. They may be associated with atheroma of the aorta, but this is only co-

incidental. The renal vessels are peculiar. In the artery outside the kidney the above changes are found; in the intra-renal arteries there is atrophy of the muscular coat, and very marked hypertrophy of intima and adventitia, culminating in occlusion of the vessels and their transformation into fibrous cords. The term *arterio-sclerosis*, then, is applied to all cases of vascular thickening other than atheroma, including (*a*) pure hypermyotrophy, (*b*) hypermyotrophy with thickening of the internal coat, and (*c*) with the adventitia also thickened.

The two important points which Russell has elucidated are—(1) that there exists a permanent diffuse thickening of the arteries which is not atheroma; and (2) that sclerosed vessels retain their contractility (hypertonus). The reasons for the first proposition have been stated; evidence of the correctness of the second is afforded by clinical observations that under appropriate treatment tightened up arteries can be made to relax. While sclerosis is irremediable, hypertonus is not; the vascular thickening of arterio-sclerosis is therefore not wholly beyond the reach of treatment.

Hypertonus may be produced by vaso-motor influence; a much more important factor, however, is the composition and condition of the blood. Nitrogenous waste, and the products of imperfect metabolism circulating in the blood, cause a contraction of the arteries and capillaries, and this is the first step in the chain of events which lead to increased blood-pressure and arterio-sclerosis. The action of the deleterious substances (the exact nature of which is unknown) is conceived of as a direct one on the vessels, not an indirect effect brought about through the agency of the nervous system. It has a twofold protective action on the tissues: (*a*) in diminishing the supply to them of the impure blood, and (*b*) in producing symptoms which lead to blood purification.

Effect of Arterial Hypertonus on Manometric Readings and on Blood-Pressure.—Russell is very definitely of opinion that the high readings in arterio-sclerosis do not represent the actual blood-pressure, but are caused by the resistance which the thickened vessel wall offers to the compression of the armlet. Experimenting with a system of rubber tubes of various diameters and thickness of wall connected with a series of manometers, he got results of which the following is an example:—The internal pressure of the system being 30 mm. Hg by the manometers, the pressure (as measured by Oliver's hæmodynamometer) required to obliterate the lumen of the tubes was 10 mm. Hg in the case of the thinnest (A), 40 mm. Hg in the medium one (B), and 84 mm. Hg in the thickest one (C). The walls of tube A were so flaccid that they were only kept apart by the internal pressure, and this internal pressure was overcome by a lateral pressure of 10 mm. Hg, hence in B the resistance of the walls must have been 30 mm. Hg (40 – 10), and in C, 74 mm. Hg (84 – 10).

Deleterious matters ("muscular excitants") being present in the blood, they cause a tightening up of the arterioles and arteries, at least vessels up to the size of the brachial. The aortic blood-pressure is raised in consequence. It is not, however, raised *in the constricted arteries themselves.* Less blood flows through them, and less reaches the capillaries. The current idea is that in a constricted area the blood-pressure rises and increases the circulation through it. This doctrine has received support from the belief that the hæmomanometer with its high readings in such cases records the blood-pressure pure and simple. Sclerosed vessels are more liable to hypertonus than normal ones. Hypertonus disappears when deleterious substances disappear; prolonged hypertonus leads to permanent thickening of the arterial wall.

In addition to the above, the grounds upon which Russell denies that the hæmomanometer affords a true index of blood-pressure when the vessels are thickened are as follows:—

1. He accepts the physiological teaching that the normal brachial blood-pressure in man is somewhere about 100-120 mm. Hg; it rises after violent exercise to about 140 mm. Hg, and this difference of 20 mm. represents more or less the reserve power of the heart. How is it possible then to reconcile with this a doctrine that in disease the heart is capable of exerting pressure equal to 200 or 250 mm. Hg?

2. In clinical work, in cases of interstitial nephritis, for instance, very high manometric readings occur. These may go on rising until just before death, when the heart is obviously failing; on the other hand, they may be reduced by measures which diminish hypertonus, and the softening of the artery which goes along with the falling pressure can be detected by the finger. Such high pressures as 300 mm. Hg in the last stage of Bright's disease simply mean that the vessels are growing steadily thicker and their lumens smaller.

3. In the interpretation of manometric readings it must be remembered that the condition of the brachial artery may differ from that of the radial. With a thickened brachial and a soft radial a reading of 200 mm. Hg may be obtained. Occasionally the removal of hypertonus raises the reading from 110 to 120 mm. Hg; the explanation given is that the relief to the heart allows it to beat with greater vigour.

Cause of Hypertonus.—The chief cause of hypertonus is the absorption from the bowel of the results of imperfect digestion or stagnation of the intestinal contents; excessive (especially proteid) food, improper food, and alcohol also conduce to it. Russell also recognises the

existence of a normal arterial abdominal reflex, whereby the flux of blood to the splanchnic area is balanced by a constriction of the systemic vessels. This reflex constriction may be accentuated by the character of the food ingested, and by the existence of arterial sclerosis. Such a conception of arterial hypertonus as has been outlined links together a variety of morbid conditions. Besides explaining the genesis of arteriosclerosis and the consecutive renal and cardiac changes which it produces, it accounts for transitory cerebral disturbances — hemiparesis, numbness in a limb, aphasia, etc., and for some cases of angina pectoris. A specially important rôle is assigned to the arterial abdominal reflex in producing attacks of angina.

The treatment of hypertonus is in the first place directed towards removing any form of digestive disturbance, and restricting the diet within moderate limits, particularly as regards nitrogenous food. In the second place, vasodilator drugs should be used. Erythrol tetranitrate is the most active of these; among others are spiritus ætheris nitrosi, potassium iodide, atropine, stramonium, valerian, paraldehyde, phenacetin, trional. Digitalis and strophanthus should be added if the heart is feeble.

LITERATURE.—Russell. *Arterial Hypertonus and Blood Pressure*, Edinburgh, 1907.

Arteries, Suture of.— During the last five or six years surgeons have begun to consider the possibility of closing wounds in arteries otherwise than by ligature, and the practice of suturing vessels so as to preserve the lumen has made some headway. The surgery of the arteries was discussed at the French Surgical Congress of 1909, on a report on the subject by Monod and Vanverts (*La Presse Médicale*, Oct. 6, 1909). They collected 66 cases of lateral suture for wounds of the arterial wall with 65 clinical successes, and 21 cases of end-to-end union by Murphy's invagination method or circular suture. The results, so far as regards hæmostasis, are perfect, but it is not so easy to state whether the permeability of the vessel was always secured. It seems not improbable that in a considerable proportion of cases thrombosis follows suture, but in 23 at least of 90 published cases the distal pulse became and remained perceptible. Suture, however, should only be attempted under three conditions:—(1) The diameter of the artery must not be less than one-eighth of an inch; when the vessel is smaller than this the tightening of the stitches obliterates the lumen. (2) The wall must be healthy. (3) Rigorous asepsis is essential. According to Carrel, who has done so much for the technique of vascular surgery, a "degree of asepsis which might suffice for the successful outcome of an abdominal operation may be incapable of ensuring success in an intervention on the vessels."

Methods of Suture.—Murphy invaginates the peripheral end of the divided vessel into the central end, the latter being split up to allow of the insertion of the lower part. This method has the advantage of giving a double thickness of the arterial wall at the point of junction, but the operation is difficult, and owing to the stretching of the artery it cannot be performed when more than three-quarters of an inch of the vessel is destroyed. The cut end of the artery is in contact with the blood-stream, and coagulation is thereby favoured. The method of inserting the stitches is shown in the diagram (Fig. 1).

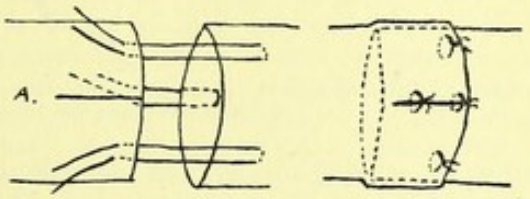

Fig. 1.—Murphy's invagination method. *A*, split in central end of divided vessel.

Dorrance (*Annals of Surgery*, Sept. 1906) has devised the following method of suturing longitudinal, oblique, or transverse wounds of arteries. Pagenstecher's No. 1 thread is used in the finest possible needle. Clamps, guarded with rubber tubing, are employed to prevent hæmorrhage during the process of suture; they are applied about an inch above and below the wound in the vessel. The suture is passed through the two outer coats of the vessel about one-sixteenth of an inch above the beginning of the longitudinal or oblique wound and tied. The edges of the cut are now brought together by a continuous mattress stitch passing through all the coats of the vessel, and about a sixteenth of an inch from the cut edge, until the lower end of the cut is reached. The suture is made fast there by a half stitch through the two outer coats, and is then brought back as a continuous suture over the mattress stitch and tied at the point it was first inserted. Transverse wounds are dealt with in much the same way by a mattress stitch followed by continuous suture. In pulling in the mattress stitch every third stitch drops back one half a suture length (Fig. 2). Dorrance describes the advantages of this method as—(1) the suture does not protrude into the lumen of the artery; (2) fibrin ferment cannot get from the ends of the cut surfaces into the blood-stream; (3) the liability to secondary hæmorrhage is lessened by the double line of suture.

A number of other methods are described by

Smith (*La Presse Médicale*, April 24, 1909), among them being Glück's method, the essential feature of which is the protection of the line of

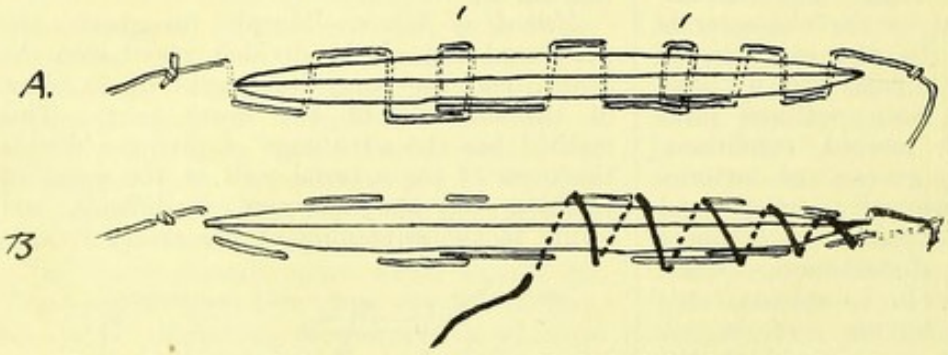

FIG. 2.—Dorrance method. *A*, mattress suture, with third stitches dropped back (1, 1). *B*, continuous suture over mattress suture.

sutures by a ring or cuff of arterial wall resected from another method, and Payr's method, in which an absorbable magnesium collar or plate is employed, through which the divided end of the vessel is passed and its edges then everted. With this plate as a support the whole is inserted into the other divided end (Fig. 3). Carrel brings the divided ends together by three equidistant tension stitches, and then unites the cut surfaces by a continuous suture (Fig. 4). Smith himself advises a quill suture for longitudinal wounds, using chromic acid gut as a support. Sweet (*Annals of Surgery*, xlvi. 350, 1907) recommends a method practically the same as Carrel's. When the vessel is extensively injured, or where a portion requires to be resected, may it be possible to replace it by a graft? So far this has not been accomplished in the human subject, but Carrel's experiments on animals on peritoneal grafting, and patching with a piece of arterial wall from another vessel, may prelude success along these lines. Along with Guthrie (*Amer. Journ. of the Med. Sci.*, Sept. 1906) he has demonstrated by experiments on dogs that by interposing a segment of vein between the two cut ends of an artery it is possible to restore the arterial circulation. The interposed segment quickly undergoes anatomical changes, and from microscopic and macroscopic standpoints has a strong tendency to assume the character of an artery. A dog in which the operation of venous transplantation after division of the carotid artery was performed was in good health eight months later, while the venous segment presented to the touch the characteristics of the carotid artery. (See also Sweet, "The Surgery of the Blood-Vessels," *International Clinics*, vol. iii. seventeenth series, Philadelphia, 1907, a general review, with literature; and Levin, *Annals of Surgery*, xlix. p. 320, 1909).

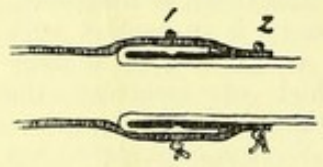

FIG. 3.—Payr's method, showing magnesium collar (black) with everted lower end of vessel (white) inserted into upper end of vessel (shaded). 1, 2, ligatures. (After Smith.)

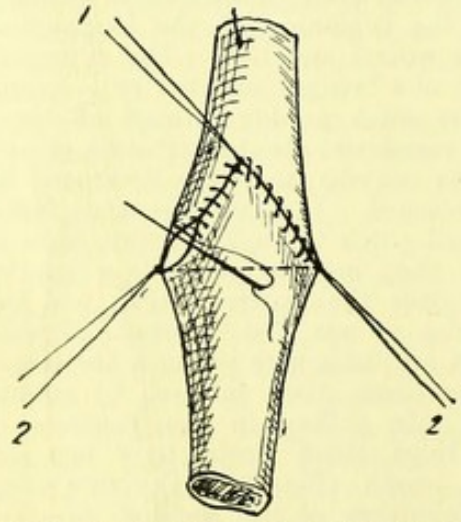

FIG. 4.—Carrel's method. 1, 2, 3, tension stitches. (After Smith.)

Arterio-venous Anastomosis has been performed in a small number of cases as a means of healing actual or impending senile or arterio-sclerotic gangrene of the foot (Müller, *Annals of Surgery*, li. p. 246, 1910). In the cases operated on by Ballance and by Wieting a good result followed. The method adopted is to make an anastomosis in Scarpa's triangle between the femoral artery and vein, so as to deflect the arterial blood into the vein. The presence of the valves in the vein is not an insuperable obstacle, as they are forced in a few hours, allowing a reversal of the circulation (Carrel). Müller concludes (1) that in the early stages of arterial disease producing ulcers on the toes, pain, etc., reversal of the circulation *may* do good, and should be tried if other means fail. (2) Where gangrene is present a line of demarcation should be awaited. If the process involves several toes, or tends to spread to the dorsum of the foot, an anastomosis between the femoral artery and vein, with ligation of the external saphenous, will almost certainly induce a line of demarcation in the region of the ankle. (3) If the superficial and deep veins are also thrombosed the operation is contra-indicated.

Records of 26 cases of arterio-venous anastomosis will be found in a paper by Monod and Vanverts (*Archives Générales de Chirurgie*, May 1910). Mauclaire is of opinion that there is at present only a limited field for the operation.

It requires, for success, that the general health be fair and the patient not too old; that the gangrene be limited; that the femoral pulse be distinct, and the vessel but slightly atheromatous—a set of conditions rarely present together. Brilliant as are the results of arterio-venous anastomosis in animals, they are far from being very encouraging in man, and it is premature, at present, to build too much on them.

Arterio-Sclerosis.—In spite of the amount of research which has been devoted to the subject, much still remains to be learned concerning arterio-sclerosis. Pathologists are by no means agreed as to the nature of the different vascular changes found, and clinicians for the most part continue to apply the name to any thickened condition of the arteries, the thickening being judged of mainly by the examination of the radial artery, without much reference to the ultimate nature of the morbid process. Russell, however, has done good service in clearing the ground in one direction, and the distinction which he draws between tonic contraction and hypertrophy of the media on one hand, and such forms of thickening as atheroma on the other, has attracted much notice. *See* ARTERIAL HYPERTONUS.

It is generally agreed that arterio-sclerosis, using the term to mean a diffuse thickening and rigidity of ihe arteries, occurs secondarily to the presence of deleterious substances in the blood. There is no such general agreement as to the part which is played by high blood-pressure. Some look on the high blood-pressure of arterio-sclerosis as due to the same agents—toxic materials—as cause that disease; others assert that the toxins produce arterio-sclerosis indirectly by raising the blood-pressure; while others again think that the toxins act directly on the vessel wall, causing thickening, and that the high blood-pressure is secondary to this. Stengel holds that in the early (pre-sclerotic) stage of arterio-sclerosis, the blood-pressure, so far from being permanently raised, is actually subnormal, with occasional rises. Huchard, on the contrary, believes in a pre-sclerotic stage of hypertension; this he regards as curable, the later, sclerotic, stage as incurable. Clifford Allbutt divides cases of arterio-sclerosis into three groups:—(1) Hyperpiesis, due to high blood-pressure extending over a number of years; (2) toxic; (3) involutional. Broadly, he associates with the hyperpietic cases tearing and shearing stresses which leave microscopic evidence of their action on the vessel wall, and hypermyotrophy; with the toxic cases thickening of the intima, but no hypertrophy of the muscular coat; with the involutional cases calcification of the media. High pressure is characteristic of hyperpiesis, not of the other two; if it can be permanently abolished the hypermyotrophy may disappear. This conception appears to harmonise to some extent with the opinions of Dr. Russell.

The factors whi h are believed to play a part in the production of arterio-sclerosis are:—(1) Heredity. (2) To xic causes—gout, lead-poisoning, syphilis, alcoholism, nicotine poisoning, deleterious substances arising from excessive or abnormal metabolism of the proteids of the food (purin bodies in particular), caffeine, and theobromine. (3) Physical or mental strain. (4) Infectious diseases, especially rheumatism and typhoid fever. Thayer has drawn special attention to the comparative frequency with which arterio-sclerosis follows typhoid fever:—"Between the ages of 10 and 50 years 48·3 per cent. of old typhoid patients show palpable arteries, as compared with 17·5 per cent. among ordinary healthy individuals." It is not improbable that the part which is played by alcohol in producing arterio-sclerosis has been to some extent over-estimated. Cabot found arterio-sclerosis in only 6 per cent. of chronic alcoholics, and a history of alcoholism in only 21 per cent. of (post-mortem) cases of arterio-sclerosis.

Although typically a disease of the later decades, arterio-sclerosis may occur in children. Fremont-Smith's study of the subject points to the conclusion that the chief causes are heredity, individual predisposition, congenital syphilis, and infectious diseases. Probably the importance of syphilis has been over-, and the importance of acute infections under-rated.

EXPERIMENTAL ARTERIO-SCLEROSIS. — Attempts have been made to throw light on the nature of the disease by experiment on animals. The main result which has been brought out is to demonstrate that injections of adrenalin will produce, with a fair degree of certainty, degenerative changes in the rabbit's aorta. It has been shown that ligature, compression, and local inflammation of vessels caused by mechanical or chemical means produce local thickening in the walls of the vessel, but the experiments which have been made by injecting poisonous substances bear more resemblance to the conditions obtaining in human pathology. Alcohol, lead, and bacterial poisons have given contradictory results: lead sometimes produces multiple aneurismal dilatations; Klotz compares the effect of diphtheria toxin to that of adrenalin, while injections of streptococci and B. typhosus cause endothelial proliferation. In the case of adrenalin the experiences of different workers have been fairly congruent. Two or three weeks after a rabbit receives injections of adrenalin changes appear in its aorta. The earliest damage is found in the media; the cells necrose, and the elastic fibres degenerate. There is no primary change in the intima. Ultimately a fusiform dilatation is developed. These experiments are interpreted as illustrating the effects of high blood-pressure. The adrena-

lin is distributed throughout the body, yet its effects are only apparent in the aorta, where the pressure is highest. Similar, though milder, changes are produced by barium, digitalis, and nicotine. If the action of adrenalin on blood-pressure be annulled by the simultaneous administration of nitrites, the arterial change is less extensive, but does not differ in character. Iodides do not seem materially to modify the action of adrenalin on the vessels.

Clinical Varieties of Arterio-Sclerosis.—More fruitful of practical results, perhaps, than investigations as to the ultimate nature of arterio-sclerosis has been the recognition of certain symptom-groups due to vascular changes.

Stengel points out that while normal senile arterio-sclerosis is a general and uniform process, accompanied by gradual failure of the organic functions, pathological arterio-sclerosis, though beginning as a general disease, tends in the long run to affect one organ prematurely; hence in its clinical manifestations cardiac, renal, or cerebral symptoms may predominate. It is in this stage that the condition is generally diagnosed for the first time, but its early detection is as important as the early detection of pulmonary tuberculosis. Stengel divides the disease into three stages:—(1) A preliminary stage; (2) a middle period, during which the arterial thickening is easy to recognise, and secondary organic changes are beginning to discover themselves; (3) a final stage of failure of the circulation, of organic failure, and of terminal infection.

During the first stage the symptoms are indefinite. The blood-pressure is not permanently high, though temporary rises may occur. The patients suffer from loss of vigour, from mild neurasthenia, from dryness of the skin or excessive perspiration. The renal equilibrium is disturbed, and reduced excretion of urine alternates with polyuria. There is often digestive disturbance and loss of weight. Three main clinical types of case occur:—(1) A nutritional type, in which loss of vigour, emaciation, and pallor ("pseudo-anæmia") from vascular contraction are the leading symptoms. (2) The neurasthenic type, in which the symptoms of nervous exhaustion are predominant (*v. infra*). (3) The nervous type, accompanied by neuralgia, migraine, tinnitus, vertigo, and muscular weakness.

In the second stage the signs of arterio-sclerosis are well marked. The vessels are thickened, the blood-pressure is raised, the arterial second sound is accentuated, there is a marked tidal wave in the pulse-tracing, and the sphygmometer shows high pressure. During this period Stengel classifies cases according to which organ is most affected—cardiac, aortic, renal, intestinal, pancreatic, arterio-capillary, cerebro-spinal. In cardiac cases the heart is irregular; there may be angina. In aortic cases there are signs of aortic degeneration and dilatation. In the renal type we find evidences of chronic interstitial nephritis; cylindroids occur in the urine long before casts can be detected. In the arterio-capillary type the vascular thickening overshadows the other features.

Arterio-Sclerosis of the Splanchnic Vessels.—Stengel describes the features of intestinal arterio-sclerosis as atrophy of the mucous membrane, sudden attacks of painful obstruction, and chronic colitis. This symptom-complex has also been carefully studied by Buch, of Helsingfors, who gives its leading symptoms as follows:—In simple arterio-sclerotic colic the patient is usually over forty, and suffers from frequently-recurring attacks of severe epigastric pain, the individual attacks being of short duration. The pain is evoked by exertion or emotion, and is associated with tenderness over the abdominal aorta. In a second group of cases the colic is complicated by the existence of granular contracted kidney, and in a further group by angina pectoris. The chief diagnostic features of the seizures are their suddenness and frequency (many during the twenty-four hours), their association with mental shock or physical strain; and the absence of any digestive disorder to account for them. Arterio-sclerotic colic may occur as an early symptom of arterio-sclerosis; usually, however, by the time it develops, general vascular thickening can be made out.

Arterio-Sclerosis of the Nervous System. Cimbal proposes the following grouping of cases, based chiefly on the views of German clinicians:—(1) Neurasthenia. (2) Cerebral destructive form, the most definite type being pseudo-bulbar palsy. (3) The results of (1) and (2)—apoplexy, and late epilepsy. (4) Spinal arterio-sclerosis. (5) Angio-sclerotic neuritis.

Of these five groups the first and last are the best defined.

Arterio-Sclerotic Neurasthenia.—The symptoms on the whole resemble those of ordinary neurasthenia, but come on more suddenly, without definite cause, and without any of the minor prodromal symptoms which usually herald an ordinary attack of neurasthenia. The patients are generally over middle life. Foremost among the symptoms is chronic headache, which is exacerbated by exertion and by the use of alcohol. This aggravation of the symptoms by alcohol is somewhat characteristic of arterio-sclerotic neurasthenia. Other pronounced symptoms are a feeling of swaying and insecurity in walking, disturbed sleep, and mental depression. Both physical and mental work rapidly cause a feeling of exhaustion. Cimbal lays stress on the following as aids to diagnosis:—The face tends to flush and pale by turns, and in the later stages is congested. There is no

history, hereditary or personal, of psychoses or previous neurasthenia, as in most forms of functional nerve disorder. Arterio-sclerotic neurasthenia sets in without cause or warning. The smallest quantity of alcohol aggravates all the symptoms. Some cases closely resemble an early stage of general paralysis: lumbar puncture (no cells in the cerebro-spinal fluid) will decide this point.

INTERMITTENT CLAUDICATION. — This condition (also called Dysbasia angio-sclerotica and Intermittent Limp) has been especially studied by Erb. Its leading features are—(1) pain in the legs brought on by walking, disappearing after a brief rest, and recurring when walking is resumed; (2) defective circulation in the limbs; (3) a tendency to progress to senile gangrene. The chief symptoms of typical cases are a feeling of tightness, or stiffness, or actual pain in the legs, paræsthesiæ, and vaso-motor disturbances—coldness, pallor, cyanosis, or heat and redness—in the feet, all of which occur on walking, and rapidly progress to such an extent that the patient has to pause for rest after he has walked for a quarter of an hour or so. After a short rest the symptoms abate completely, but when the patient sets out again the scene is re-enacted. The anterior and posterior tibial vessels are either imperceptible, or extremely small and contracted, showing evidence of arterio-sclerosis. These vascular and circulatory signs are essential to the diagnosis. The disease is usually bilateral; sometimes pulsation is absent from the popliteal and femoral arteries also. In addition to the above vascular disturbance there may be actual senile gangrene. Males are chiefly affected; the disease is most common in the fourth and fifth decades, and it is more frequently met with among the well-to-do than the labouring class. Excessive use of tobacco and exposure to cold are said to be the most important causes. Intermittent claudication is relatively common in Russia. Idelsohn regards cold as the chief etiological factor.

TREATMENT OF ARTERIO-SCLEROSIS.—The line of treatment generally advocated includes the regular use of warm baths, moderate amounts of exercise, and gentle massage. When obesity is present it should be reduced by diet, not by excessive exercise. The diet in arterio-sclerosis should consist largely of milk, vegetables, and farinaceous foods. Huchard advises that it should, as far as possible, be free from salt (see DECHLORINATION). Tea, tobacco, and alcohol should be used sparingly or altogether prohibited. *See* PURIN-FREE DIET.

Apart from these general measures the chief remedies employed are those which favour elimination, and drugs which lower the blood-pressure. As diuretics, diuretin and nitrates are advised by Huchard; benzoates by Barr. Diaphoretics and saline aperients should also be given; among Spas recommended Harrogate may be mentioned. Iodides continue the most popular drugs; next to them Barr places thyroid as a depressor of blood-pressure. The usual dose of iodide of potash is from 2 to 5 grs. thrice daily. Huchard recommends a course of iodide and nitrate alternately, thus: Potassium iodide is given to the amount of 15 to 30 grs. daily for the first twenty days of the month; during the last ten days the patient takes 2 drops 1 per cent. trinitrin night and morning. Erlenmeyer's iodide cure consists in giving 4 grs. of sodium iodide and 4 grs. of potassium iodide daily, increasing by 8 grs. of the mixed drugs every fourth day, until by the thirty-sixth day the patient is taking 80 grs. To each dose 20 grs. of sodium bicarbonate is added. This method of administration prevents iodism, and should be persisted in until the patient has had from 1500 to 2500 grs. of iodide. A shorter prophylactic cure should be undergone annually thereafter.

In the later stages of arterio-sclerosis, when the heart is failing, digitalis is required.

IN ARTERIO-SCLEROTIC NEURASTHENIA rest is essential, and no active measures (*e.g.* hydrotherapeutics) are advisable. For sleeplessness bromides are the best drugs. Veronal is unsafe. In senile insomnia a combination of morphine (gr. $\frac{1}{8}$) and veronal (grs. 4) may be used.

ARTERIO-SCLEROTIC COLIC. — Diuretin in doses of from 20 to 30 grs. daily is said to be the most useful drug, and may completely ward off attacks. Next come strophanthus and the iodides. Warm fomentations should be kept applied to the abdomen for several hours in the day; abdominal massage should be tried when the blood-pressure is high.

INTERMITTENT CLAUDICATION.—The treatment consists in giving up tobacco, and using all means of preventing exposure to cold. Cardiac tonics and iodides should be given, and the legs should be treated with galvanism.

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Arylarsonates. *See* DRUGS, RECENT (*Atoxyl*); SLEEPING SICKNESS (*Treatment*).

Ascariasis.—The invasion of the body with ascarides (*cf.* helminthiasis, filariasis, etc.).

Atmocausis. — Definition. — Vaporisation or atmocausis of the uterus is the application of steam to the interior of that organ for the purposes of arresting hæmorrhage and of modifying the mucous membrane; it is cauterisation of the endometrium by means of steam; and the steam may be applied either by means of a double catheter, whose central tube carries in the steam, which comes in contact with the mucosa, and escapes again through the outer tube, which has a number of fenestrations in its intra-uterine extremity (*atmocausis* proper, from Gr. ἀτμός, smoke or vapour, and καῦσις, a burning); or by a non-fenestrated catheter, which becomes steam-hot, the heat being applied to the uterus through the wall of the outer tube, while the steam itself does not escape into the cavity of the organ (*zestocausis*, from Gr. ζεστός, boiling, hot, and καῦσις, a burning).

History.—Although atmocausis was introduced into gynæcological practice during the closing years of the nineteenth century, Sneguireff having used it in Moscow in 1894 (*Zentralb. f. Gynäk.*, xix. pp. 74, 870, 1895) and demonstrated it at the International Medical Congress held there in 1897 (*Zentralb. f. Gynäk.*, xxi. p. 1161, 1897), yet its establishment as a recognised operative procedure in the treatment of the diseases of women belongs to the twentieth century. Sir Alexander Simpson reported (in May 1900) the results of fourteen cases in which he had used the atmocautery in Edinburgh (*Trans. Edin. Obstet. Soc.*, xxv. p. 131, 1900), and described and demonstrated its method of application; in this way it was brought under the notice of British gynæcologists. But, before this date, Dr. Ludwig Pincus of Danzig had done much to introduce the procedure into Germany (*Zentralb. f. Gynäk.*, xix. p. 284, 1895; xxi. p. 190, 1897; xxii. pp. 256, 582, 1019, 1898; xxiii. 113, 352, 1008, 1010, 1899), and other workers in that country had reported favourably or unfavourably upon the matter (*e.g.* Panecki, *Zentralb. f. Gynäk.*, xx. p. 463, 1896; Kahn, *ibid.*, xx. p. 1233, 1896; Pit'ha, *ibid.*, xxi. p. 652, 1897; Schick, *ibid.*, xxi. p. 695, 1897; Baruch, *ibid.*, xxii. p. 113, 1898; Kahn, *ibid.*, xxii. p. 618, 1898; Otto von Weiss, *ibid.*, xxii. p. 636, 1898; T. H. van de Velde, *ibid.*, xxii. p. 1409, 1898; Dührssen, *ibid.*, xxiii. p. 292, 1899; Gerich, *ibid.*, xxiii. p. 557, 1899; Beuttner, *ibid.*, xxiii. p. 993, 1899; Stapler, *ibid.*, xxiii. p. 1000, 1899; Pit'ha, *ibid.*, xxiii. p. 1011, 1899; H. A. V. Guérard, *ibid.*, xxiii. p. 1081, 1899). Since the beginning of the present century Pincus has continued to advocate atmocausis strongly, and has brought together in his book (*Atmokausis und Zestokausis* (Wiesbaden), 1903, 1906), and in a number of monographs (e.g. *Samml. klin. Vortr.*, Nos. 238, 261, 262, 1899, and No. 417, 1906), all the evidence in favour of it and all the details regarding its indications and mode of employment. There have been others in Germany, however, who have pointed out that the procedure is not free from danger and that it has disadvantages, and among these writers may be named Pfannenstiel (*Verhandl. d. deutsch. Gesellsch. f. Gynäk.* (Leipzig), p. 463, 1906), P. Meyer (*Zentralb. f. Gynäk.*, xxxi. p. 174, 1907), and H. Cramer (*Monatsschr. f. Geburtsh. u. Gynäk.*, xxvii. p. 346, 1908). In Great Britain there has been comparatively little enthusiasm evinced for the operation of atmocausis. Simpson (*loc. cit.*), indeed, was appreciative, and Macnaughton Jones spoke with some favour of the procedure; but Campbell (*Brit. Med. Journ.*, ii. for 1901, p. 964) was critical, and Blacker (*Journ. Obstet. and Gynæc. Brit. Emp.*, i. p. 488, 1902; iii. p. 444, 1903) urged greater discrimination in the selection of suitable cases. Pincus, indeed, still holds (*Zentralb. f. Gynäk.*, xxx. p. 379, 1906) that if the method be cautiously employed in carefully chosen cases it is safe, painless, and efficacious ("ungefährlich, schmerzlos und wirksam"); but it may be said with some confidence that atmocausis has not, and will not, supplant, although it may, in rare cases, supplement the use of the curette. In British gynæcological practice, at any rate, curettage maintains its place as one of the most commonly employed and generally successful operations in diseased conditions of the endometrium; atmocausis is occasionally used in hospitals or nursing homes and in special cases.

Description of the Operation. — The *requisites* are (1) a Pincus's kettle or boiler for generating the steam, strong enough to resist a pressure of three atmospheres, fitted with a thermometer, dynamometer, and safety-valve, provided with an exit tube for the steam, and heated by means of a spirit-lamp or Bunsen burner; (2) an intra-uterine two-way metal cannula or catheter (with a protected handle fitted to it at an angle) with openings in it to allow the steam to escape in atmocausis proper, or entirely closed (non-fenestrated) in zestocausis, and with a protective covering (of wood or indiarubber) for the part which comes in contact with the cervical canal; (3) two volsellæ to fix or pull down the cervix; (4) specula for protecting the vaginal walls; and (5) cervical dilators (*e.g.* Hegar's). It is best to have a return tube to bring the steam away from the uterine interior, and not to allow it to escape into the vagina. Zestocausis is now scarcely ever employed, and may be neglected in the description of the operative procedure.

The patient is prepared as for a curettage, and an anæsthetic is usually given, although it has been claimed that the operation is painless and can be performed without chloroform. The actual application of the steam to the

uterine interior should always be preceded by a careful bi-manual examination to detect traces of pelvic inflammation, and by dilatation of the cervical canal, either at the time by Hegar's bougies or overnight by a tent. A preliminary curettage may or may not be performed. The cervix is drawn down by volsellæ, the length of the cavity measured with a sound, the interior washed out, and the vaginal walls and vulvar ring are protected from the heat by specula. The steam is made to pass through the tubing and cannula so as to warm the parts of the apparatus. The cannula is introduced into the uterus with the steam shut off; it is then turned on, and the steam is allowed to play on the surface of the cavity for ten, twenty, or thirty seconds (or longer in special cases) at a temperature of 212° to 239° F. (100° to 115° C.); and the tube is moved about in the uterus to bring the whole mucous membrane under the cauterising influence. The returning steam and water come away through the india-rubber tubing and do not scald the vagina of the patient or the hands of the operator. A small plug of iodoform gauze is placed in the cervical canal after the cannula has been withdrawn, and the vagina is loosely packed with gauze. The after-treatment is the same as for curettage, the patient being kept in bed for a week and getting vaginal douches till the discharge and shreds of sloughing tissue have all come away. It is probable that the heat of the steam when it is actually in contact with the vaginal mucous membrane is never above 212° F., and does not often reach that level, for some heat is lost in conveyance.

Results of Atmocausis.—The results of uterine vaporisation have been found to differ in a rather surprising fashion. The ordinary result (and that which it is generally wished to obtain) is destruction, regular and uniform, of the superficial part of the uterine mucosa, followed by regeneration of the membrane in a normal condition. It must be admitted, however, that the necrosis is not always uniform, that the new mucous membrane may sometimes be atrophic, and that, in rare instances, complete destruction of the lining membrane with consequent obliteration of the cavity of the organ has followed vaporisation. These divergent results cannot always be accounted for by differences in the temperature of the steam or in the length of time of its application. The more serious results may perhaps be due to excessive contraction of the uterus which causes the organ tightly to grasp the atmocautery, or by the latter becoming steam-hot and acting as a zestocautery. It may be added that obliteration of the uterine cavity is, in a certain group of cases, the result which it is desired to obtain.

Contra-Indications. — The contra-indications to vaporisation of the uterus are, speaking generally, the same as to curettage; but special emphasis may perhaps be laid upon the presence of recent or old inflammatory changes in the pelvic peritoneum or cellular tissue or in the uterine annexa, for in such a case the risk of lighting up fresh inflammation is very considerable. It is also contra-indicated in puerperal sepsis which has become general, and when the uterus contains submucous fibroids or malignant neoplasms, but it constitutes a valuable palliative means of treatment in inoperable cancer. It is not so suitable for young women as for those near the menopause or older than forty-five. The *dangers* arising from the use of the atmocautery are similar to those in curettage, viz. peri-uterine inflammation, perforation of the uterus, an excessive degree of atrophy of the organ, and the production of abortion (in pregnant patients); but, in addition, there are the special risks of causing obliteration of the uterine cavity (in the cases in which this end is not aimed at) and of leading to stenosis or atresia of the cervix. There is also the danger of septic infection during the separation of the intra-uterine sloughs.

Indications. — It is a somewhat difficult matter to define exactly the cases in which vaporisation should be employed; and gynæcologists differ widely in the frequency with which they make use of it and in the kind of case which they regard as suitable. In British practice, however, it may be stated generally that the atmocautery is not thought of until curettage has failed; but if we cast our net wide, as some of the continental gynæcologists do, we may include the following morbid states:—(1) Endometritis, glandular, but more especially the interstitial variety, in which it may be hoped that the atmocausis will check the hæmorrhage and ameliorate the dysmenorrhœa (if present); (2) Climacteric and pre-climacteric hæmorrhages for which there is no clearly defined cause such as myomata or malignant neoplasms; (3) Hæmophilia in women (a rare occurrence) when the disease shows itself in the form of uterine hæmorrhage; (4) Interstitial fibro-myomata of the uterus, for the purpose of checking the bleeding, but such a result cannot be guaranteed; and (5) Systemic diseases, such as phthisis, contracted pelvis, and other morbid states in which pregnancy is to be feared, when atmocausis is used to cause complete obliteration of the uterine cavity, and consequent sterility; but atmocausis is sometimes neither effective nor safe in such cases as Meyer's report (*loc. cit. supra*) proves. Beyond these indications, there are others, such as puerperal sepsis in its early and localised stage, cancer of the cervix (as a palliative measure), subinvolution, and to cause closure of the cavity of the body of the uterus after amputation of the cervix (*e.g.* for cervical cancer); but evidence regarding the

efficacy of atmocausis or zestocausis in these directions is not forthcoming in sufficient amount or with the requisite certainty to enable us to express an emphatic opinion. The last word on the subject would appear to be, that in the vast majority of cases curettage holds its ground as the operation of election, but that atmocausis is of some value when curettage fails (especially in hæmorrhages at the menopause, with no well-defined pathological state as a cause), when there is a suspicion of hæmophilia, and when artificial sterilisation is clearly indicated (*e.g.* in women suffering from incurable diseases).

LITERATURE.—A good account of the literature of the subject is contained in Pincus's work (2nd ed., 1906), and in Blacker's article (*loc. cit. supra*), up to date of its publication (1902). Some recent articles of importance, not already referred to, may be named here:—Baisch. *Zentralb. f. Gynäk.*, xxx. p. 16, 1906. —Fuchs. *Monatsschr. f. Geburtsh. u. Gynäk.*, xxiv. p. 487, 1906.—Hugel. *Vereinsb. d. pfälz. Aerzte*, xxiii. p. 170, 1907.—Weisswange. *Zentralb. f. Gynäk.*, xxxii. p. 296, 1908; and Frankenstein. *Monatsschr. f. Geburtsh. u. Gynäk.*, xxviii. p. 396, 1908.

Atoxyl. *See* Drugs, Recent (*Atoxyl*); Sleeping Sickness (*Treatment*).

Atreptic Immunity. *See* Cancer (*Ehrlich's Theory*).

Audition, Gustatory.—A variety of synæsthesia in which gustatory sensations are felt when certain sounds (words or non-vocal sounds) are heard.

Autoserotherapy.—The treatment of serous effusions into the pleural and peritoneal cavities by the hypodermic injection into the patient of his own serum; a plan originated by Gilbert of Geneva in 1891, and practised by Marcou, Audibert, and others. See Austin's article in *International Clinics*, s. 20, vol. iii. pp. 28-32, 1910.

Babinski's Sign (No. 2).—As is well known, Babinski's sign is the inversion of the ordinary plantar reflex, *i.e.* dorsal extension of all the toes, instead of plantar flexion of them, follows stroking of the plantar surface of the foot. Recently the same observer has described *another pathological reflex*, viz. inversion of the radial reflex. In healthy circumstances percussion of the lower end of the radius causes simple flexion of the forearm on the upper arm. If the reflexes of the upper limb are strong, as in cerebral hemiplegia, other movements, such as flexion of the fingers, may be associated with the flexion of the forearm; but in health flexion of the fingers alone never follows percussion of the radius. In certain diseases, however, which affect the cervical cord (syringomyelia, tumour) this inversion of the radial reflex occurs; *i.e.* reflex flexion of the forearm is absent, but reflex flexion of the fingers is increased. This sign is believed to point to a lesion of the fifth cervical segment of the spinal cord. See *Gaz. d. hôp.*, Ann. lxxxiii. p. 1617, 1910, and *Lancet*, ii. for 1910, p. 1503.

Bacilli - Carriers. *See* Cerebro-Spinal Meningitis and Typhoid Fever (*Typhoid Carriers*).

Bacteriotropin.—A humoral substance found by Neufeld and Rimpan in immune sera; it is similar in action to Wright's opsonin (being adjuvant to phagocytosis), but differs from it in being thermostable instead of thermolabile. See Andrewes, *Lancet*, ii. for 1910, p. 1738.

Bad-Nauheim Treatment.—The treatment of certain cases of heart disease by muscular exercises ("resistance exercises"), as carried out at Bad-Nauheim, in Hesse-Darmstadt, Germany.

Balne's Cough.—A paroxysmal cough, occurring at night, and excited generally by lying down; it is met with in naso-pharyngeal obstruction, *e.g.* from chronic tonsillitis.

Bälz's Disease.—Chronic enlargement of the mucous glands of the lips with dilatation of the ducts, most marked on the lower lip.

Bang System.—A method of eradicating bovine tuberculosis in Denmark, introduced by Professor Bang. It is intended to take the place of eradication by slaughtering the animals, and consists in segregation and isolation. The tuberculin test is applied to whole herds, and the reacting are permanently separated from the non-tuberculous animals; but, further, the attempt is made to rear up a healthy stock from the reacting animals, and this is done by separating all calves born of tuberculous cows immediately after their birth and feeding them with normal milk or with milk heated to such a degree as to kill any tubercle bacilli in it. See *Brit. Med. Journ.*, i. for 1909, p. 688.

Barber's Rash.—A term somewhat loosely applied to any skin eruption occurring on the chin, and believed to be due to the use of an infected or dirty razor. As commonly employed it includes cases due to the ringworm fungus (trichophyton) and those due to a pus infection (staphylococci). In the former the morbid process is a hyphogenic sycosis, in the latter a coccogenic one. It need hardly be added that it may be acquired in other ways than from the use of the razor.

Baudon's Wine.—A proprietary tonic wine, said to contain "phosphates with a basis

of pure muscat wine." For analysis see *Brit. Med. Journ.*, i. for 1909, p. 1309.

Beckmann's Cryoscope. *See* CRYOSCOPY.

Becterew's Reflex. *See* REFLEXES.

Bedroom Disease.—The name given by Mr. John Burns, M.P., to consumption (June 1909): it is "a house disease, almost it is a bedroom disease, and is preventable." See *Brit. Med. Journ.*, ii. for 1909, p. 1428.

Beebe's Serums. *See* GRAVES'S DISEASE.

Beecham's Pills. — The analysis of this secret remedy, as given in the *British Medical Journal* (i. for 1909, p. 32), is aloes, 0·5 grain; powdered ginger, 0·55 grain; powdered soap, 0·18 grain—in one pill.

"Bends." *See* CAISSON DISEASE.

Benzedin Test. *See* DIGESTIVE FUNCTIONS, TESTS FOR THE.

Benzoyl-Nastin. *See* LEPROSY.

Bezold's Disease, or **Bezold's Mastoiditis.** — Inflammation of the mastoid air cells, causing destruction of the apex of the mastoid process, and leading to suppuration in the neck. Records of cases will be found in the *Brit. Med. Journ.*, ii. for 1909, p. 1747, and i. for 1910, p. 1110.

Bier's Method of Treatment by Hyperæmia.

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PASSIVE CONGESTION. — *Active Hyperæmia.*— Bier's method of treatment by passive congestion is one which consists in augmenting the inflammatory reaction by interfering with the blood return from the site of disease. It is capable of application to a wide variety of ailments, such as those where acute or chronic inflammation is present. As it is based on the fundamental conception that the inflammatory reaction is in the main a beneficial process, it may also be applied to any case where it is desired to stimulate wound-healing. Thus, for example, it can be used where delayed union after an osseous fracture is present. It is also found to be of great service as a prophylactic form of treatment in cases of recent lacerated wounds which have been contaminated at the time of the accident. It is necessary, in order to practise Bier's treatment, to possess a clear conception of the true significance of the inflammatory process. For many years most pathologists have maintained that inflammation and repair were the manifestation of an identical process, which only varied in degree according to the severity of the irritant to which they were the response. It is only, however, since Bier's method of treatment has become so widely practised by surgeons that the majority of medical men have become converted to this view. This variation between the pathological and clinical opinion has been largely due to the confusion of cause and effect; the pronounced inflammatory reaction called forth in response to an intense micro-organismal irritant being credited with the harmful effects which the bacterial poison caused. Holding the view that the presence of inflammation was in itself harmful to the organism, such remedies as the ice-bag were often used to carry out an anti-phlogistic method of treatment. When the cardinal phenomena of inflammation are examined and compared with those seen where repair is occurring, it will be observed that the two processes are essentially identical and only differ in degree. When repair takes place in a vascular organ, there is observed early a pronounced engorgement of blood-vessels round the wound. When inflammation is present, a similar hyperæmia causes the classical *rubor*. In the same way, when all the local vascular and cellular phenomena are studied, they are found to correspond.

The method of treatment by augmenting the inflammatory reaction for the cure of disease is of course not new. For long such means for inducing local hyperæmia as the poultice and the blister have been used in surgical practice. Neither was the very technique adopted by Bier in the treatment of his cases a novel one when he introduced it, for just as carbolic acid was used to promote the healing of wounds long before Lister enunciated the principles of antiseptic surgery, so were constricting fillets used to interfere with the return of blood from a part in order to favour healing. What was new, however, was the fundamental conception underlying the practice, and on this account it will remain for ever as "Bier's treatment by hyperæmia."

TECHNIQUE. — Where passive congestion is employed it can be carried out in one of two ways. A rubber bandage may be applied lightly on the cardiac side of the lesion, and by this means the return of venous blood to the part will be interfered with and venous engorgement produced. On the other hand, cupping-glasses may be used, which by their suction engorge the vessels of the part to which they are applied. This latter method, which is a more recent modification of Bier's method of treatment, was introduced by his assistant Klapp. Active hyperæmia or arterial conges-

tion is best produced by the application of dry heat by means of hot air. Superheated dry air is the best means, because higher temperatures can be tolerated when it is used. Thus, for example, Bier mentions that he was able to hold his forearm in superheated dry air at a temperature of 105° C., whereas in hot water only a temperature of 44° C. could be borne.

Passive Congestion by Means of the Rubber Bandage. — This method of treatment is found to give excellent results in many cases. As will be detailed later, it may be used in cases of acute suppuration, or where more chronic infection has occurred. The best material which can be used is a soft, thin, elastic rubber bandage. This may be obtained from any instrument-maker in rolls of varying width, from which pieces can be cut off as required. On the bandage being applied to a limb, it should be of a length that will enable it to go at least one-and-a-half times round its circumference. Before applying the bandage, the site of the disease is carefully inspected and cleansed, and a sterile dressing applied loosely over it. It is of importance that this latter point be carefully attended to, as the œdema which follows the application of the bandage might otherwise cause the bandage covering the dressing to become too tightly applied when the limb is swollen.

The situation in which the bandage should be applied varies with the different lesions being treated. It will be found, however, that the best results are obtained when the constriction is put on at some considerable distance from the site of disease. Thus, for example, in cases of severe whitlow, the constricting fillet should be applied around the lower part of the upper arm. Where the disease is situated in the region of the foot or ankle, the constriction can best be applied around the thigh.

The method of application which is found to be most comfortable to the patient is that where a portion of soft flannel or boracic lint intervenes between the rubber bandage and the skin. When the boracic lint has been applied loosely round the part to be constricted, the rubber bandage is then rolled round the limb, which has been previously placed in the position in which it is afterwards to remain. The best method of fixing it is by the simple device of fixing the tail to the previous turn by a piece of adhesive plaster.

It is of very great importance that the proper degree of constriction should be procured, as on it entirely depends the success of the treatment. It is only by experience that a correct standard can be arrived at, but there are certain rules which should always be adhered to. The bandage should never be applied so tightly as to obliterate the pulse beyond. It should never cause the limb to become either pale, cold, or of a dark, cyanosed appearance. The most certain guide that can be given as to the proper degree of constriction is the effect it produces in relieving pain. The properly applied bandage should never cause pain, it should always lead to the relief of pain. When the bandage has been properly applied, the superficial veins are seen to become slowly engorged. The limb will be found later to become swollen and somewhat œdematous. In some cases, where an acute infection is being treated, the amount of swelling in pronounced, and may be accompanied by the presence of *bullæ*, the inflamed area being also wider than before treatment was commenced. When this is seen for the first time by one not familiar with the effects of this treatment, it may give rise to alarm, and the bandage be in consequence removed. There is, however, no occasion for doing this, for, as Bier pointed out in his original papers, such an appearance is indicative of successful, not unskilful treatment.

When the patient is questioned as regards his sensations, he will often state, that in addition to the relief of pain that the treatment has brought about, he feels a comfortable glow at the site of the disease.

Length of Time during which the Bandage should be Applied.—In cases where acute infection is being treated, it is to be advised that it be kept on for as long as twenty hours out of the twenty-four. It is not necessary that the patient be kept under observation during this time; a method that is often adopted is to apply the bandage about ten o'clock in the morning. When the inflammation is one involving an upper extremity, the patient may perfectly well be sent home. He is told to report himself to his medical attendant in the evening, about six o'clock, when the bandage is taken off, then reapplied. He is then sent home with the instructions that he is to wear it during the night, and take it off about six o'clock in the morning. Should the bandage, however, feel uncomfortable and unduly tight, or should the part become more painful, he is instructed to remove it before this time. When the patient is seen on the following morning at ten o'clock, the bandage is again reapplied, and a similar line of treatment carried out as was previously adopted. As convalescence approaches, the interval during which the bandage is worn may be greatly shortened, until at length it is dispensed with entirely.

The introduction of passive hyperæmia may arrest infection before it has gone on to suppuration, or even where suppuration has occurred, resorption may take place. It has been the experience of every surgeon who has practised this form of treatment that cases have come under his care where a commencing whitlow is diagnosed. Before Bier's treatment was introduced, these would have been treated by prompt and free incision; by the use of Bier's treatment a

rapid improvement has been brought about, and a cure obtained without the necessity of an incision being made. These cases are, however, the exception, as in the majority, when seen twenty-four hours after the bandage was originally applied, the patient is found to be in improved health, to have less pain in the wound, and to have slept well, but examination of the local lesion shows evidences of the accumulation of pus. When such is the case, it is treated by prompt evacuation, as was formerly practised. In practising Bier's treatment in cases of acute infection, it should never be used as an excuse to avoid the evacuation of pus by incision, when the presence of such is diagnosed. The incision which is necessary where Bier's treatment is being practised is a much smaller one. A puncture wound, to permit of evacuation, is often all that is required. It is also not necessary to introduce drainage-tubes. The use of Bier's treatment, where suppuration is present, causes a more abundant discharge to take place. This discharge, however, will be found to cease earlier, and the amount of sloughing of tissue with which it is associated is much less. In the earlier cases that Bier treated, he found that, where cases of teno-synovitis and osteomyelitis were treated by passive congestion, sloughing of the tendons did not take place so readily, the amount of osseous necrosis was not so extensive, and the *sequestrum* was more rapidly exfoliated.

The regions in which the bandage may be used are more especially the extremities, and particularly the lower parts of these. Where the hip-joint or shoulder-joint are to be treated, however, this may be done by so arranging that the constriction ring is applied as high up as possible, tapes round the trunk being used for this purpose. Obstructive hyperæmia has also been practised where the lesion is one involving the head and neck. To do this, the bandage should be wound loosely round the lower part of the neck, or, if desired, an elastic neck-band can be obtained, which is specially made for this purpose.

The technique to be practised where it is desired to induce obstructive hyperæmia in diseases of the testicle is as follows:—A piece of thin rubber drainage-tubing is applied around the base of the scrotum, with a piece of boracic lint intervening between it and the skin. Where the ends of the tubing cross, these are tied with a piece of tape or caught in a clip. To prevent slipping, it will be found necessary in some cases to fix this rubber ring by means of tapes passing round the pelvis.

The *contra-indications* to the use of Bier's treatment are few. As has already been mentioned, it was never the intention of the introducer of this method to advise that it be used in preference to incision, where acute abscesses are formed. In cases where extensive lymphangitis and lymphadenitis have taken place, it is usually found impossible to apply the constriction above the level of the site of the disease. In these cases the bandage, applied in the usual way, will often be found to give an excellent result, but in some of them pain from direct pressure is found to be produced. It is obvious that where septic thrombosis has occurred in a vein, the use of Bier's bandage would be attended with an increased danger of septic embolism.

Obstructive Hyperæmia by Means of Klapp's Suction-Cups.—This method, which has been specially worked out by Klapp in Bier's clinique, has many advantages. It is a form of treatment which is now especially adopted in cases where Bier's bandage cannot be conveniently applied. There can now be obtained from the instrument-makers a large number of different cups, made to fit the different parts of the body. The principle of construction of these is identical. They all consist of a glass bell jar, with a broad everted rim, and a neck on the summit of the convexity, which is connected with a rubber tube. In the smaller jars a negative pressure is created by compressing the rubber bulb at the end of the tube. In the larger jars this suction is brought about by using an exhaust pump. The regions in which Klapp's suction-cups are found to be especially useful are the breast, the neck, and the groin. The use of the suction-cup possesses the advantage over the rubber bandage that, in cases where a sinus exists, leading to a buried septic focus, the negative pressure within the bell jar not only leads to an engorgement at the site of disease, but it also, by its suction, draws out the purulent content and cleans the abscess cavity. This is especially manifest in the treatment of cases of carbuncle, where the slough is separating.

The method of application is extremely simple. There are, however, a few points that require to be attended to. A cup is selected which is of a size adapted to the area to be treated. The instrument has, of course, been previously carefully sterilised. The rim is anointed with vaseline before the jar is applied to the skin. If this detail is neglected, unnecessary pain may be caused the patient by the skin catching on the jar when suction is applied. The suction-cup is now held loosely applied, and suction obtained. The suction should be gradually induced. A mistake commonly made with this form of treatment is to use too great a degree of suction, and to develop the same too rapidly, with the result that pain is caused, and hæmorrhage occurs from the capillaries of the granulating wound. Sometimes, owing to the inequality of the surface to which the cup is applied, it is found impossible to develop a partial vaccuum, as air gets in at the side of the bell. When this is the case, it is to be

recommended that the inequality of the surface be overcome by surrounding the rim of the bell with a ring of sterile plasticine. When properly applied, the application should be absolutely painless; there should be no interruption of circulation.

The length of time during which the suction-glass should be applied will vary with different individual cases. Bier would recommend that they be applied six times during the day, for five minutes each time, an interval of three minutes or so being allowed between each individual application. It will thus be seen that the time occupied is at the most three-quarters of an hour each day. In some cases, where the degree of suction is not great, a more lengthy application will be found to be well borne, and produce a good result. It is to be remembered, however, that any œdema and hyperæmia that may have resulted must be allowed to disappear before bell be again applied.

Active Hyperæmia by the Use of Hot Air.—As has already been mentioned, the application of hot air to a part induces an active or arterial hyperæmia. Where dry, hot air is used, a very high temperature can be comfortably borne. The class of cases for which this treatment is especially useful is where a more chronic lesion is being treated; where, for example, chronic exudate or organising adhesions are present inside a joint. The methods that are adopted in applying hot air to a part are, firstly, by means of the hot air chamber; secondly, by using the hot air douche. In order to carry out either of these means, very simple contrivances may be fitted up. In the case of the former, the treatment may be carried out by simply surrounding the part to be treated with electric lamps, such as are used for ordinary purposes of illumination. These are placed at a distance where a comfortable degree of heat will radiate on to the limb, and are covered with blankets laid over an ordinary "cage." If a more elaborate appliance is desired, this can be made with a wooden box, into which the limb is placed, and into which also a funnel passes, which is connected with a source of heat, such as an ordinary gas flame. Whichever method is adopted, it is essential that great care be taken to avoid burning the limb. This warning is necessary, as when the temperature is gradually raised, a degree of heat may be obtained that is borne comfortably by the patient, but which will be found afterwards to have caused a burn of the second degree.

Details in the Treatment of Special Cases by Means of Hyperæmia.

The Use of Passive Congestion as a Prophylactic in Recent Wounds.—Bier's treatment has undoubtedly proved of great value in cases of recent severe lacerated wounds. Such statistics as are available would appear to demonstrate that, where this treatment has been adopted, suppuration has occurred less frequently, and healing has taken place more rapidly. The class of case in which it is of especial value is one that is very commonly met with in any large industrial centre. It is that of the adult of the labouring class who has received a severe wound of a limb, into which dirt has been ground. This class of case is one which has always taxed the resources of the medical man, as the difficulty has been to cleanse the part thoroughly, and to prevent the development of widespread suppuration. Where Bier's treatment is to be used, it is recommended that it be instituted immediately the patient comes under treatment. It is applied by means of the rubber bandage, which is worn for the usual period of twenty to twenty-two hours. The maimed limb is cleansed in the usual way, with this exception, that all powerful chemical antiseptics are carefully prevented from coming in contact with the wounded surface. The wound is simply washed out with an abundant stream of sterilised physiological salt solution. A simple sterile dressing is then loosely applied to the part. The effect of the application of the bandage in this case is similar to that seen where an infective lesion is being treated. The limb becomes engorged and swollen. A fairly abundant sero-sanguineous discharge takes place from the damaged surface. In this discharge there can often be noticed foreign particles which have been buried in the wound.

On the day following the accident, the discharge from the wound will probably be serous in nature, and from the appearance which it presents and the state of the patient, the inference is justified that rapid healing without suppuration will take place. It is advisable, however, that Bier's bandage be used for several days longer. The interval during which it is worn should, however, be reduced in duration. In the class of case where suppuration develops, this will probably be seen to be abundant in amount, but the general effect upon the patient is noticed to be not so severe. Should abscesses form, or cellulitis develop, these are to be treated in the usual way, small incisions being made to allow escape of pus.

Compound Fractures.—These cases are particularly suitable for treatment by Bier's method. This is carried out by means of the rubber bandage. The advantage of using this method is that limbs may be saved that otherwise might require to be amputated, and aseptic union occurs in a greater number of cases.

Acute Infective Abscesses.—Furuncle and Carbuncle.—These lesions are particularly suitable for treatment by Klapp's suction-cups. The individual furuncle, or where multiple foci are present in a case of generalised furunculosis, are treated by applying the suction-cup for five minutes at a time. Six applications are usually

given, an interval of a few minutes intervening between each application, to allow of the œdema and hyperæmia subsiding. The effect of this treatment is that often a furuncle is aborted. Where a definite abscess forms, this is treated by making a tiny incision to allow the escape of pus, and thereafter the use of the suction-cup is resumed.

In no class of case has the treatment been more profoundly modified than in that of carbuncle. The extensive crucial incision which at one time was so commonly used in the treatment of carbuncle is now very seldom practised. The treatment by removing the infective focus by surgical operation may be now entirely abandoned. The justification for this latter line of treatment was that in certain situations, especially the head and neck, death from septic absorption occasionally occurred, and thus it was considered justifiable to cut wide of the disease, although a large raw area was left where healing often occurred extremely slowly afterwards. Although Bier's treatment of these cases by suction-cups cannot claim to have entirely abolished the mortality in cases of carbuncle, the success which has attended its use justifies its preference to any other form of treatment. The method that is practised is to apply a suction-cup of suitable size; one that is large enough to include the swelling and a margin of healthy skin as well. The degree of suction used is that which will cause the swelling to bulge into the glass and induce a distinct hyperæmia of it. On no account must suction be too powerful. The use of the glass must never be attended with any pain or discomfort. The patient will probably describe the swelling as being comfortably tense; the glass will adhere firmly to the skin. The suction-cup is applied for the usual period of from three to five minutes, and is then taken off, to be reapplied after a short interval for the same period. Six applications are usually found sufficient for the first period of treatment. After twelve hours or so, another series of applications is given. Concomitant with this line of treatment, the usual constitutional remedies are used. The effect of the treatment that has been described is to cause the swelling to become much increased in size. Points of cutaneous suppuration are seen scattered over the surface of the swelling. In certain of the cases these may be punctured, but often they are found to have opened spontaneously, and discharge of pus takes place from them. The continued use of the suction-cup, in addition to inducing hyperæmia of the part, permits the free discharge of pus and slough from the septic core of the carbuncle below. Gradually the whole of the sloughing core is discharged, and the wound presents a cribriform appearance; several small openings, separated by thinned and inflamed skin, leading down to the abscess cavity below. The use of the suction-cup being persisted in, and a dry asceptic dressing being applied in the interval, the cavity gradually granulates up, the superficial wounds heal, and all that remain are several tiny cicatrices.

Whitlow.—Cases of whitlow can be treated either with the rubber band or by special suction-glasses, made to fit the finger or hand. The latter line of treatment is perhaps the better, the former is, however, much easier to carry out, and requires no special appliance. The commencing whitlow, which is associated with severe local pain, but little constitutional reaction, can be confidently treated by Bier's method alone. A constricting band is applied in the usual way to the lower part of the upper arm. The arm is carried in a sling, and, if necessary, a dressing is loosely applied to the poisoned finger. In certain cases it will be found advisable to supplement this treatment by prescribing an aperient medicine. The immediate effect of the application of the bandage is to lead to a marked diminution of the pain felt. In some cases the patient will say that it entirely disappears. When he returns for treatment at the end of twelve hours, the limb is seen to be distinctly swollen, the local reaction is much more pronounced, and already there may be indications that an incision to allow of the evacuation of pus is required. When such is the case, all that is necessary will be a tiny puncture with a tenotomy knife. Where the infection is more widespread, and the condition more severe, such as in a case of suppurative teno-synovitis, multiple punctures into the tendon sheath should be made, and through these the sheath douched out with sterilised saline solution. It is not advisable that drainage-tubes be introduced, as these are liable to induce necrosis by pressure on the tendon sheath. A sterile dressing is applied, and the rubber bandage is not reapplied for several hours, to allow of any slight hæmorrhage which the incision may have caused to become arrested. The bandage is worn for twenty to twenty-two hours out of the twenty-four, and twice daily at least the wounds are douched out with saline solution. By carrying out this line of treatment, it will be found that healing will take place earlier, and movements to prevent the formation of adhesions may be practised sooner than in the older line of treatment.

Mastitis.—Bier's treatment has been found particularly suitable in cases of acute mastitis; especially in puerperal mastitis has it been found to be of benefit. The treatment is carried out by means of the suction-cup; the advantages that this line of treatment possess are that in some cases a cure is obtained without resort to the use of the knife. When it is necessary to make an incision, a much smaller one can be used, and it is not necessary to introduce the finger to break down the septa to anything like the

same extent as was formerly practised. In addition to the more speedy cure that is obtained as a result of the hyperæmia induced by the suction-glass, there is still another great advantage which its use possesses in the case of puerperal mastitis, and that is that the negative pressure within the glass exhausts the breast of milk, and thus relieves the pain and discomfort which the patient feels, and at the same time permits of the child being nursed from the other breast.

In carrying out Bier's treatment in cases of mastitis, the general rules followed are similar to those already described in connection with the use of the suction-cup. It is advisable that a series of large bell jars be available, so that one can be chosen which accurately and comfortably fits the contour of the breast to be treated. The rim of the glass having been anointed with sterilised vaseline, it is applied to the breast, and a negative pressure is produced within the chamber by slowly rarefying the air by means of an exhaust-pump. Suction must be slowly produced; it must never cause pain, and never be so severe as to produce any subcutaneous ecchymosis. Intermittent applications, over a period of three-quarters of an hour or so, are practised. Where a definite abscess is formed, this is to be treated by incision. It will be found that a local anæsthetic is all that is required in this case. No drainage-tube need be introduced, as the suction-glass will be found to lead to a free discharge of any retained pus. In some cases it is seen that, after the original focus of infection is healed, another forms at the periphery of it. When this is the case, the line of treatment is similar to that already described.

Arthritis.—Many infective lesions of joints may be treated by passive or active hyperæmia. Gonorrhœal arthritis is especially suitable for Bier's treatment. In the acute variety, it will be found that the induction of passive congestion by using Bier's bandage is often attended with astonishing relief of pain, and a marked improvement in the patient's health. When combined with treatment of the local lesion from which the organism has passed into the blood-stream, a speedy cure is often obtained. In a case which has passed from the acute stage into a more chronic phase, it will be found advisable to substitute active arterial hyperæmia by hot air for passive congestion. How this is carried out has already been described. It has the advantage that it permits the absorption of the exudate that persists within the joint cavity. It allows of movements of the joint being practised to prevent the formation of adhesions and development of a stiff joint.

Chronic Arthritis. — Tuberculous Synovitis.—Tuberculous synovitis and tuberculous arthritis can well be treated by passive congestion. Passive congestion was practised in the treatment of tuberculous lesions long before it was used in cases of more acute infections. The method that is now more generally adopted is where the rubber bandage is used to induce hyperæmia. In the early stage of chronic tuberculous synovitis, with thickening of the synovial membrane, and the commencing "gelatinous" degeneration of the joint, the treatment is found to be of especial value. It has the advantage over arthrectomy or erasion that in many cases a cure will be obtained with comparatively little stiffness of the joint. It must, however, be borne in mind that the progress will be slow and tedious. It is a treatment that must extend over several months, if it is to be attended with beneficial effect. It can, however, be practised by one who is still capable of partial employment; as all that is necessary is that the bandage be applied for one hour night and morning. In the severer cases it is advisable that local rest of the joint be obtained by the use of a splint.

These are a few of the lesions which are particularly suitable for treatment by Bier's method. It will, however, be obvious that the principle underlying the treatment is such as to render it capable of application to an infective lesion, wherever that may be situated. The only difficulty that presents itself is the technical one of applying the treatment in certain situations of the body. In virtually all of these cases, however, this can be overcome by using specially devised apparatus.

Bilein.—The name of a proprietary preparation containing a mixture of the essential salts of the bile. See *Journ. Amer. Med. Assoc.*, liii. p. 2101, 1909.

Bioblasts.—The granules found in the cell substance, regarded by some (*e.g.* Altmann) as the fundamental elements in cell activity.

Biophore.—Literally something which bears life, which carries the vital properties, and, according to some, the ultimate molecule possessed of the properties essential to life. It has been called a *biogen* (Verworn) or a *biont* (Rubner). For a résumé of the biophoric hypothesis in enzyme action, etc., see Adami, *Pathology*, i. p. 156.

Biotripsis. — By this term (literally, "life-wear," Gr. *βίος*, life, *τρῖψις*, a rubbing) Mr. Cheatle (*Brit. Med. Journ.*, i. for 1909, p. 1411) would designate the wear and tear effects of life visible, especially on the skin in exposed situations (back of the hands, the temples, and the forehead, etc.), in old people. The skin becomes "shiny, smooth, thin, inelastic, pigmented, and apparently scarred." The condition "resembles the bronzing of skin which has been subjected to prolonged exposure to the X-rays," and the parts which

are liable to it are also prone to cancer and papillomata.

Birth-Rate. *See* NATALITY.

"Bivo."—A proprietary dietetic preparation (meat wine) containing iron, meat extract, glucose, and alcohol, as shown by the analysis published in the *British Medical Journal* (i. for 1909, p. 796).

Blackwater Fever. — Four main theories have been held as to the nature of blackwater fever:—(1) It is a pernicious form of malaria. (2) It is a genuine intoxication. (3) It is a distinct disease due to some specific organism. (4) It is due to a specific hæmolysin. In a recently published memoir, Christophers and Bentley record an elaborate series of observations on this disease, which go in the direction of demonstrating that it is caused by an auto-hæmolysin—that is, a hæmolysin developed by the tissues of the patient by auto-immunisation against his own red cells. Bentley and Christophers believe that they are justified in denying that the disease is due to any ordinary blood parasite, in particular that it is a piroplasmosis. The most thorough and prolonged scrutiny of blood films failed to show any specific organism. They find evidence of its relation to malaria in (1) the greater incidence of malarial infection among blackwater fever patients than among the rest of the community, and (2) in the fact that during the progress of blackwater fever signs of malaria—*i.e.* the presence of the plasmodium in the blood—disappear. It is not a specific disease, but a stage in the progress of malarial infection long continued and constantly repeated—though not malaria, it is of malarial origin.

CLINICAL AND PATHOLOGICAL FEATURES.—The disease is ushered in with rigors and high temperature; there is hæmoglobinuria, splenic enlargement, epigastric pain, and, later, jaundice. As a rule the hæmoglobinuria lasts two or three days; relapses, within one to ten days, are common, especially in the more severe cases.

BLOOD CHANGES. — The blood corpuscles fall rapidly to as low as a million in bad cases. During the early stages of the disease there are not many changes in the red cells apart from the diminution in their number; "shadows" are met with in stained films, and also small globular corpuscles—"spherocytes." The large mononuclears are relatively increased. In the later stages—from the second or third day onwards into convalescence—polychromasia is well marked and nucleated reds are found. Macrophages appear in the blood; these are of three types—(1) resembling the ordinary large mononuclears but varying from 15 to 25 μ in diameter; (2) large, irregularly circular cells with compact nuclei; (3) large cells with irregular nuclei measuring 20-30 μ. The ordinary granular series of leucocytes are immature, and some myelocytes can be found. The interpretation of the blood changes by the observers is—first, a rapid blood destruction; second, evidence of phagocytosis of reds; third, regenerative appearances (polychromasia, erythroblasts, immature leucocytes).

EXPERIMENTAL HÆMOLYSIS IN ANIMALS.—After injections of hæmolytic serums into dogs, changes were found in the internal organs comparable to what are met with in blackwater fever. Christophers and Bentley found, as had previously been shown by Levaditi, that the principal cause of anæmia in animals so treated was an intense phagocytosis of the red cells in the spleen. Hæmoglobinæmia was not necessarily associated with this, but when it did occur hæmoglobinuria also took place. Hæmoglobinæmia and hæmoglobinuria are therefore concomitant phenomena, the latter necessarily following the former. The important point is that hæmoglobinæmia (without which there is no hæmoglobinuria) does not necessarily result from the most intense blood destruction, but must depend on some further factor. Therefore they distinguish two forms of blood destruction—(1) Erythrokatalysis, or phagocytosis of red cells without extra-cellular solution, and (2) lysæmia, or extra-cellular solution, hæmoglobinæmia, and hæmoglobinuria.

In seeking for a cause of lysæmia Bentley and Christophers investigated the isotonic point of the cells, and could find no evidence that the solution of the corpuscles was due to variations in the osmotic relations of these and the plasma. They believe that what happens is this: In malaria, particularly in the malignant tertian forms, there is recurrent blood destruction, with constant phagocytosis of red cells. As a result of this constant phagocytosis the tissues form hæmolysins. Periodical attacks of hæmoglobinuria are due "to sudden liberation of complement in the living body." The third part of the theory at present rests on no actual data. Acting on the assumption that blackwater fever is due to an auto-hæmolysin produced in the tissues in response to long-continued blood destruction of malarial origin, Christophers and Bentley have pushed quinine systematically, and thereby reduced the amount of blackwater in the Duars. They suggest that it may prove feasible to produce an anti-hæmolytic amboceptor, or an anti-complement, as a remedy for the disease. (*See also* PAROXYSMAL HÆMOGLOBINURIA.) Christophers and Bentley, "Blackwater Fever," *Scientific Memoirs of the Govt. of India* (Simla), 1908.

Bladder, Female.

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MANY of the advances which have been made during the past quinquennium in the diagnosis and treatment of diseases of the bladder in the female apply also to maladies of the bladder in the male; they may be consulted under other headings. But it will be well to gather together here (in a separate article) some of the most noteworthy of them, and especially those which have a special bearing upon gynæcology.

EXAMINATION.—Before any instrument (sound or catheter) is passed into the bladder, careful cleansing of the external parts, and especially of the meatus urinarius, should be carried out. This may be done by means of a number of cotton-wool pledgets soaked in an antiseptic lotion or simply sterilised. When the patient is the subject of leucorrhœa, this cleansing must be very thorough, for there is evidence that organisms from the original discharge may find their way into the bladder and set up cystitis (Porter, *Trans. Edin. Obstet. Soc.*, xxxi. p. 92, 1906). The patient is placed in the dorsal or left lateral position, and the *sound* (shorter than that used in the male and less curved), which has been sterilised by boiling, is introduced by sight into the urethra, and the bladder cavity is carefully examined. If the *catheter* be employed, in order to obtain urine for microscopical, chemical, or bacteriological examination, then the following precautions should be taken. A glass catheter, which has been sterilised by boiling and kept ready for use in a sterile solution, is taken; over its distal end is a short sheath of indiarubber tubing which can be easily removed after its introduction; the part so covered is grasped by the operator with his fore and middle fingers (which may be provided with sterile rubber finger-cots, or may wear a three-fingered rubber glove) and passed into the bladder; the rubber sheath is then withdrawn and the urine allowed to flow into the sterile receptacle (the first few drops being rejected). After it has been emptied by the catheter the holding capacity of the bladder may be determined by *hydrostatic dilatation:* normal saline solution, at a temperature of 100° F., is used; it is kept in a graduated glass jar or douche-can; by means of a catheter and tubing it is run into the bladder till it is uncomfortably full; then the level of the fluid in the reservoir is compared with what it was before, and so the quantity which has passed in is estimated. It must not be forgotten that simple *palpation* of the female bladder is very easy, and that it yields much important information; it is best done by the vagino-abdominal touch. *Cystoscopy* was dealt with in a special article in the *Encyclopedia and Dictionary* (ii. p. 264); but the few additional facts to be recorded about this method of bladder-examination may be placed here. There is perhaps a tendency to limit the use of the cystoscope to a greater extent on account of the risk of infecting the bladder, and a contra-indication is found in the presence of acute urethritis, especially when it is of a gonorrhœal nature. Simple cystitis and that following gynæcological operations often clear up with the administration of medicines (*e.g.* urotropin) and the free administration of water to drink, and do not require cystoscopy. For the examination, the patient is placed in the semi-prone position, in the elevated dorso-sacral, in the Trendelenburg, or in the genu-pectoral position. Kelly (*vide* Kelly and Noble, *Gynecology*, i. p. 444, 1907) prefers the last-named posture, the patient being on her knees and *chest*, not on her knees and elbows; and certainly one gets the best view of the interior of the bladder thus, only it is necessary to remember its irksomeness, and to shorten as far as possible the time during which the patient is kept in it. A few drops of a 5 per cent. or 10 per cent. solution of cocaine are introduced into the urethra, which is then dilated by conical dilators, but not beyond 16 or 18 millimetres. Then the Kelly speculum (or the Nitze cystoscope if it be preferred) is introduced into the bladder; air then rushes in, ballooning the bladder (Kelly recommends previous ballooning of the rectum and vagina to prevent displacement backward of the bladder at this stage), and light from a head mirror is thrown into the cavity, which is then inspected in its various parts. Residual urine may be removed with Snell's evacuator (or Ashton's modification of it, *vide* Ashton's *Gynecology*, p. 622, 1905), or with small balls of absorbent cotton introduced with alligator-jaw forceps. Kelly's ureteral searcher (a long delicate sound) may be used to find the openings of the ureters (the left first); the interureteric ridge is a useful landmark in cystoscopy in looking for the orifices of the ureters, and must not be confounded with another fold called by Kelly the vesico-uterine (because it corresponds with the vesico-uterine sulcus outside the bladder), which lies further away from the internal urethral orifice (Kelly and Noble, *op. cit.*, i. p. 448, 1907). Having found the ureters, a flexible silk catheter may be introduced to obtain a specimen of urine from each kidney, or, if a stricture be present, a metal catheter (*e.g.* Kelly's metallic ureteral catheter) may be employed, or flexible hard rubber sounds may be used for sounding the ureters and kidneys. The latter may be wax-tipped when a calculus is suspected to be present, for the rough parts of the stone will then leave marks on the sound. Conducting forceps may be needed for introducing these sounds and catheters. All the instruments should be very

carefully sterilised before use, and boiling water or steam is inapplicable in the case of the silk catheters, which have to be treated with corrosive sublimate solution (1 in 1000). In this way *catheterisation of the ureters* can be easily carried out, and the separate urine from each kidney can be got free from bladder contamination (which cannot be done with the Harris urine segregator).

MALFORMATIONS.—A curious anomaly of the bladder, the so-called *intraligamentary bladder*, has recently been described. In this condition the viscus is so developed as to distend and separate the two layers of one or both the broad ligaments of the uterus. It was first noted by Ziegenspeck in 1887, who described a case; another instance was reported by Tandler and Halban in 1901 (*Topography of Female Ureter*); and four further cases were given by Natanson and Zinner (*Monatsschr. f. Geburtsh. u. Gynäk.*, xxii. p. 615, 1905). It would appear to be a congenital anomaly; it may be unilateral or bilateral; and when it is unilateral the uterus is pushed over to the opposite side, and the relations of the uterine annexa and round ligaments are altered. Clinically, it forms a fluctuating tumour in the pouch of Douglas or in the parametrium. It is of practical importance, for when it is present the ureters are further removed from the vagina than usual, and since the peritoneum reaches deeply down into the pelvis in front of the bladder, the suprapubic operation can be no longer performed without opening into the peritoneal cavity. Fothergill recently operated on a patient for obscure vesical troubles; on opening the abdomen and distending the bladder, it was seen that there was no utero-vesical pouch and that the bladder reached the upper limits of the broad ligaments in the middle line and extended into them on each side; the peritoneum was incised and the bladder separated from the uterus down to the level of the os internum, and as a result of the operation the patient's condition was considerably improved, and she was able to retain several ounces of urine (*Journ. Obstet. and Gynæc. Brit. Emp.*, xii. p. 444, 1907). T. Arthur Helme (*ibid.*, p. 447) has recorded one case in which abdominal hysterectomy for carcinoma of the cervix uteri was made very difficult by reason of the presence of an intraligamentary bladder, and a second instance of this anomaly, in which the intraligamentary bladder formed a cystic swelling in the pouch of Douglas, which protruded from the vulva. Doubtless other instances of this vesical malformation will be reported as its existence comes to be better known.

Ectopia vesicæ, extroversion of the bladder, or vesical inversion, one of the most trying malformations which a woman has to bear, has continued to engage the attention of the surgeon. Maydl led the way in recent years in the new direction of throwing the urine into the rectum so as to control the urinary incontinence, which is the leading and the most disagreeable symptom caused by the anomaly. He transplanted the entire trigone of the bladder into the rectum or sigmoid flexure. The Maydl method was an intra-peritoneal operation, and had a considerable mortality (about 33 per cent.). Moynihan's procedure (*Ann. Surg.*, xliii. p. 237, 1906) marked an advance, for it was carried out extra-peritoneally; he catheterised the ureters and excised the entire bladder wall; he then pushed the recto-vesical peritoneum up off the anterior aspect of the rectum, which he incised; and he finally inverted the bladder and implanted it into the rectal wall. Moynihan's method, however, is not applicable to the female. Hunner (Kelly and Noble, *Gynecology*, i. p. 465, 1907) regards Peters's operation as the best: in it there is an extra-peritoneal transplantation of each ureter (with enough of the bladder wall to preserve the uretero-vesical musculature) into the corresponding side of the rectum; the ureters are first catheterised, they are then dissected out with the piece of bladder wall to which they are attached, and they are then transplanted into the rectum just above the internal sphincter (*Brit. Med. Journ.*, for 22nd June 1901). London, Newland, and Bond (*Brit. Med. Journ.*, i. for 1906, pp. 961, 964, 1151), as well as Sherman (*Journ. Amer. Med. Assoc.*, xlv. p. 890, 1905), have used this method, with a 20 per cent. mortality, but with good permanent results in the surviving patients; it is quite extra-peritoneal, it preserves the musculature, and it is said to be easier than the other plans. One of the aggravations of ectopia vesicæ is the possibility of the development of cancer in the malformed organ, an instance of which has been reported by Keitler (*Monatsschr. f. Geburtsh. u. Gynäk.*, xxii. p. 186, 1905).

DISPLACEMENTS.—It has been found necessary to distinguish between the various conditions in which the bladder or a part of it or of the urethra is displaced downwards and appears at the meatus urinarius. The displaced mass may consist of the bladder (urethral cystocele; hernia, inversion, or prolapse of the bladder); then the two ureteral orifices will be seen on it. In other cases it is simply the mucous membrane, loosened from the other layers of bladder wall, which projects; it is softer and smaller than in the former variety. In yet other instances, the mucous membrane of the urethra itself is the displaced part, and then a depressed orifice in the centre of the mass can be recognised (Villar, *Arch. prov. de chir.*, xiv. p. 373, 1905). A case has been reported in which a cystic ureter was displaced downwards and protruded from the urethra; it formed a mass the size of a hen's egg; the

patient was a female infant of six weeks; the mass was removed, but the child died, and it was at the autopsy that the condition of affairs was discovered (E. von Hibler, *Wien. klin. Wochenschr.*, xvi. p. 506, 1903).

Cystitis.—It is now generally accepted that inflammation of the bladder is practically always due to microbic invasion of the tissues, and that the other so-called causes (*e.g.* foreign bodies, such as hairpins, stone, tumours, abnormal urine, operative or non-operative trauma, displacements, and "chills") are only predisposing; it is also believed that the causal organisms in their order of frequency are the colon bacillus, the gonococcus, the streptococcus and staphylococcus pyogenes, the proteus vulgaris, and the tubercle and typhoid bacillus. But whilst this is so, these predisposing and exciting causes are generally linked together: most of the microbes may be present in the urine without infecting the bladder wall if the vesical tissues be not predisposed to their action by one or more of the above-named causes; and even when the non-microbic cause (*e.g.* trauma or chill) is very obviously present, it may not result in cystitis in the absence of infecting organisms. At the same time it is believed that the gonococcus and the tubercle bacillus may infect a healthy bladder; mixed infection (*e.g.* with the gonococcus and the colon bacillus) may also occur. In gynecology, it has always to be borne in mind that certain of the predisposing causes are more prominent than in ordinary surgery: for instance, the urethra is short, and there is evidence that foreign bodies are not infrequently introduced, carrying with them the risks of injury and infection (this may happen in connection with attempted abortion, with catheterisation, or with manœuvres carried out to excite erotic feelings); again, the proximity of the bladder to the uterus and annexa will subject it to the risks accompanying morbid states of these organs (*e.g.* microbic infections, parametritis, ovarian abscess, rupture of dermoid cysts, incidents connected with ectopic gestation, formation of vesico-vaginal or vesico-uterine fistulæ as results of dystocia, etc.). These matters must all be kept in mind in dealing with cystitis in the female; and the frequency with which hysterectomy (abdominal and vaginal) and hysteropexy or ventrofixation of the uterus are now performed must not be forgotten, for these procedures bring the bladder immediately into the sphere, and subject it to the risks of operative manipulations. The freedom with which cystoscopy is employed for diagnostic purposes, and the use of catheterisation of the ureters, etc., introduce additional risks of bladder-infection. Fortunately, these dangers of post-operative cystitis can be largely avoided by strict asepsis and by gentleness during operation, and by the rigid application of the rules of surgical cleanliness in the performance of catheterisation afterwards. The treatment of cystitis in the female is facilitated by the topographical relations of the organ; it is also modified to some extent thereby. The diagnosis must first be made by the discovery of pus in the urine; the possibility of renal or ureteric disease is in a number of instances to be excluded by cystoscopy; and the particular variety of microbe which is present is to be settled by bacteriological examination of the urine. It may be noted here that Hunner (*Amer. Med.*, vii. pp. 701-707, 1904) believes that the demonstration of the tubercle bacillus in urine can be made with comparative certainty. There have been of late years marked advances in the treatment of cystitis, and these are particularly applicable to the disease as it occurs in women. With them has come the power of differentiating various morbid states and of settling upon the special method to be used in any given case. For instance, the diagnosis of the kidney as the seat of mischief will prevent the medical man wasting valuable time in the treatment, useless under the circumstances, of the bladder. To prevent cystitis means must be taken to diminish the frequency of catheterisation, especially during and after labour and operations; for this purpose free drinking of water should be inculcated, and all other plans to aid micturition should be employed (*e.g.* injection of hot water into the rectum) before recourse is had to the catheter. Amongst the more useful medicines which may be given in cystitis, urotropin (in doses of 10 grs. thrice daily) and helmitol (also a hexamethylenetetramine preparation) and salol may be named. For local treatment, antiseptic irrigations, instillations, and topical applications have been found of great value; one may begin with irrigations of normal saline solution till the bladder is able to tolerate antiseptic solutions such as that of silver nitrate (from 1 in 5000 to 1 in 500) or of bichloride of mercury (from 1 in 150,000 to 1 in 5000). Instillations enable us to use stronger solutions at less frequent intervals (*e.g.* once or twice a week); for instance, the instillation of one ounce of protargol solution (1 to 3 per cent.) in this way is of great value. Topical applications carried out with the patient in the genu-pectoral position, with the bladder distended with air, and through a tubular speculum, enable us to attack the mucous membrane alone and to concentrate upon the specially diseased spots in it (Hunner in Kelly and Noble's *Gynecology*, i. p. 483, 1907). In this way nitrate of silver solutions give good results in ulcers of the bladder. Among the directly surgical means now employed, curettage can hardly be said to be free from risk, and is not so much used, its place being taken to a large extent (in intractable cases) by the artificial

formation of a vesico-vaginal fistula well in front of the cervix in the anterior vaginal fornix (vaginal cystotomy); the bladder is to be distended first, and the operation carried out with the patient in the knee-chest position, the incision being made from the vaginal aspect with the aid of sight. The inconvenience resulting from the urinary incontinence, which necessarily accompanies this procedure, may be obviated, as Hunner (*op. cit.*) suggests, by the tub-bath with constant bladder irrigation. In very severe cases excision of the diseased mucous membrane may be required.

Among recent contributions to the literature of cystitis in the female the following articles may be named:—

1. In 1904: Harrison, *Amer. Journ. Obstet.*, xlix. p. 95, 1904; Baisch, *Zentralb. f. Gynäk.*, xxviii. p. 380, 1904; *Beitr. z. Geburtsh. u. Gynæk.*, viii. p. 297, 1904; Hibbitt, *Amer. Practitioner and News*, xxxvii. p. 97, 1904; Spanton, *Brit. Gynæc. Journ.*, xx. p. 14, 1904-5; Rosenstein, *Zentralb. f. Gynäk.*, xxviii. p. 865, 1904; Tate, *Amer. Journ. Obstet.*, l. p. 641, 1904.—2. In 1905: Stoeckel, *Berl. klin. Wochenschr.*, xlii. p. 20, 1905; Luys, *Rev. prat. d. mal. d. org. gen.-urin.*, ii. p. 26, 1905; Knorr, *Zeitschr. f. Geburtsh. u. Gynäk.*, lv. p. 472, 1905.—3. In 1906: Gersuny, *Zentralb. f. Gynäk.*, xxx. p. 105, 1906; Kelly, *Canad. Pract and Rev.*, xxxi., p. 61, 1906; Taussig, *Surg. Gynec. and Obstet.*, ii. p. 181, 1906; Heymann, *Centralb. f. d. Krankh. d. Harn- u. Sex.-Org.*, xvii. p. 177, 1906; Richter, *Zentralb. f. Gynäk.*, xxx. p. 483, 1906; Witthauer, *ibid.*, p. 663, 1906; Taussig, *Amer. Journ. Obstet.*, liv. p. 465, 1906.—4. In 1907: Dixon, *Amer. Journ. Dermat. and Gen.-Urin. Dis.*, xi. p. 12, 1907; Ely, *Amer. Journ. Obstet.*, lvi. p. 371, 1907; Garceau, *ibid.*, p. 289, 1907; Pichevin, *Sem. gynéc.*, xii. p. 401, 1907.—5. In 1908: M'Donald, *Med. Rec.* (New York), lxxiii. p. 303, 1908; Fromme, *München. med. Wochenschr.*, lv. p. 873, 1908; Padgett, *Journ. Indiana Med. Assoc.*, i. p. 453, 1908.

Blastoma.—The term *blastoma* (Gr. βλαστός, a bud) has had at least two different meanings given to it. At one time it meant a neoplasm (granuloma) produced by the action of a germ or micro-organism, but nowadays it is used to signify a neoplasm arising from cells of the embryo, or rather of its chorionic sac or of the antecedent germ, included in the tissues of the individual. Of late Adami (*Pathology*, vol. i. pp. 650, 667, etc., 1910) has given it a wider significance still, for he regards all autonomous tumours (neoplasms proper) as being of two kinds, the teratomas and the blastomas. This extension depends, of course, upon the acceptance of the view that all these tumours are due to the aberrant growth of cells (totipotential or unipotential) of the individual. Since the teratomata constitute a comparatively small group, it follows that the blastomata comprise most the tumour growths. The teratoma is distinguished from the blastoma as developing from totipotential cells, *i.e.* from cells capable of giving rise to the individual, from cells, that is, which possess the power of giving origin to cells of every order. Such a totipotent cell is, of course, the impregnated ovum, but others are found in the primordial blastomeres, in the primitive germinal area cells, in the "growing point" cells of the germinal area, and in the germinal blastomeres. The blastoma develops, on the other hand, from a unipotential cell, a cell which represents only one tissue, and Adami places the long list of ordinary tumours (papillomas, epitheliomas, adenomas, carcinomas, endotheliomas, neuromas, fibromas, lipomas, chondromas, osteomas, myomas, angiomas, sarcomas, etc.) under the heading of the blastomas or blastomata. He has had, however, to concede a third (intermediate) group or division, which he terms the teratoblastomata, to include certain "mixed tumours," in whose substance *all* the three layers of the blastoderm are not represented; these are derived, according to the theory, from pluri- or multi-potential cells, *i.e.* from cells capable of giving rise to some of the tissues which normally arise from one or two layers of the blastoderm. Outside these groups of tumours proper are the *cysts*, which really have nothing in common with the neoplasms except the solitary fact that they cause swellings. The relations of the blastomas to the teratomas and teratoblastomas are set out in the following schematic arrangement by Adami[1] (*op. cit.* p. 667).

I. Teratoma: a tumour derived from cells capable of giving rise to all the tissues of the individual (totipotential cells).
  A. Twin teratoma (geminal or heterochthonous), *e.g.* fœtal inclusion.
  B. Filial teratoma (or autochthonous), due to the segregation and subsequent growth of totipotential cells of the individual.
    (1) From non-germinal blastomeres, *e.g.* epignathus, congenital sacral teratoma.
    (2) From germinal cells: (*a*) from aberrant germinal blastomeres, *e.g.* sporadic teratoma of cranium, etc.; (*b*) from unreduced ovarian and testicular germ cells, *e.g.* ovarian and testicular teratomas.

II. Teratoblastoma: a tumour (autochthonous) derived from pluri- or multipotential cells of the individual; a mixed tumour.
  A. Diphyllic, containing derivatives of two germinal layers, *e.g.* certain parotid and renal mixed tumours.

[1] This differs from the scheme given by the same writer in 1901 (vide *Brit. Med. Journ.*, i. for 1901, p. 623).

B. Monophyllic, containing derivatives from one germinal layer, *e.g.* most renal mixed tumours.

III. Blastoma: a tumour derived from unipotential cells.

A. Heterochthonous or teratogenous, the cells being derived from another individual, *e.g.* destructive placental mole, chorio-epithelioma malignum, epithelioma derived from an ovarian dermoid.

B. Autochthonous, from the independent growth of unipotential cells of the host individual, *e.g.* all other tumours composed of cells of one order.

It will be observed that the *B.* group of the third division, by its definition, enormously extends the scope of the term "blastoma"; further, Adami (*op. cit.* p. 837) is of opinion that blastomas may originate from congenitally displaced cells, from cells of post-natal displacement, and from cells which assume neoplastic characters without displacement, and rapidly take on malignancy. Even these wide bounds are insufficient, and a fourth group has been suggested containing the *blastomatoid* growths, "originating as a diffuse, though local, hypertrophy of the specific elements of a tissue, which may or may not pass from the hypertrophic to the malignant type."

From what has been stated above it will be evident that the term blastoma has a very wide significance in modern pathology, but it must at the same time be remembered that its position depends on the theory of origin of neoplasms adopted, for, if the theory of a parasitic origin be accepted, much of what has been postulated above falls to the ground.

Blood.

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ORIGIN AND RELATIONSHIPS OF THE BLOOD CORPUSCLES.—Notwithstanding much investigation from all sides, the origin and relationships of the blood corpuscles are still very obscure. Since, however, the subject has more scientific interest than practical bearing on clinical medicine, a short general account of the present position of affairs will suffice.

Red Corpuscles.—The non-nucleated red corpuscle of the blood is certainly derived from the nucleated erythroblast of the bone marrow. Hayem's theory, that the blood plates (hæmatoblasts) are the precursors of the red corpuscles has been altogether discarded. In extra-uterine life, then, the red corpuscles must be regarded as arising solely from nucleated cells in the bone marrow. These cells lose their nuclei either by a process of extrusion (Muir and others), or breaking down in the cell (Pappenheim). The earlier stages in the development of the red corpuscle are much less certain, the main question at issue being whether it has an ancestral cell in common with the leucocyte, or whether there are distinct and separate primitive red and white cells. On the whole, most authorities (Pappenheim, Wollf, and others) incline to the former alternative, and trace all the blood cells to a primitive undifferentiated cell, resembling a lymphocyte. The immediate precursor of the normal erythroblast of the marrow (normoblast) is the megaloblast.

In disease the process of blood-formation may revert to the embryonic type. This is evidenced by (1) the appearance of megaloblasts in the blood; (2) the extension of the blood-forming marrow beyond its normal limits; and (3) the reversion of the spleen and liver to their embryonic hæmopoietic function (myeloid transformation).

White Corpuscles.—As regards the leucocytes, also, there are two different theories. Ehrlich holds that there are two distinct varieties of these cells, the lymphocytes, and the cells of the bone marrow. These cells differ from one another—(1) in their source, the former arising from lymphatic tissue, the latter from bone marrow; (2) morphologically, the former having a round nucleus, no granules, a cytoplasm more basophile than the nucleus, while the latter have more or less irregular nuclei, and contain neutrophile, eosinophile, or basophile granules. To the marrow cells we must also add the non-granular mononuclear, which differs from the lymphocyte in having a cytoplasm less strongly basophile than the nucleus. (3) The lymphocytes are destitute of the power of amœboid movement; the marrow cells have the power of amœboid movement, and are thus able to emigrate from the vessels. According to this theory the marrow cells and lymphocytes are genetically distinct — they have no common ancestor. Leucocytosis is essentially different from lymphocytosis; the former is an active emigration of marrow cells caused by chemotactic influence, the latter is a passive flooding of the blood with lymphocytes washed out of the lymphoid tissues.

The alternative hypothesis to that of Ehrlich is that all the leucocytes are derived from a primitive undifferentiated cell (leucoblast), and is the one at present most generally adopted

(Uskow, Gulland, Grawitz, Michaelis, Pappenheim). The supporters of the monist theory, however, are in no wise agreed upon the nature of the primitive cell. According to Uskow it is a small lymphocyte; to Pappenheim a large lymphocyte; to Wollf an undifferentiated lymphoid cell, apparently resembling the "large mononuclear." The genealogy ascribed to the different forms of leucocyte naturally differs according to which of these is regarded as the true primitive cell. Ehrlich's propositions have been attacked on the grounds that—(1) granules ("azurophil") can be demonstrated in lymphocytes (Michaelis); (2) lymphocytes show amœboid movement (Hirschfeld); (3) the lymphocytosis of early tuberculous serous effusions is active, not passive. Finally, a number of anomalous cases of leukæmia have now been described which do not exactly fit into either of the two main categories of the disease, but in which both lymphocytes, myelocytes, and unclassifiable intermediate forms are in excess.

Blood in Infancy and Childhood.—The average number of red corpuscles at birth is 5½ millions, but they decrease rapidly during the first week, reaching the adult number of 5 millions by the seventh or eighth day. At birth the percentage of hæmoglobin is 110; this also falls steadily until by the sixth month it is no more than 70. It does not begin to rise again until the end of the second year. In the newly-born infant the leucocytes number 20,000 per c.mm. During the first week there is a somewhat rapid fall, followed by a slow rise, which continues during the first six months, by which time they average 15,000. After this time a still more gradual diminution occurs, but the adult figure is not reached until the fifth or sixth year. The birth leucocytosis is due to excess of polynuclears, whereas the leucocytosis of infancy is due to excess of lymphocytes, and is probably neither more nor less than a manifestation of the activity of the lymphoid tissues, which is a feature of this period of life. Within a day or two of birth a few nucleated reds may be found in the peripheral blood; at a later date their appearance must be regarded as pathological.

Pathological Changes.—In interpreting the changes in the blood in anæmia and other diseases of infancy, the following points should be borne in mind:—(1) Reversion to the fœtal type of blood-formation takes place under very slight provocation. Normoblasts, megaloblasts, and myelocytes may appear in any form of anæmia, and have not the same grave significance as in later life. (2) Leucocytosis is common in all forms of anæmia. (3) Owing to the activity of the lymphoid tissues, lymphocytosis is of frequent occurrence. (4) The colour index is always low.

Clinical Examination of the Blood.—1. *Estimation of Hæmoglobin.—Haldane's Hæmoglobinometer.*—This is a modification of Gower's instrument in which the error arising from the use of an inconstant artificial colour standard is obviated. The standard devised by Haldane consists of a hermetically sealed tube containing a dilute solution of blood of known oxygen capacity saturated with coal gas. The solution is permanent, and the colour does not deteriorate. The instrument is used in the same way as Gower's hæmoglobinometer, except that before a reading is taken the graduated tube containing the patient's blood is filled with coal gas and closed with the finger. The liquid is then made to run up and down the tube so that the hæmoglobin is saturated with CO, and shows the characteristic pink tint. The percentage is read off in the ordinary way; the error need not exceed 1 per cent., and where great accuracy is required the mean of several readings is taken. As the pigment in both tubes is the same, a standard light is unnecessary.

Tallquist's Scale provides a simple, though somewhat rough means of estimating the hæmoglobin. It consists of a lithographed scale of tints and a book of filter papers. A drop of blood is allowed to soak into a piece of filter paper, and the colour of the spot compared with the scale. The limit of error does not exceed 10 per cent.

2. *Glycogen Reaction.—Technique.*—The solution employed, which serves for fixing, staining, and mounting, is composed of iodine, 1 gram; iodide of potash, 3 grams; distilled water, 100 c.c., with enough gum arabic to give a syrupy consistence. A drop of this is placed on a slide, and covered with an ordinary air-dried smear preparation of the blood to be examined. After half a minute the superfluous iodine solution is absorbed with filter paper, when the specimen is ready for examination under an oil-immersion lens. Daylight, or incandescent gas is the best illuminant; a yellow flame is very unsatisfactory. Normally the red corpuscles stain brightish yellow, the leucocytes pale yellow. A certain amount of extracellular glycogen is seen in the form of brown or red granules, but under normal circumstances the leucocytes show no trace of it. The amount of this extra-cellular glycogen varies a good deal, and no significance can be attached to it.

These appearances are regarded as a "negative glycogen reaction." In the "positive reaction" the polynuclear leucocytes show red or brown glycogen either (1) as a diffuse coloration, (2) as a few granules scattered through the cell, or (3) as coarse granules, most abundant at the periphery of the cell body or projecting like pseudopodia from it. The number of cells so affected varies between 2 or 3 per cent. and 9 per cent., and the degree of reaction is proportionate to the severity of the cause. A positive reaction occurs—(1) in severe disturb-

ance of respiration, (2) in anæmia, (3) in toxæmias of metabolic origin, (4) in suppuration and bacterial infections. The chief importance of the reaction is in the diagnosis of the last series of diseases. Croupous pneumonia, empyema, abscess and gangrene of the lung, sepsis of all kinds, acute appendicitis and peritonitis all give a marked positive reaction. On the whole, then, the reaction occurs in the same class of case as does polynuclear leucocytosis, but it is a less ambiguous sign than the latter. Leucocytosis occurs in conditions in which the glycogen reaction is negative, and conversely in severe septic infections and pneumonia there may be no leucocytosis, while the glycogen reaction is very intense. Locke insists that a well-marked glycogen reaction occurs only in patients who are really seriously ill, hence its detection in a case which does not admit of a positive diagnosis should always put the observer on his guard.

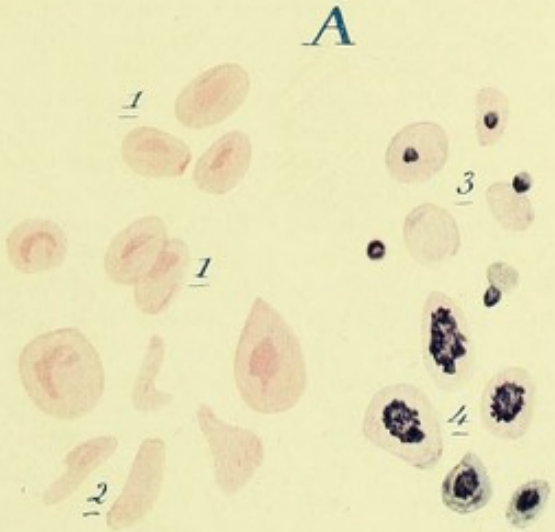
Examination of Stained Films. — The blood stains at present in use for clinical purposes are Ehrlich's triacid stain, Leishman's stain, and Jenner's stain. Of these the last is the most generally useful. Ehrlich's triacid stain is a mixture of fuchsin, orange G., and methyl green; Leishman's and Jenner's stains are eosin-methylene blue dyes, in which the latter has the polychromatic properties of Romanowsky's stain. The preparation of these stains is difficult, and it is best to procure them ready made either in solution or tablet form.

Method. — Triacid Stain. — Grübler's triacid should be used. Films are made in the usual way (*Encyclop. and Dict.*, i. p. 420) and fixed by heat, either in an oven or an oblong copper plate (2 ins. by 10 ins.), one end of which is heated by a Bunsen flame. Where an oven is used, the films are slowly raised to a temperature of 160° C., and then allowed to cool gradually. When the second method is employed, water is dropped on the plate at the end farthest from the flame until a spot is found at which it boils. Instead of water, xylol, which boils at 137° C., or toluol, which boils at 110° C., may be used. On one of these spots the films are placed face downwards for a period varying from five minutes at 160° to half an hour at 100°. The important point in heat fixation is to employ a sufficiently high temperature; bad differentiation is generally due to underheating. The best results with triacid are got by heat fixation, but, as Gulland has pointed out, it is not absolutely essential, for very fair pictures can be got by fixing the air-dried film for three minutes in 10 per cent. formalin alcohol. It is then washed and stained. The triacid solution should in either case be allowed to act for three minutes. In good preparations the red cells are orange, the neutrophile granules are violet-brown, the eosinophile granules violet-red, the nuclei green; basophile granules do not stain. The nuclei react with varying degrees of affinity to this stain: those of erythroblasts are deep greenish-blue, with well-defined outlines; those of polynuclears are scarcely so intense; while the lymphocytes and large mononuclears are often very faintly tinged. In underfixed films the red cells are reddish-brown, in overfixed films they are pale lemon-yellow.

Jenner's Stain.—The solvent of this stain, methyl alcohol, also fixes the films, so that the two processes of dyeing and fixing are carried out simultaneously. When this, or Leishman's stain, is used in the form of tablets, chemically pure methyl alcohol (Merck) must be used. A few drops of the stain are allowed to fall on the air-dried film, which may be covered to prevent evaporation. The dye is allowed to act for from one to five minutes; the film is rapidly washed in distilled water, and allowed to dry in the air. It must not be heated. Gulland advises staining for a shorter time ($\frac{1}{2}$ to $1\frac{1}{2}$ mins.); if one wishes the methylene blue to predominate, one should stain for a shorter time; if the eosin, for a longer time. Bad results are usually due to too prolonged staining. In successful preparations the red corpuscles are rose-red, nuclei blue, eosinophile granules ruby, neutrophile granules pink, basophile granules deep violet-blue, malaria parasites and bacteria blue. The weak point about the stain is that it does not always differentiate the neutrophile granules satisfactorily.

Leishman's Stain.—Enough stain is dropped on the unfixed air-dried smear to cover the whole cover-glass. This is allowed to act undiluted for half a minute (to fix the film) and then distilled water is added drop by drop until a translucent scum appears on the surface. About twice as much water as stain is required. The dilute dye is allowed to act for five minutes, and then washed off with distilled water. In Leishman-stained specimens the nuclei are a red-violet, eosinophile granules pink, neutrophile granules red, red cells pink or greenish, malaria parasites pale blue, with carmine-stained nuclei. Leishman's stain often fails to differentiate the neutrophile granules satisfactorily.

Comparison of these Stains.—They together give the maximum of clinical information, and it is unnecessary to supplement them by others in ordinary work. Jenner's is, on the whole, the most useful, and in good preparations gives all the necessary information. Unfortunately, however, the neutrophile granules are not always well brought out, and when this is the case it is impossible to distinguish between large lymphocytes and neutrophile myelocytes. For this reason it is often advisable to control it with a specimen stained by the triacid stain, which excels in differentiating neutrophile granules, though it is not so good for lymphocytes. Leishman's stain is less useful in ordinary



A. Normal, deformed and nucleated erythrocytes.

1. Normal. 2. Deformed.
3. Normoblasts. 4. Megaloblasts.

(Wright's Stain.)

B. Granular basophilia and polychromatophilia of the erythrocytes.

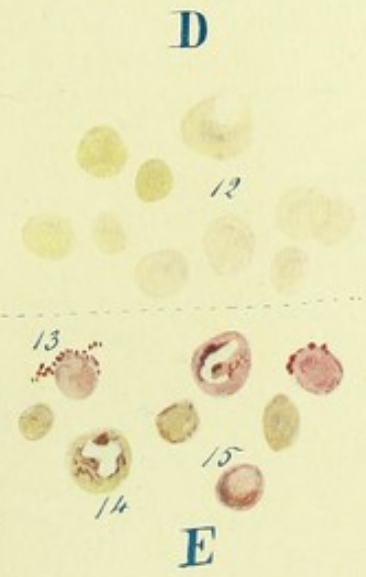
5. Normal erythrocytes. 6. Granular.
7. Polychromatophilia.

(Wright's Stain.)

C. Normal and pathological types of leucocytes.

8. Normal. 9. Polynuclear.
10. Blood Plates. 11. Eosinophilic myelocytes.

(Wright's Stain.)



D. 12. Normal blood.

E. Blood from a case of sepsis.

13. Granular type of reaction.
14. Diffuse type of reaction.
15. Extra cellular mass.

(Goldburger Weiss' Stain.)

blood examinations, but is the best for protozoa —*e.g.* malarial parasites and trypanosomes. For cyto-diagnosis of serous fluids Jenner's stain is perhaps the best. The triacid mixture is useless, as it does not stain bacteria.

Wright's Stain, a modification of Leishman's, is strongly recommended by Gulland for the azurophil granulations of lymphocytes, as follows :—Drop a smear before it is dry into a weak solution of the stain in methyl alcohol ; leave it to stain for any time up to half an hour, dry, and mount in balsam.

Examination of Stained Films.—For accurate work a $\frac{1}{12}$ in. oil-immersion lens and a mechanical stage are almost necessities. With practice it is possible to differentiate cells with a lower ($\frac{1}{6}$ in.) power, but their appearances must first have been learned with the aid of the immersion lens. Systematic differential counts can scarcely be made without a mechanical stage, and the examination of successive fields by moving the slide with the fingers is a very laborious process.

Differential Counting.—This consists in enumerating the varieties of leucocytes seen in successive fields until 500 have been counted. The numbers of the different cells are jotted down on a piece of paper as they are counted. It is customary to differentiate small lymphocytes, large lymphocytes and mononuclears, polynuclears, eosinophiles, mast cells, and myelocytes, and at the same time to note any abnormal red cells seen, as normoblasts, megaloblasts, fragmentation of nuclei, basophilia, mitoses, etc. In differential counting the chief difficulty arises in connection with the "large lymphocyte," for, on the one hand, we have to draw a distinction between a typical large lymphocyte with strongly basophile protoplasm and a small lymphocyte, and, on the other, between a large lymphocyte and a large mononuclear with a pale cytoplasm and darker nucleus. The distinction is often dependent on the personal equation of the observer, and some prefer to class as "lymphocytes" both the small and large forms with basophile cytoplasm, and as "large mononuclear and transitional cells," those with pale cytoplasm and darker rounded or irregular nuclei.

Differential counts may be stated as percentages, or converted into absolute numbers of cells per cubic millimetre. The latter is better, as by it we can distinguish between relative and absolute variations in the different cells. The following table shows in round numbers the percentages and totals of the leucocytes in the normal adult, taking the local leucocytes as 8000 per c.mm. :—

	Per Cent.	Total.
Small lymphocytes	20-30	1600-2400
Large do. (incl. "transitionals")	4-8	320-640
Polynuclears	60-75	4800-6000
Eosinophiles	·5-5	40-400
Basophiles	·5	40

The advantage of stating the absolute numbers of cells is obvious from such an example as the following :—

	Percentage.	Total Leucocyte Count. A = 4000 p. c.mm.	Total Leucocyte Count. B = 20,000 p. c.mm.
Small lymphocytes	70	2800	14,400
Large do.	5	200	1,000
Polynuclears	24	960	4,800
Eosinophiles	·5	20	100
Basophiles	·5	20	100

From the percentage alone we can only infer that there is a relative lymphocytosis. Stated as totals, however, it is obvious that in case A the lymphocytes are normal and the polynuclears diminished (inactivity of the bone marrow) while in B the polynuclears are normal and the lymphocytes increased (excessive activity of the lymphoid tissues, possibly leukæmia).

Special Examination of the Polynuclear Neutrophiles.—Arneth has studied the neutrophile cells from a fresh standpoint. He arranges them severally in groups according to the shape of the nucleus — I. mononuclear, II. bilobed nuclei, III. trilobed nuclei, and so on. He adopts Pappenheim's view that increasing polymorphism of the nucleus is a sign of progressive ripening of the cell, and on this assumption it is natural to suppose that in health some fairly constant ratio must exist between the numbers of the different stages present. Arneth states that the normal percentage is as follows : —I. 5 per cent., II. 35 per cent., III. 31 per cent., IV. 17 per cent., V. and over, 2 per cent. In disease, especially infectious disease, the neutrophile picture is altered, so that a larger number of the cells appear in groups I. and II., and Arneth and some of his followers ascribe considerable diagnostic and prognostic importance to this "pushing the neutrophile picture to the left." It must be said, however, that not all observers accept Arneth's figures as normal averages ; some think that the number of young forms in health is higher than his estimate.

Pathological Appearances. See *Encyclop. and Dict.*, i. pp. 413, 415.

Leucocytes.—1. *Mast Cells.*—The basophile cell which is normally found in small numbers in the blood has a convoluted nucleus and fine granulation. Mast cells differ from these in possessing round, faintly-staining nuclei, and coarse granules. They vary much in size (8 to 20 μ) ; they occur in leukæmia, in the splenic anæmia of infancy, and occasionally in severe anæmia from other causes. The general meaning of basophilia is unknown.

2. *Neutrophile Pseudo-Myelocyte* (*Ehrlich*).—This resembles a myelocyte, but is much smaller. It is not uncommon in infantile anæmia, and is probably a dwarfed form.

3. "*Reizungs-form*" (*Türck*).—This is a cell somewhat larger than a small lymphocyte, with

a round nucleus, poor in chromatin, and a cytoplasm which stains deep red with the triacid mixture. Its significance is unknown.

Red Corpuscles. — 1. *Megaloblasts.* — Isolated megaloblasts may occur in any bad case of anæmia, but the only conditions in which they appear in abundance are pernicious anæmia, bothriocephalus anæmia, anæmia from nitrobenzole poisoning, and anæmia in infancy.

2. *Atypical Erythroblasts.*—Under this head we may group cells intermediate between normo- and megaloblasts, cells with multiple nuclei, and cells showing fragmentation of the nucleus.

3. *Basophile Degeneration of Red Corpuscles.*—*Granular Basophilia.*—Basophile red corpuscles show a fine stippling or granulation when stained with basic dyes. The granules may be scanty (two or three only) or scattered throughout the whole cell. Basophile degeneration usually occurs in non-nucleated cells, and is believed to be a product of nuclear disintegration. The condition occurs in pernicious and serious forms of secondary anæmia, but is especially characteristic of chronic lead-poisoning.

The Bacteriological Examination of the Blood can only be satisfactorily carried out by withdrawing blood from a vein. A drop of blood obtained through a puncture of the skin is extremely liable to accidental contamination with skin organisms. *Technique.* — The skin over a vein in the forearm or on the dorsum of the foot is thoroughly sterilised by washing with lysol, sterile water, and ether. The vein is made turgid by a proximally placed bandage, and the needle of a sterile syringe (*e.g.* an antitoxin syringe) is plunged obliquely into its lumen. Several c.c. of blood should be withdrawn and inoculated in bouillon, on the surface of an agar tube, etc. Cultures from the blood made in this way often give positive results in septicæmia, pneumococcal infection, and other blood infections. It has been shown, for example, that in typhoid fever the organism can be detected in the blood from the very onset of the malady, before it appears in the stools—a fact which proves that the disease is in truth a general blood infection. *See* Typhoid.

Alkalinity of the Blood. — Haycraft's method of estimating the alkalinity of the blood (*Encyclop. and Dict.*, i. p. 417) has been superseded by Engel's alkalimeter and Dare's hæmoalkalimeter. In the former a solution of blood is titrated with $\frac{1}{75}$ normal tartaric acid against litmus; in the latter the amount of $\frac{1}{2000}$ normal tartaric acid required to neutralise a definite quantity of blood is estimated by the spectroscope, and from the figure so obtained the alkalinity is calculated. Up to the present time clinical alkalimetry has not proved of any real value.

Cryoscopy. — This method of examination has not realised the anticipations which were formed of it when first introduced. *See* Cryoscopy.

Coagulation of the Blood.—A great number of methods have been devised from time to time for estimating the coagulability of the blood, but since serious fallacies are introduced in all except Addis's apparatus, a short description of some of the more commonly used is all that is necessary.

Wright's coagulometer is perhaps the best known. It consists of a series of uniformly calibrated tubes, into which blood is sucked; these are, when filled, maintained at a fairly constant temperature of 37° C. by means of a small water-bath. The coagulation time is determined by successively blowing the contents of the tubes on to filter-paper and noting when fibrin has formed.

Sabrazes's method depends on the fact that when blood coagulates in capillary tubes a fine thread of fibrin can be demonstrated when the tube is broken across. The tubes are intended to be kept at a constant temperature. *M'Gowan's method* is somewhat similar. A tube with a lumen of 1·5 mm., and about 7 in. long, is filled with blood, and portions of the tube are broken off every half-minute until the thread of fibrin is seen.

Brodie and Russell's Method.—The apparatus consists of a circular box, which fits on the stage of a microscope. The floor is of glass, and the lid consists of an inverted truncated glass cone, on the tip of which a drop of blood can be picked up. When the glass cone is in position the edges of the drop of blood can be focussed by the microscope. A constant temperature is maintained by a water-jacket, and the blood is kept in circular motion by a stream of air from a small blowpipe, which perforates the lateral wall of the box, impinging against its edge. This coagulometer was improved by Boggs, and greatly modified by Addis, whose apparatus, although complicated, is the only one which gives consistent and comprehensible results.

Addis's Coagulometer.—The apparatus consists of Boggs's modification of Brodie and Russell's coagulometer, with a thermometer for reading the temperature in the chamber. Instead of depending on a current of air to cause a streaming movement of the corpuscles, Addis employs paraffin oil, so that when the coagulometer is in use the blood is completely surrounded by oil, except when it is in contact with the glass cone. The oil is delivered from a large tank, and there are arrangements for maintaining (*a*) an absolutely constant temperature, and (*b*) a constant pressure of outflow. Addis has proved that in all the coagulometers hitherto employed, the provision made for regulating the temperature is very imperfect, and that variations in temperature which previous observers regarded

as negligible have a profound effect on the coagulation time—are, indeed, the actual cause of the variations which have been observed, and which have been erroneously ascribed to the administration of drugs, etc. For a full description of the apparatus, and the technique which must be observed in its use, the reader is referred to Addis's paper (*Quarterly Journ. Exper. Physiology*, Nov. 1908).

According to Addis, the following conditions are essential to the accurate determination of the coagulation time of the blood by any method:—1. The blood must be obtained under the same conditions in each experiment. This condition is sufficiently fulfilled by (*a*) taking the first blood which flows after puncture, and (*b*) thoroughly cleansing the skin and all apparatus from previously shed blood and fibrin ferment. 2. All estimations must be at the same temperature; the coagulation time of the blood varies regularly with the temperature. At 3·25° C. it is 63 mins. 20 secs.; as the temperature rises it steadily diminishes, until at 36° it is only 1 min. 25 secs.; thereafter it begins to increase up to the temperature of 51·5°, when it is 5 mins. 15 secs. At higher temperatures coagulation is interfered with. Within the ordinary limits of room temperature great variations occur:—

Temp. C.°	Coag. Time. Mins.	Secs.
10·25	21	30
12·25	16	30
13·5	14	32
15·5	11	46
16·5	10	10
17·5	8	27
18·5	7	34
19·5	6	2
20·5	5	22

3. In each observation the blood must be in contact with the same amount and kind of foreign body. 4. The end point must be clear and definite, and must always indicate the same degree of coagulation. With Addis's apparatus, three possible stages might be taken as indicating coagulation—(1) The earliest appearance of a streak of clot; (2) the stoppage of the main flow of blood and the clear appearance of a laminated clot; (3) complete cessation of flow. The second of these can be most accurately determined.

In health there is practically no variation in the time of coagulation of the blood. The differences which have been observed are entirely explained by variations in temperature. The coagulation time shows no diurnal variation such as has been described by some authors. What is more important, perhaps, is the fact that the administration of calcium salts does not increase, nor the administration of citrates diminish, the coagulability of the blood. The coagulometer described is inapplicable to a number of pathological conditions, and the results quoted apply to normal individuals. In a number of diseases the corpuscles tend to become agglutinated by their own serum, which hinders their flow, and makes it impossible to determine when coagulation occurs.

Estimation of the Calcium Salts of the Blood.—Blair Bell has devised a method of estimating the calcium of the blood which is applicable to clinical work. Calcium exists in the blood in two forms—a non-dissociable form in combination with the protein molecules, and an ionizable form. Only the ionic calcium (which alone is concerned in coagulation) can be estimated by Bell's calcimeter. The instrument consists of a series of accurately calibrated pipettes. Into one of these 100 c.mm. blood is sucked, and is then thoroughly mixed with 250 c.mm. 1 in 30 aqueous solution of oxalic acid (Merck's chem. pure). After standing for ten minutes there is added 250 c.mm. of a mixture of acetic acid (1 per cent.), 95 parts, and glycerin, 5 parts, to break up the corpuscles, and the mixture is thoroughly shaken. Of this mixture 100 c.mm. is added to 500 c.mm. distilled water, and a drop is placed on a Thoma counting chamber. The crystals of calcium oxalate which have formed are counted in 256 small squares (16 sets of 16). An average of 1 crystal per square = calcium index = 1 part of CaO in 6000 distilled water. The crystals are exceedingly minute, and are often difficult to discern. Artificial light should be used for counting. Considerable practice is required before the observer's results can be depended on. In ordinary adults the normal standard varies from 1 to 4000 to 1 to 5000 CaO in the blood.

Addis investigated the accuracy of this method by comparing the counts in normal animal serum, and animal serum diluted with distilled water, and with solutions of calcium of known strength. He found that the limit of unavoidable error was between 6 and 7 per cent., and as the calcium index fluctuates considerably, this may be regarded as comparatively negligible. Addis further showed that the administration of citric acid rapidly lowered the index (*e.g.* from ·92 to ·67 in an hour and a half), and that calcium salts as rapidly raised it (*e.g.* from ·8 to 2 in the course of twenty-four hours, and from ·91 to 1·14 in an hour). As stated in the preceding paragraphs, these changes in the calcium contents of the blood do not influence its coagulation time—indeed, it is probable that the variations in the calcium which follow ordinary doses are too small to affect coagulation under any circumstances.

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Blood-Pressure.—Blood-Pressure, Measurement of.—The instruments employed for estimating the blood-pressure clinically may be divided into two groups—(1) those which compress a single artery; and (2) those which compress the whole circumference of a digit or limb. Of the very many forms of apparatus which have been devised, the following may be mentioned:—

1. *Von Basch's Sphygmomanometer.*—Although this instrument has been superseded, and is now almost obsolete, it deserves mention as one of the earliest which was of practical use. It consisted of a mercurial manometer connected with an air-chamber with an elastic membrane, which was depressed on the radial artery until pulsation in the distal portion of the vessel ceased. The pressure required for this was read on the manometer. Von Basch's sphygmomanometer was subsequently modified more than once, and an aneroid was substituted for a mercurial manometer.

2. *Oliver's Hæmodynamometer.*—Oliver points out that the principle of ascertaining arterial pressure by the force which is needed completely to close the vessel is vitiated by the resistance of the overlying tissues (this, however, is not admitted by many authorities), as well as by the different anatomical relationships of different arteries. The hæmodynamometer, which consists of a pad containing fluid actuating a spring manometer, gives readings on a dial. The first intention of the inventor was to eliminate the above fallacies by using the instrument to indicate the pressure required to evoke a maximum oscillation of the indicator, which is regarded as the criterion of the diastolic blood-pressure. He finds, however, that in using the instrument two maximum oscillations of the needle occur, separated by a period of lessened excursion. He looks on the second of these maxima as indicating the systolic pressure. The following directions are given for the use of the hæmodynamometer:—

"The right arm on its ulnar side is placed on a table (this being on a level with the ensiform cartilage in the sitting posture, and with the back in the recumbent position), and the wrist is kept bent to the angle of forty-five degrees by the observer's left hand holding back that of the patient. The feet of the slide [of the hæmodynamometer] are so placed as to elude the track of the artery, and the pad of the instrument is placed over the vessel *at right angles to its bed*. Pressure is then made by gently and gradually pushing forward the body of the instrument by the thumb of the observer's right hand holding the slide. The indicator will then rise on the dial and show the degree of pressure brought to bear on the pad and the vessel, and will begin to pulsate when measuring 50, 60, 70, or 80 mm. or so. The pulsations gradually increase in size as the indicator is made to rise farther on the scale, until the lower maximum point is reached (diastolic reading), beyond which they gradually diminish, and again increase under a higher pressure until a second maximum oscillation is produced (the systolic reading), after which they finally decrease. The readings are made at the midway point of the maximum oscillations." It is easier to read accurately when the oscillations are small, hence the ulnar artery or the superficialis volæ may be employed instead of the radial. The hæmodynamometer gives identical readings to the armlet method, except when the brachial artery is sclerosed, in which case the armlet readings, particularly the systolic pressure, are higher.

3. *Gärtner's Tonometer.*—This may be instanced as a typical apparatus based on the principle of using a band encircling a finger to estimate the pressure. It consists of a metal collar lined by an elastic membrane, with arrangements for pumping air between the elastic membrane and the metal, and for measuring the pressure in the air-containing space. The collar is placed loosely over the middle phalanx of a finger, and the terminal phalanx is blanched by bandaging it from its tip upwards with a piece of rubber tubing. Air is then pumped into the elastic bag lining the collar until the manometer indicates a pressure above that of the blood, *e.g.* 200 mm. Hg. The rubber bandage is then unwound, leaving the end of the finger pale and bloodless. Next, the air is allowed to escape slowly from the collar until the finger-tip shows a return of the circulation. The manometer reading at this point indicates the systolic arterial pressure. The tonometer is adapted for use either with a mercurial or an aneroid manometer.

4. *Riva-Rocci Sphygmomanometer.*—In this appliance the pressure is measured by means of an armlet encircling the whole upper arm,

and an apparatus of this type is now regarded as giving the most reliable information on the arterial pressure. The Riva-Rocci sphygmomanometer has been extensively employed, and numerous modifications of it exist. The armlet, which should measure 12 cm. in width, consists of a distensible bag capable of surrounding the arm, enclosed in a rigid leather or canvas outer case. It is connected with a pump and a mercurial manometer. Air is forced into it until the radial pulse stops; the air is then allowed to escape slowly, and the pressure noted at the time when the pulsation of the radial returns.

Hill and Barnard have modified the apparatus by improving the armlet and substituting a compressed-air or an aneroid for the mercurial manometer. In Janeway's instrument the manometer is jointed for convenience in carriage, and in Erlanger's model a recording apparatus is included.

5. *Oliver's Compressed Air and Spirit Hæmomanometer* is a recent pattern, and its inventor claims for it advantages over both mercurial and aneroid forms. Omitting minor details, the leading features of the instrument are—(1) a full-sized armlet, 12 × 16 cm.; (2) a compressor (pump), actuated by a rapid screw, which inflates the armlet steadily, not intermittently as the ordinary pump does; (3) the recorder, consisting merely of a glass tube, 8 or more inches long, having a capillary bore and a bulb at its upper end. The lower end is V-shaped, and forms a smaller bulb. The tube can be moved from the horizontal to the vertical position. Tinted absolute alcohol is used as an indicator. To use the instrument the recorder is placed in the horizontal position, the spirit reaching the zero mark. The tube of the armlet is connected with it, and air is pumped in. The pressure is estimated by the distance the spirit is driven along the recorder against the resistance of the contained column of air.

6. G. A. Gibson has introduced a *recording sphygmomanometer*, giving absolute records of the arterial pressure. In Erlanger's instrument the pressure readings have to be written on the tracing by the observer, but in Gibson's apparatus the absolute pressure is recorded. The instrument is of the Riva-Rocci type. On the mercury there is a float furnished with an aluminium rod, topped by a style writing on a revolving drum. Another style traces on the drum an abscissa, marking the zero point of the mercurial column. A tambour, connected with a writing lever, is strapped over the radial artery, and records the movements of the pulse on the drum. In using the instrument the armlet is inflated by steady strokes of the pump until a pressure of 160 mm. Hg or thereby is attained. If sufficient pressure has been employed, the pulsations of the artery below the armlet are checked, and the pen recording these remains stationary. The drum is then caused to revolve, and the air is allowed to escape slowly from the armlet through a valve. The point of maximum (systolic) pressure is recorded by the first appearance of small waves in the radial tracing. The minimum (diastolic) pressure is taken as the lowest point of the largest wave in the manometer trace. As there is a double column of mercury in the V-tube of the manometer, the height of the tracing above the abscissa has to be doubled to give the absolute pressure.

Measurements of Venous Pressure.—Oliver gives the following as a ready clinical method of estimating the venous pressure. The hand being held vertical, and below the apex beat, slowly raise it and note the height in inches above the apex beat at which the veins in the dorsum are seen to collapse. The number of inches multiplied by two gives approximately the pressure in mm. Hg.

Clinical Sphygmomanometry.—The *maximum (systolic) pressure* is estimated by the pressure required to obliterate the artery completely. It can therefore be determined (*a*) by noting the pressure on the brachial artery which abolishes the pulse at the wrist; or (*b*) the radial pulse being abolished, by allowing the air to escape slowly from the armlet, and noting the point at which the pulse returns at the wrist.

The *minimum (diastolic) pressure* is usually measured by noting the point at which the oscillations of the manometer attain the highest amplitude. According to Leonard Hill, this point of maximum oscillation represents not the minimum, but the mean blood-pressure. Most clinicians, however, take the *mean pressure* to be midway between the minimum and maximum pressures, as defined above. Another method of determining the minimum pressure is by observing the point at which the volume of the radial pulse first becomes sensibly less. This may be done either by the finger or sphygmograph. The method is less reliable than the first mentioned.

The normal maximum pressure in the brachial artery during rest is 110-130 mm. Hg, the minimum 95-100 mm. Hg. Oliver gives as a good average reading for an adult $\frac{115\text{-}125\ \text{S.}}{95\text{-}100\ \text{D.}}$; readings of $\frac{95\text{-}145\ \text{S.}}{80\text{-}115\ \text{D.}}$ are within normal limits. In children they approximate to the lower, in persons over middle life to the higher, of these figures. In women the readings are from 5 to 10 per cent. less than in men. The difference between the maximum and minimum pressures is the *pulse-amplitude*; it is from 10 to 40 mm. Hg, the average being about 25 mm. The mean pressure is taken as the arithmetical mean of the maximum and minimum pressures.

The blood-pressure is raised by muscular

exercise; it falls after exercise. Cold contracts the peripheral vessels and raises the pressure; warmth has the opposite effect. After a meal the pressure first rises, then falls; during sleep it falls, then rises. A supernormal pressure is much more common than a subnormal pressure. It seems as though the normal degree of pressure is pretty near the minimum at which life can be constantly sustained, and every effort is made to uphold it (Hutchison).

High arterial pressure occurs as a result of senility. After middle life the systolic pressure in particular tends to rise; the diastolic rises more gradually, or may for a time remain normal. The chief conditions in which persistent supernormal arterial pressure is met with are arterio-sclerosis and chronic interstitial nephritis. The pressure is also raised in many forms of neurasthenia, in melancholia, in insomnia, in cerebral hæmorrhage, in angina pectoris, in polycythæmia, and in the crisis of locomotor ataxia.

Low arterial pressure is found in collapse, in anæmia, in Addison's disease, in diphtheria, in typhoid, and in exhausting diseases generally. In pneumonia a sudden rise before the crisis presages a complication; a sudden fall, heart failure (G. A. Gibson). Aortic incompetence is characterised by a high systolic and a low diastolic pressure.

In typhoid fever the blood-pressure is usually low—below 100—and if it remains fairly steady during the course of the disease, Barach (*New York Med. Journ.*, p. 348, 1907) looks on the prospects of the patient as favourable. A steady fall, on the other hand, is a bad sign. Equally ominous is a sudden rise, which is said by Huchard (*Rev. de méd.*, p. 609, 1907) to precede hæmorrhage or perforation. When perforation actually occurs there is a rise in the blood-pressure to 160 or 200 mm. Hg. (Shephard, *Lancet*, i. p. 1293, 1907).

The whole subject of arterial pressure, and the inferences to be drawn from sphygmomanometric observations, is an extremely difficult one. The blood-pressure depends on many factors: the force and output of the left ventricle; the peripheral resistance; the elasticity of the arteries; and the volume of blood in the circulation. Variations in any of these will cause alterations in the pressure. The difficulties introduced by thickening of the walls of the vessels, and by arterial hypertonus, are discussed under ARTERIO-SCLEROSIS and ARTERIAL HYPERTONUS, and will not be further mentioned here, except to say that great difference of opinion exists as to what part a thickened artery plays in vitiating the correctness of a high reading as a witness to the state of matters inside the artery.

Müller sums up the main problem in the diagnosis of diseases of the circulation thus:—To discover a ready clinical means of estimating changes in the volume of the heart-beat (*Schlagvolumen*), on the one hand, and changes in total sectional area of the vessels on the other. Unfortunately (he says), the comparatively simple methods of sphygmomanometry do not furnish the necessary information.

Strasburger has made an effort in this direction. He assumes that the brachial pressure is identical with that of the aorta. It alters (*a*) with changes in the volume of blood expelled by the ventricular contractions, and (*b*) with contraction and expansion of the sectional area of the peripheral vessels. Strasburger further takes the pulse amplitude (*Pulsdruck*), defined above as the difference between the maximum and minimum pressures, as a measure of the volume of blood expelled by each ventricular contraction — factor (*a*) above. When the volume varies, so does the pulse amplitude; when it remains constant the pulse amplitude does the same. The sectional area of the vessels —factor (*b*) above—is measured by the minimum blood-pressure. The relation of the two factors is expressed as the *blood-pressure quotient* $\frac{\text{Pulse amplitude}}{\text{Diastolic pressure}} = \text{Q.}$ Thus $\frac{\text{P. A.} = 25\text{-}30}{\text{D. P.} = 88\text{-}100} =$ about ·3 on the average. On this basis he formulates the following general statements:—

1. When the systolic pressure alters and the quotient remains the same there is alteration in the work of the heart. S. P. + = increased work; S. P. − = diminished work.

2. When both the systolic pressure and the quotient *vary equally in opposite directions*, there is alteration in the vascular tone. S. P. + and Q. − = increased tone; S. P. − and Q. + = lowered tone.

3. When both the systolic pressure and the quotient *vary in the same direction or unequally in opposite directions* both the work of the heart and the tone of the vessels are altered.

A very important practical point in connection with supernormal arterial pressure is made by Janeway, namely, that high arterial pressure is often a necessary evil, being a compensatory effort of the organism. In some patients "an average level of arterial pressure far above the normal is absolutely necessary to insure the requisite speed of capillary blood-flow. For them the optimum pressure for the maintenance of a normal circulation may become 200 mm. or more, instead of 100 to 145 mm. . . . . a systolic pressure of 200 mm.—yes, even 250 mm. and over—is not incompatible with a number of years of comparative comfort and activity, particularly if the response to treatment is favourable, and the patient co-operates heartily."

TREATMENT OF SUPERNORMAL PRESSURE.—The following are the main points as laid down by Oliver:—1. Reduce the bulk of the meals

and eliminate articles which stimulate the circulation — alcohol, condiments, extractives. 2. Reduce the proteid of the diet, and the fluid drunk. 3. Encourage thorough mastication. 4. Moderate use of tea and coffee. Forbid alcohol. 5. A lacto-farinaceous diet for a period of several weeks is sometimes useful. 6. Tobacco should be prohibited, as it causes the pressure to rise. 7. There should be a period of absolute rest, followed by carefully graduated exercise. 8. Various forms of baths are useful. 9. The cutaneous function should be attended to. The bowels ought to be evacuated freely. Intestinal antiseptics may be given. 10. Vaso-dilator drugs—thyroid and nitrites.

ACTION OF THE NITRITES.—The action of the different nitrites in high blood-pressure has been worked out comparatively by Matthew. He finds that liquor trinitrini (ɱii) produces an average fall of 28 mm. Hg within 5 minutes; the action is short-lived, the pressure regaining its old level in half an hour. Sodium nitrite (2 grs.) produces an average fall of 32·5 mm. Hg in a quarter of an hour. The effect lasts longer, and the old level is not reached until 1 to 2 hours has elapsed. Erythrol tetranitrate (1 tablet) produces an average fall of 34 mm. Hg in 22 minutes. The pressure remains low for 1 to 2 hours, and the effect does not wholly pass off for from 4 to 6 hours.

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Bordet-Gengou Phenomenon. —A term used in bacteriology and immunity to signify certain phenomena observed independently by Bordet and Gengou. It consists in the deviation of the complement by means of an antigen and its antibody, and it is of use in the diagnosis of syphilis (Wassermann's reaction) and of hydatid disease. See Adami, *Pathology*, i. p. 547, 1910; Editorial in *Lancet*, i. for 1910, p. 734.

Bovril Wine.—A proprietary meat wine containing alcohol, meat extract, and glucose. *Vide* analysis in *Brit. Med. Journ.*, i. for 1909, p. 795.

Boy-Scout Movement. — A movement initiated in 1908 by Lieut.-General Sir Robert Baden-Powell for the training of boys and youths in scouting, including physical exercises and drills and the development of the faculties of judgment and observation; besides its other advantages it possesses that of giving the lads healthy outdoor exercise with some measure of adventurous excitement, but the advice of the family doctor ought to be invoked before any boy is permitted to take part in it. See Annotation in *Lancet*, i. for 1910, p. 445.

Brevon Bread. — An easily digested and highly nutritive bread. For Report see *Lancet*, i. for 1910, p. 36.

Brill's Disease.—One of the diseases which simulates typhoid fever in its clinical symptoms, and yet seems to be a separate malady, has received the above name, after Nathan E. Brill, who first described its characters in 1898 (*New York Med. Journ.*, lxvii. pp. 48, 77, 1898). Dr. Brill's article was entitled "A Study of Seventeen Cases of a Disease Clinically Resembling Typhoid Fever, but without the Widal Reaction, together with a Short Review of the Present Status of the Sero-Diagnosis of Typhoid Fever," and since its appearance E. Libman (*Johns Hopkins Hosp. Bull.*, xvii. p. 215, 1906) and H. F. L. Ziegel (*Med. Rec.*, June 25, 1910), and others have agreed with the conclusions reached. Dr. Brill himself has recently brought the whole subject afresh before the medical world in a paper entitled "An Acute Infectious Disease of Unknown Origin: a Clinical Study Based on 221 Cases" (*Amer. Journ. Med. Sci.*, N.S., cxxxix. p. 484, 1910), and the matter has been discussed in an editorial in the *Medical Record* of April 30, 1910. There are several morbid states which resemble typhoid fever, viz., tuberculosis, septic endocarditis, malaria, influenza, some forms of meningitis, intestinal sapræmia, the coli infections, meat poisoning, and what has been called paratyphoid fever, but Brill is of opinion that the disease described by him is none of these, and yet is not typhoid fever. The Widal test is always negative, and the Eberth bacillus is invariably absent; leucopenia is exceptional, and the leucocyte count is usually normal. In place of the roseolar eruption of typhoid there occurs a maculo-papular one; the spots appear in a single crop, generally before the seventh day, on the abdomen and back at first, but elsewhere (chest, neck, hands, feet) later, are profuse, and do not entirely disappear on pressure. The rash disappears rapidly with defervescence. At the commencement of the disease fever begins abruptly (after a few days' malaise) and is often high, reaching its acme in about three days, and remaining high till defervescence (in one or two weeks), which is either by crisis or rapid lysis. There is severe headache, and in some cases meningism, but recovery is very frequent and convalescence

rapid; relapses and serious sequelæ are almost unknown. During the progress of the malady there is a good deal of apathy and prostration. The chief objection that may be raised against regarding the disease as a new one is, of course, the fact that it largely depends on negative signs.

Broad Ligaments of the Uterus.—The advances in our knowledge of the broad ligaments of the uterus which have been made during the past few years are most conveniently described under ECTOPIC PREGNANCY, under PELVIS (*Diseases of Cellular Tissue and Peritoneum and Hæmatocele*), and under UTERUS (*Displacements and Inflammations*). The reader is referred to these articles. At the same time, there are one or two matters which may be alluded to here.

The parovarium must still remain among the embryonic relics to which no function has as yet been ascribed; it lies, as has been said, on the "dust heap of the useless relics" of the human body. Time will show whether it may not yet be rescued therefrom by some physiologist, and placed, like the suprarenal capsule, the thyroid gland, and the pituitary body, among the structures which profoundly influence the working of the whole system by the elaboration of an internal secretion or otherwise. In the meantime, its interest is a purely pathological one, and it is, owing to its tendency to form cystic growths, a dangerous, or at any rate a troublesome, relic.

Varicocele of the broad ligament (parovarian or tubo-ovarian varicocele) is a varicose condition of the veins of the mesosalpinx. Phleboliths in the broad ligament of the uterus may thus be produced. It is the homologue of varicocele in the male, but apparently occurs with much less frequency, perhaps because the ovarian veins follow a horizontal instead of a vertical course (Ashton, *Gynecology*, p. 549, 1905). It forms a mass in the broad ligament (usually the left), varying in size from a walnut to a hen's egg, and very often gives rise to no symptoms, although lancinating pains, obstinate menorrhagia, and recurrent abortion have been recorded. Pain and discomfort are relieved by the recumbent posture, but are made worse by any form of exercise. It is hardly ever diagnosed prior to operation (abdominal section), for its only physical sign is the presence of a soft compressible swelling in the region of the appendages (as detected by the recto-abdominal bimanual examination), which becomes smaller when the patient lies down. There is always danger of rupture of the enlarged veins, although, of course, pelvic hæmorrhage from this cause is much less frequent than from ectopic pregnancy. If tubo-ovarian varicocele exist apart from tubal and ovarian disease, each vein should be tied separately and then the whole mass removed without sacrificing the uterine annexa. Reed's operation (C. A. L. Reed, *Gynecology*, p. 685, 1904) consists in ligaturing the plexus of veins in sections and incising the veins between the ligatures. Of course if the tube or ovary be diseased the ordinary operation of salpingo-oophorectomy is performed. Camusset (*Thèse de Lyon*, 1908-9) gives a good account of this morbid state of the broad ligament, and Michel and Bichat's article (*Arch. gén. de méd.*, i. for 1903, p. 1419) may also be referred to.

Bromiase.—A combination of bromides with yeast (levurine), stated to be free from the inconvenience of producing bromism. For Report see *Lancet*, i. for 1910, p. 307.

Bromural.—A synthetic hypnotic (α-monobrom-isoval-erylurea), constituting a white crystalline substance, with a slightly bitter taste and nearly insoluble in cold water; it is claimed to act as a gentle sedative without harmful effects. For Report see *British Medical Journal*, i. for 1910, p. 388; *see also* DRUGS, RECENT.

Broncho-Oidiosis.—A form of bronchitis in which an oidium (*O. tropicale*) is present in the expectoration, of common occurrence in Ceylon; clinically it presents resemblances to pulmonary tuberculosis, but is to be distinguished by bacteriology. See Castellani, *British Medical Journal*, ii. for 1910, p. 868.

Bronzed Diabetes. *See* HÆMOCHROMATOSIS.

Buddised Milk. *See* INFANT FEEDING (*Methods*).

Budin's Method of Infant Feeding. *See* INFANT FEEDING (*Methods*).

Bugeaud's Wine.—A proprietary tonic wine, described as "Nutritive-Tonic Wine of Cinchona Bark and Cocoa;" for analysis see *British Medical Journal*, i. for 1909, p. 1308.

Bumm's Method. *See* SYMPHYSIOTOMY AND PUBIOTOMY.

Burns, X-Ray. *See* RONTGEN RAYS (*Dangers of*).

Buttermilk. *See* INFANT FEEDING (*Buttermilk*).

Buvo.—A proprietary preparation in tablet form, stated to contain beef extract combined with the antiscorbutic principles of vegetables. For Report see *Lancet*, i. for 1910, p. 36.

Bynin.—A proprietary malt extract, containing, according to analysis (*Brit. Med. Journ.*, ii. for 1909, p. 1478), 52·9 per cent. of total solids, 51·6 per cent. of reducing sugars calculated as maltose, 3·39 per cent. of protein, 3·1

per cent of dextrin, 0·9 per cent of ash, 8·3 per cent. of alcohol, and having a diastatic power represented by 38.

Cacodylates. *See* DRUGS, RECENT.

Cæsarean Section.

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DURING the past few years, since the beginning of the twentieth century, a tendency to extend the sphere of Cæsarean section has been evidently present, and, with this, there have been sundry alterations in the technique of the operation, some of which, at least, are likely to be permanently retained. Two obstacles remain, the effect of which is to check obstetricians who are desirious of performing the Cæsarean section still more frequently; I refer to the patient's (or her husband's) right of veto, and to the unsatisfactory results which have followed the carrying out of the operation late in labour after attempts have been made to deliver the patient in other ways.

INDICATIONS. — There has been a manifest tendency to increase the number of conditions which should be regarded as indications for the performance of Cæsarean section.

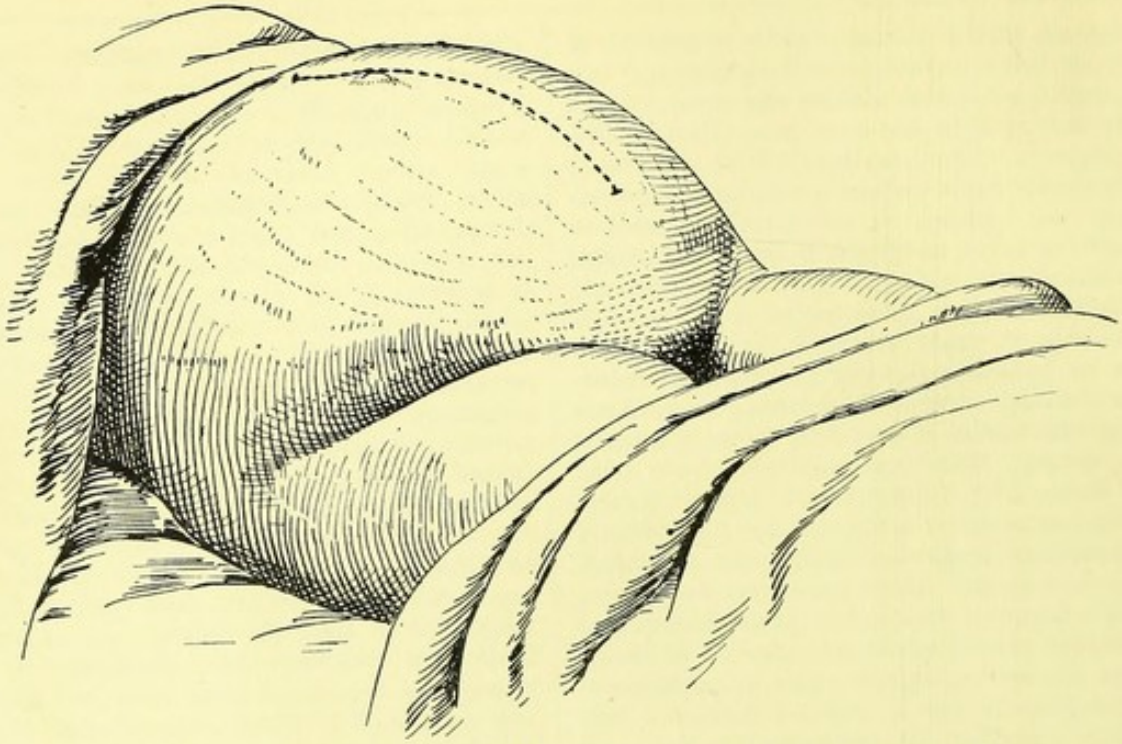
(1) *Placenta Prævia.*—Lawson Tait proposed Cæsarean section as a possible method of treatment in cases of placenta prævia, but at first no one was bold enough to adopt the suggestion. Reports of cases slowly began to appear; Bernays (*Journ. Amer. Med. Assoc.*, xxii. p. 687, 1894) recorded the first successful case in 1894, and in 1902 Zinke (*Amer. Gynæc. and Obstet. Journ.*, xix. p. 334, 1901) was able to refer to eight sections for placenta prævia in which five mothers and six infants were saved. In six of the eight cases the ordinary Cæsarean section was employed and in two Porro's modification. In 1902, Carbonelli (*Progresso Med.*, i. p. 158, 1902) reported three cases; Ehrenfest (*Amer. Med.*, iii. p. 64, 1902), on the other hand, regarded the operation as an improper one in placenta prævia. The operation was thought by its supporters to be specially appropriate in a primipara, with a closed os, with the central variety of placenta prævia, in whom the hæmorrhage was profuse and could not be controlled with tampons. If the Porro operation were performed, an additional advantage was gained in the removal of an organ which might very easily have become septic. Since 1902 there has been little progress in the establishment of placenta prævia as a legitimate indication for Cæsarean section. In 1907 Jardine of Glasgow (*Journ. Obstet. and Gynæc. Brit. Emp.*, xiv. p. 399, 1908) performed the ordinary Cæsarean operation successfully in a case of twins with placenta prævia, but the indication was a contracted pelvis and not placenta prævia; and the writer stated that he would never feel justified in doing this operation in an ordinary case. Zweifel (*Münch. med. Wochenschr.*, liv. p. 2361, 1907) is also opposed to this method of treatment. Munro Kerr (*Operative Midwifery*, p. 594, 1908), however, thinks that in certain exceptional cases of placenta prævia it might be justifiable to perform Cæsarean section; he refers to "old primiparæ, where the hæmorrhage occurs at full time and before labour has started, and where, to judge by the condition of the parturient canal and the size of the child, delivery would be tedious and difficult." Sellheim (*Gynaek. Rundschau*, iii. p. 61, 1909) proposes, not the ordinary Cæsarean section, but the extra-peritoneal incision of the uterus (suprasymphysary hysterotomy), in order to reduce the mortality (maternal and fœtal) in placenta prævia. If, however, we strive to form a fair estimate of the present position of this suggested indication, it must be owned that its supporters have not established a strong claim. In the course of a discussion on Cæsarean section in placenta prævia before the American Gynecological Society last April (*Amer. Journ. Obstet.*, lix. pp. 937-961, 1909) H. D. Fry stated that forty-three cases had been operated on, with a maternal mortality of 16·3 per cent., and that in the thirteen reported since 1905 the death-rate had fallen to 7·7 per cent. Some of the speakers thought there was a limited field of usefulness for the operation. Recently, *vaginal* Cæsarean section has been performed several times for placenta prævia (by Dührssen, Caturani, Weisbein, and Büttner); but this is quite a different matter, although it may be said that it has met with even less approval.

(2) *Accidental Hæmorrhage.*—For accidental hæmorrhage when the bleeding is concealed, the os closed, and the uterus inert, it would seem that Cæsarean section, or rather the supravaginal form of hysterectomy, might fairly be considered. Munro Kerr (*op. cit.*, p. 606) treated two cases in this way, but both proved fatal. Targett (*Journ. Obstet. and Gynæc. Brit. Emp.*, vii. p. 344, 1905), however, had a successful case at the sixth month of pregnancy; but the patient's recovery was greatly delayed by parametritis and thrombosis, and the writer states that on reflection he thinks this would have been a suitable case for the *vaginal* rather than the abdominal operation. W. Rühl (*Zentralb. f. Gynäk.*, xxv. p. 1283, 1901) and Bumm (*ibid.*, xxvi. p. 1417, 1902) and others have accordingly performed vaginal Cæsarean section for this form of ante-

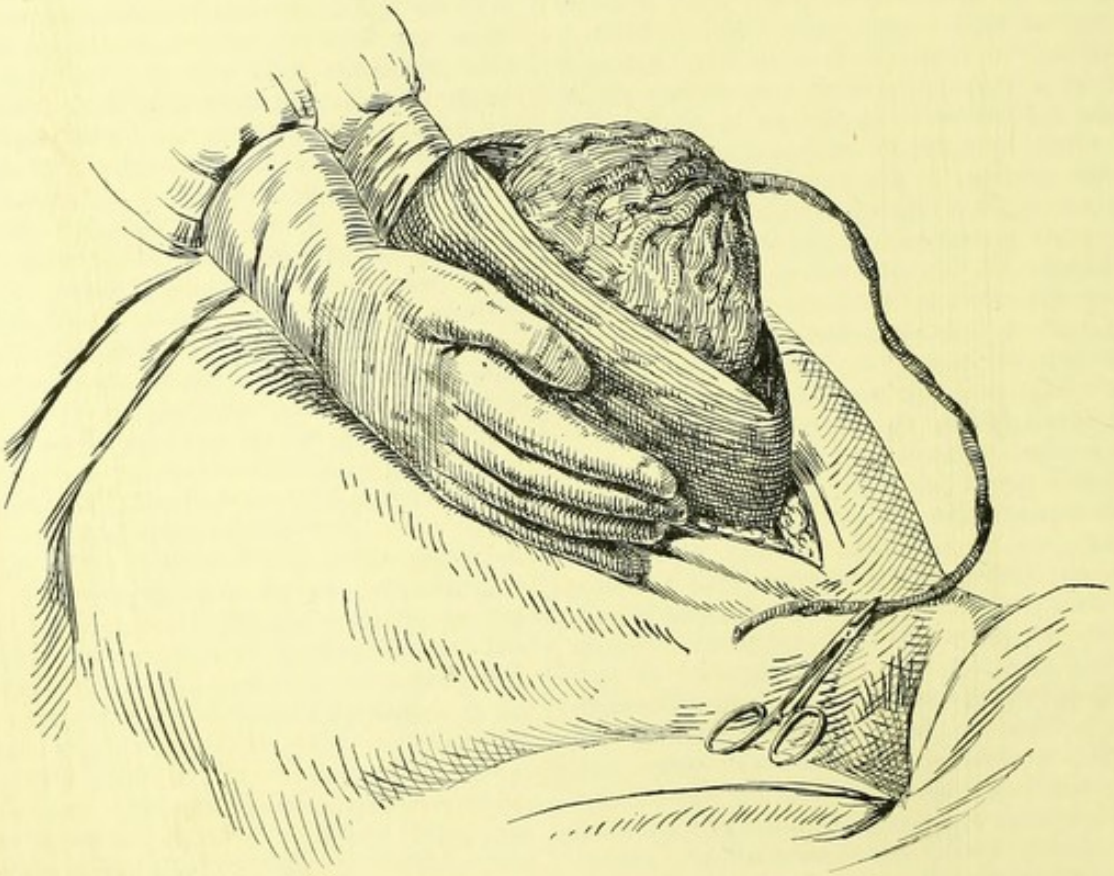
partum hæmorrhage; the mother's in Rühl's and Bumm's cases recovered. F. Montuoro (*Il Taglio Cesareo ed il Parto Forzato* (Genova), p. 190, 1904), thinks that the Bossi dilator gives better results in such cases than Cæsarean section, abdominal or vaginal. It is not very easy to forecast the future in regard to this indication for Cæsarean section; for accidental hæmorrhage may be so serious a complication of pregnancy and labour as to justify extreme measures. There is, however, an evident reluctance among obstetricians to perform the conservative abdominal operation in these rare cases, and a tendency to remove the uterus (supravaginal hysterectomy) or to have recourse to vaginal Cæsarean section (anterior hysterotomy).

(3) *Eclampsia.*—It has been stated elsewhere (*see* ECLAMPSIA) that whilst vaginal Cæsarean section has been widely adopted in the treatment of eclampsia, the ordinary abdominal operation has been little used, and has generally had unfortunate results. Montuoro (*op. cit.*, pp. 106-109), writing in the year 1904, was able, however, to give a list of sixty-two cases, in most of which the conservative Cæsarean section was performed (the Porro method was used in four cases), with a maternal mortality of thirty-five (56 per cent.), an immediate fœtal mortality of 27·5 per cent. and a later one of 36·3 per cent. Obviously this is a very high mortality, and it can hardly be fully explained by the statement that only the most serious cases of eclampsia are submitted to Cæsarean section. Notwithstanding the large number of deaths that have occurred, "there is now," writes Munro Kerr (*Operative Midwifery*, p. 404, 1908), "a general consensus of opinion that in certain cases—they are, of course, few in number—Cæsarean section is not only permissible, but is actually the treatment indicated;" further, the cases are those in which "the eclamptic seizures are of great severity and frequency in the later weeks of pregnancy, and, above all, when the cervix is not taken up and is very rigid and undilatable."

(4) *Contracted Pelvis.*—Pelvic deformity is, of course, no new indication for the performance of Cæsarean section; the novelty consists in the extension of the range of applicability of the operation. It is now generally admitted that a true conjugate of less than $2\frac{1}{4}$ inches is an absolute indication for Cæsarean section; but what of the pelvis with a conjugata vera of $2\frac{1}{4}$, $2\frac{1}{2}$, or more? Two somewhat opposed tendencies are in existence at the present time, and their opposition makes it difficult to answer the above question definitely and directly. In the first place, there is the assertion which is constantly being made that craniotomy or embryulcia in the case of the living fœtus is unjustifiable, and the conclusion would appear to be that in all the cases in which craniotomy was formerly performed, and in which the fœtus is alive, Cæsarean section should be substituted. Theoretically, and from the high ethical standpoint, this is the only conclusion to which one can come; to save a mother from certain death it may be justifiable to destroy her unborn infant, but to do it simply in order to diminish the risk of delivery when the risk is not more than, say, 8 or 10 per cent., is indefensible. On the other hand, however, there is a tendency which is becoming more accentuated to refuse the Cæsarean section to women who come under treatment when advanced in labour and having been previously interfered with. Munro Kerr (*op. cit.*, p. 404, 1908) writes: "In recent years I have made it a rule never to perform Cæsarean section in cases which have been interfered with prior to their coming under the care of myself or my assistants, unless the deformity of the pelvis is so extreme as to render craniotomy impossible, or more dangerous to the mother than Cæsarean section; I am compelled, therefore, not infrequently to perforate a living child." Further, there is the difficulty of obtaining the consent of the patient or her husband to the performance of Cæsarean section, while the facility with which one is permitted to do craniotomy is notorious. About this matter Galabin says (*Brit. Med. Journ.*, ii. for 1902, p. 1125): "A doctor may refuse to perform repeated inductions of abortion for contracted pelvis, and he may decline to attend a labour if the patient is unwilling to follow his advice; but having engaged to attend, and labour having begun, may he refuse to perform embryotomy, if he thinks Cæsarean section the right treatment, and throw up the case if the patient refuses to accept his advice? I should say certainly not, unless he is sure that the patient can obtain other assistance, and I should not myself approve such a course in any case." Now, if one places these opinions fairly before one's mind, the conclusion would seem to be that it is not possible at once to make a clean sweep of craniotomy upon the living fœtus, but that it is desirable that its performance should be strictly limited, and that it be gradually replaced by Cæsarean section or by the induction of premature labour (in a subsequent pregnancy). In order that this change in practice may be brought about, the obstetric specialist must still further reduce the mortality following Cæsarean section; and, in order that he may play his part, the general practitioner must make an early diagnosis of disproportion between the fœtal head and the maternal pelvis in his confinement cases, must refrain from interference with forceps and other attempts at delivery, and must indeed send his patient to the specialist, or bring the latter to her, before the commencement of the second stage of labour. Obviously the diagnosis during pregnancy of so



Abdominal incision for abdominal Cæsarean operation, one-third above and two-thirds below umbilicus.



Expression of the placenta after removal of fœtus.

marked a pelvic deformity as will make the passage of a full-time living child through the pelvis impossible is of the highest importance; and it may well be that the first step in the abolition of embryulcia in labour will be the routine performance of pelvimetry in pregnancy. If the impending presence of disproportion between the maternal pelvis and the fœtal head be discovered about the sixth or seventh month of pregnancy, the medical practitioner will be able to place before his patient and her friends the alternatives of induction of premature labour or of Cæsarean section at the full term. In this way he will have leisure calmly to consult his patient's best interests and those of her child, and in this way it is likely that the performance of Cæsarean section may be more often chosen for the cases of pelvic contraction in which the conjugata vera measures from $2\frac{3}{4}$ to $3\frac{1}{2}$ inches. Of course other matters must also be considered, such as the type of pelvis, for, given two pelves with equal conjugates, one a simple or rachitic flat and the other a generally contracted, Cæsarean section will be more likely to be needed in the latter than in the former (see Jardine, *Brit. Med. Journ.*, ii. for 1908, p. 800). In the midst of all the discussion which is going on at present about the widening of the indications for the performance of Cæsarean section in cases of moderate pelvic contraction, one must keep constantly in view that an improvement in the results of the induction of premature labour so far as the infants are concerned would at once alter all our views, and force even the continental obstetricians, who are so insistent upon Cæsarean section, to reconsider their position. It must not be forgotten that it is solely the high infantile mortality that prevents induction of premature labour being the operation of choice in many of the cases in which Cæsarean section is being so vehemently urged. It may here be added that it has been established to the point of demonstration that Cæsarean section may safely be performed several times on the same patient, and Fruhinsholz (*Ann. de gynéc. et d'obstét.*, xxxiii. p. 135, 1906) and Sinclair (*Journ. Obstet. and Gynæc. Brit. Emp.*, xii. p. 337, 1907) have shown that, even when utero-parietal adhesions exist, their presence will not contra-indicate the repeated performance of section, although difficulties will thus be introduced. There have, of course, been cases of rupture of the cicatrix in subsequent pregnancies, as in Convelaire's case, in which the gestation was complicated by hydramnios (*Ann. de gynéc. et d'obstét.*, xxxiii. p. 148, 1906); but these have been surprisingly infrequent (only eight between 1896 and 1905 according to Convelaire). During the past few years a great many contributions to the subject of the extension of Cæsarean section in moderate degrees of pelvic contraction have been made, and in addition to the references already given the reader may consult the following:—Pfannenstiel (*Med. Bl.* (Wien), xxix. p. 613, 1906); Bauer (*Monatsschr. f. Geburtsh. u. Gynäk*, xxiv. p. 713, 1906); Davis (*Surg. Gynec. and Obstet.*, iii. p. 593, 1906); Kholmogoroff (*Russk. Vrach*, v. p. 1372, 1906); Everke (*Verhandl. d. deutsch. Gesellsch. f. Gynäk.*, p. 546, 1906); Wallace (*Practitioner*, lxxviii. p. 337, 1907); Leopold (*Arch. f. Gynaek.*, lxxxi. p. 702, 1907); Seiffart (*Zentralb. f. Gynäk.*, xxxi. p. 956, 1907); Calderini (*Ginecologia*, iv. p. 261, 1907); Kynoch (*Edin. Med. Journ.*, N. S. xxii. p. 221, 1907); Canton (*Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 542, 1907); Reynolds (*Boston Med. and Surg. Journ.*, clvii. p. 581, 1907); Reid (*New York State Journ. Med.*, viii. p. 3, 1908); Gushee (*Bull. Lying-in Hosp.* (New York), iv. p. 91, 1907); Halpenny (*Amer. Journ. Obstet.*, lvii. p. 713, 1908); Reynolds (*Amer. Journ. Obstet.*, lviii. p. 231, 1908); Hirst (*ibid.*, p. 128); Smith (*Surg. Gynec. and Obstet.*, vii. p. 25, 1908); M'Pherson (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908); Frederick (*Amer. Journ. Obstet.*, lviii. p. 847, 1908); Küstner (*Zeitschr. f. Geburtsh. u. Gynäk*, lxiii. p. 407, 1908); Allen (*Amer. Journ. Obstet.*, lix. p. 189, 1909).

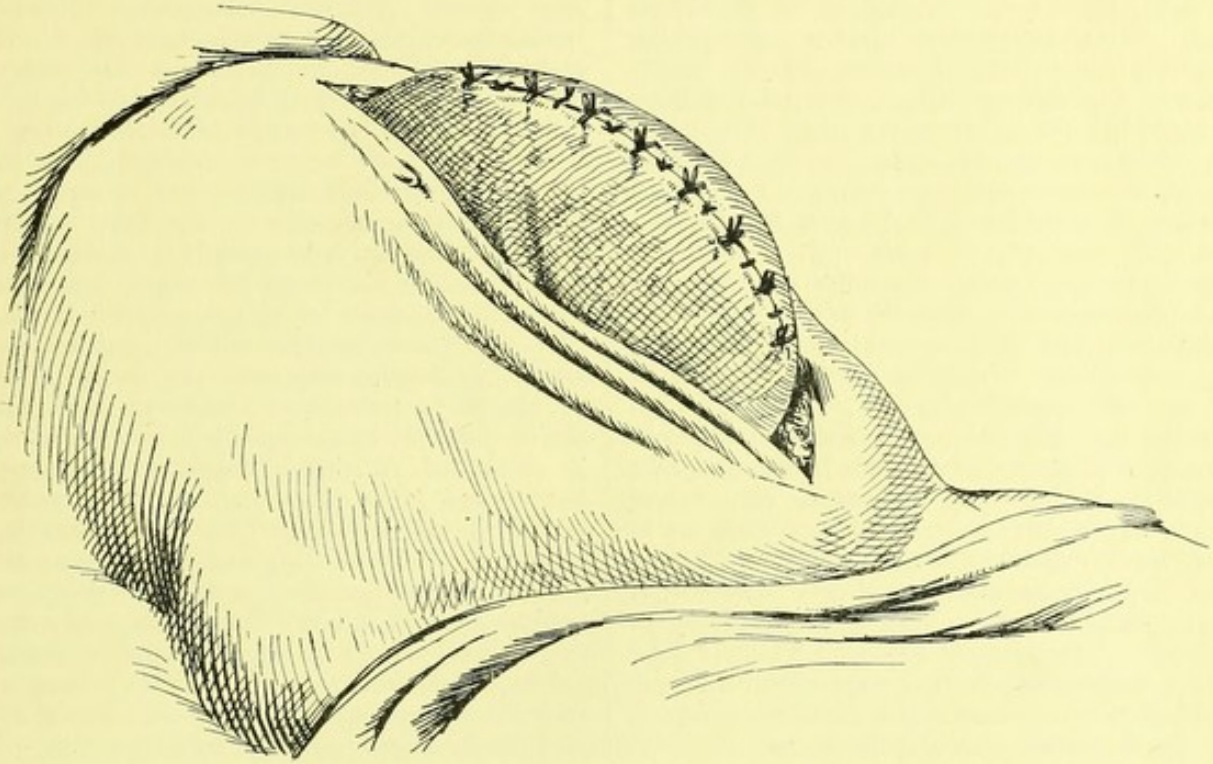
METHODS.—At the present time four methods of performing Cæsarean section (excluding the so-called vaginal Cæsarean section) are in use; these are as follow:—

1. There is first what may be called the *old Porro operation*. At one time this method enabled the operator to obtain much better results than had previously been obtained; but it is now abandoned by nearly everyone, and is carried out only in septic cases. The uterus was opened either before or after it was turned out of the abdomen; the child was removed; the uterus was amputated supravaginally, an elastic ligature having been tied round the upper part of the cervix to control the hæmorrhage; the ovaries and tubes were removed with the uterus; the uterine stump was then fastened into the lower end of the abdominal incision, at first by means of one or two long straight needles fixed at right angles, and later, as the technique was perfected, by stitching the peritoneal covering of the stump to the peritoneum of the abdominal wall; the rest of the abdominal wound was closed; and in time the stump, with the ligature round it, sloughed off, leaving a depressed wound, which slowly healed by granulation. This extra-peritoneal method gave better results than the ordinary unimproved conservative Cæsarean section, but it was far from perfect; there was often trouble with the stump, and of maternal deaths there were not a few.

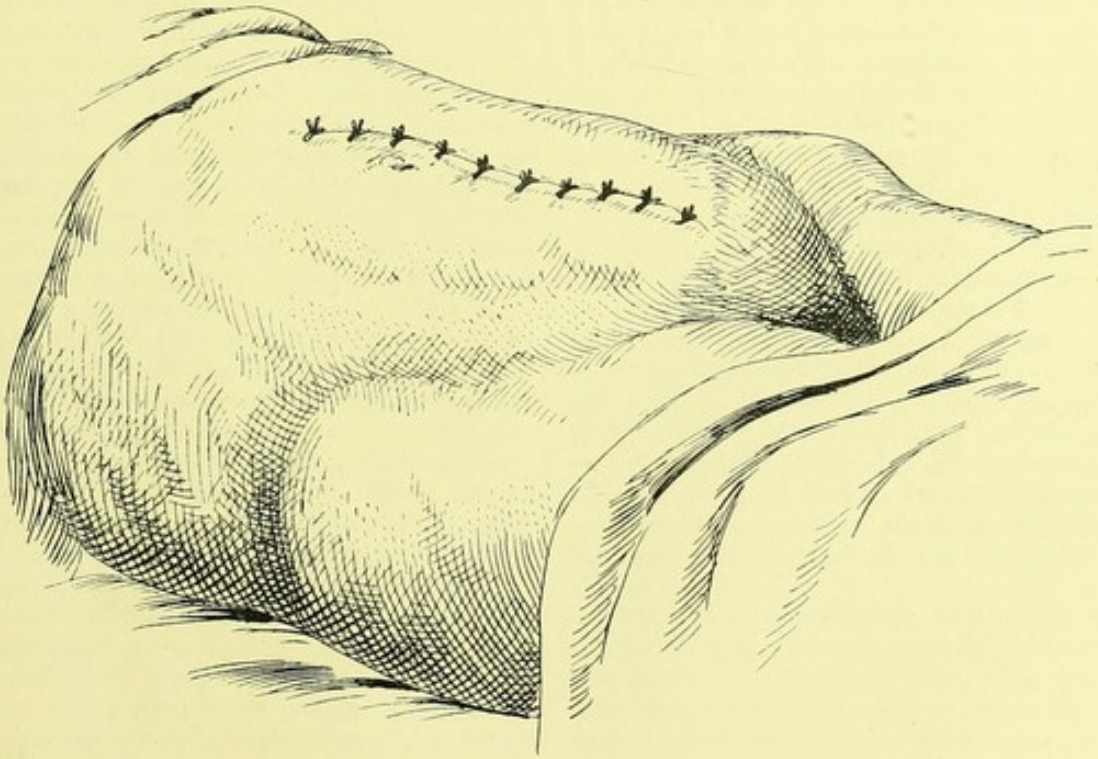
2. What has been called the *new* or *modified Porro operation* is practically a supravaginal hysterectomy, such as is commonly carried out in cases of fibroid tumour, with retro-peritoneal or sub-peritoneal treatment of the stump. The infant is extracted from the uterus; then, the patient having been placed in the Trendelen-

burg position (although this is not always necessary), the empty organ is brought out of the abdomen, and hæmorrhage from the incision in it checked by a long clamp or by swabs. First on one side, and then on the other, the round ligaments and the ovarian vessels in the upper part of the broad ligaments are ligatured. Munro Kerr (whose description is here in the main followed, *Operative Midwifery*, p. 419) applies a second ligature to the ovarian vessels for safety, and clamps the broad ligaments close to the uterus as well. The ligatures are, of course, placed internal to the ovaries, if it has been decided to leave these glands. The broad ligaments are then divided between the ligatures and the clamps, and the securing of the uterine vessels is proceeded with. These vessels can be felt well down in the wound, and should be tied near the cervix, so as to avoid wounding or including the ureters. A good plan is to divide transversely the peritoneum covering the anterior surface of the uterus, raise the lower part of it with the bladder and push it well forward, and divide also the peritoneum on the posterior surface of the uterus; this procedure, by opening up the lower part of the broad ligaments, enables the operator to see the uterine vessels, which can then be ligatured with greater certainty and safety. Having tied these vessels and any others of sufficient size the operator can now cut across the uterus in its upper cervical portion. If the stump thus produced be very wide, a wedge-shaped portion (including the mucosa of the cervical canal) can be cut out of its centre; the anterior and posterior parts of the stump are then stitched together (with catgut), the peritoneum brought over the whole with a layer of sutures, and the opened-up parts of the broad ligaments closed in with a few stitches, so as to prevent the exposure of any raw surfaces. The stump is now allowed to fall back into the pelvis, the abdominal cavity is cleansed, and the abdominal wound is closed (preferably in layers, if there be sufficient time). Occasionally, as in cases of cancer of the cervix or of septic infection of the uterus, the whole organ is removed by panhysterectomy. Instead of amputating the uterus supravaginally after the uterine arteries are tied, the vaginal canal is opened into through the pouch of Douglas posteriorly, whilst in front the bladder is pushed forwards from off the cervix, and the anterior fornix vaginæ opened into; then the tissues still attaching the uterus at the sides are clamped, and the whole organ is cut away; any vessels that bleed are secured, and the anterior and posterior vaginal walls are stitched together, the pelvic peritoneum being brought over the line of sutures and fixed in position, so restoring the integrity of the peritoneal cavity. Both these forms of Cæsarean section (supravaginal and panhysterectomy) are especially useful when there is a risk that septic infection of the uterus has already taken place, or when the organ is diseased in some other way, or is the seat of a fibroid or a malignant growth. In both it will be well to leave one or both ovaries, so that the patient may not lose the ovarian secretions.

3. The third method is known as the *conservative Cæsarean section* as modified by Sänger, Murdoch Cameron, and others. It is the operation which is commonly performed at the present day, and it is undoubtedly the operation of election in the cases which are seen early, either during the last days of pregnancy or in the first stage of labour, and in which the chances of septic infection are few. In it the abdomen is opened, and then the uterus, the child, and placenta are extracted; the uterus is closed by means of sutures, and the operation is brought to an end by the suturing of the abdominal incision. The technique is well known, has been fully described in the *Encyclopedia and Dictionary* (v. pp. 299-305), and need not, therefore, be described here; but certain details have recently been made the subject of discussion and require to be referred to. There is, first, the question of the position and direction of the *uterine incision*. The usual incision is in the anterior wall of the uterus and runs longitudinally, but several others have been recommended and practised. Thus a posterior longitudinal one has been advocated; so has a posterior longitudinal one low down, with an opening for drainage into the vaginal canal; so has a transverse incision low down anteriorly; so has a fundal incision running in a sagittal direction; and, finally, so has the most discussed of them all, the transverse fundal incision of Fritsch. H. Fritsch made his suggestion fourteen years ago (*Centralb. f. Gynäk.*, xxi. p. 561, 1897), and described a case in which he practised it; G. Braun (*ibid.*, p. 1351) soon thereafter described another; and then for some five or six years (till 1902 or 1903) an animated discussion on the comparative merits of the longitudinal anterior and of the transverse fundal incision took place, as a glance through the annual volumes of the *Centralblatt für Gynäkologie* abundantly shows. In 1902 it began to be possible to form a calm judgment upon the question at issue, some of the initial excitement having died down; and Munro Kerr (*Brit. Med. Journ.*, ii. for 1902, p. 1129) made a well-reasoned contribution to the subject in an article, in which he referred to six cases in which he had practised the fundal incision. He took up in turn the five advantages which Fritsch had claimed for his incision—these were, less risk of subsequent hernia on account of the higher position of the abdominal wound, the fact that the abdominal cavity could be kept cleaner, less amount of bleeding, con-



Deep and superficial sutures in the anterior wall of uterus.



Closure of the abdominal incision.

traction of the uterine incision, and greater ease in the extraction of the child—and showed that only one of them (the last) was really of much importance. Further, Munro Kerr pointed out that against this single advantage (greater ease in extracting the infant) had to be placed the tendency there was for the uterus to become attached higher up to the abdominal wall and to remain larger. On the whole, he was prepared to state that the best incision for ordinary cases was an anterior longitudinal one made *high up* in the uterus; but the transverse fundal cut might be found useful in cases in which the uterus was to be removed. There is a second detail in the performance of Cæsarean section which has been the subject of controversy, viz. coincident *sterilisation of the patient.* The question which has arisen is this: If the uterus is left, ought means to be taken to prevent a subsequent pregnancy, and if so, what is the best method of procedure? It has been urged by many that sterilisation should accompany Cæsarean section, because of the danger of rupture of the uterus in a subsequent pregnancy, and because of the increasing risk of repeated sections; on the other hand, it has been stated that if the uterine wound be carefully sutured there is little danger of rupture (and certainly not many cases of rupture have been reported), and that the repeated operation is, as a matter of fact, less dangerous than the primary one, because of the presence of adhesions between the uterus and the anterior abdominal wall, which shut off the peritoneal cavity and enable the obstetrician to carry out the operation extra-peritoneally (Sir Wm. Sinclair, *Journ. Obstet. and Gynæc. Brit. Emp.*, xii. p. 335, 1907). So far, however, as the surgical question is concerned, it must be admitted that the arguments in favour of sterilisation are the stronger ones, for it cannot be maintained that subsequent pregnancies and Cæsarean sections are as safe as subsequent sterility. The ethical question is a much more open one. Some have said that the right plan is not to sterilise but to tell the patient and her husband the possible results of a subsequent pregnancy and a repeated Cæsarean section, and so to shift the responsibility on to their shoulders (Green, *Amer. Journ. Obstet.*, xlvii. p. 773, 1903); others have recommended sterilisation in pauper patients, but not in those of the better class until the operation has been twice performed (Whitridge Williams, *ibid.*); and yet others have taken the high ground that the obstetrician's duty is to deliver his patient as safely as he can and leave her organs in as natural a condition as possible, repeating the operation of Cæsarean section when called upon to do so (Spencer, *Trans. Obstet. Soc. Lond.*, xlvi. for 1904, p. 334). Sir Wm. Sinclair (*Journ. Obstet. and Gynæc. Brit. Emp.*, xii. p. 342, 1907) is of the same opinion. Galabin (*Brit. Med. Journ.*, ii. for 1902, p. 1124) says, "I think it right to leave to the patient the decision as to whether she should be sterilised for the future; considering that, if a woman is so formed by Nature, that she cannot bear a child spontaneously, she is entitled to be relieved from the perils of artificial delivery." The question of sterilisation is obviously a very difficult one, especially from the ethical side; but on the whole, the progress of events and the trend of opinion would seem to be in the direction of carrying it out in as few cases as possible. The next question has reference to the best method of sterilising, if the procedure be determined on. There are three plans—removal of the ovaries, supravaginal amputation of the uterus, and resection of the Fallopian tubes. Save in the case of osteomalacia (where there is evidence that removal of the ovaries checks the progress of the bone disease) the first of these procedures is not usually followed; the value of the ovarian secretion in the general economy of the body is now too well known and appreciated for it to be lightly dispensed with, and there are, as well, risks of ligatures slipping, etc., which are peculiar to the operation of oophorectomy when conjoined with Cæsarean section. Supravaginal hysterectomy is, of course, a certain method of sterilising the patient, and has the advantage of preserving the ovaries; but it presupposes a greater amount of operative experience than is usually possessed by anyone save a specialist in obstetrics, and it may turn out that the uterus, like the ovaries, has an internal secretion which is of value in the regulation of the metabolism of the female bodily economy. Further, it is not, of course, available in cases of Cæsarean section. The third method of sterilising the patient, viz. by resection of the tubes, is the most suitable in the great majority of cases of the conservative operation; it consists in ligaturing the Fallopian tubes in two places, and removing the portion of the tube between the ligatures; since it has been known to fail (pregnancy again occurring), it may be well to bring the peritoneum over the openings in the tubes. Munro Kerr (*Operative Midwifery*, p. 425, 1908) points out that this method has an advantage which the other two lack—it may be undone again by operation, if, for any reason, the patient desire to conceive; the abdomen can be opened and the ends of the tubes reunited.

What may be regarded as a fourth method of performing Cæsarean section is the *supra-symphysary extra-peritoneal* plan, or *extra-peritoneal abdominal hysterotomy.* It has also been called *cervical Cæsarean section*, a name which, although correct enough anatomically, is apt to lead to confusion, suggesting, as it does, the vaginal Cæsarean section. *Sectio Cæsarea abdominalis inferior*, but for its unwieldiness, would be a satisfactory appellation. This new method

was introduced by Frank in 1907 (*Arch. f. Gynaek.*, lxxxi. p. 46, 1907), and modified by Sellheim and others in 1908 (*Zentralb. f. Gynäk.*, xxxii. p. 133, 1908). The anterior abdominal wall is cut through by means of a transverse incision (down to the peritoneum) a few centimetres above the symphysis pubis (the patient being in the Trendelenburg position); the peritoneum is then separated from the posterior surface of the bladder and from the anterior surface of the lower uterine segment, and fixed to the parietal peritoneum in the upper margin of the incision; in this way the lower part of the uterus is laid bare, and yet the peritoneal sac is kept closed; a transverse cut is then made into the uterine cavity, and the child and placenta are extracted through it; and, finally, the uterine incision is closed with sutures, the parts restored to their normal relationships, and the abdominal wound closed. A plug of iodoform gauze may be used for drainage. The advantages claimed for this method are that it is done extra-peritoneally, that hæmorrhage is slight, that there is no trouble with the intestines, that the risk of infection of the peritoneal cavity from below is much lessened, that there is an opportunity for the expulsion of the child and placenta by the natural efforts, that the chances of ventral hernia are lessened, and that the patient can rise earlier. Frank reported thirteen cases thus operated on, and in all of them the mother recovered. Sellheim (*Zentralb. f. Gynäk.*, xxxii. pp. 133, 319, 1908) soon afterwards described five cases in which he operated extra-peritoneally, but with some alterations in the technique: he made a transverse concave incision (Pfannenstiel), but only carried it down through the skin and subcutaneous tissue to the fascia; then he split the fascia to the width of the skin incision; then the recti muscles were separated from each other and the peritoneum stripped of their inner surfaces, as also from the surface of the bladder (which had been distended with water so as to carry upwards the reflection of peritoneum). The cervix uteri was then opened into in the middle line by means of a longitudinal incision (not by a transverse one, as practised by Frank), the child and placenta were extracted, and the incision closed in the usual way. One of Sellheim's five cases died. Fromme, in Veit's Clinique (*Zentralb. f. Gynäk.*, xxxii. pp. 301, 545, 1908; *Berl. klin. Wochenschr.*, xlv. p. 147, 1908), also preferred the longitudinal incision, and reported seven cases; he, however, divided the uterine peritoneum longitudinally and stitched it together again later, and thus avoided the lifting up of the bladder; in fact Veit's later method differed markedly from Frank's. Other modifications were introduced by Baumm (*Zentralb. f. Gynäk.*, xxxii. p. 451, 1908), Czyzewicz (*ibid.*, p. 817), Döderlein (*ibid.*, xxxiii., p. 121, 1909), and Freund (*ibid.*, p. 560, 1909). There had been all along a tendency to divide the peritoneum temporarily, making the operation a trans-peritoneal (rather than a truly extra-peritoneal) one, but Döderlein and Freund endeavoured to ensure an entirely extra-peritoneal approach by entering from the side. It is probable that other modifications will yet be introduced, for, at present, the operation is rather difficult. Sellheim's latest modification, delivery through a *utero-abdominal fistula*, is a long and complicated operation, involving a great deal of preliminary suturing of parietal peritoneum to skin and of uterine peritoneum to parietal peritoneum before the uterus is opened into. It will not replace the ordinary conservative operation for uninfected cases, but it is very likely to prove of value in the perplexing class in which efforts have already been made to deliver, in which the child is still alive, and in which the obstetrician hesitates to employ the ordinary Cæsarean section on account of the risk of giving the infection access to the peritoneum. It may also be found useful in cases of threatening rupture of the uterus and in blocking of the pelvis by neoplasms of the internal generative organs. There is already a large literature on the subject of *sectio Cæsarea abdominalis inferior*, and the following articles may be named as worthy of consultation:—Pfannenstiel (*Zentralb. f. Gynäk.*, xxxii. p. 313, 1908); Baumm (*ibid.*, p. 451); Küstner (*ibid.*, p. 505); Spaeth (*ibid.*, p. 654); Hofmeier (*ibid.*, p. 937); Luchsinger (*ibid.*, p. 1081); Wiemer (*ibid.*, p. 1276); Hammerschlag (*ibid.*, p. 1600); Kahn (*ibid.*, p. 1604); Jahreiss (*ibid.*, xxxiii. p. 249, 1909); Latzko (*ibid.*, p. 275); Dobbert (*ibid.*, p. 379); Freund (*ibid.*, p. 560); Fuchs (*ibid.*, p. 730); Nürnberger (*ibid.*, p. 899); Fraipoint (*Scalpel* (Liége), lxi. p. 29, 1908-9); Sellheim (*Ann. de gynéc. et d'obstét.*, 2 s. v. p. 424, 1908); Blumreich (*Berl. klin. Wochenschr.*, xlv. p. 1483, 1908); Pfannenstiel (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908; *Deutsche med. Wochenschr.*, xxxiv. p. 1718, 1908); Zweifel (*Brit. Med. Journ.*, ii. for 1908, p. 801); Von Franqué (*Zeitschr. f. Geburtsh. u. Gynäk.*, lxiii. p. 37, 1908-9); Sellheim (*München. med. Wochenschr.*, lv. p. 2207, 1908); Nijhoff (*Nederl. Tijdschr. v. Geneesk.*, ii. for 1908, p. 1864); Klein (*Strassb. med. Ztg.*, v. p. 263, 1908); Franz (*Prakt. Ergeb. d. Geburtsh. u. Gynäk.*, i. p. 48, 1909); and Jung (*München. med. Wochenschr.*, lvi. p. 841, 1909). Ballantyne has summarised the literature in the *Edinburgh Medical Journal* for September 1909.

Conclusions.—It is difficult to forecast the position which Cæsarean section in its various forms is likely to occupy in the immediate future. At present there is undoubtedly a very strong tendency to extend its employment to a wide range of cases, and, if the trans-

peritoneal or extra-peritoneal method can be simplified, this range will be made still wider. For the obstetrician will then be able to include within the scope of his operating-knife infected cases and cases in which other plans of procedure have been unsuccessfully tried. Cases, also, in which rupture of the uterus is threatening may be treated more hopefully by a method which aims at reaching the lower uterine segment extra-peritoneally. Already, however, some voices are being raised in protest, at least in deprecation of the widespread practice of Cæsarean section in Germany; and Pfannenstiel (*Journ. Amer. Med. Assoc.*, li. p. 734, 1908) asks whether it is right that all these operative procedures on the mother should be carried out merely to save a child already in danger from infected liquor amnii. "I believe," Pfannenstiel says, "that our modern attempts to save the child's life shoot beyond the mark." But this cannot be the last word in obstetrics, and with a simplification of the Frank-Sellheim operation we may hope to see babies, which are now perforated, saved alive, and their mothers' risks of recovery little if anything increased thereby.

Caisson Disease.—In certain occupations the workers are necessarily exposed to compressed air, and, in consequence, they not infrequently suffer from symptoms which range from trivial joint pains to rapidly fatal cyanosis and coma. These are directly due to the effects of high atmospheric pressure. The disease was formerly known as "Diver's paralysis," but, since the use of compressed-air chambers—"caissons"—has become general in subaqueous engineering, it is now generally called "Caisson Disease." A caisson is essentially a diving bell. Its lower end is open and rests on the sea- or river-bed; in its ceiling there is a sliding-door connected with an air-lock, through which the excavated material is removed, and at one side there is a second air-lock through which the workers enter and leave. Water is prevented from entering the caisson by air pumped into it from above; the surplus air escapes round its lower edge, so that ventilation is secured. When the necessary depth is reached the caisson is filled with cement and becomes the foundation for a pier or similar superstructure.

Symptoms.—The characteristic symptoms of caisson disease appear after the worker has left the compressed-air chamber; they are produced by decompression. On entering a compressed-air chamber for the first time some unpleasant symptoms may arise. These are oppression and quickening of the heart-beat, and more especially pain in the ear from the drum being driven inwards. The membrane may rupture and hæmorrhage take place in the middle ear. Greenwood and Hill, however, who subjected themselves to pressure up to 92 lbs., found that no real sense of pressure was experienced. The only sensations they experienced were a change in the timbre of the voice, and a feeling of anæsthesia about the lips leading to inability to whistle.

While working in compressed air the men as a rule suffer no discomfort. Cases of illness occurring actually in the caisson are due to impurity of the air from imperfect supply, or because strata containing CO_2 or H_2S are being pierced. Snell brought forward the theory that caisson disease was more likely to arise during the stage of decompression if the air in the caisson was foul. During the construction of Blackwall Tunnel he found that when the air supplied was 4000 cubic feet per man there were 28 cases of caisson disease in 100 days, but when 12,000 cubic feet were supplied the number of cases fell to zero. Recent work, however, has failed to substantiate Snell's theory.

The symptoms may begin during decompression, but are more frequently delayed for some little time. Muscular pains, known as "bends" or "screws" are the most common; paresis of the legs with retention of the urine, abdominal pain, nausea and vomiting, giddiness, epistaxis, nervousness, and excitement may also occur. Paralysis generally passes off in the course of a few days; it is sometimes permanent, with signs of myelitis. A rapidly fatal case, quoted by Greenwood, runs as follows:—The patient was a diver who had remained at a depth of 24½ fathoms (between 4 and 5 atmospheres) for 40 minutes, and had ascended in half that time. He had no inconvenience during his sojourn in the water, nor for 8 or 9 minutes thereafter, when he suddenly complained of pain in the stomach and then collapsed. He immediately became cyanosed, his breathing was stertorous, and his lips covered with foam. He died within 15 minutes of leaving the water. On post-mortem examination the brain was engorged; many air-bubbles were present in the veins of Galen and in the choroid plexus and superficial cerebral vessels. The veins of the surface of the heart were beaded with air, while the organ felt like a bladder half full of water, and gurgled loudly when pressed upon. On incising the right ventricle air escaped with a puff. The mesenteric vessels were likewise filled with air, and the liver frothed on section.

Physiology and Pathology of Caisson Disease.—The effects of exposure to compressed air were first correctly interpreted by Paul Bert, and have recently been greatly elucidated by the researches of Leonard Hill, Haldane, Greenwood, and Boycott. Bert proved that—(1) increased pressure up to 7 or 8 atmospheres does not produce injurious

symptoms; (2) accidents during decompression are due to the liberation of bubbles of nitrogen from the blood and tissue juices, leading to air-embolism; (3) these effects can be prevented by slow decompression.

One atmosphere equals 15 lbs. on the square

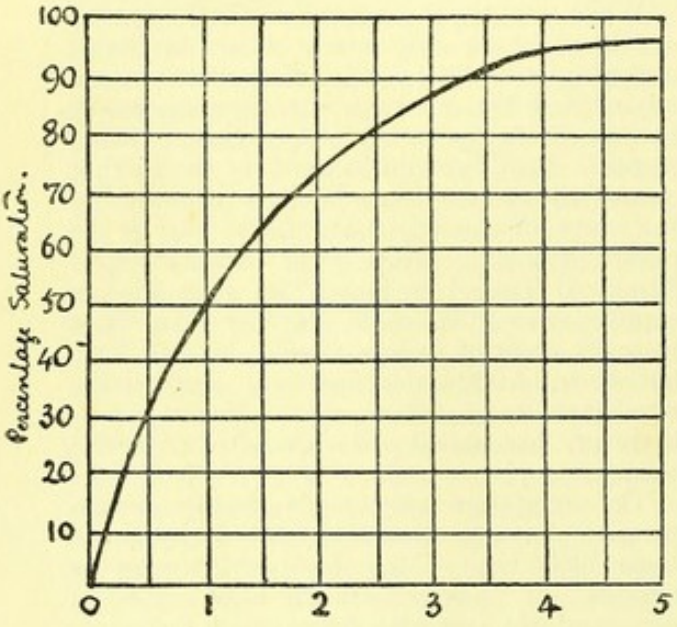


FIG. 1.—Curve showing the progress of saturation of any part of the body with nitrogen after any given sudden rise of air-pressure.—(After A. E. Boycott.)

inch (actually 14·7), and is practically equal to the weight of 33 feet, or 5½ fathoms, of water. A pressure of "+ 30 lbs." means 2 atmospheres above normal, or 3 atmospheres in all, or 66 feet of water. As a rule caisson workers are not exposed to higher pressure than this. Divers commonly descend to depths of 20 to 25 fathoms—120 to 150 feet, or +53 to +67 lbs. The difference between the two trades is that the former are subjected to relatively lower pressure for a longer period; the latter to higher pressure for a shorter period. The importance of this will be seen when the phenomena of saturation are discussed.

Compression, at any rate to the extent generally employed, is not dangerous; it is the process of decompression which leads to the evolution of bubbles of gas in the tissues as the body, on exposure to the lowered pressure, gives up the gases with which it has been saturated at higher pressure. The bubbles of gas occur most commonly in the pulmonary veins, causing an embolus which may be rapidly fatal; in the white matter of the cord, causing paralysis; in the fluids of the body—bile, and possibly synovia;—"bends" are supposed to be due to their production in the latter situation. The bubbles consist chiefly of nitrogen. The tissues are capable of combining with considerable excess of oxygen (up to 10 atmospheres at least); even under very high pressure the percentage of CO_2 in the body remains constant, as has been shown by Hill and Greenwood, hence only nitrogen has to be considered. The composition of air in the bubbles is—Nitrogen 82, CO_2 16, Oxygen 2.

In order to understand the rationale of the prevention and treatment of caisson disease, it is necessary to realise how saturation and desaturation of the body with nitrogen occur. Under normal circumstances the tissues dissolve a given quantity of nitrogen, x. After prolonged exposure to 2 atmospheres of pressure (+15 lbs.) the quantity will be $2x$; at 3 atmospheres (+30 lbs.), $3x$, and so on. Nitrogen is not equally soluble in all tissues; fat takes up about five times as much as blood; neither do all tissues become saturated at the same rate—those with a sluggish circulation saturate and desaturate very slowly as compared with the rest. Both these statements have practical bearings.

The blood in the pulmonary capillaries becomes saturated with nitrogen at the pressure of the air in the pulmonary alveoli, and carries this excess of nitrogen to the tissues, where it is partially desaturated, and partially saturates them. It then returns to the lungs and is again saturated. Allowing for the fact that fat can dissolve large quantities of nitrogen, the body, as a whole, can take up 35 times as much of the gas as can the total volume of blood. From this it follows, that at the end of one complete round of the circulation the tissues will have received from the blood $\frac{1}{35}$ part of the nitrogen required to saturate them completely. But during the second round of the circulation the tissues will not receive another $\frac{1}{35}$ of their total capacity, but only $\frac{1}{35}$ of the difference between their actual content and their total capacity, *i.e.* $\frac{1}{35}$ of $\frac{34}{35}$. Thus with each round of the circulation the amount taken up diminishes. In other words, the process of saturation is not steady; rapid at first, it becomes slower and slower as times goes on, for as the differences between the tissue pressure and the atmospheric pressure diminishes, the rate at which nitrogen is taken up diminishes also. The same holds good, *mutatis mutandis*, as regards desaturation.

Experience shows that visitors to caissons, who are never exposed to the effects of compressed air for any great length of time, do not suffer from caisson disease. Shifts of 8 hours are definitely more dangerous than shifts of 4 hours. In all probability the body is pretty thoroughly saturated after 5 hours' exposure to compressed air. The fact that some tissues saturate and desaturate more slowly than others is practically important. It is this property of the white matter of the cord which renders paralysis so common a

result of caisson disease. The slow saturation of the fat and nerve tissues may lead to the process of saturation going on in them while the body, as a whole, is being slowly decompressed. In desaturation the body gives up its nitrogen rapidly at first; then, as the difference between the tissue pressure and atmospheric pressure becomes less, desaturation goes on more and more slowly.

DECOMPRESSION.—It has been found that caisson disease does not occur unless the pressure has exceeded one atmosphere (+15 lbs.). It may also be prevented by very slow decompression, nor does it occur if exposure to high pressure is limited to 10 minutes or so. The practical problem is, how to get the surplus nitrogen out of the body as quickly as possible, consistent with the safety of the worker. Two methods are employed, "slow decompression" and "stage decompression," and the two classes of work, diving and caisson work, have to be considered. When slow decompression is employed, Hill recommends that 20 minutes be allowed for each atmosphere. The process is necessarily tedious, because there may only be a difference of one or two pounds between the atmosphere and tissue pressures.

STAGE DECOMPRESSION.—Starting from the proposition that no symptoms are produced in man by quick decompression after an exposure of any duration to pressure not exceeding 15 lbs.—that is, a decompression of from 2 to 1 atmosphere—Boycott and Haldane conceived that, since halving the pressure always doubles the volume, it would be equally safe to decompress rapidly from 4 to 2 atmospheres, or from 6 to 3, and experiments on animals verified the correctness of their supposition. On this is founded the method of stage decompression, which is now officially adopted for divers.

"The rationale of safe, quick decompression is, then, (1) never to allow the nitrogen pressure in the tissues to be more than twice the air pressure, and (2) to make the fullest use of the permissible difference of pressure to get the nitrogen out of the tissues. Suppose, for example, that it is necessary to decompress a man saturated at +75 lbs. [90 lbs. absolute]. He can be quickly brought to +30 lbs. [45 lbs. absolute]; nitrogen diffuses out rapidly under the stress of this drop of +45 lbs., and the saturation of those of his tissues that matter falls to +65 lbs. in a time which can be approximately determined by calculation. . . . The absolute air pressure may now again be reduced to half the tissue pressure, *i.e.* to $\frac{65+15}{2}=40$ lbs. absolute or +25 lbs. The nitrogen-extracting stress is now only 40 lbs. at first, so that a longer wait is necessary before the tissue pressure will have fallen another 10 lbs., *i.e.* to +55 lbs. When this point is reached the air pressure is again reduced to $\frac{55+15}{2}=35$ lbs. absolute = +20 lbs. positive, and the stress is only 30 lbs. Hence the waits become longer and longer as the pressure falls. . . . The essential peculiarity of this method of decompression, however, lies in the fact, not that it is done *per saltus* but that it is quite quick at the beginning and very slow at the end" (Boycott). Boycott points out that in slow decompressions there are three fallacies: —(1) No use is made of the possibility of hastening the exit of nitrogen from the tissues by putting on the greatest permissible stress. (2) However slow continuous decompression is, the difference between the tissue pressure and the atmospheric pressure becomes larger and larger (because desaturation proceeds at a diminishing rate of speed, while in slow decompression the atmospheric pressure falls steadily); hence the body may reach atmospheric pressure with a tissue pressure above +15 lbs., whereupon symptoms are likely to occur. (3) In cases of short exposure to high pressure the tissues which saturate slowly will go on taking up more nitrogen during slow decompression, and will ultimately be exposed to a dangerously rapid rate of decompression.

Greenwood agrees as to the value of stage decompression in divers; he apparently doubts whether it has any real advantage over continuous decompression at the rate of 20 minutes per atmosphere in caisson workers. All workers agree as to the importance of avoiding hurrying the later stages of the process. Particulars as to decompression will be found in the Addenda to the Diving Manual of the Royal Navy, from which the following example is taken:—

"If a diver has been working at a depth of 144 feet for between 45 minutes and 1½ hours he is directed to ascend rapidly to 50 feet and then pause for 10 minutes; he next comes to 40 feet and again waits for 10 minutes; at 30 feet he stops 20 minutes and at 20 feet 30 minutes, at 10 feet 35 minutes and then leaves the water, the whole ascent occupying 108 minutes."

For caisson work decompression can be effected by a sudden drop to half the pressure, followed by slow uniform decompression at the rate of 7 or 8 minutes for each pound of pressure. During the later stages of decompression, particularly, the workers should exercise their muscles so as to assist in the elimination of nitrogen. Fat men are ill adapted for caisson work.

When symptoms arise recompression is the only rational treatment. The diver should be send down again; the caisson worker placed in a compression chamber.

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Mummery. *Ibid*, June 27, 1908.—Grant. *Ibid.*—Oliver. *Ibid.*, Jan. 30, 1909.—Boycott. *Quarterly Journ. Med.*, April 1908.

Calcimeter. *See* Blood (*Estimation of Calcium Salts*).

Calcium Index. *See* Blood (*Estimation of Calcium Salts*).

Calmette's Oculo - Reaction. *See* Immunity (*Specific Tuberculin Tests*).

Calmine.—A proprietary preparation having a soporific effect, and recommended (under medical advice) in epilepsy, hysteria, and mania. It contains diethylbarbituric acid combined with sodium, and is therefore nearly related to veronal. See Report in *Lancet*, ii. for 1910, p. 1495.

Calsa.—A proprietary preparation of agar-agar recommended for its softening effect on the bowel-contents in the rational treatment of constipation. It contains no laxative drug, but may be combined therewith if thought desirable. See Report in *Lancet*, ii. for 1910, p. 467.

Cammidge's Reaction. *See* Gall Bladder and Bile Ducts, Diseases of; Pancreas, Diseases of the (*Urine, Pancreatic Reaction*).

Camptodactyly.—Camptodactylia or camptodactyly, from the Greek κάμπτω, I bend, and δάκτυλος, a finger, is the term given by Landouzy to a deformity of the fingers which he regarded as a stigma of neuro-arthritism, and the result of some functional disturbance in the cervical and dorsal region of the spinal cord. It is characterised by permanent and irreducible inflexibility of one or more fingers. There is no inflammation, and the stiffness develops gradually and painlessly. The joints affected are solely the interphalangeal ones, the bones show no nodosities, and the palmar fascia is not contracted. Other writers have regarded camptodactyly as a stigma of tuberculosis, and Lesieur (quoted in the *Lancet*) has described the morbid state in detail. It may affect one or both hands, but the right hand seems to be more prone to be attacked. The little finger is that which is most often involved, but the ring and middle fingers are also susceptible. There is fixity at one or both interphalangeal joints, and the resulting deformity is a hooking or bending of the finger which permits flexion but not extension of the digit, and does not interfere much with the use of the hand. The family history of patients suffering from camptodactyly has often been found to contain indications of tuberculosis, and the patients themselves have very frequently shown tubercular signs (pulmonary or glandular); further, the tubercular manifestations have been noted to be tending towards cure, or even cured. Lesieur and others, therefore, have regarded camptodactyly as a means both of diagnosing tuberculosis and of forming a favourable prognosis. In Secheyron's case the deformity was associated with a morbid state of the skin (chéloïde verruqueuse).

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Cancer.—The term cancer is used by many to designate malignant tumours arising in epithelium. It is a convenient term, which can be applied to malignant growths irrespective of the nature of their histological structure, and thus in this article it is proposed to apply the designation in the latter sense.

There is at present no disease that has been the subject of more widespread and thorough investigation than cancer. This investigation has been conducted mainly in institutions specially endowed for this purpose, and many able pathologists have been engaged upon it. As the result, there has been accumulated in recent years a large amount of material concerning the nature of cancer and its mode of growth. Most of the facts have been obtained by experimental investigation, and many of them may ultimately prove to be of great value to the clinician. It should, however, be clearly understood that from our knowledge of cancer there is at present no treatment which is to be recommended in preference to removal of the growth by surgical operation, where that is possible. It should also be distinctly understood that, although certain therapeutic remedies have been found to influence the progress of new growths, there are none which may be used justifiably when surgical operation is possible. The treatment of cancer, according to our present knowledge of the disease, consists in the prompt removal of the growth in its entirety.

As has already been said, the facts brought out concerning cancer in recent years have been obtained mainly as the result of experimental investigation. Until comparatively recently the experimental investigation of cancer was rendered difficult, as it was found almost impossible to propagate the disease by the inoculation of it into animals of the same or different species. Some eight years ago Jensen of Copenhagen gave a great impetus to cancer research by his discovery of a tumour which occurred in mice, and which could be propagated readily by inoculation into other mice. It is this tumour — Jensen's adeno-carcinoma—that has formed the basis of most

of the experimental work done in recent years. Jensen's tumour is a subcutaneous adeno-carcinoma, homologous in every respect with carcinoma as it is met with in man, and is looked upon by virtually all pathologists as a true cancer. There are some who dissent from this view. Lazarus Barlow would describe it as an "endotheliomatous growth," and Roger Williams classifies it as a "quasi-malignant pseudo-plasm."

In his original communication in 1903, Jensen describes how the tumours which develop after the subcutaneous inoculation of a portion of the growth into mice were derived solely from the epithelial cells introduced. The tumours were created, therefore, by the cells introduced grafting on to the tissues of the new host. Jensen's tumour has now been propagated from generation to generation for five years, and it still retains its original characteristics of an adeno-carcinoma. The origin of the connective-tissue stroma of the tumour has been investigated by various workers. There is no absolute unanimity upon its source of origin. Bashford describes it as being formed from the tissues of the host. In his opinion, the stroma introduced undergoes degeneration, and is entirely replaced by supporting structures from the tissues into which it is introduced. Thus, although the epithelial cells of the tumour may be looked upon as the direct descendants of the tumour discovered originally in Copenhagen, the cells of the stroma are renewed with each succeeding generation, and arise from the tissues of the animal into which the cancer has been grafted.

Michaelis and Apolant were the first to observe in some animals the occurrence of spontaneous recovery after inoculation, a fact that was independently noted by Gaylord and Clowes, who found that in quite a large percentage of cases the tumours which formed after inoculation underwent gradual resorption and disappeared. The latter investigators also showed that mice in which spontaneous recovery had occurred could not be successfully reinoculated, and they claimed that serum obtained from the blood of such animals conferred a degree of immunity when injected into healthy mice, and furthermore, promoted resorption when introduced into animals with growing tumours. Their conclusion regarding the active immunity present in animals after spontaneous recovery has been confirmed by other investigators. With reference to their claim that they were able to get a passive immunity by the injection of an anti-cancerous serum, the same unanimity of opinion does not exist. One of the most important facts concerning cancer as it occurs in mice is that brought out by Ehrlich and Apolant. They have been able to demonstrate that in certain circumstances a carcinoma may develop into a sarcoma. It has already been mentioned how, after five years of passage through succeeding generations of mice, Jensen's tumour retained its original characteristics as a carcinoma. Its histological characters remained unaltered. Working with tumours similar in nature but mostly of a more virulent strain, Ehrlich and Apolant found that a carcinoma might gradually develop into a sarcoma. In three tumours of different degrees of virulence, they found that, after breeding true for ten, fourteen, and sixty-eight transplantations respectively, their histological characteristics became altered, and gradually assumed the structure of a sarcoma. Ehrlich's explanation of this most remarkable phenomenon is that the injected cancer cells so stimulated the connective-tissue cells of the mouse that they developed into sarcomatous tissue. Ehrlich succeeded in conferring a high degree of immunity to mice against virulent strains of carcinoma by injecting into them the pulp of a tumour of low virulence; the absorption of the tissue fragments producing active immunity, which persisted for a long time. This immunity was obtained in a couple of weeks, and lasted for months in from 66 per cent. to 94 per cent. of all the animals experimented upon. He also found that when a virulent mouse-carcinoma was injected into the rat a tumour grew and then gradually underwent resorption and disappeared. These animals were thereafter found to be immune on subsequent inoculation. He also demonstrated another and most interesting fact: he found that the growing tumour in the rat could not be reinoculated into other rats, although it could be reinoculated with ease into mice. His explanation of this state of affairs is that there is present in the portion of tumour inoculated a substance necessary for its growth, and that the tumour ceases growing in the rat when this is exhausted, because the tissues of the rat do not possess this substance, and the tumour must in consequence of necessity remain sterile for all other rats. When it is reimplanted into a mouse it can replenish from it its stock of this substance, as such is normally present in that animal. This immunity Ehrlich describes as "atreptic." The problem of immunity to cancer in mice has been studied in another aspect by Schöne. His researches were undertaken to endeavour to obtain an immunising effect with other tissues than tumour substance. He used mouse embryo, mouse liver and testis; embryo of chick and human carcinoma. He injected an emulsion of these organs into a healthy mouse, repeating the injection for from four to eight times, over a period varying from fifty to eighty days, and then inoculated the animal with mouse carcinoma. He found that an immunity against epithelial mouse tumour can be obtained by the repeated injection of pulp derived from

mouse embryos. The other tissues used showed no constant effect in the direction of immunity. This, however, might be due to the blood introduced, for that, as Bashford had previously shown, can, like embryo pulp, produce a certain degree of immunity.

Dr. Bashford and his colleagues of the Imperial Cancer Research Laboratories have recently investigated certain problems in connection with carcinoma, as it occurs in mice. They have found that when mice were injected with normal tissue, immunity was conferred when the tissue injected was similar to that from which the neoplasm arose. Other organs, whether used collectively or individually, were devoid of this power. They were thus able to induce a nearly absolute degree of protection against squamous-celled carcinoma, by injecting macerated skin. By heating the skin previous to inoculating it, instead of protection being obtained, a condition was set up which favoured the growth of the tumour.

The question of malignancy has recently been experimentally investigated by Apolant, and the conclusions he derives from his work are of interest and considerable consequence. Prior to embarking upon his investigations, he held the view that the degree of apparent malignancy of a tumour was a question entirely of its rate of growth, and that the progressive apparent increase of malignancy was due to a progressively increasing rate of growth with each succeeding inoculation. He now holds that "the type of structure of the tumour is dependent upon biological changes in the organism of the animal host." He found experimentally that in one tumour which had for fifty generations reproduced a solid reticulated type of carcinoma, that it assumed an innocent adenomatous type in such animals as had been previously treated by the immunising methods of Ehrlich and Bashford, which, of course, does not in every case prevent the tumour's development. He found that in the cases where he commenced the immunising injections just after the inoculation of the tumour, this developed with a structure of the usual malignant type. When the animals were inoculated at a later period, however, or when secondary nodules developed, these were found to have the structure of the innocent adenomatous type. His work shows an exact counterpart of the development of malignant characteristics in a previously innocent tumour due to loss of tissue resistance, and it demonstrates clearly how, by immunising methods the loss of tissue resistance may be restored, and a malignant tumour become an innocent one.

Cathcart has published a study of tumour growth, maintaining the essential similarity of innocent and malignant tumours, and showing how gradual transition-stages from one to the other are met with.

It will be seen from the record of the aforedescribed investigations that, although many results of great interest have been obtained, no discoveries have been made which have a direct therapeutic application. At the same time, it cannot be denied that a great advance in our knowledge of cancer has recently occurred. Although only obtained experimentally in laboratory mice, it is a fact of profound significance that animals have been immunised against cancer growth, that the type of growth has been altered from malignant to innocent, and that spontaneous disappearance of cancer can be induced with fairly regular constancy in animals in which tumours have become well established.

The etiology of cancer is still obscure. Most of the investigators whose work has been already referred to would seek to explain the origin of cancer in some perverted bodily metabolism. There are many able investigators who, on the other hand, maintain that tumours arise by the operation of a living virus introduced from without. Ford Robertson has done much work at this subject, and by investigating the histological features of carcinomatous tumours, revealed by an improved ammonio-silver method of staining, claims to have obtained a considerable amount of additional evidence of the occurrence of intra-cellular parasites in human carcinoma. The experimental evidence of the infective origin of carcinoma has been investigated further. He experimented with mice, and injected into their abdominal wall a fluid which had been obtained from the peritoneal cavity of a case of malignant peritonitis following cancer, and which had been incubated at 37° C. for two months. The result of the experiments was negative. Other mice were given the same fluid in their food, with a similar negative result. Thirty mice were similarly fed on one occasion with fluid from the pleural cavity of a case of malignant pleurisy. This fluid had been incubated at 37° C. for seven weeks. On the following day they were given fluid from a case of malignant peritonitis, which had been incubated for nine weeks. In the course of the succeeding five to fourteen months, seven of these mice developed carcinomatous tumours, viz., three of the mamma, two of the lung, one of the testicle, and one of the uterus. These tumours possessed the structure and characteristics of true carcinoma. Ford Robertson's results are undoubtedly of interest, for although it is not denied that carcinoma may arise spontaneously in mice, the number of animals in which tumours developed is vastly greater than is found when they arise sporadically. The prolonged incubation period to which the malignant fluid was subjected has the effect, according to Ford Robertson, of enabling the intra-cellular parasite to reach that stage in its cycle, at which it is capable of propagating the disease to another species.

In C. E. Green's recently published book, *The Cancer Problem* (Edinburgh, 1911), there is described a theory regarding the origin of cancer which is worthy of careful consideration. The author divides his work up into three parts. The first is concerned with parasitic tumours as they occur in the vegetable kingdom, especially with that disease which occurs in turnips, and is known as "*Plasmodiophora brassicæ*," or "finger-and-toe disease." There is a most suggestive chapter on the local incidence, and the other portion of the work is concerned with a careful analysis of the statistical returns of the mortality from cancer in various trades and professions, and an investigation of the factors possessed in common by these where the cancer mortality is high. Although at first it might appear that there was little in common between the various occupations having a high mortality from cancer, Green shows that they have this one factor in common, that they are occupations where imperfect oxygenation of the tissues takes place. The point of his argument is that a fungoid organism cannot grow in a freely oxidised medium, and sulphuric and sulphurous acid are powerful de-oxidising agents. In the case of *Plasmodiophora brassicæ*, it is found that it is a disease that is started and fostered by manures which have been dissolved in sulphurous acid In the case of those trades and professions in which the cancer mortality is high, Green has been able to show also that in many of them there is exposure to sulpho acids.

Doyen described an organism which he called the micrococcus neoformans, and which he claimed to be the causal parasite in the production of carcinoma. The organism can undoubtedly be found in many new growths, but it is looked upon by all pathologists as a mere casual concomitant. Wright, however, has published an account of a case of inoperable cancer of the larynx treated by him by the subcutaneous injection of a vaccine prepared from the micrococcus neoformans. The treatment is claimed to have produced some beneficial results; the patient, however, ultimately died of the malignant growth.

Cancer following Exposure to Röntgen Rays.—It is unfortunately now only too clearly proved that prolonged exposure to X-rays may, under certain circumstances, lead to the development of cancer. There are now on record a number of cases where this has occurred, and ultimately proved fatal. Porter and White have collected eleven cases of an undoubted X-ray cancer, and six of these proved fatal. In the case which Porter had the care of himself, he found this interesting result, that where he skin-grafted for the intractable ulceration which precedes the epitheliomatous change, the majority of the grafts adhered, they never broke down afterwards, and epitheliomata did not develop in them. He recommended accordingly that early excision be practised in cases of persistent X-ray ulceration, to avoid the development of malignant characteristics in them. Now that certain of the properties of X-rays are more clearly understood, the risk of the occurrence of this disaster are not great. It is recognised that it was especially in those who were exposed to the double irritant of the X-rays and the chemicals used in afterwards developing the plates that cancer occurred.

As a contribution to the etiology of cancer, Lazarus Barlow has carried out a line of investigation starting from the assumption that workers exposed to X-rays are liable to become affected with true squamous-celled carcinoma. He examined electrically and photographically a variety of substances which are commonly looked upon as predisposing to cancer by the irritation their presence produces. He endeavoured to find out whether these irritants shared with the X-rays any factor in common. He found such substances as paraffin, soot, gall-stone, clay pipes, etc., did not fall exactly under the category of recognised radio-active substances. It was not common radio-activity which was responsible for their share of the accusation of predisposing under certain circumstances to the production of cancer.

As has already been said, no treatment has so far been discovered to replace the surgeon's knife, where the use of such is practicable.

Every year witnesses the arrival of a new method of treating cancer. The popularity of these usually varies directly with the extent to which they are advertised in the lay press. The pancreatic ferment, as originally suggested by Beard and Mackenzie, is still being used occasionally to treat cases of inoperable cancer. The results obtained do not warrant the assumption that this form of treatment is ever likely to be widely adopted. It is a treatment which is based on the assumption that cancerous growths arise from a wandering germ cell which has settled in some situation other than the germinal ridge. After having lain dormant for a varying period, it is excited to active division by any of the irritants which are generally recognised as predisposing to the production of cancer. By its growth it gives rise to a tumour which, although simulating in structure the tissue in which it is developed, is really, according to Beard, of the nature of aberrant trophoblast. The normal trophoblast is recognised to behave at first in the manner in which it invades the maternal tissue very like a cancer. Very soon comes a period, however, when this active invasion ceases. According to Beard, this stage of arrest of the active invasion by the trophoblast is coincident with the appearance of the pancreas as a functionating gland. He thus considers that the scientific method of treating a malignant growth, a structure which, as has been said, consists of nothing

else than aberrant trophoblast, should be the administration of the pancreatic ferment. Von Leyden and Bergell have tried the effect of various ferments on malignant tumours. They found that the pancreatic ferment produced only a local non-selective reaction. They especially experimented with a ferment obtained from the liver, and found that this produced an increased reaction, which they claimed was selected for the cancerous tissue. Practical therapeutical application of the remedy, according to them, at present was unjustifiable. Bier, who has already used injection of blood as a treatment for non-union, or the delayed union of fractures, claims to have obtained benefit from injecting pig's blood into cancerous growths. When injected into a healthy individual, these substances produced an inflammatory reaction, but no destructive effect on the healthy tissue. When, on the other hand, it is injected into a cancerous mass, it produces, according to Bier, marked improvement by inducing a pronounced reaction, the pathological tissue being destroyed to a great extent, and a dry necrosis occurring in some cases.

At the International Medical Congress at Buda-Pesth Dr. E. F. Bashford delivered an important address on cancer (*Lancet*, Sept. 4, 1909). The experimental studies of the Imperial Cancer Research Laboratories have been co-ordinated from their inception in 1902 with the study of the natural incidence of cancer in all races and throughout the vertebrate kingdom. From the facts gathered together it is not unreasonable to suppose that the general incidence is similar to that in England. For two years it looked as though the experimental study of cancer would break down on account of the impossibility of reproducing the lesions experimentally, but now, by a suitable technique, the natural process can be produced artificially — local infiltration, systemic dissemination, terminal cachexia. The experimental transference of cancer is not an infection, but a true transplantation of living cells.

Statistical Aspects of the Cancer Problem.—The investigations of the Imperial Cancer Research have settled once and for all that cancer is a disease common to mankind throughout the world and to vertebrates. The primary lesions closely resemble one another even in animals so remote as man and the fish. Another common and more striking feature is its age-incidence. It is peculiarly associated with special periods of the life of man, and the same holds good for all vertebrates. Bashford gives a curve plotted from 10,598 cases, showing a rise in frequency up to the 50-55 quinquennium in males and the 45-50 quinquennium in females, and thereafter a fall. A demonstration of the validity of the law for mice is given in the following table :—

	6 to 9 months.	9 to 12 months.	12 to 15 months.	15 to 18 months.	18 to 21 months.	21 to 24 months and over.
Total .	135	110	94	21	6	—
Cancer .	3	4	7	3	·2	—
Per cent.	2·2	3·5	7·4	14·2	33	—

Since the less perfect data for other vertebrates accord with the facts for man and the mouse, the general application of the law is probable; therefore any explanation of the etiology of cancer must agree with the circumstance that when considered statistically cancer is a function of age, and considered biologically a function of senescence. From these facts it follows that attention must be paid to the relative numbers of the population at different age periods in attempting to appraise the frequency of cancer. But the relative frequency of cancer overlaps the much-discussed question of its alleged increase. Savage races are unsuited for the study of these problems, and there is no doubt that as improvements in national statistics take place different countries become interested in questions of its real or apparent increase. The number of deaths assigned to cancer has increased from year to year in practically all countries. If this is regarded as a merely national problem, the fact may be made to appear alarming, but when due regard is paid to (1) its universality; (2) to the fact that when statistics were first compiled in Japan, India, and Egypt, the question at issue was whether cancer occurred at all or was a rarity, while the statistics showed that it was actually common and increased in frequency from year to year; (3) that number of deaths assigned to cancer increases *pari passu* with increased accuracy of the vital statistics; (4) that part at least of the absolute increase of cases of cancer recorded can be referred with certainty to a larger number of individuals attaining the "cancer age"; (5) that as the disease is sought for much more carefully than ever before; there is no excuse whatever for talking of an "increase of cancer" so as to enhance the anxiety of the lay public.

Sites of Predilection.—In males cancer of the abdominal viscera accounts for two-fifths of the total cases; among females the breast and generative organs are affected in more than two-fifths, while a further two-fifths are contributed by the stomach, liver, and bowel taken together. The predilection for some sites rather than others in mankind may partly be accounted for by exposure to chronic irritants, but endogenous factors must also exist, because in surveying the incidence of cancer in the vertebrate kingdom one is struck by the fact that certain forms preponderate in different classes, *e.g.* carcinoma of the thyroid in trout.

In mammalia some species are very liable to cancer of the breast (*e.g.* man, dog, mouse); in others (*e.g.* the cow) it is very rare. Not only this, but in animals liable to cancer of the breast the growth shows characteristic specific differences—scirrhus in man, connective tissue and bone or cartilage formation in the dog, delicate stroma in mice. As instances of the part played by chronic irritation in determining the incidence of cancer, Bashford quotes carcinoma of the skin among the natives of Cashmere on account of the practice there of wearing next to the skin an oven containing burning charcoal (*see* KANGRI CANCER); carcinoma of the floor of the mouth among Cingalese and Indian women from chewing betel-nut and sleeping with the plug in the mouth. It seems that cancer can arise locally in a circumscribed area, and that any part of the covering of the body can acquire cancerous properties. Nothing more than an indirect etiological significance can be assigned to chronic irritation and other exogenous factors. Chronic irritation does not cause cancer in all individuals. A prolonged or an intermittent process of regeneration and repair is intercalated before the development of cancer in tissues subject to chronic irritation. Now there is great variety among carcinoma cells all descended from normal tissue cells; some pass into one another, others do not, and are able to maintain their characters for long periods. Conceivably under the influence of chronic irritants the tissue cells may exhibit similar variations, some being capable of advancing to malignant cells, others incapable.

HEREDITARY TRANSMISSION of cancer has not been settled either way for mouse or man. For years Bashford and his associates have been breeding mice of cancerous stocks. The incidence of cancer in the offspring continues to obey the law of age-incidence without giving any indication of inborn predisposition determining a local or constitutional liability to the disease.

The pessimistic views widely held in regard to cancer are due to the general existence of an ill-defined notion that malignant growths are of "congenital origin." This belief arises (1) from the fact that certain forms of cancer are associated with congenital abnormalities; (2) from seeking for an analogy for the powers of growth of cancer in embryonic tissue; (3) from the assumption that the absence of histological variation in many cancers proves a reversion to embryonic conditions. None of these inferences is justified. The growth of cancer is essentially different from that of embryonic tissue, and is a unique biological phenomenon. When a carcinoma is transplanted the blood-vessels and connective tissue are supplied afresh, as a reaction elicited by the chemotactic influence of the parenchyma cells. If the characteristic elements of a tumour possessed primary undifferentiated embryonic properties, the stroma of transplanted tumour should be uniform. As a matter of fact, however, it is not; tumours without any apparent histological differentiation elicit distinctive vascular and connective tissue scaffoldings, and the peculiarities of the stroma remain constant during propagation. For over sixty transplantable carcinomata growing in the Cancer Research Laboratories it can be said that no single one is a duplicate of another. Cells of malignant new growths, therefore, even when showing little or no differentiation, are specialised. In the phenomena of induced resistance to inoculation, especially in the specificity of immunity following the absorption of normal or cancer tissues, there is much that is opposed to the assumption that the cells are embryonic.

INFECTIVITY.—The comparative work of the past seven years has shown that cancer has no analogy with any known form of infective disease. Many tens of thousands of mice with cancer have been observed in the laboratory. If cancer were communicable animals housed along with these should surely suffer. In an experience of six years, thrice the average length of a mouse's life, during which time 200,000 have been inoculated, this has not occurred. Those handling the animals incur still less risk in passing many hours daily dealing with cancerous animals in a room in which 10,000 mice and rats are usually housed at one time. No case of spontaneous transference of cancer in mice has been observed. Epidemics have been alleged to occur in the establishments of breeders of rats and mice. Bashford's experience of these alleged epidemics may be illustrated by the proportions of cancer to total mice supplied by four establishments from January 1, 1906 to October 21, 1907:—

Breeding Establishments .	A.	B.	C.	D.
Tumour Mice .	10	6	35	18
Total Mice . .	1302	1547	9698	11,842

The number of tumours depends solely on the number of mice of cancer age; *e.g.* D.'s stock invariably contains a larger number of young animals than C.'s. The incidence of tumours as they occur among mice arriving at the laboratory coincides with the ageing of groups of mice. These aggregations of tumours, loosely called "epidemics," are really evidence of the importance of knowing the age-constitution of the mouse population in which the cases occurred.

ENZYME TREATMENT OF CANCER.—The trypsin treatment of cancer, brought under the notice of the medical profession by Beard (*Brit. Med. Journ.*, Jan. 20, 1906), has had a thorough scientific test applied to it by

Bainbridge (*Scientific Report on the Enzyme Treatment of Cancer*, New York Skin and Cancer Hospital, 1909), who has treated a hundred cases over a period of nearly three years. The materials used consisted of:—(1) Holadin capsules, a pancreas gland extract containing trypsin, amylopsin, and lipase, given to aid digestion; (2) Pepule ox gall compressed, containing inspissated ox bile and pancreatic extract, for the same purpose; (3) Lotio pancreatis, a solvent of broken down tissues applied locally to ulcerated surfaces; (4) injection of trypsin, which, according to Beard, kills cancer cells; (5) injection of amylopsin, which was thought to digest dead cancer cells. The main conclusions arrived at are:—The internal medication—(1) and (2)—aids digestion and increases elimination. Pancreatic lotion cleans the ulcerated surface. Injections of trypsin seem to disintegrate cancerous tissue. While it may accelerate the breaking down of the interior of the tumour, the periphery grows rapidly. This disintegrating action may be dangerous (*a*) by eroding vessels or (*b*) by setting free toxins. Injections are often painful. The injections of amylopsin appear to have little effect. Control cases, given injections of glycerine and water, did as well as those treated with enzymes. Thus the enzyme treatment, given according to Beard's suggestion, is not successful. It neither checks the cancerous process nor does it prevent metastasis. See also Bainbridge, *Brit. Med. Journ.*, March 2, 1907.

Treatment by Mixed Toxins of Erysipelas and B. Prodigiosus.—Coley, in two recent papers (*Amer. Journ. Med. Sci.*, March 1906, and *New York Med. Record*, July 27, 1907), reports on the late results in the treatment of inoperable sarcoma by this method. He gives the following directions for the preparation of the mixed toxins:—"One pound of minced beef soaked overnight in 1000 c.c. of tap water. Then boiled for an hour; filtered through flannel. Add peptone (Witte's), 10 grains, NaCl, 5 grains, test reaction to litmus, and render alkaline by addition of sufficient quantity of ten per cent. NaOH. Boil for one hour. Sterilise by boiling half an hour on three successive days. 25 c.c. of broth, in a small flask, is sown from a culture of streptococcus in broth (a few c.c. of such culture being used). Allowed to grow in the incubator for three weeks. These sown with bacillus prodigiosus (agar or broth culture) and allowed to grow at room temperature in the daylight (not direct sun) for ten days more. Poured in sterile bottles, heated to 60° in water bath for one hour. Four to five c.c. of glycerine and a small lump of thymol added. Kept on ice till used."

As result of personal use of the toxins in every variety of inoperable sarcoma over a period of thirteen years Coley offers the following suggestions:—(1) Begin with a minimum dose. The more vascular the tumour the greater the reaction. (2) For local injections (into the tumour) the initial injections should be $\frac{1}{4}$ to $\frac{1}{2}$ minim; for injections remote from the tumour, 1 minim. (3) Increase the dose until a chill, followed by a temperature of 101°-104°, occurs one and a half to two hours after injection. (4) If patient can bear daily injections, so much the better; if the reaction is followed by depression give the injections every second day. (5) If the tumour is so placed that injections are difficult or dangerous, give systemic injections. (6) If the tumour becomes soft and fluctuating, incise and drain softened areas. (7) Give strychnine, iron, and quinine during treatment, and keep bowels open. (8) In successful cases improvement occurs in from one to four weeks. If at the end of that time there is no benefit the treatment may be abandoned. If there is improvement continue injections till tumour totally, or almost, disappears. In some cases treatment has been continued in small doses more than a year, and patients are well years after the cessation of treatment. (9) Toxins should be kept in a cool dark place; they remain active for at least a year. The average duration of treatment in successful cases is two to three months. An ordinary sterile syringe is used. Dilute toxins with boiled water for smaller doses. Sterilise skin with alcohol. (10) In post-operative prophylactic use of toxins small doses should be given—a slight rise of temperature with malaise is enough reaction. (11) Long-continued use of toxins is harmless. In the two papers Coley reports 42 successful cases—17 round-celled sarcoma, 17 spindle-celled sarcoma, 2 mixed-celled sarcoma, 1 chondro sarcoma, 1 epithelioma, 4 not examined microscopically; of these 21 patients remained well 5 to 14 years after treatment, 26 well from 3 to 14 years, 10 well from 10 to 14 years. Other surgeons have reported some 60 more or less successful cases, of which 12 remained well for less than a year. In 6 the tumour disappeared and the patient was alive and well from 1 to 2 years later; in 12, alive and well from 3 to 5 years later; in 10, alive and well from 5 to 12 years later. Five cases recurred in from 6 months to 2 years, and two cases died during treatment.

Doyen's Serum.—Like many other vaunted "cures" for cancer, Doyen's serum has not stood the test of scientific scrutiny. In 1901 Doyen stated that he had isolated a micro-organism from simple and malignant tumours, which, when inoculated into animals cause neoplasms; this organism he named *micrococcus neoformans*. In the natural sequence of events there came, a few years later, an anti-cancerous vaccine and serum, for which it was claimed

that by their use certain cases of cancer could be cured. These serums were investigated by Paine and Morgan at the Cancer Hospital (*Lancet*, April 7, 1906), who treated 9 suitable cases. In 4 the injections produced no result, in 3 they caused severe constitutional disturbance, and in 2 great pain. The investigators could not confirm the alleged specificity of *m. neoformans*. Alexis Thomson (*Edin. Med. Journ.*, xix. p. 53, 1906) treated three cases without benefit, and observed a marked reaction in a fourth case, which turned out to be of a simple (papillomatous) nature. See also a résumé of Doyen's work, by Alexis Thomson, *Edin. Med. Journ.*, xvii., p. 373, 1905, for details concerning the serum and vaccine, and on the bacteriology of *m. neoformans*.

Cancer Reactions.—A number of attempts have been made to find some characteristic blood reaction which would prove useful in the diagnosis of malignant disease. Among these may be mentioned—(1) hæmolytic tests, (2) the antitryptic reaction, (3) the meiostagmin reaction.

(1) *Hæmolytic Reactions.*—The fact that extracts of cancerous tumours cause hæmolysis has led to a search for hæmolysins in the blood of cancer patients, but, while it seems from the work of Johnstone and Canning (*Journ. Amer. Med. Assoc.*, Oct. 30, 1909) that a positive reaction (hæmolysis) with cancer serum and alien corpuscles is much more common than where either normal or serum from other diseases is used, much work is yet required before this test is, if indeed it ever becomes, available for clinical purposes. See also Janeway (*Annals of Surgery*, xlix. p. 27, 1909—positive reaction in 40 to 57 per cent. of cases). Elsbey, Neutrof, and Geist describe (*Amer. Journ. Med. Sci.*, Feb. 1910) a cutaneous reaction following the subcutaneous injection of a suspension of normal human corpuscles under the skin of cancer patients. A positive reaction shows itself by the formation at the point of inoculation, in the course of a few hours, of a red, raised area with a pale areola. A positive reaction occurred in from 77 to 90 per cent. of cases of cancer, while in normal (non-cancerous) cases it occurred in only 4·6 per cent. Advanced or miliary cancer does not give the reaction.

(2) *Antitryptic Reaction.*—This was described by Brieger and Trebing in 1908. It consists in a marked increase in the power of the blood serum to inhibit the proteolytic activity of a solution of trypsin. Details of the technique may be found in a paper by Weil (*Amer. Journ. Med. Sci.*, May 1910). Here it is sufficient to say that in the original method of Brieger and Trebing plates of coagulated blood serum are employed, and the test is made by applying loopfuls of varying quantities of a solution of trypsin and a constant quantity of the serum to be tested. After incubating the plate the largest quantity of trypsin which has been inhibited gives the "antitryptic index" of the serum. In another method solutions of casein are employed instead of blood serum, and after being digested with the trypsin and serum acid is added, whereupon any undigested casein is precipitated. Here the lowest amount of trypsin which causes complete digestion gives the antitryptic index. The nature of the antitrypsin present in the serum is not known; it is not certain whether it is a true immune body. An increase in the antitryptic index occurs—(1) in nearly all (95 per cent.) cases of cancer. (2) In chronic wasting diseases—diabetes, severe anæmias. (3) In Graves' disease. (4) In chronic infections—tuberculosis; and acute infections—pneumonia, sepsis, typhoid. (5) After labour, during the puerperium. (6) In infants, on the transition from breast to artificial feeding. The chief points of diagnostic value to be obtained from testing the antitryptic index are these:—(1) Absence of a raised index is against cancer; (2) a raised index in a patient with a tumour of doubtful nature is in favour of either cancer or tuberculosis: (3) a raised index is constant in Graves' disease, hence in the larval forms of the malady it may be of assistance.

(3) *Meiostagmin Reaction* (μείων, small; στάζω, I drop).—The principle involved in this reaction, invented by Ascoli of Pavia (*Münch. medizinische Wochenschrift*, Jan. 11, Feb. 22, April 19, May 24, May 31, 1910), is not new, but its application in immunity tests is a novel one. The idea is to employ the measurement of the surface tension of a mixture of antigen and antibody as a means of discovering whether an interaction has occurred. Thus, with mixtures of known antigens (typhoid and tubercle bacilli extract) and tuberculous and typhoid serums, it was found that the surface tension of the mixtures was lowered in comparison to that of normal serum. The surface tension is measured by Traube's stalagmometer, an instrument by which the number of drops yielded by a given quantity of fluid is counted; the smaller the drop the lower the surface tension, and *vice versâ*. Using extracts of cancerous tissue as antigens, a similar lowering of the surface tension was obtained with the serums of cancer patients, but not with those of normal persons. The same phenomenon was observed with extracts of ankylostoma and echinococcus and the serums of persons suffering from ankylostomiasis and hydatid disease.

Sarcoma, Operative Treatment of.—On account of the disappointing outcome of high amputation for the more malignant forms of sarcoma of the extremities, *e.g.* periosteal

sarcomata, surgeons now are generally inclined to adopt a more conservative line of treatment than formerly. Few patients survive high amputation without recurrence or metastasis for more than a year or two. Babcock and Pfahler (*Surgery, Gynecology, and Obstetrics*, Feb. 1908) quote Bullin's statistics of sixty-eight cases of amputations for periosteal sarcoma of the femur in which only one patient was known to have survived the operation for three years. Amputation should only be performed when the function of the limb is destroyed, otherwise the tumour should be excised by subcapsular enucleation and a thorough course of X-rays be given. They also advise Coley's fluid (*v. supra*) and painting the cavity after enucleation with a solution of pyoktanin, 5, phenol, 1, alcohol, 20, and water to 100. In the more benign sarcomata—myeloid sarcomata, fibroid sarcomata—the disease can in some cases be eradicated by enucleation or resection. See a résumé by A. Miles, *Edin. Med. Journ.*, xxiii. p. 461, 1908.

Sarcoma and Carcinoma, X-Ray Treatment of.—Coley draws the following conclusions as to the final results in this method of treatment (*Annals of Surgery*, Aug. 1905):—1. The X-rays exert a powerful influence on cancer cells of all varieties, especially in cases of cutaneous cancer. 2. In some cases, chiefly in superficial epithelioma, the entire tumour may disappear, probably through fatty degeneration and absorption of its cells. 3. In a small number of cases of deep-seated tumours, chiefly cancer of the breast and glandular sarcoma, tumours have disappeared under long treatment by the X-ray. In nearly every case, however, that has been carefully traced to a final result there has been a local or general return of the disease within two years. 4. In view of this practically constant tendency to early recurrence, furthermore, in the absence of any reported cases remaining well beyond three years, the method should never be used except in inoperable cases, or as a prophylactic after operation—a possible though not proven means of avoiding recurrence. 5. The use of X-rays as a pre-operation measure in other than cutaneous cancer is contra-indicated, because (1) the rays have not been proved to be curative; there is risk of extension of the disease, or metastasis, during the period required for a trial of the X-ray.

Carbon Dioxide Snow.—*See* Lupus Erythematosus (*Treatment by Freezing*); Nævi (*Treatment*).

Carcinoma Cutis.—In the treatment of carcinoma of the skin, free removal with a wide margin of healthy tissue is still the method of choice where the disease is on a covered part; but not infrequently the patient objects to the use of the knife, and some other method is advisable. Caustics are preferable to the knife in some cases. There is no doubt that the zone of reaction around a cauterised area is beneficial, blocking up the lymphatics and tending to prevent a spread of the disease; whereas when the knife is used the lymphatics are cut across and left exposed to infection by any traces of the growth which may be left behind. Arsenious acid paste (50 per cent.), which is the one usually used, is a good caustic, but exceedingly painful. A less painful application is that of Wallace Brown, who uses two pastes, the one consisting of a saturated solution of caustic potash with sufficient hydrastis canadensis to produce a thick paste, and the other of a similar paste with a saturated solution of zinc chloride. These two pastes are applied for one to five hours according to the size of the growth to be destroyed, the caustic soda on one day and the zinc chloride on the next. After one application of each a slough is produced. A dressing of some soothing powder is applied till the slough separates, and if any disease is left the pastes are reapplied as before to the diseased area. These methods by caustics are especially useful in carcinomata arising in old scars and in lupus carcinoma. In such cases the knife cannot readily be used, as there would be difficulty in getting the edges of the scar tissue together, and therefore caustics are to be preferred. There is no great risk of causing metastasis of the disease by the irritation of caustics in such cases, as the scar is not rich in lymphatics, and local spread does not readily occur.

We are now in a position to state fairly accurately in which cases X-rays will be found beneficial in skin cancers. All are agreed that X-rays are of much less value in the rapidly-growing malignant epitheliomata than in the more slowly-growing rodent-ulcers. Some prefer to give frequent small doses of the rays, others large doses at longer intervals, but it does not matter which method is used so long as sufficient rays are given, and the case is a suitable one for X-ray treatment. The X-ray method is the one to be preferred when the patient refuses operation, or the cosmetic result is important, and where there is no deep infection. All cutaneous cancers can be cured by X-rays except those of large extent and rapid growth. Large carcinomata are best treated by removal of the greater part of the growth by the knife or caustics, and then X-rays subsequently. It has been shown by Darier that X-rays do not produce any effect on the epithelial tissue deeper than 1 cm. from the surface. Therefore, whenever possible, as much of the growth as possible should first be removed, and then X-rays applied to destroy any traces which may be left. For rodent ulcers which are still under the size of a five

shilling-piece a good method is to scrape away the hard raised edge by a sharp spoon and apply to the raw surface a chromic acid bead which has been obtained by the crystals of chromic acid on to the end of a probe in the flame of a spirit-lamp. After the scab which forms falls off, the X-rays are applied, and as a rule a rapid cure effected.

Radium has also been used successfully in the treatment of rodent ulcers, and will cure some cases which are not benefited by X-rays. *See* RADIUM.

The Finsen-light treatment may also be applied in the treatment of rodent ulcer, but its usefulness cannot compare with X-rays. It will cure small rodents which have not ulcerated, and also the warty growth which so often is the first sign of a commencing rodent. Morris recommends its use in larger rodents to soften the edge and reduce the number of subsequent X-ray exposures.

LITERATURE.—WALLACE BROWN. *Med. Rec.*, 18th May 1907. — MORRIS and DORE. *Light and X-Ray Treatment of Skin Diseases*, 1907.—WETTERER. *Handbuch der Röntgentherapie*, 1908. — DAIRER and Others. *La revue pratique des maladies cutanées, syph. et vener.*, March 1906.

Cardiolysis.—Precordial thoracotomy or the operation of resection of the ribs in cases of adhesion of the pericardium (concretio cordis) and great vessels to the sternum, lungs, diaphragm and structures in the anterior and posterior mediastinum has now been performed a considerable number of times (some twenty cases had been published by the middle of 1910). It was first employed by Brauer in the above circumstances to lessen heart embarrassment and relieve respiration, which is seriously interfered with, but it has been advocated in cases of intra-thoracic pressure due simply to the large size of the heart and to the presence of a mediastinal tumour. In the latter indications adhesions may be absent, but Thorburn (*Brit. Med. Journ.*, i. for 1910, pp. 12, 1128) is of opinion that the name cardiolysis may also be applied thereto. The technique of the operation is not specially difficult, although the separation of the posterior periosteum from the pleura may give some anxiety, but the anæsthetisation of the patient requires great care, and possibly a mixture of chloroform and ether gives the best results. *See also* HEART, SURGERY OF.

Carnabyn.—A proprietary food preparation; for analysis see *Brit. Med. Journ.*, ii. for 1909, p. 562.

Carnaubic Acid.—One of the higher fatty acids, $C_{24}H_{48}O_2$.

Carnrick's Liquid Peptonoids.—A proprietary food preparation said to contain "the albuminoid principles of beef, milk, and wheat, entirely digested and ready for assimilation." For report see *Brit. Med. Journ.*, ii. for 1909, p. 562.

Car-Sickness.—The unpleasant symptoms (nausea, giddiness, vomiting, etc.) due to riding in vehicles, such as railway carriages, electric or motor cars, and even baby carriages. It resembles sea-sickness in some particulars, but differs in others (*e.g.* it affects infants and young children and may occur during sleep), and it has been ascribed to movements of the endolymph in the semi-circular canals.

Casoid Bread. *See* DIABETES (*Diet*).

Cataphoresis. — The introduction of drugs through the unbroken skin by the agency of a galvanic current has recently been revived as a method of treatment under the names of cataphoresis, electrolysis, or ionic medication. Only medicaments which act as electrolytes—*i.e.* break up into ions—can be so introduced, *e.g.* aqueous solutions of salts, acids, and bases. Chloroform, alcohol, sugars, etc., are not ionisable, and cannot be used. In a solution of common salt, for example, the particles of sodium chloride are more or less dissociated into sodium ions and chlorine ions. The sodium ions are positively charged with electricity (= kations), while the chlorine ions are negatively charged (= anions). It is by the bodily movement of these ions that an electric current passes through an electrolyte; the kations flow towards the kathode, the anions towards the anode. The human body is an electrolyte; if it be connected with the poles of a battery through the agency of an electrolytic solution such as sodium chloride, the sodium ions will move from the anode into the body—towards the kathode, while the chlorine ions will move in the reverse direction. Kations are constituted by metallic radicles — K, Na, Fe, H, alkaloids, etc.; anions are constituted by acid radicles—Cl, SO_4, OH, etc. The main pharmacological action of most salts is due to one or other ion—thus in potassium iodide the anion, in strychnine sulphate the kation, is active. It is therefore necessary to select either the anode or the kathode according as it is desired to introduce a kation or an anion. It has been shown by Le Duc (who has done much to popularise ionic medication) that if two rabbits be connected by a pad of wet lint, and if electrodes moistened with strychnine sulphate be applied to each, the rabbit connected with the anode is poisoned (kation) while the other escapes. Conversely, if potassium cyanide replace strychnine, the animal at the kathode is killed by the poisonous anion.

The method of employing cataphoresis is as follows:—The active electrode is covered with ten or twelve thicknesses of lint soaked in the electrolyte, and is kept firmly applied to the

skin in order that the current may pass uniformly through it. The indifferent electrode is connected with a basin of salt solution in which the patient places his hand. The active electrolyte is placed over the part it is desired to treat; its size is governed by the size of the ulcer, fistula, joint, etc. The object of using so many thicknesses of lint is to prevent burning of the skin, which is apt to occur when electrodes covered only with a thin piece of chamois-leather, or the like, are used. The current is gradually raised to as much as the patient can bear (40-60 ma.), and this is kept up for half an hour, then slowly reduced to zero. Turner gives the following list of maladies in which ionic medication has been used with more or less success:—Rodent ulcer, sinuses and fistulæ, strictures, fibrous adhesions, tic douloureux, neuralgia, sciatica, rheumatism, gouty conditions. Especially good results have been obtained in rodent ulcer from the introduction of zinc ions. A 5 per cent. solution of zinc sulphate is used at the anode, applied on lint over the ulcer. Chronic ulcers, fistulæ, etc., are treated in the same way. Copper ions have been used in sycosis, Cl ions in all forms of chronic fibroid change—*e.g.* Dupuytren's contraction, stricture, and even sclerosis of the cord. Salicylic ions have been used in rheumatic affections, lithium ions in gout, iodine ions in chronic pleuritic thickening. The method of cataphoresis has obviously many possibilities.

LITERATURE.—Le Duc. *Brit. Med. Journ.*, 4th Sept. 1907.—Dawson Turner. *Ibid.*, 4th April 1908; *Edin. Med. Journ.*, April 1908.

Cavernoma.—A blood-vascular tumour or angioma, not uncommonly found in the liver, sometimes congenital in origin, consisting of blood spaces lined with endothelium; it varies in size from that of a pea to that of an orange, or even larger.

Cavitation.—The formation of a vomica or cavity in the lung (*e.g.* in tuberculosis). This term is not found in Murray's *New English Dictionary*, in Appleton's *Medical Dictionary*, nor in Gould's *Practitioners' Medical Dictionary*, but it is creeping into common use.

Cellasin. — A proprietary preparation, stated to be a ferment prepared from the cultivation of fungi, and to be capable of resolving sugar and starch into lactic acid. It is claimed that the change is due to an enzyme and not to bacteria. It is stated to pass unaffected through the stomach and to exert an emulsifying effect upon fats in the alkaline environment of the intestine. It is recommended in tuberculosis and wasting diseases. See reports in *Lancet*, ii. for 1910, p. 895, and in *Journ. Amer. Med. Assoc.*, li. p. 931, 1908.

Cerebellum, Symptomatology of Tumours of (See also *Encyclop. and Dict.*, i. p. 526).—This subject has been exhaustively studied by Grainger Stewart and Holmes, whose paper is based on an analysis of forty cases. Their series is divided into intra-cerebellar and extra-cerebellar (cerebello-pontine angle) tumours.

Vertigo.—When definite vertigo is present (indefinite giddiness is of no localising value) it consists either (*a*) of a sensation of the rotation of external objects, or (*b*) of a sensation of self-rotation. In (*a*) objects appear to move in front of the patient from the side of the lesion to the sound side. In (*b*) the movement is from the lesion to the sound side in cases of intra-cerebellar tumour; from the healthy to the diseased side in extra-cerebellar tumour.

Deafness. — Some homolateral deafness always accompanies extra-cerebellar tumour; it is rare in intra-cerebellar tumour.

Ocular Symptoms.—Nystagmus is invariable in both classes of tumour. Typically, it is a slow, jerking movement towards the side of the lesion on looking in that direction.

Motor Symptoms.—*Homolateral hemiparesis* is one of the most definite symptoms of unilateral cerebellar tumour. It is an atonic paresis, and is not accompanied by organic rigidity. The limbs are hypotonic, assume unusual positions during rest, and the muscles are flabby. Hypotonicity is best marked in early cases of acute onset, or when the cerebellum has been considerably damaged at operation. The hypotonicity is not associated with any constant change in the reflexes. *Cerebellar ataxy* differs from that of tabes in being due to a lack of accurate co-operation and association of individual muscular contractions, not to impairment of the muscular sense and sense of position. It is not increased when the patient shuts his eyes. Ataxia appears only with active movement, and does not increase towards the completion of an act. In lesions of one lobe the inco-ordination is homolateral (though the other side may be slightly affected); in lesions of the vermis the inco-ordination is bilateral, or more pronounced on one or other side as the effect of the tumour varies.

Diadococinesia.—A phenomenon described by Babinski as pathognomonic of cerebellar tumour, consisting of an inability to perform accurately and rapidly alternate movements—*e.g.* pronation and supination—is common, but is not, Stewart and Holmes think, either pathognomonic of cerebellar tumour, or constant.

Homolateral Tremor is frequent in extra-cerebellar tumour; absent in cerebellar tumour.

Gait.—There is a tendency (*a*) to stumble towards the lesion, and (*b*) to deviate from a straight path towards the lesion. Patients

correct the latter by rotating the body so that the homolateral shoulder is in advance of the other. On days when the gait is improved they may over-correct this tendency to homolateral deviation, or deviate to the opposite side.

Reflexes. — The knee-jerks vary much. In intra-cerebellar tumour they are usually diminished on the side of the lesion; in extra-cerebellar tumour, the reverse.

Diagnosis between Cerebellar and Extra-Cerebellar Tumours.—In cerebellar tumour the cardinal symptoms — headache, vomiting, and optic neuritis — appear early; in extra-cerebellar tumours, late. In intra-cerebellar tumours there is less implication of the 6th, 7th, and 8th cranial nerves than in extra-cerebellar tumours. The characters of the vertigo (*v. supra*) are also of assistance. In cerebellar tumour homolateral paresis is more marked than in extra-cerebellar tumour. Tremor is present in many cases of extra-cerebellar tumour, absent in cerebellar tumour. Crossed hemiplegia is highly suggestive of extra-cerebellar tumour compressing the pons. An extensor plantar response absolutely excludes uncomplicated cerebellar disease. (T. Grainger Stewart and Gordon Holmes, *Brain*, xxvii. pp. 522-591.)

Cerebrosides. — Nitrogen-containing, phosphorus-free bodies, resembling glucosides, found in brain protagon, *e.g.* phrenosin, kerasin, etc.

Cerebro-Spinal Meningitis, Epidemic.—After having been unknown in this country for many years, cerebro-spinal fever revisited it in 1906, and during the winter of 1906-1907 the disease occurred in an epidemic form. Belfast, Glasgow, and Edinburgh suffered most, though scarcely any considerable area throughout the country was quite exempt. With the summer of 1907 the virulence of the epidemic declined, though the disease still lingered on in 1908, cases occurring especially during the colder months. The recrudescence of cerebro-spinal fever has only been a part of a rather general prevalence of the disease throughout the western world. In 1904 it appeared in epidemic form in New York and various other parts of the United States, and about the same time epidemics were reported from Germany, chiefly from Silesia and Galicia; thence it has spread in various directions over the continent of Europe, and has naturally engaged the attention of many bacteriologists, clinicians, and sanitarians.

To the description of the clinical features of the disease as described in the *Encyclopædia and Dictionary*, vi. p. 324 there is little or nothing to add. The type of the disease varies in no respect from the classical picture. Diagnosis has been rendered more sure by the introduction of lumbar puncture and the universal recognition of the specific organism, which in most instances can be easily and certainly detected in the cerebro-spinal fluid.

The chief new facts which have been brought to light concerning epidemic meningitis since the present epidemic set in may be discussed under the heads of—(*a*) bacteriology; (*b*) mode of infection; (*c*) relation of epidemic to posterior basic meningitis; and (*d*) treatment. In the last of these, happily, marked advance has been made.

1. Bacteriology.—An immense amount of literature has appeared on the bacteriology of the disease, and it is not proposed to enter upon technical details as to the morphology and cultural characters of the organism here. For these, original papers and special text-books must be referred to. Only some of the main points will be noticed. All observers have confirmed the specificity of the *diplococcus intracellularis meningitidis* of Weichselbaum. The organism can almost always be detected with comparative ease in the fluid withdrawn by lumbar puncture, and has also been detected in the blood, although its isolation from the blood is difficult, and not always successful. It stains readily with ordinary dyes—for clinical purposes Leishman's or Jenner's stain is convenient — and is found inside as well as outside the polynuclear leucocytes. It is usually present in the cerebro-spinal fluid from the onset of the disease, but as time goes on it disappears therefrom. It may be found as late as the fortieth day. Organisms are usually scanty in the very acute (fulminant) cases, and in very mild infections; they are, on the whole, most abundant in the moderately severe type. Though the cultural and staining reactions of the meningococcus have been carefully studied, there is not entire agreement on some details. Here it is enough to say that one of the leading matters in dispute is their reaction to Gram's stain. Meningococci are, as is generally known, Gram-negative organisms, but some bacteriologists deny that this is an absolutely invariable character. Stuart M'Donald has described strains of meningococci which, Gram-negative in smears of cerebro-spinal fluid, became Gram-positive in cultures. Ritchie and others who hold strongly that the true meningococcus is always Gram-negative, believe that supposed variations are to be ascribed either to contaminations of the cultures with extraneous organisms (Gram-positive diplococci) or to differences in the technique of staining by Gram's method. The supporters of the variability of the organism hold that such an explanation is untenable, and here, at present, the matter rests. In most cases the meningococcus, and the meningococcus alone, is found on lumbar puncture and on post-mortem

examination; M'Donald, however, has made the very interesting observation that in some cases it is associated with a leptothrix. For the methods by which the meningococcus is distinguished from the gonococcus and micrococcus catarrhalis special text-books must be referred to. W. T. Ritchie has described an incontrovertible case of gonococcal meningitis in which the accuracy of the bacteriological diagnosis was controlled by the method of complement fixation. The micrococcus catarrhalis is a common denizen of the naso-pharynx, and is a fertile source of difficulty in the detection of infection-carriers.

The opsonic and agglutinating power of the blood in meningitis has been thoroughly worked out. Normal blood serum has very little opsonic action, and no agglutinating action on the meningococcus. Serum of cases of cerebro-spinal fever, on the other hand, has a very high opsonic index and very marked power of agglutination. An opsonic index of 40 or 50 is not uncommon. The opsonic power of the blood is developed from the second day onwards; it disappears during convalescence. Houston and Rankin found a high opsonic index and marked agglutination ("positive reaction") in 25 per cent. of cases examined between the second and fourth days of the disease, in 60 per cent. on the fifth day, and in 96 per cent. on the sixth day and after. The blood serum of patients suffering from typhoid, tuberculosis, pneumonia, or staphylococcal infection was found to have no agglutinating action whatever. It is difficult to escape supposing that the unusually high opsonic index met with in this disease is due to some extent to the clumping of the bacilli affording the phagocytes special opportunities for ingesting masses of organisms, in a way which would not be the case were agglutination less marked. Houston and Rankin, while admitting this possibility, point out that very high agglutinative power is sometimes accompanied by a lower degree of phagocytosis.

Another noteworthy fact in connection with the pathology of the disease is that the cerebro-spinal fluid of epidemic meningitis always has a low opsonic and agglutinative power. This explains why the symptoms of the disease go on unchecked despite the high opsonic and agglutinative power which the blood serum develops. Dingwall Fordyce found that, even when as much cerebro-spinal fluid as possible was withdrawn, that which replaced it (derived, of course, from the highly agglutinative and opsonic blood serum) had little or no opsonic power. As an example the following may be quoted from his observations:—"In the second case three estimations were made. At the first all the obtainable lumbar fluid was drawn off, lumbar puncture was again performed half an hour later, and a little fluid withdrawn, and three hours later more fluid was withdrawn. The index of the blood serum of the patient at the time was 20, and there was distinct clumping. Examination of the fluid first withdrawn showed an index of 0·6, of that withdrawn second, 0·8 and of that withdrawn last 0·7. It would appear, therefore, that the idea of performing frequent lumbar puncture with a view to bathing the parts in a fluid of high opsonic power is not one likely to meet with marked success."

So constant, after the fifth day, is this "positive reaction" of the blood serum that a diagnosis may be founded on it alone. The recognition of the meningococcus is, of course, preferable, as being a simpler method, and a direct, instead of an indirect diagnostic agent.

2. Mode of Infection.—This may be considered under two heads—(*a*) Channel of entry of the organism, and (*b*) nature of the spread of infection from one person to another.

(*a*) *Channel of Entry.*—It has been proved that the meningococcus can be recovered from the naso-pharynx of most cases of cerebro-spinal meningitis, and it used to be assumed without question that it entered the cranial cavity directly from the throat. The latter point, however, is by no means so clear as the former, and there is some reason to suppose that the meningococcus may gain entry to the blood-stream and attack the nervous system from the spinal canal. M'Donald and others have drawn attention to the fact that in many autopsies the lesion is more advanced in the spinal cord than at the base of the brain. No direct spread from the naso-pharynx to the cranium has been conclusively demonstrated by post-mortem evidence. The possibility of an intestinal infection through swallowing the meningococcus has been suggested by the observation that in cerebro-spinal fever there is often a very marked hyperæmia of the lymphatic glands and follicles of the intestine. M'Donald, however (who was one of the earliest to direct attention to this), found similar changes in a monkey infected by direct inoculation into the spinal cord, so that it may well be due to the general toxæmia. From the clinical standpoint Fowler points to the abolition of the abdominal reflex from the commencement of the disease, and to the retention of consciousness and intelligence in children until its later stages, as suggesting an earlier implication of the cord than the brain. For practical purposes, however, it is important to recollect that, by whatever path the meningococcus actually enters the central nervous system, it gains its first lodgment in the body in the naso-pharynx.

(*b*) *Spread of the Disease.*—In the present, as in former epidemics, it has been noticed that the incidence of the disease in a community is

capricious in the extreme. Cases occur scattered all over a town; they neither select especially the poorer quarters, nor group themselves in streets or houses, as might be expected to take place were there direct infection from patient to patient. In 1906 Jehle published the results of some very interesting investigations on the mode of spread of the disease, in an epidemic occurring in two mining districts, Orlau and Neumühl. He showed that cases which occurred in rapid succession in point of time were separated from each other by such distances as to put the idea of direct contagion out of count. Children, who form a majority of the patients, cannot be carriers of the infection, for school epidemics do not occur. Jehle then looked to the adult population in his search for infection-carriers. In the districts under his supervision there were various mining villages, the inhabitants of which worked in different mines, so that in each village there were workers in several mines, and in each mine, dwellers in several villages. Children who fell victims to cerebro-spinal fever were nearly all members of families of miners who worked in one or two particular mines, while neighbouring children, whose parents worked in other mines, escaped. Other channels of inter-communication did not complicate the research. Mines, according to Jehle, being warm, damp, sunless places, favour the growth of the meningococcus. They may act as foci of infection, just as schools do with regard to measles. Miners become infected with meningococci without contracting the disease; it flourishes in their post-nasal spaces, and is disseminated by sneezing and coughing. As a class, miners are prone to catarrh; children do not expectorate and sneeze as adults do, hence even when they harbour meningococci they are not dangerous sources of infection. Further confirmation of Jehle's theory is afforded by the following facts:—At Neumühl there are two large mines, the workers in which inhabit separate villages communicating freely with one another by rail and tram. For the first four weeks of the epidemic cases occurred in only one of these villages; from 10th February onward cases cropped up in the second, and then the epidemic became general. During the first period no miner was transferred from one mine to the other; early in February, some miners left the infected mine and went to the other; ten days later the disease appeared in a hitherto uninfected village. This theory of the epidemiology of the disease, that adults chiefly transmit, and children chiefly become infected with, without transmitting, the disease, explains why, when several children in a house suffer, they are usually attacked almost simultaneously, while in garrisons, etc., where adults are congregated together, they are attacked successively.

An investigation at Leith in 1907 led to similar conclusions. Comrie and Fraser found meningococci in the nares of 10 out of 69 contacts. Of these 69 contacts, 15 were fathers of patients, 54 were in some other relationship. Five of the infected contacts were fathers, 5 were not fathers; that is, 33 per cent. of the fathers harboured meningococci, as against 9 per cent. of the not-fathers. Of the 15 fathers 5 worked on a ship lying in Leith Docks; in the air of the engine-room meningococci were found.

The generally accepted view of the transmission of the disease may be stated thus:—The meningococcus can be discovered in the upper air passages of all cases of cerebro-spinal fever provided it is sought for early enough in the disease; it is also present in healthy contacts (bacilli-carriers).

Bacilli-carriers are probably about four times as numerous as patients (Lingelsheim); they have little tendency to contract the disease.

Susceptibility to the disease is rather limited (to children, especially); the predisposition to receive and harbour the organism is somewhat general. Commonly, but not invariably, it is associated with nasal catarrh; this predisposes to, but is not a result of, the reception of the organism. The meningococcus disappears from the naso-pharynx in a fortnight (dating from the time it is discovered) in 75 per cent., and by the end of the third week in 90 per cent., of cases.

Apparently the carriers who are most dangerous are adults whose occupation brings them in contact with numbers of children, and who, suffering from catarrh, are careless about sneezing and expectorating. Children are much less dangerous as carriers, for school epidemics do not occur.

3. Relation of Epidemic to Posterior Basic Meningitis.—While an acute case of cerebro-spinal fever is totally distinct from a typical case of posterior basic meningitis, it is impossible by reference to the clinical symptoms alone to draw a hard and fast line between the two diseases. During the Edinburgh epidemic of 1907 several cases were admitted to the wards of the Sick Children's Hospital, which in their course and symptoms were practically indistinguishable from ordinary post-basic meningitis. The most that could be said was, that they differed in some minor particular—*e.g.* herpes was relatively common, whereas it is rare in sporadic posterior basic meningitis. In its cultural and tinctorial reactions, Still's organism (to which posterior basic meningitis is due) resembles Weichselbaum's meningococcus very closely indeed. If we regard the two diseases as having an identical etiology, posterior basic meningitis would represent the sporadic (and attenuated) form of cerebro-spinal fever, and we might look upon it as the means by which the contagion is kept alive between epidemics. To this hypothesis, however, certain difficulties oppose themselves. Posterior basic meningitis is always present in large communities; epi-

demics are rare. Again, if they are identical, why does the type of posterior basic meningitis remain so constant? Why does it not more often assume an acute form? The only answer to these difficulties is to suppose that, for some unknown reason, the diplococcus meningitidis periodically acquires exalted virulence.

Houston and Rankin's work on the opsonic and agglutinative reactions of meningococci throw some light on the relation of the two diseases, and prove that the diplococcus of Still and the diplococcus of Weichselbaum, though alike in most respects, are not quite identical. By comparing the reactions of meningococci from the Belfast epidemic with meningococci from London and Edinburgh post-basic cases, and of both these with London and Edinburgh epidemic cases, they found a post-basic meningococcus was only agglutinated and opsonised by the blood serum of post-basic cases, not by the blood serum of epidemic cases, while the meningococcus of epidemic cases was only agglutinated and opsonised by the blood serum of that disease, not by the blood serum of post-basic meningitis. They believe that "at least one variety of Gram-negative coccus, corresponding closely in cultural characters with the true meningococcus, is capable of producing meningitis. This coccus, for the present, may be styled the coccus of posterior basic meningitis, or of Still's disease. It differs entirely from the true meningococcus in its opsonic and agglutinative reactions." The correctness of Houston and Rankin's observations has been confirmed by other workers, and they certainly point strongly towards there being a more fundamental difference between posterior basic meningitis and cerebro-spinal fever than is implied in the adjectives "sporadic" and "epidemic."

4. TREATMENT.—This naturally divides itself into preventive and curative.

(*a*) *Preventive Treatment.*—The line of treatment laid down by Lingelsheim in a recent paper, officially communicated to the Prussian Government, is as follows:—Patients are less dangerous sources of infection than healthy bacilli-carriers, because on account of the dryness of their upper air passages they excrete few bacilli. The cerebro-spinal fever patient is, so to speak, the product of a widely diffused contagium, and regulations framed solely to prevent his spreading the disease have little prophylactic value. Cases should, however, be removed to hospital, and the dwellings disinfected. The meningococcus has such slight power of resisting drying that elaborate disinfection of houses is not necessary. It is more important to examine for infected contacts, especially the more remote contacts—*e.g.* visitors to the household, etc. When a case of cerebro-spinal fever develops it may almost be taken for granted that the immediate contacts will have meningococci in their throats; the chief step which can be taken to prevent the disease spreading is to identify the more remote carriers. Hence as many as possible of the visitors to the house, especially such as suffer from catarrh, should be examined. At the beginning of an epidemic such carriers should be isolated. When an epidemic has once taken firm hold it is almost impracticable to isolate carriers, because for every case of fever there are so many carriers, and it is almost useless to isolate a few. No satisfactory way of disinfecting the nose is known: pyocyanase (recommended by Jehle), sublimate, silver salts, zinc sulphate, permanganate, boric acid, and volatile oils have all proved unsatisfactory, however applied to the nose. Contacts should be isolated for three weeks, or until meningococci can no longer be found. In addition to isolation the public should be instructed as to how the disease spreads, and persons suffering from catarrh ought to exercise care in the matter of expectorating, coughing, and sneezing.

(*b*) *Curative.*—The recent additions to our armamentarium against the disease comprise—(1) repeated lumbar puncture, (2) the injection of antiseptics into the spinal canal, and (3) anti-meningococcus serums.

(1) Repeated lumbar puncture is possibly beneficial, and certainly harmless. It may relieve the severity of the headache. Whether it has much curative effect is doubtful, but it should be employed if other remedies are not available.

(2) Injections of antiseptics (lysol, 1 per cent., and collargol, 5 per cent.) have been tried. Several cubic centimetres of cerebro-spinal fluid are withdrawn, and an equal quantity of the (warmed) antiseptic solution injected. A few successes have been reported, but failures have been more numerous. On post-mortem examination of patients treated with collargol, traces of the brown solution can be found at the base of the brain, showing that intra-spinal injections diffuse widely through the central nervous system.

(3) Anti-bacterial serums hold out by far the best prospect of cure. Mackenzie and Martin have tried injecting the patient's own blood serum into the spinal canal. The serum contains immune body and complement, and is also anti-bacterial. The results are said to have been encouraging. Serum of convalescent patients has also been used.

Flexner's serum (which is not yet procurable commercially) is derived from horses immunised against many strains of meningococci; the process requires four or five months. The serum acts chiefly on the vitality of the coccus, and increases its liability to phagocytosis. It is bacteriolytic, and to some extent antitoxic. Early administration is extremely important. Lumbar puncture should be performed, and as much fluid as possible withdrawn. In bad cases 30 or even 40 c.c. of serum are then injected into the spinal canal and the dose

is repeated in twelve or twenty-four hours if the temperature does not fall and the symptoms abate. In mild cases the dose is 15-20 c.c. In twenty-four hours the meningococci in the cerebro-spinal fluid are reduced in number and stain badly; the polynuclear cells also diminish. The temperature falls, and the symptoms rapidly improve in favourable cases. Very good results have been obtained with Flexner's serum by those who have been so fortunate as to have it placed at their disposal. Holt gives the following statistics of 442 collected cases treated:—The general mortality of the disease is 50 to 80 per cent.; in the series of cases treated by Flexner's serum it was 33 per cent. Eliminating patients who were moribund when the serum was first injected, the mortality was 25 per cent. In patients injected on the first day the mortality was only 14·9 per cent.; from fourth to seventh day, 22 per cent.; after seventh day, 36 per cent. The mortality among untreated patients under two is 90 per cent., of serum-treated, 46 per cent. The average duration of symptoms in serum-treated cases is eleven days; a quarter of the cases end by crisis, three-quarters by lysis. In 5 per cent. of cases relapses occur; these are usually recovered from. Relapse is most likely to occur if the temperature has not reached normal after the injection of serum, hence persistence of the fever shows that more serum is required. Dr. C. B. Ker also speaks favourably of the results of using Flexner's serum.

Ruppell's serum (Meister, Lucius, and Brüning) is an anti-bacterial serum prepared from several strains of meningococcus of high pathogenicity. Intra-peritoneal injections of 1 c.c. of a fluid culture in dilution of 1:200,000,000 is lethal to rabbits. It appears to do good in some cases, and ought to be tried. Poynton and Fowler have reported cures in cases of posterior basic meningitis with Ruppell's serum. Of other serums, Kolle's is perhaps the best known. *Vaccines* have been tried by Dingwall Fordyce and Hector Mackenzie; their utility is doubtful.

The serum treatment of meningitis appears to promise much. Flexner's serum seems to be the most efficient; next to it probably Ruppell's. Whichever be used, it should be injected into the spinal canal. Subcutaneous injections are useless, as indeed might be expected considering that the agglutinative and opsonic power of the blood is already high in cerebro-spinal fever.

LITERATURE. — Houston and Rankin, *Lancet*, 4th May 1907; *Brit. Med. Journ.*, 16th Nov. 1907.—Lingelsheim, *Klinisches Jahrbuch*, xix. Heft 4, 1908.—John Thomson and Stuart M'Donald, *Scott. Med. and Surg. Journ.*, Mar. 1907.—Symmers and Wilson, *Brit. Med. Journ.*, 22nd June 1907.—Rotch, *Trans. Assoc. Amer. Physn.*, 1907.—Symmers, Holt, Kolle, W. T. Ritchie, Ker, Batten, and Others (Discussion), *Brit. Med. Journ.* 31st Oct. 1908.—Fowler, *Rev. Neur. and Psychiatry*, April 1907; Jan. 1909.—Comrie and Fraser, *Trans. Edin. Med.-Chir. Soc.*, xxi. p. 230, 1906-7.—Jehle, *Wein. klin. Wochensch.*, No. 25, 1906; *Münch. med. Wochensch.*, No. 29, 1906.—Gordon, *Report to L. G. B. on Meningococcus and its Identification*, 1907.—Dingwall Fordyce, *Internat. Clinics.* vol. i. ser. 18, 1908.—Hector Mackenzie, *Brit. Med. Journ.*, 15th June 1907.—Ruppell, *Deutsche med. Wochensch.*, 23rd Aug. 1906.

Cervical Ribs.—Although cervical ribs have long been known as anatomical curiosities, the fact that in some cases they give rise to definite symptoms has escaped recognition until within the past year or two. Their morphology was fully described by Sir William Turner in 1870. More or less developed ribs are not infrequently met with in connection with the seventh cervical vertebra, and in rare instances the sixth cervical also carries ribs. The abnormality is usually bilateral. Cervical ribs may be quite rudimentary—mere elongations of the transverse process; they may be longer, fusing by their extremities with the first dorsal rib; they may form complete ribs, articulating anteriorly with the sternum. A cervical rib is sometimes long, thin, and pointed; sometimes broad and flat, like the first dorsal rib. Its direction, as well as its size, is important. If it runs directly outwards, it may give rise to considerable deformity in the neck, whereas if it curves round towards the sternum it will come into relation with the subclavian artery. If the rib be short, the subclavian artery and brachial plexus lie in front of it; if it be longer and curved it has a groove in its upper surface, and in this groove the artery lies. The artery is thus lengthened, and is rendered unduly prominent in the neck; the vein, lying below and in front of the artery, is less liable to be lifted into the neck. The brachial plexus, lying behind the artery, always crosses the rib if the artery does so; its lowest cord is most likely to suffer.

Symptoms.—Apart from the deformity in the neck which may exist, the symptoms which are caused by cervical ribs are due to pressure on the vessels and nerves. Pressure symptoms are not found in every case of cervical ribs; it is estimated that they occur in from 5 to 10 per cent. of all cases. Thorburn, to whom much of our knowledge of the symptomatology of the condition is due, found that thirteen out of seventeen patients showed symptoms, but points out that this is obviously an excessive proportion, because it was generally only the existence of the symptoms which lead to a diagnosis being arrived at. The symptoms are not, as might be supposed, congenital, although the malformation is. They develop gradually, their evolution depending on the progressive growth and rigidity of the ribs. The period of greatest growth is from the fifteenth to the twenty-fifth year, and in most cases symptoms do not manifest themselves until after the fifteenth year, though the onset may be delayed

until much later—fifty in one of Thorburn's cases. Symptoms rarely occur during childhood; Keen collected only six cases in which they began before the fourteenth year. When symptoms appear for the first time in advanced life, their onset is apparently due to senile changes (rigidity) in the arteries.

Although cervical ribs are almost always bilateral, the symptoms which they produce are often limited to one side (nine out of thirteen in Thorburn's cases). The right arm is more commonly affected than the left, probably because it is more freely used. The onset of the symptoms is sometimes preceded by a strain or wrench. For some reason cervical ribs more frequently give rise to symptoms in women than in men.

Affection of the Subclavian Artery is shown by weakening of the radial pulsations, which become stronger when the arm is raised so as to remove the bend in the vessel where it crosses the rib. From the abnormally high position of the vessel, aneurism in the neck may be simulated. Thrombosis of the artery and gangrene of the finger-tips may occur. The subclavian vein is seldom compressed; œdema of the hand has, however, been observed.

Affections of the Nerves is more important; neuralgia or paralysis may be caused. In neuralgic cases the pain has a characteristic distribution, corresponding with the area supplied by the first dorsal or first dorsal and eighth cervical roots. It is most marked along the ulnar border of the forearm, extending from above the elbow to the wrist or fingers. It is of a tingling character, and is associated with a sensation of coldness. Pressure above the clavicle may aggravate it.

In paralytic cases there is generally a history of antecedent neuralgia. The motor symptoms are due to irritation of, and pressure on, the brachial plexus, and differ in degree in different cases. The intrinsic muscles of the hand are partially or completely paralysed, and some or all of them are wasted; adduction and abduction of the fingers and thumb are impaired; cramps, clonic twitchings, and spasms may occur. There is often anæsthesia or hyperæsthesia of the skin of the inner aspect of the arm and the ulnar half of the hand. The paralysis involves the domain of the first dorsal or first dorsal and eighth cervical roots, and, as in other affections of the brachial plexus, dissociated disturbances of sensation may occur.

In rare instances the cervical sympathetic is involved, perhaps from pressure, perhaps, as Keen suggests, from associated syringomyelia; inequality of the pupils and palpebral fissures and unilateral sweating result. Scoliosis is a not uncommon associated symptom (twenty-two out of sixty-one cases). In some cases the association is merely accidental, in others (congenital scoliosis) the curvature is due to inequalities in the sizes of the vertebræ, or intercalated vertebræ. Torticollis may also be met with.

Diagnosis. — Hitherto the true nature of these cases has frequently been overlooked, but the diagnosis is not difficult if the possibility of cervical ribs be borne in mind. Unless the rib is palpable, a diagnosis can only be made by X-rays. Sometimes, even when the rib is long, it may, from its position and angle, be hidden by a transverse process and cast no shadow. The association of vascular with nervous symptoms is of diagnostic importance, particularly the fact that the pulse becomes stronger when the arm is raised. Cervical ribs have been mistaken for Raynaud's disease and writer's cramp; the condition has also been diagnosed as "brachial neuralgia," "symmetrical palsy of the hands," or "radicular paralysis." Thorburn states that "uniradicular paralyses due to causes other than cervical ribs are very rare, and their true pathology is unknown." According to Keen, affection of the cervical sympathetic is presumptive evidence of an associated syringomyelia.

Treatment.—The rib should be removed. The fact that paralysis may, and often does, supervene upon neuralgia warrants operation as soon as the condition is diagnosed. Thorburn advises a vertical incision in the posterior triangle of the neck, the vessels and nerves being displaced forwards. The suprascapular nerve must be carefully guarded from injury. After clearing the rib, it, with its periosteum, is cut through near the spine, and then drawn forwards. "If attached in front by ligaments only it comes up into the wound very readily, and can be excised with scissors, but if its anterior attachments be bony, its total removal becomes very difficult on account of its relation to the pleura. In such cases it may be cut away anteriorly with gouge forceps. In any event, the radial pulse should be watched, and enough of the anterior part of the rib should be removed to make it certain that all pressure is removed from the artery" (Thorburn). Certain definite dangers may be encountered during the operation: — (1) Paralysis (not always transient) of the brachial plexus from the stretching to which it is subjected. (2) Consecutive aneurism of the subclavian artery. (3) Injury to, or wound of, the pleura. The result of removal of the rib is very satisfactory; even wasted muscles may recover.

LITERATURE. — Thorburn, *Manchester Medical Chronicle*, vol. xiv., 1908.—Keen, *Amer. Journ. Med. Sci.*, Feb. 1907.—Gardner, *Gaz. des Hôpitaux de Paris*, 25th May and 1st June, 1907 (General Review, with References).

Chauffeur's Fracture. — Fracture of the lower end of the radius due to the firing back of motor car engines when an

attempt has been made by the chauffeur to start them without retarding the spark; the blow is given by the crank handle revolving suddenly, and the fracture is transverse or oblique into the wrist joint; three weeks are needed for recovery; and the injury is often mistaken at first for a strain.

Chapman's Food.—A proprietary preparation; entire wheat flour. *See* Report in *British Medical Journal*, i. for 1910, p. 1240.

Cheltine Food.—A proprietary food preparation, the analysis of which is given in the *British Medical Journal*, i. for 1910, p. 1240.

"Chemical Juice."—*See* Digestion (*Gastric*).

Chittenden's Standard Diet.—*See* Diet.

Chloride-free Diet.—*See* Nephritis, Treatment of (*Dechlorination*).

Chloroma.

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Chloroma is a rare disease, characterised by progressive anæmia and asthenia, greenish tumour-like deposits in various parts of the body, most typically in the temporal regions and orbits, and a leukæmic condition of the blood. It is more common in males than females, usually occurs before the age of twenty, and is invariably fatal within a few weeks or months of its onset. Between 1893 and 1904 about twenty-one cases were reported, and since that date a considerable number of others have been described, without, however, adding materially to our knowledge of the disease.

Clinical Features.—The usual symptoms of profound anæmia are present, and need not be referred to at length. Unless the greenish tumours are visible the diagnosis cannot be made from leukæmia either by physical examination or examination of the blood. In many cases the true nature of the disease has only been discovered at the autopsy. In a well-marked case, however, the aspect is very striking. The chloromatous tumours invade the orbits and temporal regions, causing bilateral proptosis and broadening of the upper part of the face; the swellings have a distinct greenish-yellow colour, much more apparent than the green tint which is sometimes present in chlorosis, and this is quite characteristic. On post-mortem examination the chloromatous deposits are found dispersed widely throughout the organs; and they are sometimes localised in superficial parts of the body other than the cranium, so as to be visible as greenish tumours during life. Thus Schmidt records a green discoloration of the skin of the face, and Bramwell and Hitschmann nodular green tumours of the skin. In Dunlop's patient, one of the first in which a correct diagnosis during life was made, green deposits appeared on both conjunctivæ.

Among other noteworthy symptoms which have been met with in the disease are Bence Jones's albumosuria, deafness, blindness, hæmorrhages, ulceration about the mouth, enormous swelling of the gums (Bramwell), tumour-formation in the breasts, and enlargement of the spleen, liver, and glands. Chloroma, therefore, is protean in its symptoms, but, as Dock states, most of them can be referred to one of three causes:—the mechanical result of the green growths—exophthalmos, blindness, deafness; the toxic symptoms—asthenia, fever, and emaciation; and the blood symptoms—pallor, hæmorrhages, and the abnormal blood picture.

Changes in the Blood.—In all cases carefully examined leukæmic condition of the blood has been found. The full picture of luekæmia, however, does not always develop. Sometimes there is at the beginning a normal, or almost normal white count, but even with this there will generally be found a relative excess of lymphocytes—*e.g.* Bramwell's case, which showed only 8000 leucocytes, with 95 per cent. of (mostly large) lymphocytes. As a rule, the blood corresponds with the picture of lymphatic leukæmia, but in several cases a myelocytic condition has been seen. Cases intermediate between the two also occur—*e.g.* Dunlop's patient, who during the early stage of the disease had a less leucocyte count (24,000), with between 70 and 80 per cent. of lymphocytes, and during the later stages a leucocyte count of 123,000, with nearly 15 per cent. of neutrophile myelocytes.

Localisation of the Chloromatous Tumours.—In nearly all cases some part of the head is involved—the orbits, dura, temporal bones, especially the temporal fossa and auditory region, sphenoid and ethmoid, are favourite sites. The vertebræ, ribs, sternum, clavicles, pelvis, and diploe of the skull are also frequently involved. New growths also occur in the viscera, especially in the kidneys, liver, glands, and spleen—indeed, scarcely any organ can be mentioned which has not been affected

in one or other of the recorded cases. The marrow of the long bones has been invaded in a good many instances.

Colour of Chloroma.—The nodules and deposits are of a very remarkable green tint, which is sometimes so brilliant as to merit the appellation grass-green. More commonly, however, the colour is more like that of greenish pus. In most cases all the tumours have shown this green colour; in a few the colour has not been universal, but some of the tumours have been red or brown. The nature of the colouring agent is not known. It is neither due to putrefaction, to the action of bacteria, nor to bile pigment. It rapidly fades on exposure to air, and cannot be preserved in any of the ordinary mounting fluids. Faded organs sometimes regain their colour when reducing agents are applied to them; in other cases peroxide of hydrogen has had a similar effect. It is supposed that the characteristic green colour may be due to blood pigment, or to the presence of highly refractile granules in the tumour cells. Bramwell doubts whether the colour is of identical origin in all cases; he considers that in some cases of true chloroma the colour may be absent.

Pathology.—Histologically the new growths resemble a leukæmic lymphoma. According to Treadgold the chief distinctions are:—(1) In chloroma the infiltration of the walls of the small blood-vessels is better marked; (2) metastases are more frequent; (3) the eroding power of the cells is greater, for bone and nerve may be infiltrated and destroyed; (4) the cells are larger and possess more protoplasm. Apparently the new growths may be composed either of cells of the lymphocyte type, or granular cells. Warthin found many eosinophiles in his case; others have found neutrophile myelocytes. Meixner divides cases into "myeloid" and "lymphoid" chloroma on the basis of these findings. It is generally agreed that chloroma originates in the red marrow. It will be remembered that after puberty the red marrow is limited to the epiphyses of the long bones, the cranium, sternum, ribs, vertebræ, pelvis, etc.—precisely the sites which are most constantly involved by the tumour. Treadgold points out that where, as is often the case, a new growth is found involving diploe, periosteum, and dura mater, it is only reasonable to suppose that it arises from the red marrow. That it does not originate outside the bones is shown by Meixner's case (myeloid chloroma) in which only the skeleton was invaded by the neoplasm.

Classification of Chloroma.—There is much conflict of opinion as to the nosological position of the disease. In some respects it resembles the sarcomata, in others, leukæmia. Dock links it to the leukæmias, and proposes the following scheme:—

- Chloroma (Chloromatous Leukæmia).
  - Aleukæmic Chloroma (?)
  - Leukæmic Chloroma
    1. Small lymphocyte type (?)
    2. Large lymphocyte type (?)
    3. Neutrophile type
    4. Eosinophile type
    5. A typical type
    6. Mixed type

Treadgold looks on the leukæmias and chloroma as very closely allied to the sarcomata. Chloromatous new growths arise from the myeloblasts of the bone marrow, and therefore the disease is more closely related to acute myelocytic leukæmia than to any other condition. He offers the following scheme to elucidate the interrelationships of the group of diseases:—(1) Lymphosarcoma. (2) Leucoblastoma (acute lymphatic leukæmia). (3) Lymphocytoma—myelogenous (chronic lymphatic leukæmia) and glandular (pseudo-leukæmia). (4) Myeloblastoma (acute myelocytic leukæmia and chloroma). (5) Myelocytoma (chronic myelocytic leukæmia).

Meixner, distinguishing between lymphoid and myeloid chloroma, regards both as sarcomatous: we have lymphosarcoma and chlorolymphosarcoma and (an as yet hypothetical) myelosarcoma, and chloromyelosarcoma.

LITERATURE.—Dunlop, *Brit. Med. Journ.*, vol. i. p. 1072.—Bramwell, *Ibid.*, vol. ii. p. 453, 1902, and *Scott. Med. and Surg. Journ.*, vol. x. p. 219, 1902.—Dock, *Trans. Assoc. Amer. Physn.* (Phila.), 1904 (with literature to date).—Klein-Steinhaus, *Zentralb. f. allg. Path.*, Bd. 2, 1904.—Meixner, *Wien. klin. Wochensch.*, No. 20, 1907.—Treadgold, *Quarterly Journ. Med.*, April 1908 (with literature).

Chorea.—Poynton and Paine have isolated the diplococcus rheumaticus from the cerebro-spinal fluid of cases of fatal chorea; they have produced twitching movements and arthritis by injecting it into rabbits; they have demonstrated it in the pia and brain in chorea and in rabbits which have shown twitching movements. Dr. D. B. Lees urges that since, in the majority of cases, chorea means a brain infected with rheumatic diplococci, the treatment which cures rheumatism ought to cure chorea. Acting on this idea he gives to cases of acute chorea large and frequent doses of sodium salicylate. He states that success depends on the amount given daily, a further improvement sometimes following each increase in the dose. In treating a case of chorea (or rheumatism) with the large doses of salicylate advocated by Lees, there is a certain degree of risk of producing acid intoxication (see Acidosis), and

to obviate this risk the following rules must be adhered to:—(1) Enough bicarbonate of soda must be given along with the sodium salicylate to keep the urine alkaline. For this purpose it is customary to give twice as much bicarbonate as salicylate. (2) Constipation must be prevented; the bowels should act freely every day. (3) Careful watch should be kept for any symptoms of salicylate poisoning, especially for a peculiar deep inspiration resembling the "air-hunger" of diabetes. If this occurs, the salicylate should be stopped, and the bicarbonate increased.

For a child aged six to ten years Lees advises that the dose should be at first 10 grs. of salicylate with 20 grs. of bicarbonate; after two or three days the quantities should be raised to 15 grs. and 30 grs. respectively, and after another two or three days to 20 grs. and 40 grs. Ten doses are given in the twenty-four hours—two hourly by day, three hourly by night. The unpleasant symptoms occasionally caused by salicylate on adults—deafness, singing in the ears, delirium—are rare in childhood. Vomiting is sometimes troublesome, but may be overcome by intermitting the treatment for a day or two. Heart failure is due to rheumatic dilatation of the left ventricle, not to the drug, and "general depression" is usually absent.

In many cases this method of treatment yields extremely good results: the choreic movements speedily cease, and the patient puts on weight steadily. The risk of acid intoxication, which undoubtedly exists, can to a very large extent be prevented by attention to the reaction of the urine and the state of the bowels. It is, however, obvious that these large doses of salicylate can only be used with safety if the child is under constant medical supervision; "air-hunger" may develop rapidly, and unless it is at once recognised and the salicylate withdrawn, disaster may follow. In a discussion on the subject at the British Medical Association meeting of 1903, the late Dr. Ashby confessed that he was afraid of giving such large doses as Dr. Lees recommends, and thought that more moderate doses—40 to 60 grs. daily—would do as much as the large ones, with less risk. Langmead has reported a series of cases of acid intoxication from sodium salicylate. The urine of the patients contained acetone and diacetic acid (nitro-prusside test); oxybutyric acid was not examined for. The main facts are as tabulated:—

Case.	Age.	Dose of salicylate per 24 hours.	Total quantity of salicylate before acidosis developed.	Duration of treatment.	Sodium bicarbonate before onset of sympton.
1	5 years	20 grs.	1400 grs.	10 weeks	none
2	7 „	120 grs. for 6 doses, then 60 grs.	210 grs.	3 days	420 grs.
3	7 „	150 grs.	400 grs.	3 „	300 grs.
4	6 „	60 grs.	240 grs.	4 „	120 grs.
5	7 „	240 grs.	360 grs.	36 hours	480 grs.
6	10 „	60 grs.	140 grs.	4 „	none
7	4 „	20 grs.	360 grs.	5 „	none
8	8 „	160 grs.	580 grs.	5 „	none

Ocular Symptoms in Chorea.—Langmead describes the occurrence in some cases of chorea of the following ocular symptoms, which do not find a place in the ordinary text-book descriptions of the disease. (1) Hippus. This is often difficult to detect, because the rapid jerking movements of the eyes allow a constantly varying amount of light to fall on the retina, and in consequence the pupils perpetually alter in size. True hippus, however, can sometimes be observed. (2) The movements of accommodation are sometimes asymmetrical, particularly when the pupils are unequal, one pupil contracting to accommodation while the other remains dilated. (3) Contraction to light and accommodation unequal on the two sides. (4) Variable irregularity of the pupils, one being larger than the other at one time, and smaller at another. (5) Eccentricity of the pupils. Similar ocular changes have also been described by R. W. Philip.

Septicæmic Chorea.—Sachs reports two fatal cases of acute chorea with endocarditis and septicæmia—staphylococcus aureus in one case and streptococcal in the other: several other cases seen in hospital and private practice are referred to. He proposes the following classification of chorea:—(1) Chorea with no evidence of any infection. (2) Rheumatic chorea. (3) Chorea gravidarum. (4) Senile chorea. (5) Septicæmic chorea.

References.—Lees, *Brit. Med. Journ.*, 29th Aug. 1903 (with discussion).—Langmead, *ibid.*, ii. p. 820, 1907.—*Idem*, *Lancet*, 18th Jan. 1908.—Sachs, *Med. Rec.*, New York, 28th Mar. 1908.—Poynton and Paine, *Lancet*, 16th Dec. 1908.

Chorea Gravidarum.

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No very striking advance has been made in the past five or six years in the understanding of chorea gravidarum, and the malady still remains one of the most serious complications of the pregnant state. Still, there have been additions to our knowledge of the disease.

Nature and Diagnosis.—Just as with eclampsia, so with chorea, there have been attempts to differentiate between the cases which may be called true chorea gravidarum and those in which a large hysterical or purely neurotic element is present. Whilst most of the patients are no doubt suffering from ordinary chorea (Sydenham's chorea), modified by the metabolic and other changes of pregnancy, there are some in whom the morbid state is really hysteria (L. Launay, *Thèse de Paris*, 1901), and there are others in whom hysterical symptoms (ovarian hyperæsthesia, tenderness of the spine, and globus hystericus) are combined with the choreic phenomena.

Etiology.—Many of the patients have had chorea at an earlier age (*e.g.* in the fatal case reported by Ballantyne, *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 182, 1909), and in them the malady commonly recurs in the first half of pregnancy; other cases are due to shock, injury, or emotional disturbance, and then the onset of the choreic symptoms is commonly later in gestation (Hirschl, *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 56, 1903). Rheumatism no doubt plays a part in the causation of chorea gravidarum; but there is a growing tendency to ascribe considerable etiological importance to the special conditions present in pregnancy, to the tendency to auto-intoxication due to poisonous matters retained in the maternal organism and produced by the mother's tissues or those of the fœtus, or by both, to the diminished power of emotional control then present (Wall and Andrews, *Journ. Obstet. and Gynæc. Brit. Emp.*, iii. p. 541, 1903), and to the worry and mental suffering due to the patient's state being undesired by her or altogether illegitimate. The toxæmic theory of the origin of chorea gravidarum would seem to be gaining considerable ground (Fletcher Shaw, *Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 289, 1907), and it is supported by the proclivity of primigravidæ to the malady; the toxin is probably very similar in nature to that causing acute rheumatism, and it probably acts by making the nervous system irritable and unstable, and so bringing it back to the state in which it was in childhood (the other period in life which shares with pregnancy the tendency to the development of chorea).

Prognosis.—Chorea gravidarum is a very grave complication, and as yet it cannot be said that new plans of treatment have materially altered its dangerous character. It is true that it is very rare for it to recur in successive pregnancies, although Martin (*Deutsche med. Wochensch.*, xxxii. p. 1265, 1906) has seen two such cases, and H. K. Wallace (*Brit. Med. Journ.*, i. for 1906, p. 260) one; but the explanation of this fact may be that the pregnant women who are specially susceptible to its attacks are carried off by it in their first pregnancies. It is difficult to determine the effect which the artificial interruption of pregnancy has upon the prognosis; but Wall and Andrews (*loc. cit.*) think it is not good enough to make the procedure desirable. Spontaneous abortion apparently is not to be looked for: for the proportion of women with chorea who abort is only 5 per cent., while in normal (*sic*) pregnancies it is 16 per cent.

Treatment.—The adoption by many of the toxæmic theory of origin for chorea gravidarum has led to a change in the line of treatment employed, although it must be said that the introduction of the new methods is taking place very slowly. In 1903 Wall and Andrews (*loc. cit.*), from their exhaustive analysis of the cases occurring at the London Hospital, were inclined to recommend good nursing and full feeding (especially with carbohydrates), with chloral hydrate or chloralamide (in small doses not frequently repeated) as hypnotics. They condemned treatment by the bromides, and thought the induction of abortion undesirable, although they admitted that the more rigorous antisepsis now in use might diminish the risks of this operative interference. Opium, they thought, was unsuitable, and alcohol to be preferred to arsenic. Martin (*loc. cit.*), on the other hand, thought well of the bromides, and gave the bromides of sodium and ammonium in doses of 2 grams, and bromide of magnesium in doses of 4 grams (60 grains); iron and arsenic were useful in mild cases; but he did not recommend morphine or chloral. He thought that if the life of the mother were seriously threatened induction of abortion or premature labour should be carried out; but if the chorea supervened in the later stages of pregnancy he did not think induction should be quickly adopted. If the immediate emptying of the uterus be desirable, Martin thought it was best done by colpohysterotomy.

The influence upon treatment of the new views regarding the etiology of chorea gravidarum is seen in the suggestion by Fletcher Shaw (*Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 300, 1907; xiii. p. 347, 1908), Rudaux, and others that eliminative methods be adopted. Chorea is thus brought into into the same category as eclampsia and hyperemesis. Thyroid extract has been tried for this purpose, but Shaw could not feel certain of its results. The treatment recommended was rest in bed, with a diet restricted entirely to milk, till the choreic movements showed signs of lessening, with a return to milk if they again increased; the skin and kidneys were kept acting freely

by a saline diaphoretic and diuretic mixture, and the bowels were regulary opened with calomel or jalap; enemata of saline solution were to be given in serious cases. No hypnotics were recommended, and the induction of labour was regarded as strongly contra-indicated. Of course this plan of treatment is revolutionary as regards the management of chorea gravidarum; but its good effect is borne out by Shaw's statistics, and, if the toxæmic theory of the malady be the right one, the eliminative method of dealing with it is, at any rate, theoretically correct. The next quinquennium will show whether it has answered expectations.

Christian Science.—A system of healing by religious suggestion, introduced by the late Mrs. Eddy, who published her book, *Science and Health*, in 1875, and organised the first Christian Science Church in Boston in 1879; it is stated that "the only means employed in Christian science practice for the healing of sickness and sin are mental" (C. Lilias Ramsay, *Encyclop. Relig. v. Ethics*, iii. p. 578); the whole matter is discussed from the medical aspect in the *British Medical Journal* (i. for 1910, pp. 1453-1478, 1483-1503) by Sir Clifford Allbutt, Sir Henry Morris, Mr. H. T. Butlin, Professor Osler, Dr. Claye Shaw, and others, and by Mr. Stephen Paget in his book, *The Faith and Works of Christian Science* (1909).

Chromaffin Cells.—Cells possessing a marked affinity for chrome salts, found in the medulla of the suprarenal body, in sympathetic ganglia in the abdomen, in the coccygeal gland, and in the carotid body; they differ in their functions from ordinary nerve cells, and they seem to be always associated with the production of adrenin.

Chromatophores. Pigmented cells found in the choroid coat of the eye, in the corium and between the cells of the stratum malpighii, and also in pigmented moles (melanomas); they are stellate in form, and are believed by some to absorb certain substances from the blood, to elaborate these substances into melanin, and to carry them (hence the name *chromatophore*) to the epithelial cells, but differences of opinion exist as to their origin and actions.

Chromidia.—Nucleolar matter in the form of globules or granules discharged from the nucleus of a cell into the cytoplasm; plasmosomes; mitochondria.

Chromidiation.—The discharge of nucleolar globules (chromidia or plasmosomes) into the cytoplasm of the cell.

Citrated Milk.—*See* INFANT FEEDING (*Use of Sodium Citrate*).

Cleidorrhexis.—*See* EMBRYOTOMY (*Cleidotomy*).

Cleidotripsy.—*See* EMBRYOTOMY (*Cleidotomy*).

Clupeine.—A basic amino-acid, derived from simple proteins (protamins) in the fish sperm; it has the formula $C_{30}H_{57}N_{17}O_6 + 4H_2O$; salmin.

Coagulometer.—*See* BLOOD (*Coagulation*).

Coccidiidea.—*See* PROTOZOA (*Sporozoa*).

Codrenin.—A proprietary preparation, being a solution containing cocaine hydrochloride and adrenaline chloride, acting as a local anæsthetic and hæmostatic; for Report, *see Journ. Amer. Med. Assoc.*, xlix. p. 1029, 1907.

Coliuria.—The presence of bacterium coli in the urine; colibacilluria.

Collargol.—A colloid solution of silver in a state of fine suspension; it has been used in the treatment of sepsis (*e.g.* puerperal infection) in the form of pills (10 grains), as an inunction (1 drachm to 1 oz. of lard), per rectum, and by intravenous injection (10 c.c. of a 1 per cent. or 2 per cent. solution); and it is also known as *colloidal silver*, *Argentum colloidale*, and *Argentum Credé*.

Complementophile.—*See* IMMUNITY (*Ehrlich's Side-Chain Theory*).

Concrement.—A term used often as a synonym of calculus, but better restricted to deposits of calcareous salts (growing by concretion) within the ducts and passages, the word calculus being reserved for deposits of the specific excretions of various glands. *See* Adami, *Pathology*, vol. i. p. 934.

Confabulation.—*See* ALCOHOLISM (*Korsakoff's Psychosis*).

Congestin.—*See* ANAPHYLAXIS; IMMUNITY.

Conjunctival Reaction.—*See* IMMUNITY (*Specific Tuberculin Tests*).

Conservation of Child Life.—The attempts that are being made to increase the birth rate and to preserve in life and health the new-born infants of parents living in

insanitary surroundings; much depends upon the hygiene of the mother during her pregnancy as well as upon the feeding and care of the child during the months that follow birth; puericulture. *See* NATALITY AND DEPOPULATION.

Constipation, Chronic, Surgical Treatment of.—Appendicostomy is strongly advocated as a means of treating chronic constipation by C. B. Keetley (*Lancet*, 2nd January, 1909). "It is," he says, "the best surgical treatment for constipation that has yet been devised. So far it has proved with me unfailing. One or two of the most obstinate cases I have met with or read of have yielded to it at once." The first appendicostomy was performed by Weir of New York in 1902, and during the next few years cases of mucous and other forms of colitis were operated on in this way by various surgeons. Keetley operated on his first case in 1905, and the results were most satisfactory. The uses of appendicostomy practised or suggested up to the end of 1908 may be tabulated thus:—(1) Colitis of various kinds—mucomembranous, ulcerative, amœbic, syphilitic, tuberculous; (2) Certain forms of intussusception, with the view of preventing recurrence (by anchoring the cæcum), &c.; (3) intestinal hæmorrhage; (4) typhoid; (5) cases of enterotomy and colotomy, as a safety-valve; intestinal distension in toxic conditions; (7) administration of nutrient enemata; (8) constipation.

Strictly speaking, appendicostomy is not in itself a remedy for constipation, but an operation which facilitates the employment of remedies. After it is performed the patient washes out the colon regularly, as often as required, with dilute aperients, especially salines or cascara. It is not found necessary to increase the strength of the aperients. On the contrary, it has generally been found possible to diminish it, and ultimately injections of plain water may suffice. Among the purgatives used by Keetley's patients are mistura alba, magnesum sulphate, much diluted with hot water, extr. casc. sagr. liq. ℥ii, glycerine ℥iii, hot water a pint, protargol 1:1000 (in mucous colitis), and weak solutions of borax and sodium bicarbonate.

Technique of Appendicostomy.—Appendix transplantation being a plastic operation, tension must be avoided. The upper end of the parietal incision must not, therefore, be too low or too near the middle line. An appendix and cæcum which do not readily come to the surface when first exposed can be persuaded to do so by gentle traction and the separation of abnormal adhesions and needless external and posterior parietal connections. Care must be taken of the free margin of the mesoappendix which contains the main appendical artery. If the appendix is kinked or twisted it should be gently straightened without bruising it. Movable and small concretions are squeezed along its lumen into the cæcum, larger ones expressed through a longitudinal incision which is then sutured. The appendix should be laid in an easy position obliquely on the abdominal wall by preference with its apex upwards and outwards. Its base should lie at the edge of the original wound, and its tip is drawn through a buttonhole in the skin some little distance off, a passage for the structure being burrowed through the fat from this opening to the original wound. The cæcum is then sutured to the edge of the peritoneum, and the rest of the peritoneum closed by a continuous suture. The transversalis and external oblique are then successively sutured in such a way that more of the appendix lies beneath the latter than beneath the former. One inch of the appendix should protrude through the skin, to which it is united with a fine silk suture. It is best not to open the appendix for forty-eight hours; the structure is quite insensitive, so no anæsthetic is needed. The neatest method of opening it is to cut away the seromuscular coat to the level of the skin and then turn back the mucous and submucous layers like a cuff, so that a neat little nipple results. To prevent gangrene do not open the appendix until it has adhered to its bed; do not leave a catheter in unless absolutely necessary, and if so, let it be a very small one; take every care to avoid wound infection.

Ileosigmoidostomy.—Mansell Moullin (*Lancet*, 16th January, 1909) in 1900 originated the operation of ileosigmoidostomy for the relief of moderate constipation dependent on inefficient action of the large intestine, and has treated seven cases in this manner without fatality, and with considerable benefit. He unites the lower end of the ileum, about 6 ins. from the cæcum by direct suture to a convenient part of the sigmoid, making a lateral anastomosis over 4 ins. in length between the two. The merits of the operation are:—(1) It meets the requirements of the case in the simplest way by enabling the intestinal contents to evade that portion of the bowel in which they are specially prone to be detained. (2) It is almost devoid of risk. (3) It does not deprive the patient of any organ. The functions of the large intestine is imperfectly understood, but probably that part extending to the middle of the transverse colon differs from that of the rest. There fluid is absorbed, and possibly the antiperistaltic waves which occur have to do with the absorption of nutriment. The idea of the operation is not to exclude a part of the bowel, but to help it, and give a certain measure of relief by providing an alternative route. Therefore the opening must be free—not less than 4 ins.

in length, and the ileum must not be divided, for division means leaving the cæcum and the greater part of the colon literally as a blind receptacle—a condition which *a priori* would seem more likely to perpetuate than to relieve the condition of stagnation.

Convulsions in Infancy.—Dr. John Thomson has drawn attention to the occurrence of a group of cases which may conveniently be termed "idiopathic convulsions," because no organic or peripheral cause can be found to account for them. Their special features are:—(1) Appearance very early in life, often during the first few weeks. (2) The fits are at first short, not very severe, but fairly numerous—two or three in the day. (3) If untreated, or inefficiently treated, they soon increase in frequency, and as many as twenty or thirty may occur in the day. (4) This state of matters may last for weeks. (5) A condition of drowsiness or stupor may remain after the fits have ceased, but permanent mental impairment does not occur. The best treatment is to get the baby thoroughly under the influence of chloral. Bromide is of little or no use. Chloral hydrate should be given in doses of from 1 to 2 grs. every two hours, the object being to keep the baby constantly asleep. By regulating the dosage it is easy to keep the baby so drowsy that the fits are checked, yet not so drowsy as to prevent him swallowing. When once the baby is thoroughly under chloral the fits cease, but the drugs should be continued for thirty-six or forty-eight hours longer, and gradually withdrawn. Infants who suffer from fits of this kind are often small and puny, hence special attention should be paid to the diet. Most cases can be cured by the above line of treatment, but some die. No naked-eye lesions of the nervous system are found. The prognosis is least favourable in weakly infants. (*See* also SPASMOPHILE DIATHESIS.)

REFERENCE.—Thomson, *Practitioner*, Oct. 1905.

Coolie Itch.—A dermatitis set up by the larvæ of *Strongyloides intestinalis* and *Ankylostoma duodenale* which have passed in through the skin of the human host.

Copula.—A disused synonymous term for amboceptor or immune body. *See* IMMUNITY (*Anti-bacterial Action*).

Coryfin.—A proprietary preparation, described as the ethyl-glycollic ester of menthol, recommended for its analgesic and sedative effects in neuralgia, headache, and respiratory affections (nasal catarrh), and stated to have a more prolonged effect than that possessed by menthol; it is a yellowish oily fluid. See reports in *Lancet*, i. for 1908, p. 1778, and *Journ. Amer. Med. Assoc.*, xlix. p. 1921, 1907.

Cranio-Cleido-Dysostosis.

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CRANIO-CLEIDO-DYSOSTOSIS or cleido-cranial dysostosis is the name which has been proposed by Marie and Sainton (in 1897) for the association of cranial and facial defects (persistence of the fontanelles, imperfect ossification of the bones of the vault and face), with absence or defective development of one or both clavicles; heredity can often be traced.

The *morbid anatomy* varies somewhat. One of the clavicles may be entirely absent (P. Niemeyer, *Tagebl. d. Versammldeutsch. Naturf. u. Aerzte*, Hannover, xl. 68, 1865); but entire absence of one or both bones would appear to be rarer than incomplete development. The form taken by the latter anomaly is absence or non-ossification of the outer or acromial end of the bone, and this has the clinical effect of allowing the shoulders to be closely approximated in front of the thorax (just as happens naturally in the cat). A man, described by L. H. D. van den Bussche (*Diss. inaug.*, Freiburg, 1890), had bilateral absence of the corpus and acromial part of the clavicle; and the state of the platysma, pectoralis major, deltoid, trapezius, sterno-mastoid, omohyoid, rhomboideus, and serratus anticus muscles agreed with the osseous defect, *e.g.* the clavicular part of the sterno-cleido-mastoid muscle was poorly developed. In an another man (Giannettasio, *Arch. di ortoped.*, xvi. 65, 1899), fifty-four years of age, the clavicles were represented by sternal fragments, the ends of which, instead of reaching the scapula, floated free among the soft parts of the supra-clavicular triangle. In some sixty cases collected by Fitzwilliams (*Lancet*, ii. for 1910, pp. 1466-1475), both clavicles were absent in six instances, and the left bone was totally absent in two; but in all the other cases some trace of one or both bones was found. In the great majority of cases it was the acromial end that was wanting, but in three it was the sternal end. When both ends of the clavicle were present, but ununited, it was common to find the condition on both sides of the body. When the sternal end alone was to be made out, there was often a fibrous or ligamentous prolongation to be detected running out from it, and, somewhat unexpectedly, this band generally passed not to the acromion or to the glenoid cavity, but to the coracoid process. Cranial deformity is not invariably met with in association with the clavicular defect, but in Fitzwilliams' collected list of cases the head was described as normal in three only. As a

rule a large part of the vertex of the cranium remains membranous in infancy; there the anterior and posterior fontanelles unite with the wide sagittal and the open metopic sutures to form a large area of membrane; further, the absence of the interparietal portion of the occipital bone greatly increases this area posteriorly. As age advances bone gradually develops, although, in some cases, the anterior fontanelle never properly closes; and in time certain parts of bone appear in an exaggerated form, as is seen in the presence of six bosses on the vertex corresponding to the frontals, the parietals, and the two sides of the interparietal occipital bone. Between the three bosses on the one side and the three on the other there is a deep median groove. When these cranial anomalies are found the face bones are also discovered to be deformed. The face itself is small, and the supra-orbital ridges are prominent, and stand out in marked contrast with the stunted bones which close in the orbit below. Through depression of the roof of the orbit a certain degree of exophthalmos may be noted. On account of defective growth of the superior maxillæ the palate is high-vaulted, and dentition is irregular. The nasal bones are short and irregular. The muscles may be remarkably little affected; but some defects can generally be made out if a careful examination is made. The subclavius, for instance, would seem to be often wanting. If the sternal end of the clavicle is well represented the sterno-mastoid muscle may be normal, but if that particular part of the bone be rudimentary, the corresponding part of the muscle will be reduced to a thin band; the same statement applies to the clavicular head of the pectoralis major, and the part of the trapezius passing to the clavicle may also be wanting.

The *clinical features*, curiously enough, may be very slight. Ordinary movements are generally not interfered with, and many individuals suffering from this dysostosis have been able for strenuous muscular exercise. Certain unusual movements and positions of the arms and shoulder-girdle are made possible, and the bisacromial diameter of the shoulders can be reduced in a way and to a degree similar to that seen in animals which have no clavicles. It is certainly remarkable that so distinct a deformity should cause so little disability (*vide* Schorstein, *Lancet*, i. for 1899, p. 10).

The most striking fact as regards the *etiology* of this malformation or group of malformations is its hereditary tendency. In looking over the list of sixty cases collected by Fitzwilliams (*loc. cit.*) one cannot fail to be arrested by the frequency with which the entry occurs, "son (or daughter) of the preceding"; from the time (1864) when Gegenbaur (*Jenaische Ztschr. f. Med. u. Naturw.* i. 1, 1864) described a woman who had thus clavicular defect, and who gave birth to similarly affected children, both by her first and second husbands, up to such recent cases as those of Villaret and, Francoz (1906), in which a mother and three children were all malformed, heredity forces itself upon our notice. Further, it may be transmitted by either parent, for in Carpenter's patients (*Lancet*, i. for 1899, p. 13) the deformity was found in father, son, and daughter. From the comparatively small number of cases which are known little more can be said about its etiology, but the clavicular anomaly does not seem to have any sexual predilection. It is apt to be associated with deformities in other parts (*e.g.* spinal curvature, sternal anomalies, and genu valgum); and bad health or habits of the parents seem to occur in the histories with a greater frequency than is usual.

The *pathology and pathogenesis* of cleido-cranial dysostosis are involved in obscurity. The bones affected are mainly, if not wholly, developed in membrane, and the malformation thus contrasts sharply with achondroplasia (which affects bones developed in cartilage); indeed, the facts have been turned round somewhat, and it has been affirmed that since the sternal end of the clavicle is generally represented in cranio-cleido-dysostosis, that portion of the bone must normally be developed in cartilage. It is possible that the causal agent may be tightness of the amnion of a local and temporary nature; but it is, perhaps, more common to think of some toxic agent, such as alcohol, syphilis, or tuberculosis, as influencing the nutrition of the developing skeleton. All the theories, however, which have been advanced (including the Mendelian explanation of Berry Hart) leave many facts unexplained.

Crèches.—Day nurseries for the feeding and care of the children of women who have to go out daily to work for their living (Fr. *crèche*, manger or crib).

Cremalto.—A proprietary food preparation, described as "a scientific combination of pure sterilised Devonshire cream," the analysis is given in the *British Medical Journal*, i. for 1910, p. 30.

Crescendo Murmur.—The cardiac murmur heard sometimes in mitral stenosis, and characterised by gradually increasing loudness ending in a snap; it is regarded by some physicians as systolic in time but by a greater number as presystolic.

Cresylone.—A proprietary preparation similar to the Liquor Cresolis Compositus of the U.S. Pharmacopœia.

Culicides.—Agents, chemical or other-

wise, which are destructive to the mosquito (culex), *e.g.* sulphur, camphor-phenol, pyrofume, etc.

Curettage.—There has been no radical change in either the method of performing uterine curettage or in the indications for its use during the past five or six years. For a time interest was centred in the operation of vaporisation of the uterus (atmocausis), which was expected by some to take the place of curettage; and although this expectation has not been realised, it has been thought well to give a description of this competing method of treating uterine morbid states. *See* ATMOCAUSIS.

Considerable discussion has taken place, more particularly in the pages of the *Zentralblatt für Gynäkologie*, regarding the explanation of the cases of curettage and sounding of the uterus in which the instrument perforates or appears to perforate the uterine wall. That there is a real danger of uterine perforation with the curette was abundantly proved during a discussion which took place in the American Gynecological Society in 1905 (*Trans. Amer. Gynec. Soc.*, xxx. p. 15, 1905), when cases were reported in which prolapse of intestine through the uterus had followed curettage. Congdon, also, has put on record (*Amer. Journ. Obstet.*, liv. p. 618, 1906) an extraordinary case in which sixteen inches of gut had been torn away during curetting; the patient came under his care, and he opened the abdomen, closed the uterine wounds, and attached ileum to cæcum by means of a Murphy button; recovery followed without pyrexia. There are other instances, however, in which there is reason to believe that the perforation of the organ by the curette is only apparent: the curette slips in suddenly as if it had passed through the wall, but after-events (*e.g.* the opening of the abdomen) show complete integrity of the uterine tissue. Various explanations have been given of these "false perforations": it has been thought that sudden uterine relaxation (atony or loss of tone) occurs, or that the curette (or sound) passes for some distance into a Fallopian tube, or that there has been a septate condition of the uterus. Articles on the subject have appeared by W. Thorn (*Zentralb. f. Gynäk.*, xxviii. pp. 1072, 1128, 1253, 1904), by O. Schaeffer (*ibid.*, xxix. p. 1209, 1905), by Robert Asch (*ibid.*, xxix. p. 1250, 1905; xxx. p. 172, 1906), by R. Kossmann (*ibid.*, xxix. p. 1529, 1905), by Catharine van Tussenbroek (*ibid.*, xxx. p. 47, 1906), by Jakob (*Diss. inaug.* (München), 1905), by Meyer (*Zentralb. f. Gynäk.*, xxx. p. 1045, 1906, by Braun-Fernwald (*ibid.*, xxxi. p. 1161, 1907), and Kuntzsch (*ibid.*, xxxi. p. 1590, 1907). Some of the cases are possibly explicable as partial perforations in which the curette has passed through the muscle without wounding the peritoneum.

Cuti-reaction.—*See* IMMUNITY (*Specific Tuberculin Tests*).

Cyclic Vomiting. — *See* ACIDOSIS (*Types*).

Cyclodialysis.—An operation for acute glaucoma introduced by Heine in which a permanent communication is opened up between the anterior chamber of the eye and the suprachoroidal space by partial detachment of the ciliary body (Heine, *Mitth. f. d. Ver. Schlesw.-Holst. Aerzte*, N.F., xviii. 35, 1909; *Brit. Med. Journ.*, i. for 1910, p. 1193).

Cyclophoria. — The morbid condition characterised by abnormal rotation of the eyes (Gr. κύκλος, circular motion, and φορέω, I bear.

Cyclothymia.—Circular insanity, or, according to others, a constitutional tendency to cyclic alternations of emotional exaltation and depression which may, but usually does not, lead on to actual insanity. *See* Deny, *Semaine méd.*, xxviii. p. 169, 1908.

Cyesiognosis.—The diagnosis of pregnancy, founded upon the recognition of its signs and the ascertainment of its symptoms.

Cyllin.—A proprietary preparation described as "a disinfectant which combines the maximum of efficiency with the minimum of causticity and toxicity to the higher forms of life"; it is to be had in a fluid form, made up in capsules or pastilles, as a dusting powder, and in soap, gauze, lint, etc.; "cyllin inhalant" is stated to be beneficial in pulmonary tuberculosis, tonsillitis, diphtheria, etc.

Cynarase.—A rennet ferment obtained from a plant (*Cynara cardunculus*).

Cystinuria. — The morbid state, frequently hereditary, in which cystin is excreted in the urine.

Cytase.—A synonymous term for *complement*. *See* IMMUNITY (*Metchnikoff's Theory of Phacocytosis*).

Danyscz's Phenomenon.—An apparently anomalous result obtained with certain toxins when treated with antitoxin; if the exact amount of toxin which completely neutralises a given amount of antitoxin serum be determined, and if only half instead of the whole amount of the toxin be used, and the addition of the other half be made at a later period, *then* the result is not a neutral but a poisonous mixture requiring more antitoxin to be added before neutralisation is reached; possibly this anomalous result may be due to an

enzyme-like action on the part of the toxins, but there are differences of opinion on this subject.

Dealin Powder.—A proprietary preparation, described as an antiseptic medicament for wounds; it contains sodium perborate, boric acid, zinc oxide, talc, starch, and magnesium carbonate. *See Brit. Med. Journ.*, i. for 1910, p. 761.

Dechlorination. — *See* NEPHRITIS (*Treatment*).

Decidual Reaction.—The changes occurring in a mucous membrane as the result of the implantation of an impregnated ovum thereupon; normally it is limited to the mucosa of the uterine corpus, but it is believed by some to be possessed occasionally by the mucous membrane of the Fallopian tube and to account for tubal pregnancy.

Deciduoma Malignum. — *See* UTERUS, TUMOURS OF.

Decompression.—*See* CAISSON DISEASE (*Decompression*).

Defectives.—*See* DEGENERATES.

Degenerates, Sterilisation of.—Asexualisation has been proposed as a preventive measure in certain forms of mental, moral, and physical degeneration; there are various operative procedures, but a simple one is to make a small incision through the skin of the scrotum near the pubis, and to take up the vas deferens and vessels and tie them off (vasectomy); a more serious operation is castration; some of the States of the American Union have passed laws permitting the sterilisation of criminals; it is maintained that laws for the prevention of marriage between the unfit are not sufficient, and that segregation (or colonisation) is expensive, and that some form of sterilisation is needed; in women the corresponding operation would be salpingectomy. H. C. Sharp (*Journ. Amer. Med. Assoc.*, liii. pp. 1897-1902, 1909) gives an account of nearly 500 cases of vasectomy done in Indiana on confirmed criminals, idiots, imbeciles, etc. *See also Journ. Amer. Med. Assoc.*, vol. l. p. 55, 1908; vol. lii. p. 1114, 1909; Belfield, *ibid.*, lii. p. 1211, 1909.

Dementia Paranoides.—A variety of dementia præcox (*q.v.*).

Dementia Præcox.—Dementia præcox is a term recently introduced by Kraepelin to include a large number of clinical types of insanity. It is the adolescent insanity of English writers, the Jugendirresein of the Germans, the démence précoce of the French, and the primary dementia of the Americans. Kraepelin's conception of dementia præcox is generally regarded as constituting a distinct advance in psychiatry, although his views have not by any means received universal acceptance in their entirety. It is impossible to give any short, comprehensive definition of the term. Before Kraepelin's generalisation, alienists classified the primary insanities of adolescence and young adult life in a great variety of ways—mania, melancholia, stupor, dementia, catalepsy, delusional insanity, and so on. What Kraepelin does is to subordinate all these clinical features to one which is common to all cases—namely, progressive mental deterioration. At the beginning of the chapter on dementia præcox in his text-book, he says: "Under the term dementia præcox we range a series of disease pictures whose common characteristic is a termination in a peculiar weakened state of the mind. This unfavourable outcome need not occur in every instance, but is nevertheless so exceedingly frequent as to justify our holding fast to this general name."

Practically, Kraepelin raises the ultimate result of a disease process to the level of a nosological criterion; his presentation of dementia præcox is therefore an advance in the prognosis of a hitherto unclassified group of cases. An excellent historical sketch of the gradual evolution of the modern idea of dementia præcox is given by Dorsay Hecht (*Journ. of Nervous and Mental Diseases*, 1905), who quotes Clouston as having recognised the existence of the condition in question in 1888—"There are many cases [of adolescent insanity] where previous excitement was so slight and so short-lived that we must conclude that the essential nature of the mental disease was a tendency to dementia from the very beginning."

Dementia præcox may begin in adolescence, or its onset may be delayed until the third or fourth decade. The variety of clinical forms included under the term is very great, and Kraepelin admits that to a superficial observer the connection between them may not be very readily discernible. A very clear account of Kraepelin's presentation of dementia præcox is given by Dr. Macpherson in the *Review of Neurology and Psychiatry*, vol. v., 1907, and the following description of the main symptoms is taken from that paper:—

(1) A peculiar stupid listlessness in which patients appear oblivious of their surroundings, but are in reality able to appreciate what is happening. Only when there is profound stupor, a grave melancholic condition, or serious delusion, are orientation and the perception of the surroundings markedly interfered with.

(2) The sensory sphere is implicated; there

are dream perceptions and occasionally hallucinations, often of an unpleasant nature.

(3) Consciousness remains clear, except in the excited and stuporose conditions. Attention, however, is affected, and sustained conversation is impossible. On the other hand, it is not infrequent to see such patients observe stealthily what goes on around them, look curiously in at open doors, follow people at a distance, and manifest generally a sort of morbid curiosity in their surroundings.

(4) Memory is relatively little disturbed, except after severe stupor. Even up to the time of the occurrence of deep dementia, patients retain all they have learned at school.

(5) Mental processes undergo deterioration sooner or later. There is incoherence or repetition of (often unmeaning) words—"verbigeration." The phenomenon known as "stereotypism"—*i.e.* the recurrent use of phrases expressive of special ideas which dominate the mind for long periods—is almost always present as a symptom of a disordered mentation.

(6) Judgment is always affected; patients are incapable of correctly comprehending their position, and are helpless when placed under new or novel conditions.

(7) Delusions are apt to arise on this basis. At first these tend to be sad; later, grandiose. Owing to the mental weakness the delusions ultimately, as a general rule, become nonsensical, and at last terminate in forgetfulness.

(8) The disposition changes. At first the patient is depressed, with outbursts of exaltation. Next follows a state of good-natured dementia, with dislike for recreation, apathy towards friends, and complete indifference towards bodily discomfort.

(9) Conduct. There is loss of initiative and neglect of work; suicidal, destructive, or self-mutilation impulses occur. The ordinary actions of life are traversed by morbid impulses, and mannerisms result.

(10) This loss of volition and the dominance of impulses leads to a state of matters called "negativism," which shows itself by an obstinate opposition to all the ordinary practices of daily life—such as going to bed, eating, going to stool, etc.

(11) The working capacity of the patients fails greatly.

(12) Kraepelin also gives the following bodily symptoms:—Epileptiform spasms, choreiform movements, increased tendon reflexes, increased mechanical irritability of muscle and nerve, dilatation of the pupils, irregular cardiac action, increase of the sweat and saliva, diffuse enlargement of the thyroid, disturbed sleep, variations in the body weight.

Dementia præcox is subdivided into three great groups, defined as follows:—

(1) *Hebephrenia* (ἥβη, puberty; φρήν, mind).—"By hebephrenia is meant all those forms of dementia præcox in which a uniform, more or less profound, condition of mental weakness is developed under the accompanying influence of subacute—more seldom of acute—mental disturbances."

(2) *Katatonia* (κατατείνω, I stretch tightly).—"Katatonia is essentially a peculiar disease process, progressing through stupor or excitement to a condition of dementia, with intercurrent symptoms of negativism, stereotypism, and auto-suggestibility in the spheres of action and work."

(3) *Dementia paranoides* (παρά, beyond; νοέω, I know).—"Dementia paranoides includes a group of cases in which delusions and hallucinations are produced in an otherwise clear mind throughout many years of a steadily advancing mental weakness."

Kraepelin admits that these distinctions are largely artificial, and that cases run into each other and overlap continually. The *hebephrenic type* begins in adolescence; heredity is a factor in 70 per cent. of cases. Three-quarters of the patients pass into dementia; of the other quarter, two-thirds recover partially, and one-third completely. *Katatonia* begins a little later (at the average age of 24—the youngest of Hecht's cases was 15, the oldest 30). Brain workers are most prone; a bad heredity is given in 45 per cent. The special features of katatonia are muscular rigidity leading to the assumption of bizarre attitudes, constrained gait, puckering of the features, etc. Stupor and excitement alternate; during the excitable stage, self-mutilation, coprophagia, and other filthy habits may be practised. Kraepelin holds that 60 per cent. of katatonics become dements, 27 per cent. practically so, and 13 per cent. recover. *Dementia paranoides* is a rapidly progressive dementia, with delusions, illusions, and hallucinations. These may lead to suicide, infanticide, fire-raising, etc. The delusions are mostly of an exalted nature, and are not coherent. The outlook is very unpromising; weak-mindedness sets in rapidly.

DIAGNOSIS.—Dementia præcox has to be differentiated from circular insanity, from paranoia, and from general paresis. Hecht lays stress on the negativism of dementia præcox as opposed to the simple inaction of circular insanity, on the absence of systematised delusion and the presence of feeble-mindedness as opposed to paranoia, and on the absence of organic signs and the retention of memory until a late stage of the disease as against general paralysis.

It would take more space than is available to mention the criticisms brought against Kraepelin's views. A summary of them is given by Hecht in the paper referred to, which also contains a large number of references to the literature of the subject.

Deportation of Villi.—The separa-

tion of villi or of the syncytium or Langhans's cells covering them in the wall of the pregnant uterus, and their transference in the blood stream to other parts of the body. *See* ECTOPIC PREGNANCY (*Pathology*).

Dermatitis Artefacta.—Inflammation of the skin, produced by chemical or mechanical means employed by the patient himself or herself in malingering, or for the feigning of disease. *See* articles by Norman Walker (*Brit. Med. Journ.*, i. for 1910, p. 1481), and Adamson (*Ibid.*, ii. for 1910, p. 15).

De Seigneux's Cervical Dilator.—*See* ACCOUCHEMENT FORCÉ (*Methods*).

Desmoid Reaction.—*See* DIGESTIVE FUNCTIONS, TESTS FOR THE (Sahli's *Reaction.*)

Desmon.—A synonymous term for amboceptor or immune body; it is hardly ever used now. *See* IMMUNITY.

Determinants.—In the language of heredity, as set forth by Weismann, determinants are biophores or groups of biophores, each of which "controls or determines the structure and function of one particular cell area of the body"; combinations of determinants are termed *ids*.

Diabetes.—PANCREATIC DIABETES.—Opie's work on the relation of pancreatic disease has attracted a great deal of attention, but his views are not universally held as proved correct. According to his theory, diabetes is associated with a lesion of the bodies in the pancreas known as the islands of Langerhans. Opie described two forms of interstitial pancreatitis—an interlobular and an interacinar type. In the interacinar variety the chief new development of connective tissue takes place between the acini, and is likely to involve the islands of Langerhans. The lesion characteristic of diabetes is either a disappearance of many or all of the islands, or a hyaline degeneration. The pancreas may show no changes to the naked eye, although extensively involved on microscopic examination. On this theory it is easy to explain why some cases of gross lesion of the pancreas are associated with diabetes, and others not; and also why in some cases of diabetes the pancreas appears diseased, while in others it is healthy to the naked eye. The theory involves the assumption that the islands are intimately related to carbohydrate metabolism, possibly by furnishing an internal secretion to the body fluids. A very ingenious explanation of the nature of the glycolytic action of the pancreas has been promulgated by Cohnheim. He found that, whereas neither pancreatic juice (expressed from the crushed gland) nor muscle juice was glycolytic, a mixture of the two was actively glycolytic. He suggests that the two tissues provide complement and amboceptor respectively, which together split up glucose, or, alternatively, that the muscle juice contains a proenzyme, which requires to be activated by a pancreatic ferment before it becomes glycolytic. The objections to Opie's theory of the function of the islands of Langerhans are partly based on the anatomy and development of the structures (see DIGESTION, p. 118). Van Noorden states that Cohnheim's experiments have been completely disproved by experiments in his laboratory. He believes that probably all cases of real diabetes are of pancreatic origin, but doubts whether Langerhans islands are really blood glands.

RENAL DIABETES.—Phloridzin poisoning leads to diabetes—"phloridzin diabetes." This is due to a lesion of the renal epithelium, whereby the cells become permeable to the sugar normally present in the blood. Attempts have been made to show that renal diabetes may occur in man (apart, of course, from phloridzin diabetes, which is only observed experimentally in animals). In renal diabetes it would be necessary to prove (1) that the glycosuria was largely independent of the carbohydrates of the food, and (2) that the sugar in the blood was at least not increased, but rather diminished, in consequence of the loss by the kidneys. Klemperer's case is usually quoted in support of the existence of "renal diabetes." The patient suffered from chronic nephritis, and excreted considerable quantities of sugar, but did not suffer from hyperglycæmia. Van Noorden looks on the case as doubtful. He points out that, if renal diabetes exists, it must have a clinical course quite different from ordinary diabetes, agreeing only in having glycosuria as a symptom. There is great doubt as to whether true renal diabetes actually exists.

DIABETES AND OBESITY.—That diabetes is often associated with obesity is well known, and Van Noorden has recently brought forward a suggestive theory of the connection which exists between the two conditions. In health, the carbohydrate of the food which is not at once burned up or stored as glycogen is converted into fat. When carbohydrate metabolism is disturbed, this fat synthesis may also be affected. In some persons there is deficient power of katabolising carbohydrate, but fat synthesis is carried on; in others, both katabolism and fat synthesis are interfered with. In the former case the tissues would be bathed in fluid rich in sugar, which they could not assimilate, but which would be converted into fat. Such patients suffer from faulty metabolism of sugar, but do not eliminate it in the urine. They become obese; the "fat disease" masks the diabetes. Van Noorden gives the following clinical scheme:—

"1. There is the case in which the com-

bustion of sugar, and its conversion into fat, are simultaneously interfered with: glycosuria of various degrees, with wasting; ordinary diabetes.

"2. There is the case in which the combustion of sugar, but not its conversion into fat, is defective: obesity without glycosuria; masked diabetes. These cases readily develop at a later date into—

"3. Cases in which the combustion of sugar is defective, and the heaping up of carbohydrate in the form of excessive fat also begins to fail: obesity with subsequent glycosuria; ordinary diabetes of fat people.

"4. By going a step farther, cases of group 3 become cases of group 1."

DIABETIC COMA is now admitted to be due to an acid intoxication from the presence of the acetone bodies, especially oxybutyric acid, in the blood. As has been said in the paragraphs dealing with ACIDOSIS (p. 21), acetonuria is brought about by carbohydrate starvation of the tissues, hence it is easy to perceive that in diabetes, in which carbohydrates are poorly assimilated, an abnormal metabolism of fatty acids may take place, whereby the blood is flooded with acetone and its allies. This fact is practically important, because the sudden withdrawal of carbohydrate from the diet of a diabetic may precipitate acid intoxication. When there is any sign of acidosis—*e.g.* high output of ammonia nitrogen, or a positive ferric chloride reaction in the urine, the proteins in the diet ought to be diminished, carbohydrate given, and alkalies administered freely. The production of the acetone bodies (ketones) is inhibited by carbohydrates in proportion as the latter are assimilated. Von Noorden points out that oatmeal is well oxidised by some patients, and is therefore beneficial in this respect. The following substances have also an antiketogenous action:—albuminates, pentoses, glyconic acid, glycerin, citric acid.

DIET IN DIABETES.—The modern treatment of diabetes is entirely a matter of diet. Special diabetic foods are less used than formerly. Gluten bread, in particular, often contains quantities of starch. Casein breads—*e.g.* casoid meal bread—are practically free from carbohydrate. Janeway, however, objects to them on the ground that casein increases glycosuria more than any other proteid (*Amer. Journ. Med. Sci.*, March 1909.) Hutchison has introduced a special sugar-free milk, which can be obtained from Messrs. Callard, Regent Street, W. Janeway points out that in selecting a diet two main points have to be settled: (1) the patient's tolerance of carbohydrate, and (2) the degree of acidosis. The acidosis can be measured by estimating the output of urinary ammonia nitrogen, but in everyday work it is sufficient to apply the ferric chloride test regularly. A positive ferric chloride reaction indicates the free use of alkalies (¼-1 oz. of sodium bicarbonate daily), and possibly also the addition of carbohydrates to the diet and restriction of the intake of proteid.

The patient is put on a test diet (I.), with two or three ounces of white bread daily, and the allowance of bread is gradually reduced until the glycosuria disappears, or until he has been for a week on a strict diet without the glycosuria disappearing. If the glycosuria disappears, the case is mild, and bread is added in weighed amounts until sugar reappears. The patient's tolerance of carbohydrate is expressed in terms of two, three, or four ounces of white bread, as the case may be, and the ration of carbohydrate ultimately allowed should be well within this limit (see Table of Equivalents below). If the glycosuria does not disappear, the proteid of the diet should then be restricted (Test Diet II.); should it disappear on this diet, the case is moderately severe; should it persist, severe. In these two classes of cases acetonuria may be looked for.

Having classified the case on the basis of their ability to assimilate carbohydrate, the problem is to maintain adequate nutrition without hyperglycæmia and acidosis. The normal adult obtains from 1500 to 2000 calories daily from carbohydrates, and in diabetes this, or most of this, is lost to the organism (2-4 ozs. bread = 240-480 calories). About 600 calories can be supplied as protein, leaving 2000 to be provided as fat. In order to assist in the digestion of so much fat, alcohol is required (Diets I.-II.).

In mild cases, the carbohydrate allowed may be bread or its equivalent. In moderately severe cases, periodical "hunger days" (Naunyn) or "green days" (Von Noorden) should be interpolated. On a "hunger day" the diet consists mainly of broths; the diet of a "green day" is given below (Diet III.). In severe cases, it is doubtful whether adding carbohydrate to the diet will overcome acidosis, because the carbohydrate does not enter into the metabolic processes of the body, and is therefore valueless in aiding the oxidation of the fatty acids. Butter given to such patients should be thoroughly freed from butyric acid by washing.

I.—STANDARD STRICT DIET.

Breakfast.

Coffee, with 1½ ozs. cream.
2 eggs cooked with ½ oz. butter.
3 ozs. ham.

Lunch.

Soup, with 1 raw egg.
3 ozs. steak, chicken, or lamb.
1 oz. bacon

2 tablespoonfuls green vegetable, with ½ oz. butter.
Custard—1 egg and 1½ ozs. cream.
6 ozs. wine or 1 oz. whisky.

Afternoon Tea, with ½ oz. cream.

Dinner.

Clear soup.
3 ozs. fish, with ½ oz. butter.
¼ lb. roast beef, mutton, etc.
Vegetables, as lunch.
Salad, with ½ oz. oil.
1 oz. cheese.
Wine, as lunch.

Protein	=	126 grams ;	515	calories.
Fat	=	222 „	2065	„
Carbohydrate	=	15 „	60	„
Alcohol	=	30 „	210	„
			2850	„

II.—Diet with Restricted Proteid.

Breakfast.

Coffee, 1½ ozs. cream.
2 eggs. ½ oz. butter.
1 oz. bacon.

Luncheon.

2 eggs.
1 oz. bacon.
2 ozs. chop, ham, beefsteak, chicken, or fish, broiled, with ½ oz. butter.
Vegetables, etc., as in Diet I.

Afternoon Tea, ½ oz. cream.

Dinner.

Clear soup.
¼ lb. roast pork, beef, mutton, lamb, or chicken.
Vegetables, etc., as in Diet I.

Protein	=	82 grams ;	334	calories.
Fat	=	215 „	2008	„
Carbohydrate	=	15 „	60	„
Alcohol	=	30 „	210	„
			2612	„

III.—"Green Diet."

Breakfast.

1 egg.
Cup of black coffee.

Dinner.

Spinach and egg.
½ oz. bacon.
Salad, with ½ oz. oil.
6 ozs. wine or 1 oz. brandy.

Afternoon.

Beef-tea or chicken broth.

Supper.

Scrambled egg, tomato, and butter.
½ oz. bacon.
Cabbage, asparagus, or other green vegetable.
Cup of tea.
½ oz. sodium bicarbonate in 24 hours.

Table of Equivalents to 1 *oz. White Bread.*

1 oz. bread, roll, or biscuit.	1 oz. lentil flour.
5 ozs. boiled or 1½ ozs. raw oatmeal.	10 ozs. milk.
	4 ozs. apples.
3½ ozs. boiled macaroni.	2½ ozs. bananas.
2⅛ ozs. boiled rice.	3½ ozs. almonds.
3 ozs. cooked potatoes.	3½ ozs. cherries.
3½ ozs. cooked green peas.	2½ ozs. plums.

Von Noorden's "Oatmeal Cure."—Von Noorden advises a special oatmeal cure in certain cases of diabetes. He states that in many cases oatmeal is well borne in comparison with other carbohydrates. This only applies when oatmeal is given alone ; when added to a mixed diet it seems to have no special advantage. The oatmeal is given in the form of well boiled gruel or porridge, to which eggs, or vegetable protein, and butter are added. Brandy and strong black coffee are also allowed. The ordinary daily ration consists of oatmeal 250 grams (9 ozs.), 7 or 8 eggs, and (300 grams) 10 ozs. of butter. On this treatment some diabetics become free from sugar, although they remained glycosuric on a strict diet. Von Noorden distinguishes three possible good results :—(1) Glycosuria disappears; (2) glycosuria diminishes; (3) glycosuria uninfluenced, or may even rise, but the assimilation of carbohydrate is improved, and acidosis is overcome. The cure is not always successful. Von Noorden advises it only in severe cases with acidosis. Why oatmeal is tolerated better than other carbohydrates is not known. Siegel reports good results, and Langstein treated a child of one and a half years thus with some success. When first introduced, the oatmeal diet was given continuously for several weeks; now Von Noorden advises that it should be limited to three-day periods, each preceded by one or two "green days," interpolated in the ordinary régime of strict dieting.

REFERENCES. — Von Noorden, *Berl. klin. Wochensch.*, No. 36. 1902, *Deutsche Aerzte-Zeitung*, Heft 22, 1902.—Siegel, *Berl. klin. Wochensch.* p. 45, 1904.—Langstein, *Ibid.*, March 1905.

Secretin in the Treatment of Diabetes. —When the hormone secretin was discovered by Bayliss and Starling (*see* Digestion), its remarkable effect on the secretion of the pan-

creas led to its being tried as a remedy for diabetes, on the theory that the latter was due to failure of an internal secretion of the pancreas. Secretin was usually given in the form of an acid extract of the duodenal mucous membrane. Unfortunately the results of the secretin treatment have not realised anticipations, though some favourable cases have been reported. Little has been heard of it during the past year or two.

REFERENCES.—Moore, Edie, and Abram, *Biochemical Journ.*, p. 28, 1906.—Foster, *Journ. Biological Chemistry*, Jan. 1907.—Dakin and Bransom, *Ibid.*

Diadococinesia. — The inability to perform accurately and rapidly alternate movements, such as pronation and supination ; it is regarded by Babinski as pathognomonic of cerebellar tumour ; it is derived from Greek διαδοχος, succeeding, and κίνησις, a moving. *See* Cerebellum, Symptomatology of Tumours of (*Diadococinesia*).

Diamalt.—A proprietary preparation, an analysis of which appeared in the *Brit. Med. Journ.* (ii. for 1909, p 1478) ; reducing sugars amounted to 63·9 per cent., protein to 6·52 per cent., dextrin to 12·7 per cent., and ash to 1·2 per cent. ; the diastatic power was 1060.

Diamalt with Cod Liver Oil.—A proprietary preparation, the analysis of which is given in the *Brit. Med. Journ.*, i. for 1910, p. 30 ; according to this, it contained 64 per cent. of reducing sugars, 4·1 per cent. of oil, and 5·6 per cent. of protein, and had a diastatic power of 74.

Diathermy.—The heating of diseased tissue by electrical currents of high frequency as employed for surgical purposes (coagulation of tumours followed by their removal by curette, etc.), and for medical (*e.g.* in neuritis) ; electro-coagulation ; thermo-penetration (*Brit. Med. Journ.*, ii. for 1910, p. 1547).

Diet. — Chittenden's work (*Physiological Economy in Nutrition*) on the amount of proteid required by the normal adult has led to a great deal of discussion since its publication in 1904. Voit's standard dietary, which was based on the average of a large number of observations on actual diets, and was given as that suitable for a man of 11 stones doing moderate work, is 118 grams protein, 56 grams fat, and 500 grams carbohydrate—roughly equal to 3000 calories. Chittenden found that he could maintain himself in nitrogenous equilibrium on a diet containing only from 37 to 40 grams of protein, and furnishing from 1500 to 1600 calories. He instituted a series of observations extending over several months on 26 individuals who were divided into three groups —(1) the laboratory staff ; (2) volunteers from the army medical corps ; (3) students engaged in athletics. The first and second groups were doing moderate, the third group hard, muscular work. The main restriction on the diet was to enjoin moderation, and, without in most cases eliminating animal food from the diet, Chittenden gradually reduced the protein intake very greatly below Voit's standard. It was found that to keep these men in nitrogenous equilibrium only from 47 to 55 grams of protein were required. In most cases there was a slight initial fall in weight, but thereafter the weight remained stationary at the new level. Bodily strength was gained (100 per cent. as registered by the dynamometer in group (2) ; 50 per cent. in the case of the athletes who were previously in training) ; endurance was heightened ; the subjects enjoyed a feeling of increased well-being, and remained in excellent health throughout the experiment.

Chittenden's experiments undoubtedly prove that the *minimum* protein intake required is much below Voit's standard. In the opinion of most competent judges, however, they do not prove that this minimum standard is also the *optimum*. It is urged that Chittenden's subjects were in an exceptional position ; they were leading quiet, regular lives, with ample sleep and abstinence from alcohol ; their work, though hard, was that to which they were accustomed ; they were interested in it, and in the experiment they were making. These circumstances, along with a natural enthusiasm for the new régime, tended to favour the success of the experiment. The chief arguments against the general adoption of a very low protein standard are, that it may not improbably lower the power of resistance to disease, and that Voit's standard has proved reliable from a hygienic and social standpoint.

Purin-Free Diet.—A purin-free diet has been advised in gout and other conditions—renal disease, headaches, migraine, recurrent vomiting, etc., on the theory that such conditions are associated with the retention or abnormal metabolism of uric acid. The purin bodies are formed from nucleo-proteids ; their relations are shown in the following :—

Purin . .	$C_5H_4N_4$	
Hypo-Xanthin	$C_5H_4N_4O$	oxypurins.
Xanthin .	$C_5H_4N_4O_2$	
Uric acid .	$C_5H_4N_4O_3$	
Adenin . .	$C_5N_4H_4NH$	amino-purins.
Guanin . .	$C_5N_4H_4ONH$	
Caffeine . .	$C_5N_4H(CH_3)_3O_2$	trimethylxanthin
Theobromine	$C_5N_4H_2(CH_3)_2O_2$	dimethylxanthin.

Uric acid arises from two sources—(1) from the nucleo-proteins and purin bodies of the food

—*exogenous uric acid*; (2) from the disintegration of the nuclear tissues of the body, and from the metabolism of muscles (Burian)—*endogenous uric acid*. The amount of endogenous uric acid excreted may be estimated by placing the subject on a diet approximately free from purins. It is then found to vary considerably in different persons, but to remain at a fairly constant level in each individual; the average amount is from ·3 to ·6 gram. In some persons the metabolism of purin bodies appears to be abnormal. Cases are recorded in which on a purin-free diet the output of uric acid was much higher than the above, and others in which, after the consumption of articles rich in purin, enormous quantities of uric acid were excreted for a considerable period. Observations of this kind render the existence of "a uric acid diathesis" at least probable.

Purins are contained in many articles of ordinary food, especially those which are rich in nuclei. All forms of fish and flesh, particularly sweetbread, liver, and the like, contain purins; the pulses, oatmeal, and asparagus yield a considerable amount; tea, coffee, and malt liquors contain smaller quantities.

White bread, rice, eggs, vegetables other than the above, nuts, dates, macaroni, raisins, milk, cream, butter, fruits, fat, and honey are practically free from purin. Guanin and adenin, the purin bodies derived from sweetbread (pancreas and thymus), are absorbed from the bowel with difficulty, and can be recovered from the fæces. It is therefore doubtful whether these should be classed as purin-containing foods from this point of view. The whole question of the value of a purin-free diet is unsettled. Luff believes that its benefit is due to its low proteid content. The metabolism of the purin bodies is discussed in Von Noorden's *Metabolism and Practical Medicine*, vol. i., London, 1907.

Digalen.—A solution of Dr. Cloetta's amorphous digitoxin (prepared from digitalis). See *Brit. Med. Journ.*, i. for 1909, p. 1243; *Journ. Amer. Med. Assoc.*, vol. liii. p. 869, 1909.

Digestion.—Movements of the Alimentary Tract.—The movements of the stomach and intestine during digestion have been studied by Cannon in unanæsthetised animals by means of X-rays. To the food (bread and milk) given sufficient subnitrate of bismuth is added to render it opaque to the rays. The *stomach* is divided functionally (*v. infra*) into two portions—the fundus, and the pyloric part or antrum. In the living animal this division is marked by the transverse band of the stomach—a contraction of the circular fibres—which separates the large sack-like fundus from the small pyloric antrum. When food enters the stomach it first accumulates in the fundus, being cut off from the pylorus by constriction of the transverse band, and during the whole process of digestion the fundus remains steadily contracted on its contents. In about twenty minutes or half an hour rhythmical contractions set in, beginning on the cardiac side of the circular fibres, and these pass towards the pylorus, into which they drive part of the food from the fundus. The pyloric sphincter remains firmly closed, and the food which is driven along the pyloric antrum is squeezed back in an axial stream towards the fundus again. It is thus thoroughly mixed in this pyloric mill, and every part of it is brought into intimate contact with the mucous membrane. At intervals during digestion the pyloric sphincter relaxes, and allows a little of the now fluid gastric contents to escape into the duodenum. As the stomach gradually discharges its contents it little by little assumes the shape of a curved tube. Cannon shows that two factors are concerned in the mechanism of the emptying of the stomach—pressure on the food at the pylorus by the recurrent gastric waves, and the action of the pyloric sphincter. The pylorus is tonically closed when food is ingested, and remains closed against recurrent pressure. The appearance of acid at the pylorus causes the sphincter to relax. The pressing peristaltic waves now force some of the acid chyme into the duodenum. The acid in the duodenum at once tightens the sphincter against further exit. This is what is known as the "acid control" of the pylorus. Carbohydrates stimulate secretion, but do not combine with acid, hence they escape quickly. Proteids fix acid and delay the development of an acid reaction. Fats make a slow continuous exit from the stomach. Cannon has recently (*Amer. Journ. Phys.*, Nov. 1908) discussed "acid control" of the cardiac sphincter. He concludes that it is kept closed by the presence of acid in the stomach. Neutralisation of acid leads to regurgitation, which continues until the normal acidity of the stomach is regained. *Intestine.*—During digestion the food in the small intestine forms a continuous column. Contractions of the wall of the gut appear, the effect of which is to divide the column into a series of segments. At intervals of a few seconds each of these segments is divided into two halves by a fresh constriction, and the adjacent halves of the old segments fuse. There is thus a constant successive formation of new segments, and undoing the old ones, the effect being to bring every particle of chyme into close relation with the intestinal wall. This process of segmentation does not drive the food onwards; that takes place by true peristalsis—*i.e.* a co-ordinate proximal contraction and distal relaxation of the walls of the bowel. The food gradually escapes into

the cæcum by periodical relaxation of the ileo-cæcal valve. As the cæcum and ascending colon fill up, contractions pass along the bowel in a backward direction, driving the contents of the colon into the cæcum and churning them up there. As more and more food enters the large intestine while this churning is taking place, the transverse colon gradually becomes filled. In consequence of the mixing to which they are subjected the contents of the bowel lose water, and are gradually transferred to the descending colon, which is mainly a channel for storage.

All the movements of the alimentary tract depend on a nervous mechanism, and are not produced through the agency of internal secretions or hormones (*v. infra*). True peristalsis—proximal contraction and distal relaxation of a segment of the bowel—is a co-ordinated movement depending on a central mechanism in the medulla or chord. The movements of the stomach described above occur independently of the extrinsic nerves, and must, therefore, be controlled by the nerve plexuses in the walls of the viscus, or, as Starling supposes, be of myogenic origin. Bayliss and Starling regard the local contractions of the small intestine as myogenic.

Gastric Digestion.—The mucous membrane of the stomach is divisible into two parts—the cardiac four-fifths and the pyloric fifth. In the living animal these are distinguishable, and are demarcated by a transverse band. The glands in the fundus secrete hydrochloric acid and pepsin; those of the pylorus, pepsin only. After the insalivated bolus of food is swallowed it lies in the fundus, and the acid gastric juice penetrates it so slowly that salivary digestion goes on in its interior for twenty minutes or half an hour. The secretion of gastric juice consequent on a normal meal consists of two phases—(1) a large amount which is reflexly secreted immediately, and (2) a smaller quantity which is excited chemically during the later stage of digestion by the presence of food in the stomach.

(1) "*Appetite*" *Juice.*—Pawlow's experiments prove that the flow of gastric juice into the stomach which occurs at the beginning of a meal is a reflex phenomenon. In a dog with a gastric fistula direct irritation of the lining of the stomach evokes no secretion, but the sight of food, especially if the animal is hungry, produces a copious flow. If an œsophageal fistula is made, so that food swallowed does not enter the stomach, and the dog be fed, gastric juice begins to flow five minutes after the "sham feeding" commences. As the sham feeding does not appease the dog's appetite, it will go on eating for hours, during the whole of which period the juice flows freely. The reflex arc which controls this phase of gastric secretions has, therefore, several afferent channels—sight, smell, etc.; its efferent path is by the vagus, for division of both vagi prevents the flow, and stimulation of their divided ends produces it.

(2) "*Chemical*" *Juice.*—The second phase of gastric secretion is independent of the above mechanism, because it occurs even after all the nerves going to the stomach are divided. Neither is it due simply to the mechanical presence of food, because some foods do not produce it. The foods which are most active in exciting it are soups and extracts of meat, and these act only when introduced locally into the stomach, not when they are injected into the circulation. The earlier explanation of this fact was that the second phase of gastric secretion was controlled by a peripheral reflex mechanism, but Edkins has proved that the correct interpretation is quite different. The second phase of gastric secretion is really the result of a specific chemical excitant which is produced in the pyloric mucous membrane by the first products of digestion. This chemical excitant is called the *gastric secretin*, or *hormone* (see Hormone). In an anæsthetised animal's stomach which has been completely cut away from all extrinsic nerves, and into which no food enters, the introduction by way of the vessels of a decoction of pyloric mucous membrane causes a flow of gastric juice. The injection of bouillon, or of decoctions of cardiac mucous membrane, has no such effect.

Gastric digestion, therefore, is due to the co-operation of two factors:—The first gastric secretion, aroused by appetite and mastication, is of fairly constant composition. Its acidity equals ·48 per cent. HCl. If allowed to act on proteids for a sufficient time, amino-acids and other of ultimate products of proteolysis are formed, but if the time of digestion be restricted to four or six hours, only albumoses and peptones are produced. The second gastric secretion, which appears long after the appetite is satisfied, varies considerably according to the nature of the food and the amount of hormone it produces. The quantity of gastric secretion is diminished by the administration of oil, or of alkalies; acids increase it.

Pancreatic Secretion.—The greatest flow of pancreatic juice occurs during the third hour after a meal, at the time when the largest quantity of acid chyme is entering the duodenum. The secretion is excited by the flow of an acid into the beginning of the small intestine. This action does not take place through the agency of the vagus or splanchnic reflex arc, for secretion is undisturbed even though these nerves are cut. Bayliss and Starling have shown, moreover, that pancreatic secretion can be excited by the injection of acid into a loop of duodenum which has been entirely deprived of all nervous connection with the pancreas. It follows that the effect is a chemical

one, taking place through the blood-stream. The same observers also found that intravenous injection of an extract made by pounding up duodenal mucous membrane with dilute hydrochloric acid caused a profuse flow of pancreatic juice. The active substance, which has not been isolated, is called *secretin*. Secretin does not exist as such in the cells of the mucous membrane, but is formed by hydrolysis from a body known as *prosecretin*. The nervous system probably plays no part whatever in the secretion of the pancreas.

Changes in the Pancreas during Secretion.—In addition to the changes described in the *Encyclopædia and Dictionary of Medicine* (Vol. VII. p. 241), which are strictly analogous to those occurring in salivary glands, a series of special changes of quite a different nature occur. These concern the islands of Langerhans. These islands are not, as has been supposed, structures independent of the rest of the gland tissue, but represent phases in the life history of the secreting alveoli. They consist of rounded masses of small polygonal cells which stain with difficulty, and, in consequence, they stand out prominently from among the rest of the glandular structures. They are developed from the secreting acini as a result of exhaustion of the gland, and when this exhaustion is extreme (which can be brought about by repeated injections of secretin) the islets spread diffusely through the pancreas. The proportion of islet tissue is also increased by prolonged inactivity —*e.g.* from starvation. "Since the islets are in constant process of formation from alveoli as a result of activity, there must be a constant disappearance of the islets and new formation of alveoli to maintain the balance between the tissues. The embryological evidence brought forward by Laguesse, as well as by Dale's experiments on the toad, show that pancreatic growth is a function of the islets, cell multiplication being observed only in the islets which are produced as a result of extreme activity" (Starling). There is no evidence that Langerhans's islands are organs producing an internal secretion, or that they are in any way specially connected with carbohydrate metabolism.

The *pancreatic juice* is alkaline. Its alkalinity corresponds closely with the acidity of the gastric juice. The normal juice contains no trypsin, and has no effect on coagulated proteid. It, however, contains trypsinogen, and when it comes in contact with the intestinal juice it acquires very powerful proteolytic properties from the conversion of the trypsinogen into trypsin. This conversion is brought about by a ferment—*enterokinase*—in the intestinal juice. The spontaneous conversion of trypsinogen into trypsin, described by earlier observers as taking place in extracts of pancreas, was due to accidental contamination with intestinal juice. Enterokinase is a specific ferment of the intestinal mucous membrane. Its relation to trypsinogen is probably that of a ferment, not, as has been suggested, that of complement to amboceptor, in which the trypsinogen links the enterokinase to the proteid molecule.

Bile.—The flow of bile runs parallel to that of the pancreatic juice—it is greatest during the third hour of digestion. The excitory mechanism is the same as that of the pancreatic juice—the secretin formed in the cells of the duodenal mucous membrane by the acid chyme. The action of bile in facilitating the splitting of fats by the pancreatic juice depends on the bile salts it holds in solution. The solution acts physically, by lowering the surface tension between oily and watery fluids, and also has the power of dissolving fatty acids and soaps. It thus acts as a vehicle for conveying fats in solution through the basilar epithelium lining the gut into the deeper layers of cells, where resynthesis of the fat occurs and the bile salts are released to return to the liver. There they act as cholagogues and are rapidly excreted.

Intestinal Juice.—The secretion of intestinal juice begins soon after a meal, and attains its maximum during the third hour of digestion. It is probably excited by a hormone-secretin, and is also produced by mechanical irritation. It contains enterokinase, and a ferment named erepsin, which, though it has little action on proteids, splits up the results of proteolysis—albumoses and peptones—into further cleavage products. It also contains ferments acting on sugars—invertase, which converts cane-sugar into glucose and lævulose; maltase, which converts maltose into glucose; and lactase, which converts lactose into glucose and galactose.

References.—*Recent Advances in the Physiology of Digestion*, by E. H. Starling, London, 1906.—Pawlow, *The Work of the Digestive Glands* (trans. Thomson), London, 1902.

Digestive Functions, Tests for the.—From time to time a number of new tests for the digestive functions have been devised, but many of them seem scarcely to have been employed except by their inventors. The following, however, have enjoyed a certain amount of popularity, and have given rise to some discussion in the medical journals.

Einhorn's Test.—This is an ingenious though rather complicated procedure. The principle is to administer a capsule containing a series of substances which should normally undergo digestion in different parts of the alimentary tract, each substance having attached to it a coloured glass bead. The beads are subsequently recovered from the stools, and the amount of digestion of the

attached material is determined. The test substances are—catgut, thin fish bone, fibre of raw beef, potato with a piece of the skin, fat, and thymus. Catgut is digested in the stomach and intestine, fish bone in the stomach only—from the state of the corresponding beads the relative activity of the stomach and intestine is estimated. The raw beef, potato, and fat give a clue to the digestion of proteid fat and starch. Thymus is used to test the activity of the pancreas. Unless the pancreas is active the nuclei of the thymus are not digested.

REFERENCES.—Einhorn, *Arch. f. Verdauungsk.*, 20th Feb. 1906 ; *ibid.*, 28th Feb. 1907 ; *ibid.*, 25th Oct. 1907.

Sahli's Desmoid Reaction.—This depends on the fact that raw connective tissue is digested only by the gastric juice, not by the pancreatic or intestinal solution. It is therefore a test of gastric activity, and was intended to replace, or to be an adjunct to, the use of the test meal. "Desmoid capsules" consist of small rubber bags containing methylene blue. The mouth of the bag is tightly tied up with fine catgut. One of these is swallowed during a meal, and when the catgut is loosened by digestion the methylene blue is set free and discolours the urine. It seems that if the drug appears in the urine within eight hours of administration, the functions of the stomach may be regarded as active.

REFERENCES.—Sahli, *Corr. Blatt. f. Schweig. Aerzte*, pp. 8-9, 1905 ; *Deutsche med. Wochensch.*, No. 30, 1907.—Hillman, *Arch. f. Verdauungsk.*, 28th Aug. 1907.—Horwitz, *Ibid.*, 30th Aug. 1906.

Schmidt's Test Diet.—To estimate the functional activity of intestinal digestion, Schmidt gives a diet consisting of—Breakfast, half a litre of milk or cocoa and 50 grams of rusks. Lunch, half a litre of gruel (40 grams oatmeal, an egg, 10 grams butter, 200 grams milk, 300 grams water). Dinner, 125 grams underdone minced meat cooked with 20 grams butter, and 25 grams of potato purée (mashed potato, milk, and butter). Afternoon, as breakfast. Supper, as lunch. The essential components of the diet are the cereals and the underdone meat. The diet is continued for several days ; some colouring matter (charcoal) may be added to show when the stools are beginning to be affected. The fæces are rubbed up with water and a quantity is spread out for examination on a suitable black surface. They are then examined for (1) mucus ; (2) residue of connective tissue and muscular fibre ; (3) carbohydrate residue ; (4) fat. The examination is conducted with the naked eye, and by the microscope.

Mucus indicates intestinal catarrh. Large shreds occur in mucous colitis, and in affection of the colon generally (*e.g.* constipation masked by irritative diarrhœa) ; small, bile-stained flakes of mucus come from the small intestine. *Connective tissue fibre.*—If these are present, gastric digestion is deficient, for the gastric juice alone can digest fibrous tissue. Muscle fibre is digested both in the stomach and intestine. Connective tissue may be found either on account of gastric inadequacy, or because the contents of the stomach are hurried too rapidly into the duodenum. Therefore connective tissue residue only = gastric indigestion ; muscle fibre alone = intestinal indigestion ; connective tissue and muscle fibre = gastric and intestinal indigestion. *Carbohydrate.*—Only a few cells of potato should be found under normal circumstances. If there is any excess, the digestion of starch is faulty. Under the name of "intestinal dyspepsia with fermentation," Schmidt describes a symptom-group of colic, loose stools containing quantities of starch but no fat or proteid, and malnutrition. *Fat* is rarely present. Excess can only be estimated roughly, hence the diet gives little information as to the digestion of fat. If the stools are normal, or nearly so, solid particles are so small as to require microscopic examination for their identification. Three slides are made—one of the liquid fæces alone, one stained with iodine in iodide of potash to show starches, and one with the addition of 30 per cent. acetic acid to dissolve soaps and lime salts and show fatty acids. Chemical examination has also been resorted to (Steel) and a fermentation test has been applied, but the main information obtainable from the test diet is got by simple inspection.

REFERENCES.—Schmidt, *Die functionsprüfung des Darmes mittels der Probekost* (Wiesbaden), 1904.—Roux and Riva, *Gaz. d. Hôp.*, 17th June 1905.—Steel, *Med. News* (New York), 16th Dec. 1905.

Occult Blood in the Fæces.—By the term "occult hæmorrhage" is meant that the amount of blood is so small as to elude visual detection, and requires the application of chemical tests for its recognition. The presence of even these very minute quantities of blood in the motions is sometimes of considerable diagnostic importance in deciding as to the presence or absence of gastric cancer or ulcer. Boas states that in hyper- and hypo-chlorhydria, in hyper-secretion, and in simple dilatation occult blood is never found. In cases of pyloric stenosis secondary to ulcer, it may or may not occur, while in gastric cancer it is invariably, and in gastric ulcer usually, present. Certain precautions must be taken in testing for occult blood. For two or three days before the test is made the patient's diet must have contained nothing which will give a reaction—*i.e.* no flesh, no meat extract containing hæmoglobin. A stomach tube must not have been passed recently, as it may have caused an abrasion of the œsophageal or gastric mucosa. Other sources of hæmorrhage

—mouth, gums, throat, nose, piles, must be excluded. Among the tests employed are—(1) the guaiac reaction; (2) the aloin reaction; (3) the benzedin reaction. The last is extremely delicate.

Guaiac and Aloin Tests.—Rub down with water a piece of fæces the size of a walnut, and add to 5 or 6 c.c. of the fluid one-third of its volume of acetic acid. Shake thoroughly, and extract with 6-8 c.c. ether. When the mixture clears, pour the ether off into two tubes; to one add tincture of guaiacum, to the other tincture of aloes, and to both add 20-25 drops of oil of turpentine. A blue colour in the one case, a cherry red in the other, shows that blood is present.

Benzedin Test.—Dissolve as much benzedin puriss. (Merck) as will lie on the point of a knife in 2 c.c. glacial acetic acid. Infuse a pea-sized mass of fæces in a test tube full of boiling water (to destroy ferments) and add a few drops of the liquid to a mixture of 10 drops of the benzedin-acetic acid solution, and 2 or 3 c.c. commercial solution (3 per cent.) of hydrogen peroxide. The presence of blood is shown by a deep greenish-blue colour.

References.—Schloss, *Arch. f. Verdauungsk.*, 30th June 1904.—Hartmann, *Ibid.*, 25th Feb. 1904.—Davis, *Bost. Med. and Surg. Journ.*, 8th Aug. 1907.—Goodman, *Amer. Journ. Med. Sci.*, Oct. 1907.

Dioxydiamidoarsenobenzol. — *See* also Syphilis (*Treatment*). An organic compound of arsenic, better known as "606," brought forward by Ehrlich for the treatment of syphilis; it is also known as the Ehrlich-Hata specific and as salvarsan; it has been given by intra-muscular and by intra-venous injection; the enthusiastic early reports of its value have hardly been maintained. *Vide* Dr. Emery's article (*Lancet*, ii. for 1910, pp. 1543-1548).

Disuse-Atrophy. — The group of changes in functional cells following upon continued disuse; they resemble those following atrophy from reduced blood supply.

Diversion of Complement. — A peculiar phenomenon in bacteriolysis, first observed by Neisser and Wechsberg (in 1901) and described as follows by Adami (*Pathology*, i. p. 546, 1910):—"If a suspension of bacteria be taken in a normal serum containing sufficient complement to cause bacteriolysis when a known amount of inactivated serum is added (*i.e.* containing x amboceptors), then if, say 10 x amboceptors be added, instead of the solution of the bacteria being hastened, the opposite occurs; it may be wholly arrested. There is evidently a diversion of the complements, the excess unattached amboceptors have a greater avidity or attraction for the complement molecules than have those that have become partially satisfied by attachment to the bacteria, or, conversely, it may be that the avidity of the bacterial receptors is greater for amboceptors pure and simple than for the combined amboceptors plus complement." Various explanations of the phenomenon have been given, but its practical importance is that in immunisation the amount of immune serum injected should be kept within certain limits, if it is to be effective (Adami).

Dominants and Dominance.—*See* Heredity (*Mendel's Law*).

Dominici Tubes.—Tubes for the application of radium, made of silver and allowing only β and γ rays to pass.

Dosimetric Method.—The administration of medicines by accurate and systematic measurement.

Dreuw's Method.—A method of treating lupus vulgaris by first freezing the affected skin (*e.g.* with carbon dioxide snow) and then rubbing crude hydrochloric acid well in. *See* Lupus Vulgaris.

Drugs, Recent.

Aspirin 120
Atoxyl 120
Bromural 121
Cacodylic Acid 121
Colloidal Metals 121
Fibrolysin 121
Formic Acid 122
Heroin 122
Veronal 122

Aspirin.—One of the trade names of acetyl-salicylic acid (also known as Xaxa, etc.). Acetyl-salicylic acid has the same general action as the salicylates, and is in many respects a very useful drug. It seems to be a more powerful analgesic than salicylic acid or sodium salicylate, and often does good in neuralgia, headache, muscular rheumatism, sciatica, lumbago, and the like. Unpleasant symptoms (tinnitus aurium and giddiness) rarely occur, but in some persons it produces nausea. It does not induce perspiration in febrile conditions to the same extent as sodium salicylate. In afebrile cases there is no sweating. Aceto-salicylic acid is best administered in cachets; the dose is 5-15 grs. for an adult. It is decomposed by alkalies, and is incompatible with many other drugs, and therefore should be prescribed alone, without admixture. It does not keep well if exposed to the air as tablets or in powder.

Atoxyl is the trade name of an organic compound of arsenic, much employed in the

treatment of trypanosome infections, and also in syphilis. Soamin is another name for the same substance. Atoxyl was originally stated to be the anilide of metarsenious acid, but Moore, Nierenstein, and Todd, who have investigated its composition, regard it as a sodium salt of amidophenyl-arsenic acid, containing the arsenic directly united to the benzene ring. Ehrlich has independently arrived at nearly the same result. Moore and his colleagues find that it is a very stable compound, neither aniline nor arsenic being readily detachable from the molecule by chemical means. Its aqueous solution is, however, strongly dissociable electrolytically. Moore points out that the poisonous effects of atoxyl (of which blindness is the most serious) are not those of arsenic, and that on long continued administration neither the toxic action of arsenic on the nervous system nor that of aniline on the blood are seen. He therefore does not believe that the action of atoxyl is due to slow ionisation of arsenic, but thinks it is a direct specific effect of a complex organic ion containing both the aniline and arsenic group. The very rapid action of a single large dose of atoxyl on the parasites (trypanosomes) of a highly-infected animal is in harmony with such a view of its action, and is incompatible with the notion of a slow decomposition of the drug (see SLEEPING SICKNESS). Koch advises the use of atoxyl in doses of half a gram, given subcutaneously on two successive days. In syphilis the dose recommended is from 3 to 7 grs. every second day. If a larger doze be given, headache, dizziness, strangury, cough, and transitory or permanent blindness may be caused. *References.*—Ehrlich, *Berl. klin. Wochensch.*, Nos. 9-12, 1907; Moore, Nierenstein, and Todd, *Biochemical Journ.* ii. pp. 316-324, 1907.

BROMURAL.—The α-monobrom-isovalerianyl-urea. It is a safe and moderately powerful hypnotic, with apparently no harmful secondary actions. The dose is from 5 to 10 grs. at bedtime, in hot milk, tea, or water. It is sparingly soluble in cold water. It does not seem to be cumulative, and it is not necessary, as a rule, to increase the dose.

CACODYLIC ACID AND ITS SALTS.—These are organic combinations of arsenic, by which large quantities of arsenic can be introduced into the system without producing poisonous symptoms. Sodium cacodylate, containing 46·8 per cent. of arsenic, may be given in doses of ½ to 1 gr.; cacodylic acid (54·4 per cent. of arsenic) in doses of ¾ gr. once daily. The drug is given hypodermically, as a sterile solution (½-1 per cent.). Cacodylates have been used in chorea, tuberculosis, and various skin diseases. They have to a large extent been superseded by atoxyl.

COLLOIDAL METALS—"Metallic Ferments"—"Electrosols."—When an electric spark is passed through pure water between terminals of a metal, minute quantities of the metal become diffused through the liquid. The solutions are dichroic, and conform to the tests for colloidal solutions. The metals exist in them in a state of minute subdivision, and the particles possess a vibratory "Brownian movement." Their action depends on their physical constitution, not on any special property of the metal used; gold, silver, platinum, palladium, etc., may be employed. Robin asserts that these colloidal metallic solutions profoundly influence metabolism when injected subcutaneously. They are said to (1) reduce the temperature; (2) raise the blood-pressure; (3) increase the output of urea, uric acid, and urinary indoxyl; (4) cause leucocytosis; (5) decrease the consumpt of oxygen without diminishing the carbonic acid exhaled; (6) increase the co-efficient of nitrogenous utilisation. The solutions are believed to act in virtue of the extreme subdivision and separation of the metallic particles; Robin compares the action to the radiant properties of gases in a vacuum tube in which a similar wide separation of atoms prevails. Metallic ferments have been used in pneumonia, etc., it is said, with benefit. Further investigations are required before any conclusion can be formed. *References.*—Robin, *Les ferments metalliques* (Paris), 1907; Iscovesco, *Presse méd.*, 8th May 1907.

FIBROLYSIN.—This is a double salt of thiosinamin and sodium salicylate, which is freely soluble in water, and is said to possess a selective action on pathological fibrous tissue, causing in it a softening process which facilitates the absorption or stretching of such cicatricial formations. It is given by intramuscular injection; for this purpose the sterilised solution sealed in glass tubes, each containing a single dose (3 grs. of thiosinamin in 37 minims), are very convenient. W. J. Stuart (*Folia Therapeutica*, Jan. 1909) prefers subcutaneous injection, near to the scar tissue; the majority of surgeons prefer gluteal injections, as less painful, and unattended by the slight risk of sloughing which is said to accompany subcutaneous injections. There are rarely any unpleasant after-effects. Soon after an injection near a scar the colour of the scar becomes paler and infiltrated with serum. The strands of fibrous tissue swell, and the nuclei become separated (Mendel). "It is of vital importance, from the therapeutic standpoint, to remember that one cannot count on fibrolysin causing actual absorption of scar-tissue; it causes a softening, and must be supplemented by massage, baths, movements, and other mechanical means appropriate to each case, which, without the softening action of fibrolysin, would be ineffective" (Stuart). Fibrolysin may be tried in all conditions in which it is desirable that cicatricial or pathological fibrous tissue should be softened—*e.g.* operation scars,

contractions following burns and injuries, scleroderma, lupus, Dupuytren's contraction, etc. It has also been employed in the treatment of corneal opacity, deafness associated with sclerotic processes in the ear, strictures of the urethra and œsophagus in association with the use of bougies, stenosis of the pylorus, polyarthritis, pleuritic thickening, neuritis, and a great many other diseases. The reports of its efficacy vary a good deal, but the remedy is at least worthy of trial in such conditions. Injections should be given on every second or third day; a course of twenty-five or fifty may be required before much improvement is seen, but good results may follow a considerably smaller number.

Formic Acid and the Formates.—Formic acid and the formates have been introduced on account of their supposed stimulant and tonic action on the muscles. It has not been proved that they really have the efficacy ascribed to them; Goodall was unable to ascertain any definite pharmacological action on the blood-pressure, heart-beat, or voluntary muscles. No diuresis was observed. Formic acid is used as a twenty-five per cent. solution in doses of 2-10 minims; the sodium salt ($\frac{1}{2}$-5 grs.) is also employed. Ker and Croom speak favourably of formic acid in preventing heart-failure in diphtheria. The formates are largely used as "tonics," and seem to produce at least a subjective sensation of well-being and to remove fatigue.

Heroin (acetomorphine) hydrochloride is a morphine derivative chiefly used in respiratory affections. It is a sedative to the respiratory centre, increasing the force of the expiration and inspiration, and reducing the rate. It is also an expectorant, and soothes irritable cough. It does not tend to produce the disagreeable secondary effects of morphia—nausea, constipation, headache. It is not depressant, and does not tend to produce a craving for the drug. It is used in hæmoptysis, and as an expectorant generally. The dose is $\frac{1}{24}$-$\frac{1}{6}$ gr. The elixir heroin *c.* terpen. (B.P.C.) is a convenient preparation.

Veronal.—This is a recently introduced hypnotic drug, also known as malourea. The dose is from 5 to 10 grs. It should be administered about half an hour before bedtime, dissolved in a cup of hot fluid. Toxic symptoms are rare. Its chief use is in simple insomnia; it has also been employed as a prophylactic against sea-sickness during short voyages, and as an aid to chloroform narcosis, a dose being given an hour before the anæsthetic is administered. Veronal may be administered by the rectum instead of the mouth. It is not cumulative. Proponal is a somewhat similar drug.

Dugong Oil.—An oil obtained from the fat of *Halicore australis* and *Halicore dugong* by boiling, proposed by Hobbs, of Brisbane, as a substitute for cod liver oil, and used as such in Queensland in various wasting diseases.

Dührssen's Method.—The making of multiple deep incisions in the cervix uteri to hasten delivery. *See* Accouchement Forcé (*Methods*).

Dührssen's Operation.—Vaginal Cæsarean Section or vaginal hysterotomy. *See* Accouchement Forcé (*Methods*).

Dukes' Disease.—*See* Erythema Infectiosum (Fourth Disease).

Dupre, Syndrome of.—*See* Meningism.

Dupuytren's Contraction.—Keen (*Amer. Journ. Med. Sci.*, Jan. 1906) describes a new operation for Dupuytren's contraction of the palmar fascia. He dissected out the entire palmar fascia in the following manner. An incision was made from the ball of the thumb on a line with the interspace between the forefinger and middle finger down almost to the web between these fingers, then across the palm along the roots of the fingers to a point opposite the web between the ring and little fingers, and then up to the ball of the little finger to a point opposite where it started from. The entire flap was dissected back, down to the sheaths of the tendons. It included on its under surface the entire palmar fascia. The next step was to direct the palmar fascia off the flap. Then the small fibres of fascia going to the index and little fingers were dissected out from under the skin at the edges of the wound. Half a dozen small vessels were tied, and the skin flap replaced and held in position by sutures. The movement of the fingers were almost normal when the patient left hospital. To have dissected up the skin alone first before removing the fascia, would almost certainly be followed by sloughing of the flap, but by lifting a flap consisting of all the tissues down to the tendons sufficient nourishment for the flap was ensured, and at the same time the palmar fascia was rendered readily accessible for removal. It was perfectly easy to reach the fibres to the index and little fingers by simply undermining the skin slightly.

Dusart's Wine.—A proprietary tonic wine, described as a "lacto-phosphate de chaux, ferrugineux"; for analysis, see *Brit. Med. Journ.*, i. for 1909, p. 1309.

Dusmo.—A hygroscopic sawdust used for removing dust from carpets and renovating their colour; it is reported on in the *Lancet*

(i. for 1909, p. 925) where it is stated that it promises to be a useful sanitary adjunct.

Dyostosis, Cleido-Cranial. — *See* Cranio-Cleido-Dyostosis.

Dyspraxia. — Difficulty in performing certain actions (*e.g.* protruding or withdrawing tongue, bending arm, etc.) ; it may be hysterical, and is then sometimes removable by suggestion (Williams, *Lancet*, ii. for 1910, p. 1548) ; it is derived from Gr. δυς, bad, and πρᾶξις, a doing.

Eclampsia.

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One is justified in using the word "enormous" to characterise the literature which has gathered round the eclampsia gravidarum during the past five or seven years. New theories of origin have been put forward, and new methods of treatment founded thereon have been tried ; but it has still to be confessed that all this wealth of research, with its theoretical discussions and its therapeutical novelties, leaves the mortality of this complication of the pregnant and parturient state very much where it was ten years ago. Eclampsia is still the *opprobrium medicorum* in obstetrics. At the same time, it may be well to indicate briefly the new theories of pathogenesis and methods of treatment, for in some of them may lie concealed the long-looked-for explanation and cure of this disastrous malady or group of maladies.

Theory of Thyroid Inadequacy.—This novel theory had its origin in Lange's observations, published in 1899 (*Zeitsch. f. Geburtsh. u. Gynäk.*, xl. p. 34, 1899). Beginning with the fact that normally the thyroid gland is enlarged in pregnancy, Lange noted that in twenty out of twenty-two cases in which this hypertrophy was absent there was albuminuria ; he observed that thyroidin given to pregnant women in whom hypertrophy had occurred caused diminution in the size of the gland ; diminution in size also followed the administration of thyroidin in a case in which there was pathological enlargement of the gland ; and he found that iodothyrin, given to patients suffering from the nephritis of pregnancy, was productive of diuresis, although the albuminuria was not much lessened. These observations led Oliphant Nicholson, in October 1900, to test the effect of thyroid extract in eclampsia (*Trans. Edin. Obstet. Soc.*, xxvi. p. 188, 1900-1), in one case under the care of Elmslie Henderson, and in another in the Edinburgh Royal Maternity Hospital, under Ballantyne ; later, Nicholson reported four additional instances (*Trans. Edin. Obstet. Soc.*, xxvii. p. 160, 1901-2), and since then has discussed on several occasions the theoretical aspects of the subject, and given details of other cases similarly treated (*ibid.*, xxviii. p. 84, 1902-3 ; xxix p. 50, 1903-4 ; xxxi. p. 213, 1905-6 ; *Edin. Med. Journ.*, N. S., ii. p. 456, 1909). This theory proceeds on the assumptions that there is always a toxæmia in pregnancy (the result of fœtal metabolism) ; that this state is more marked towards the close of gestation (causing increased blood-tension and cardiac hypertrophy) ; that errors of diet, etc., may at any time so increase the toxic condition as to cause convulsions ; and that, although the toxæmia is constant, the toxic agent causing the convulsions may differ, and (for this is the part in which this theory stands apart from others) may in some instances be produced by thyroid inadequacy. So long as the kidneys are able to eliminate the toxines no grave symptoms will result, but any checking (especially a sudden one) of the renal functions will produce evil consequences. Nicholson discussed the pre-eclamptic signs and symptoms (œdema, albuminuria, diminished secretion of urine, high arterial tension, headache, eye conditions, diarrhœa, and muscular twitchings), and maintained that they were all capable of explanation by the theory of thyroid inadequacy. He thought, also, that through defect of the thyroid secretion the action of the suprarenal glands might be permitted to become excessive, leading to constriction of arterioles (especially those of the kidney) and increased blood-pressure, that the formation of urea ("the most powerful diuretic substance with which we are acquainted") would be diminished and the quantity of urine be lessened, and that the liver, being unable to cope with the untransformed proteids sent to it, would also become inadequate. These factors would combine to produce eclampsia. In a later article (1902), Nicholson introduced inadequacy of the parathyroids as well as of the thyroid gland into his scheme of pathogenesis. For the treatment of eclampsia and the pre-eclamptic state he therefore recommended and practiced the use of thyroid extract alone or in combination with morphia ; the morphia was employed for its immediate effect in checking the convulsions, and was given in a dose of half a grain (repeated once or even twice) hypodermically, and the thyroid could be admin stered before the convulsions or between them (if the patient were unable to swallow), or it might be given, as the liquor thyroidei, by the hypodermic needle, or dissolved in saline solution (MacNab, *Journ.*

Obstet. and Gynæc. Brit. Emp., vi. p. 386, 1904). Nicholson recommended that the dose of the thyroid extract should be large, and the drug continued till symptoms of thyroidism appeared (30 to 60 grs. at a time, *Trans. Edin. Obstet. Soc.*, xxxi. p. 229, 1906). To a patient under the care of Ballantyne, in the Edinburgh Royal Maternity Hospital, Nicholson gave as much as 100 grs. within twelve hours; it was a serious case of eclampsia, and recovery followed, but a transient attack of hemiplegia was noticed on the eleventh day after the occurrence of the eclamptic fits.

It is difficult to judge if the giving of thyroid extract has greatly benefited cases of eclampsia or no. In Sturmer's series of 41 cases (*Journ. Obstet. and Gynæc. Brit. Emp.*, v. p. 531, 1904) at Madras, the mortality was reduced to 12·2 per cent. for the mothers, and 27 of the infants were alive at birth, although 8 of them died within 3 days (54 per cent. infantile mortality). Baldovsky's 2 cases (*Vrach Gaz.*, xi. p. 31, 1904) recovered. The remedy would appear to be most beneficial in those cases in which there is hard œdema, and those in which there is a myxœdematous or pseudo myxœdematous condition; at any rate, clinical evidence shows that the drug may be safely given, even in large doses, in cases of eclampsia, and that it may also be administered for prolonged periods during pregnancy. Latterly, the question has been complicated by the problem of the action of the parathyroids. Frommer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiv. p. 748, 1906), for instance, has proven experimentally that removal of the parathyroid glands in non-pregnant rabbits and bitches has no effect on their health, but that when placental substance was placed in the abdomen death from tetany followed; further, removal of the parathyroids from pregnant bitches and rabbits caused eclamptic seizures and tetany. It is, however, to Vassale (*Arch. ital. de biol.*, xliii. p. 177, 1905) that we owe the parathyroid theory of the origin of eclampsia and its treatment by paraganglin or parathyroidin (Bellotti, *Gaz. d. osp.*, xxviii. p. 91, 1907; Kaiser, *Zentralb. f. Gynäk.*, xxx. p. 1240, 1907). According to this theory, it is parathyroid insufficiency (congenital or from disease) which causes eclampsia, and in support thereof it has been found that removal of the parathyroids causes eclampsia in gravid bitches, and that this can be held in check by the administration of large doses of parathyroidin (Vassale, *Arch. ital. de biol.*, xlvi. p. 143, 1906-7). At the present time, therefore, the theory of thyroid inadequacy in eclampsia has become one of parathyroid inadequacy, and the administration of parathyroidin or paraganglin is tending to supplant that of thyroid extract. In this connection it may be stated that Chirié (*Obstétrique*, N.S., i. p. 247, 1908) has found hyperplasia of the suprarenal glands (cortex and medulla) in eclampsia and nephritis. The occurrence of hypertrophy of the *fœtal* thyroid in Fothergill's case of maternal eclampsia following the administration of thyroidin (*Trans. Edin. Obstet. Soc.*, xxix. p. 41, 1903-4) may possibly be found to be of significance in connection with the pathogenesis of this grave complication of pregnancy.

Theory of Placental or Chorionic Origin.—The idea that eclampsia is caused or at any rate precipitated by the passages of poisonous materials from the fœtus to the mother is not new; but it has always been rendered difficult of acceptance by the occurrence of convulsions in the puerperium after the influence of the infant has been removed. This difficulty exists also in regard to the more recent views of a placental or syncytial origin for eclampsia, although the occurrence of cases in which convulsions accompanied a vesicular mole (*e.g.* Hitschmann's observation in the *Zentralb. f. Gynäk.*, xxviii. p. 1089, 1904), where, of course, there was no fœtus but where there was a great proliferation of syncytium, is in favour of the latter theory. Liepmann (*Münch. med. Wochensch.*, lii.p. 2484, 1905; *Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 366, 1905, and lvi. p. 232, 1905) supported this view, and stated that a solution made from the placentas of eclamptic patients had a toxic character; he believed that the toxine, which was very labile, was fixed in the protoplasm of the cells of the placenta, and that it was absent from the normal placenta; he was also of opinion that the fewer the fits which occurred the greater was the amount of toxine in the placenta, and that, conversely, the more numerous were the fits the less toxine was found in the placenta. He thought that the toxine had a special affinity for the cells of the brain which fixed it, neutralised it, and were paralysed by it; that it acted deleteriously on the renal and hepatic parenchyma, and that the lesions in these organs were, therefore, secondary to the toxæmia, and that the epithelium of the chorionic part of the placenta appeared to play an important part in forming the toxine. Liepmann surmounted the difficulty of the puerperal cases by supposing that the liver might temporarily store up the toxine during pregnancy and labour to liberate it later (*Zentralb. f. Gynäk.*, xxx. p. 693, 1906). His reason for not accepting the theory that the fœtus was the source of the toxine was the fact that the child itself was so seldom injured by it. Before Liepmann's observations were published, Kœnig (*Zentralb. f. Gynäk.*, xxvii. p. 1175, 1903) had pointed out the occasional association of eclampsia and large placenta (with a relatively small infant); but this fact cannot be freely used in support of the theory of placental origin, for the large size might be due to syphilis. Dienst (*Zentralb. f. Gynäk.*, xxix. p. 353, 1905) regarded the causal factor in eclampsia as the mixing of the fœtal and

maternal blood, for he found that the placenta in such cases was more permeable, and he thought that blood from the fœtus acted upon that of the mother like the blood of a distinct species. In support of his views, Dienst discovered that blood obtained by venesection from two cases of albuminuria, when tested upon normal blood, caused agglutination and hæmolysis; after delivery, the maternal blood was tested upon that of the infants for agglutination, with a positive result. A special development of the theory of the placental origin of eclampsia is expressed in the statement that there is a deportation of villi or parts of villi from the placenta into the mother's blood. Labhardt (*Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 264, 1905) discussed this view and its modifications, grouping them into three classes—(1) Schmorl thought that placental cells passed into the maternal circulation, and, placing this idea in conjunction with Ehrlich's demonstration that the entrance of foreign cells into an organism caused chemical changes, and with Veit's belief that the placental cells produced a poison in the mother, considered that the poison thus carried over caused eclampsia, and that as only a few cells were deported the amount of the poison was small and the disease rare; (2) Ascoli expanded this view, and stated that the foreign cells brought about the formation of new substances which dissolved them and neutralised their poisonous effects; these new substances were lysins (syncytiolysins), and, if they were formed in excess, they caused eclampsia; (3) Weichardt, again, thought that by the solution of the placental cells a new poison was formed (syncytiotoxine), which was usually neutralised by an antitoxine, and that if the latter failed to be formed in sufficient amount, the syncytiotoxine caused the eclamptic seizures. Labhardt (*loc. cit.*) criticised these views, pointing out that deportation of villi was frequent, whilst eclampsia was rare; that the placental cells were hardly "foreign" to the maternal organism; that eclampsia was very rare in animals that possessed placentas; and that the frequency of eclampsia in primparæ, in cases of flat pelvis and hydramnios, and in certain places at certain times, could not be accounted for by this theory. He added that its non-occurrence in cases of tubal abortion was a mystery. The examination of ectopic pregnancies has still further weakened the placental theory of origin of eclampsia, for it has shown that the appearances described as deportation of villi may possibly be due to decidual reaction and formation in the walls of blood-vessels in the Fallopian tube (*see* ECTOPIC PREGNANCY, TUBAL, p. 132). Whilst it cannot be affirmed that the placental theory of origin of eclampsia has been fully established, it may at any rate be stated that truth in large or small measure is contained in it. Eclampsia does not occur without pregnancy; it occurs most often in women who are for the first time experiencing the metabolic changes produced by utero-gestation, the great biological link between the mother and her fœtus is the placenta, and the theory founded upon placental conditions fulfils the requirements of modern views on the pathogenesis of toxæmia. There is always danger of concentrating our attention too much upon a detail (*e.g.* lacticaciduria as developed by Zweifel (*Arch. f. Gynaek.*, lxxvi. p. 537, 1905; Füth and Lockemann, *Zentralb. f. Gynäk.*, xxx. p. 41, 1906), and forgetting the great generalisation that eclampsia is due to a toxæmia. In time it may be possible to differentiate various types of eclampsia, and a placental variety, a thyroidal variety, an intestinal variety, and so on, may be recognised and separated and treated along lines peculiar to each; meanwhile, the safest procedure to be adopted must be to treat the disease as a toxæmia and on the general principles which have proved to be most beneficial.

METHODS OF TREATMENT, OLD AND NEW.—Turning now to treatment, we find the same divergence of opinion still prevailing as was noticeable at the end of the nineteenth century. Veit's morphine treatment is still popular with some obstetricians (Harpe, *Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 102, 1906), but Bumm and others have declared against it. Chloroform and chloral are still extensively used, but it has been found that the administration of chloral by the rectum (the usual plan) is uncertain, and that it is better to give it by the mouth, the stomach having been previously washed out; chloral has been given hypodermically (Ballantyne, *Trans. Edin. Obstet. Soc.*, xxxiii. p. 43, 1907-8), but this requires caution. In America the treatment by hypodermic injections of the tincture of veratrum viride is yet in vogue, but apparently it is less popular; the drug is given till the pulse-rate falls to 60. It may be, however, that the reduction of the blood-tension produced by veratrum is itself dangerous, and hence it has become customary to combine its administration with that of camphor or caffeine. In Europe, Mirto (*Ann. di ostet. e ginec.*, ii. for 1905, p. 580) and others have spoken highly of the value of veratrum viride. Venesection and the injection of saline solution under the breasts or into the veins has been highly reported upon, and Jardine put on record fifteen cases of eclampsia with no maternal deaths treated by the above means, combined with free purgation and the use of hot packs (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 14, 1905). Budin (*Rev. gén. de clin. et de thérap.*, xxi. p. 101, 1907) emphasised the immense importance of clearing out the intestine both for the prevention and treatment of eclampsia; rectal washing and bleeding were strongly recommended by him. The use of nitroglycerin internally or

by hypodermic injection has been highly spoken of (M'Carthy, *Brit. Med. Journ.*, i. for 1908, p. 1220). Hot packs have been freely employed by some, while others dread their effect in concentrating the blood and so increasing the amount of toxines in it. The use of thyroid extract and of paraganglin has been already touched upon (*vide antea*, p. 123). Recently Ballantyne has reported nine cases of eclampsia with no maternal deaths treated by venesection, intravenous injection of saline, stomach washing with bicarbonate of soda solution, the introduction of six ounces of magnesium sulphate into the stomach by the stomach tube, the giving of a large enema and the hot pack (*Journ. Obstet. and Gynæc. Brit. Empire*, xviii. pp. 378-383, 1910). No active measures were taken to expedite labour in any of these cases. The difficulty of coming to any conclusion among all these methods depends on the varying circumstances: sometimes and in some places the disease appears to be milder than in others; seldom does the obstetrician confine himself strictly to any one line of treatment, but uses several in conjunction, and may even employ two or more which are pharmacologically incompatible; little or no attempt is made to differentiate types of eclampsia and treat differently in accordance with the clinical variety which is presently being dealt with; and to some extent prejudice and the usage of different schools of obstetrics have hindered the formation of unbiassed opinion.

Standing somewhat apart from the various methods of management referred to above are the obstetric treatment and the preventive treatment of eclampsia. With regard to the former, which generally means *rapid emptying of the uterus*, there is still a very clearly defined difference of opinion. Those, who perhaps represent the obstetricians of the past, who maintained that "meddlesome midwifery is bad," cry out against operative interference to terminate labour; these, who perhaps take the place to-day of the men whose watchword was "delays are dangerous," are insistent upon the necessity of removing from the interior of the uterus the fœtus and the placenta, one or both of which they regard as the causal factor in the production of the convulsions. Much has been said and written on both sides during the past five or six years (*vide*, for instance, the discussion in the *Brit. Med. Journ.*, 23rd September 1905), but the general impression left on the mind after a careful reading of the literature of the subject (great in amount and of varying value) is that, on the whole, those who advocate early emptying of the uterus and who employ the safest methods of doing so have achieved results which compare favourably with those obtained by others who pursue more conservative methods. Bumm's statistics as quoted by Liepmann (*Münch. med. Wochensch.*, lii. p. 2484, 1905) and by Bumm himself (*Deutsche med. Wochensch.*, xxxiii. p. 1945, 1907), although they have been attacked by Hastings Tweedy (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 106, 1906), are strikingly in favour of early operative interference; and Osterloh (*Münch. med. Wochensch.*, lv. p. 553, 1908) at Dresden, and Esch (*Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 11, 1906) for the Olshausen Clinique at Berlin, are agreed in recommending immediate termination of all the cases of eclampsia in which there is marked disturbance of the general condition (coma, fever, rapid pulse, etc.). At the same time, the other side has constantly to be heard, and it cannot be said that this matter is definitely decided; evidence is still being led.

If, however, the obstetrician have decided to terminate labour quickly, it may be asked whether the obstetric advances of the past six or seven years have furnished him with any better methods of rapidly emptying the uterus than he possessed in the nineteenth century. Let us look first at *Bossi's metallic dilator* (with its modifications by Frommer and others), which was introduced in Italy during the last decade of the past century. In eight cases of complicated labour (in three of which eclampsia formed the complication) Ballantyne employed Bossi's dilator, and all the three mothers recovered (*Trans. Edin. Obstet. Soc.*, xxix. p. 76, 1903-4); at the same time he regarded it as an exceptional method, to be employed in exceptional cases, and did not minimise its dangers. It was about this time that dilatation of the cervix with the Bossi instrument and others of similar type was being most often performed, if we may judge by the literature of the subject, and among many articles we may name those of Cocq (*Bull. soc. belge de gynéc. et d'obstét.*, xiv. p. 116, 1903-4), Hartz (*Monatssch. f. Geburtsh. u. Gynäk.*, xix. p. 91, 1904), de Seigneux (*Arch. f. Gynaek.*, lxx. p. 614, 1903), Bossi (*Arch. ital. di ginec.*, vii. p. 60, 1904), Ricci (*ibid.*, p. 71), Armstrong (*Brit. Med. Journ.*, i. for 1904, p. 717), Kerr (*Glasgow Med. Journ.*, lxi. p. 169, 1904), Hahl (*Arch. f. Gynaek.*, lxxi. p. 509, 1904), Nubiola (*Rev de med. y cirug.*, xviii. p. 241, 1904), F. Montuoro (*Il taglio cesareo ed il parto forzato* (Genova), 1904), and Frommer (*Zentralb. f. Gynäk.*, xxviii. p. 1017, 1904). From this time onward we hear less of metallic dilators in eclampsia and more of cutting operations (*vide infra*). In 1905, for instance, we find Hammerschlag (*Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 351, 1905), after an experience of twenty-five cases, stating that Bossi's dilator should only be used by the specialist; and Holdich Leicester (*Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 230, 1907) thought it should be employed only by those accustomed to perform major obstetrical operations.

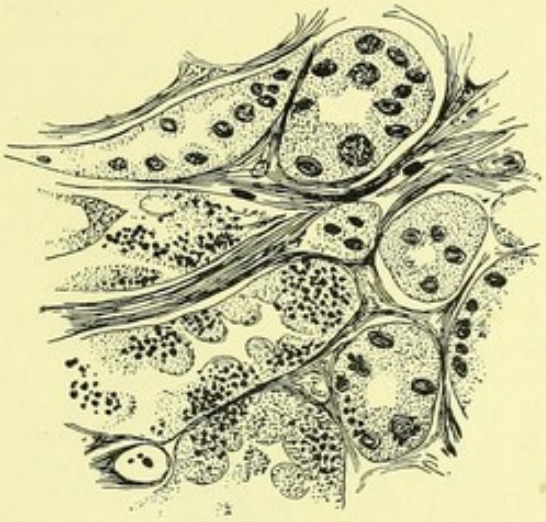
Weber, however (*Arch. f. Gynaek.*, lxxxii. p. 717, 1907), and Keyserlingk (*Zentralb. f. Gynäk.*, xxxi. p. 711, 1907) still prefer Bossi's method to Dührssen's incisions and vaginal Cæsarean section. It must be admitted that in cases in which the cervix is not taken up its use is attended by grave danger of serious cervical lacerations; it finds, therefore, its most distinct indication in the cases in which the cervix is undilated, but in the shape of a ring.

During the past few years a good deal has been written in favour of *vaginal section* (the so-called vaginal Cæsarean section) as a means of rapidly emptying the uterus in serious cases of eclampsia. With the patient in the lithotomy position, the operator exposes the cervix (with a speculum) and draws it down to the vulva (with volsellæ). If (as is often the case) the patient be a primipara, with a narrow vulva and vagina, it may be well to do an episiotomy at once, in order to give room. An incision is then made through the mucous membrance of the anterior lip of the cervix and the anterior vaginal wall of an inverted T (⊥) shape. The bladder is now separated from the cervix by the fingers or by the handle of the knife until the peritoneum of the utero-vesical pouch comes into the view; the latter is not incised. The cervix is next split in the middle line with scissors, pulled further down with the volsellæ, and the incision (four inches long) is carried further up into the lower uterine segment. If the operation be performed near the full term it will be well to incise the posterior as well as the anterior lip of the cervix. Bleeding is controlled during the making of the incisions by downward traction upon the cervix. The delivery of the infant is now rapidly accomplished, the placenta removed, and the uterus massaged and sometimes packed with gauze. The incisions in the cervix are closed with sutures (continuous or interrupted catgut) placed near together; the posterior incision (when present) is closed first. Care must be taken that the sutures do not catch in the gauze packing. The vaginal incision is closed by a continuous catgut suture, and the perineum is repaired if a preliminary episiotomy has been performed. Carstens, in 1904 (*Amer. Journ. Obstet.*, l. p. 633, 1904), spoke very favourably of this operation, and affirmed that it could be performed by any general practitioner; but Zinke (*ibid.*) doubted this, and, as a matter of fact, vaginal section is more difficult of performance than a reading of the descriptions given in text-books would lead us to expect, for it must not be forgotten that the anatomical relations of parts are considerably altered in late pregnancy. Fry (*Surg. Gynec. and Obstet.*, i. p. 58, 1905) emphasised the short time (10 minutes) required to remove the child by the vaginal section, and reported a case of eclampsia at the sixth month successfully treated by this means. Hammerschlag (*Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 351, 1905) regarded it as an excellent operation, involving only slight injury and danger, and Keyserlingk (*Zentralb. f. Gynäk.*, xxxi. p. 711, 1907), Büttner (*Beitr. z. Geburtsh. u. Gynaek.*, xi. p. 401, 1907) and Weisswange (*Zentralb. f. Gynäk.*, xxxii. p. 337, 1908) have all written favourably of it, and described cases in which it was used. Bumm's recent statistics give forty consecutive cases of eclampsia thus treated with one death, whilst Veit has had thirty-three cases with one death. If it be admitted that rapid delivery is *the* treatment in serious eclampsia, then vaginal Cæsarean section will be the operation of choice in the very instances in which Bossi's dilator is contra-indicated, viz. those occurring early in pregnancy, with an undilated cervix, not yet taken up. A recent paper on the subject is that by Humpstone (*Amer. Journ. Obstet.*, lix. p. 92, 1909), who reports five cases (none of them in labour) thus treated, with one maternal death. A somewhat extraordinary case was reported by Boldt in 1905 (*Post-Graduate*, xx. p. 1251, 1905), in which ordinary Cæsarean section was performed upon a girl, twelve years and eight months old, who had a small pelvis and severe eclampsia; but, as a general rule, the ordinary operation has been very seldom employed in cases of convulsions, and where it has been done the mortality was high. Digital dilatation and dilatation by means of the Champetier de Ribes's bag are still occasionally used in eclampsia for rapid evacuation of the uterus, but Bossi's dilator and the vaginal Cæsarean section are more in evidence.

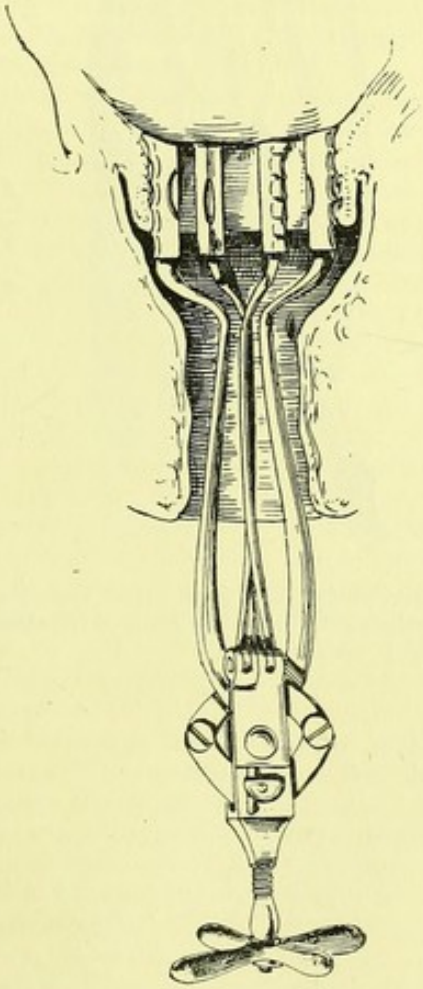
Quite apart from operative dilatation of the cervix two other surgical procedures have found advocates within the past few years, viz. *lumbar puncture* and *renal decapsulation*. The former, perhaps, can hardly be called surgical, for it is an extremely simple operation. Helme of Manchester used this method in December 1903 (*Brit. Med. Journ.*, i. for 1904, p. 1131) in a typically severe case of eclampsia in which saline injections, thyroid extract, and chloral had previously been given; he noted that the cerebro-spinal fluid escaped as if under considerable pressure; the patient recovered. The theory which was advanced to explain the mode of action of lumbar puncture was very simple. It was taken for granted that the convulsions were due to increased cerebro-spinal tension; therefore, if some of the fluid was removed by puncture of the arachnoid space, it was concluded that the tension would be reduced and the fits would for the time cease; the interval of freedom from fits could be utilised for the application of other forms of treatment, which would effectually and permanently remove the cause of the high tension. Three cases treated by lumbar puncture by Krönig also recovered (*Zentralb. f. Gynäk.*, xxviii. p. 1153, 1904), but out of sixteen cases dealt with by Max Henkel

four terminated fatally (*ibid.*, xxviii. p. 1329, 1904). In a grave case of eclampsia treated by lumbar puncture, Ballantyne noticed that the spinal fluid did not escape freely from the needle, but rather oozed out drop by drop; it was a fatal case (*Trans. Edin. Obstet. Soc.*, xxx. p. 132, 1904-5). Proud (*Brit. Med. Journ.*, i. for 1906, p. 678) reported two successful cases, and Jardine used lumbar puncture along with other means, in an extraordinary case in which there were over 200 fits, with ultimate recovery (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 38, 1906). Mirto (*Ann. di ostet. e ginec.*, ii. for 1905, p. 580) did not find lumbar puncture to be founded on a solid basis of theory; and, certainly, little has been heard of the plan during the past two years, although Audebert and Fournier (*Compt. rend. soc. d'obstét. de gynéc. et de pédiat. de Paris*, ix. p. 119, 1907; *Ann. de gynéc. et d'obstét.*, 2 s., iv. p. 350, 1907) have reported two cases, one of which recovered, and the other died.

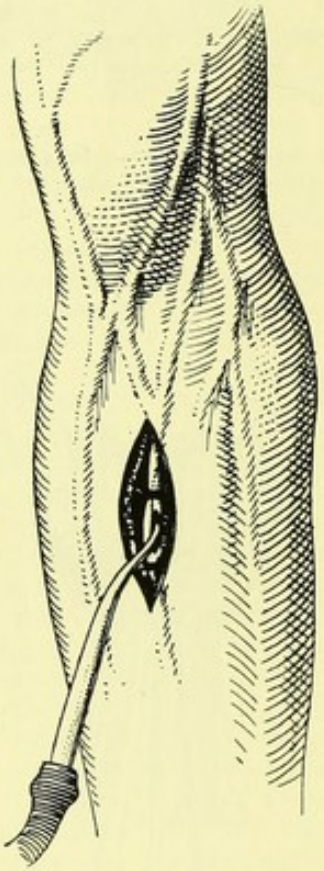
Renal decapsulation is the most recently suggested means of combating eclampsia, and already a considerable literature has gathered round it. It was introduced by Edebohls in 1903 (*Amer. Journ. Obstet.*, xlvii. p. 783, 1903; l. p. 260, 1904), and was, soon afterwards, recommended by Sippel (*Zentralb. f. Gynäk.*, xxviii. p. 479, 1904). The view that is held regarding this surgical procedure in cases of puerperal eclampsia must depend largely upon its success in nephritis unaccompanied by pregnancy; and it must be owned that neither experimental evidence (such as that provided by Rondoni, *Policlin.*, xiv., sez. chir., p. 40, 1907) nor clinical experience have absolutely established its value in the latter condition. But it may be maintained that pregnancy-kidney is very different from ordinary nephritis, and that eclampsia is not necessarily uræmia, and that renal decapsulation may serve in a special way to meet some of the indications peculiar to the former morbid state. It is necessary, therefore, to judge by the results obtained in eclampsia alone. Now, E. Kehrer of Heidelberg has collected together (*Zeitsch. f. Gynäk. Urologie*, i. p. 111, 1908) the records of twenty-three cases, in which Edebohls's operation of renal decapsulation was performed; eight patients died, giving a mortality of 34·7 per cent., although in three of the fatal cases the death was due to complications (bronchopneumonia, bleeding from a gastric ulcer, and late infection of the wound). In most of the instances cited the operation was performed some hours or some days post-partum, but in two it was done during pregnancy. In the two last named it was successful, in one of them vaginal Cæsarean section being also carried out. Edebohls himself, the introducer of the operation into this sphere of obstetric practice, had done decapsulation in three cases, in all of which it was successful; Wiemer also had operated thrice, with one death on the thirteenth day from infection of the operation wound (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 321, 1908). It is doubtful whether the principles on which this operation proceeds are correct; it is also doubtful whether the death-rate can be used as a strong argument against its employment, for the records show that it was in many instances only after all other means of treatment had failed that renal decapsulation or incision was tried. In future its use will probably be restricted to those grave cases of eclampsia in which the renal element is markedly present (*e.g.* as shown by anuria), and in which, in spite of emptying the uterus, and in spite of employing all the other means of stimulating the excretory organs, the convulsions are becoming stronger, and the general condition getting worse. These indications were present, for instance, in the successful case reported by Sir Halliday Croom (*Edin. Med. Journ.*, N. S., ii. p. 443, 1909). Under these circumstances, Edebohls's operation, if contemplated, should not be delayed more than a few hours. Bumm considers that this operative procedure should be reserved for the puerperium, and certainly it has been most often employed then; Pinard, also, would strictly limit its sphere of application (*Ann. de gynéc. et d'obstét.*, 2 s., iii. p. 193, 1906). It is noteworthy that the condition of the kidney itself found at the time of operation differed considerably; in some cases it was tense, and protruded at once through the divided capsule, but in others it was soft and sodden (Runge, *Berl. klin. Wochensch.*, xlv. p. 2068, 1908). As a result of the decapsulation it is commonly found that there is an increase in the flow of urine and in the excretion of urea, usually at once, but sometimes only after several hours; in this way the toxines will be got rid off more quickly. Other explanations have been advanced, such as the formation of anastomoses between the surface of the kidney and the fatty capsule, but these have not been supported by actual demonstration, and it is probable that the physiological effect described above is the only one about which we can be certain. At the time of writing, the value of renal decapsulation, with or without renal incision, must be regarded as not accurately defined; but, granted its value, the indications for its employment are very different from those guiding us in having recourse to vaginal Cæsarean section. Vaginal section finds its chief indication in eclampsia occurring about the fifth or sixth month of pregnancy, with a cervix undilated and not taken up; renal decapsulation, on the other hand, is to be thought of preferably in the puerperium, when it is clear that the emptying of the uterus has not succeeded in



Renal tubule from a case of eclampsia ; fat globules occur in the degenerated cells. (*After* Hamilton Bell.)



Bossi's dilator in place for the parturient cervix.



Method of intravenous infusion in eclampsia. Cannula introduced in the median vein below the bend of the elbow.

arresting the eclampsia. Between these two methods, with their relative indications, are the cases calling for the use of the Bossi dilator or other form of cervical distension.

Whatever may be the form of operative interference found most suitable in cases of eclampsia, prevention will ever be the most satisfactory method of treatment. Indeed, it may be said that the *prevention of eclampsia* is the one bright spot in a gloomy sky at the present time. Of course it is difficult to establish a claim in many cases, for we are met with the objection that in them eclampsia would not have occurred even if no preventive measures had been taken; but every obstetrician of experience must have noticed that cases of albuminuria in pregnancy brought under treatment before the onset of labour very often pass through their confinements without eclampsia, and that even if fits occur they are seldom many or severe. It is admitted by all (and it is something to be able to say this in connection with eclampsia, in which, as Evans has said (*Brit. Med. Journ.*, ii. for 1906, p. 1205), there "is not a drug used nor a procedure employed on theoretical grounds, or as a result of experience, that has not as many enemies as friends")—it is admitted by all that albuminuria in pregnancy often precedes eclampsia, and that if the former be early recognised and promptly treated the latter can very often, almost always, be prevented; there is also a consensus of opinion that a rigid milk diet, regular daily evacuation of the bowels, the avoidance of chilling of the surface of the body, and the cautious use of diuretics will act most beneficially on the albuminuria of pregnancy; and the reasonable conclusions to be drawn are the systematic examination of the urine in pregnancy and the immediate treatment of the patient on the appearance of the slightest trace of albumin therein. To the general practitioner with a large number of midwifery cases these precautions may seem irksome, and in many instances unnecessary, but they form the sound basis of the rational treatment of eclampsia, and he will soon be convinced, if he have to treat some four or five cases of eclampsia, that the time and care spent in carrying out precautionary measures are far less than those needed successfully to manage one single case of convulsions in labour or the puerperium. When in addition to the presence of albumin there is marked diminution in the quantity of urine passed, a fall in the quantity of urea secreted, the presence of tube casts or blood, and a state of high tension of the pulse, it is doubtful whether it is not already too late to prevent the occurrence of eclampsia; but even then prophylaxis may accomplish much. To the staff of a maternity hospital the prevention of eclampsia is a matter of even greater importance than to the general practitioner. Every maternity hospital ought to have a pre-maternity department or ward or pavilion set apart exclusively for the treatment of the diseases of pregnancy (Ballantyne, *Brit. Med. Journ.*, i. for 1901, p. 813; i. for 1902, p. 65; *Trans. Edin. Obstet. Soc.*, xxxiii. p. 25, 1907-8; *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. pp. 93, 169, 1909), and an out-patient clinique to which pregnant women should be invited to come for purposes of diagnosis, and through which admission to the pre-maternity ward might, if necessary, be obtained. In an editorial published in the *Lancet* of 2nd November 1901, the following sentences occurred:—"We are inclined to think that if a correct knowledge of the causation of eclampsia is ever to be arrived at, attention must be directed to the pre-eclamptic stages of the disease. It is an encouraging sign to see that . . . a bed is to be endowed and set apart for the study of the diseases of pregnancy in the Royal Maternity Hospital of Edinburgh. We can imagine no more worthy object for philanthropy than the endowment of such beds in some of our large maternity hospitals, where the diseases of pregnancy and of the unborn child could be investigated with all the advantages of modern science." The bed in the above hospital is now a ward, and Ballantyne was able to report that in his quarter in 1908 none of the cases of albuminuria in pregnancy treated in that ward developed eclampsia, and that all the patients (five in number) which were brought into the ward suffering from eclampsia, and which were treated therein for some days before labour supervened, recovered (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. pp. 98, 104, 1909). In such wards the early indications of the toxæmia of pregnancy could be recognised and treated; in this way the grave forms of toxæmia could be almost certainly prevented, or, at any rate, so reduced in virulence as not to pass on into eclampsias. Boxall (*Brit. Med. Journ.*, ii. for 1905, p. 717) thinks that every maternity hospital ought not only to have a pre-maternity ward but also "a department where women who are able to work either in the house or garden attached to the institution could be kept under observation for two or three months prior to delivery"; but it is possibly too much to expect so radical a change to occur, and so increased a responsibility to be undertaken by maternity charities in the near future. It may be said, in conclusion, that the most hopeful aspect of eclampsia at present is undoubtedly prevention; the toxæmia of gestation need not occur in a grave form in a well-watched pregnancy, and even if it occur it can nearly always be prevented from culminating in eclampsia if suitable dietetic and therapeutic means be employed early and energetically. Until such time as a certain means of checking and curing eclampsia be

discovered, our watchword must, of necessity, be "prevention."

Eclampsism.—The term "eclampism" (or "eclampsia sans accès") has been proposed by Paul Bar (*Rev. mens. de gynéc. d'obstét. et de pédiat.*, iii. p. 41, 1908) for the group of signs and symptoms which indicate that an attack of eclampsia is imminent. These are—(1) a persistent decrease in the amount of urine passed; (2) a diminution in the percentage of chlorides contained in the urine; (3) the development of slight or of more marked œdema; (4) albuminuria, especially if the albumen be associated with albumoses, with peptones, and with acetosoluble albumen; and (5) urobilinuria and slight jaundice. The signs and symptoms which have been named may exist for some time without convulsive seizures actually occurring; but if, in addition, there be arterial high tension, amblyopia, severe headache, epigastric pain, dyspnœa, ringing in the ears, and sudden paralysis of groups of muscles, the supervention of eclamptic seizures is imminent. Now, in a few cases eclampsism is present without eclampsia following it; or, rather, it is sometimes followed by a condition known as "eclampsia without convulsions," and this may prove fatal, with post-mortem lesions similar to those found in fatal cases of ordinary eclampsia. For example, a patient with eclampsism may pass into a state of coma without the occurrence of convulsions, or she may have very grave dyspnœa, or severe trigeminal neuralgia, or a hallucination. Bar regarded these symptoms as equivalent to the more commonly observed convulsive seizures. It might be suggested that this morbid state, called by the Germans "Eclampsie ohne Krämpfe" or "status eclampticus," is really uræmia, were it not that the post-mortem examination reveals the lesions peculiar to eclampsia (Schmorl, *Münch. med. Wochensch.*, lv. p. 363, 1908; Schlutius, *Zentralb. f. Gynäk.*, xxxi. p. 107, 1907). The treatment of eclampsism is that which has already been called the preventive treatment of eclampsia, and Bar was of opinion that if it were not very soon followed by the disappearance of the signs of toxæmia, the induction of labour was indicated, and that this was specially to be recommended in the irregular cases of *eclampsia sine convulsionibus*. In addition to the articles already named, the references of the following are added:—Binder, *Zentralb. f. Gynäk.*, xxx. p. 1017, 1906; Esch, *ibid.*, xxx. p. 295, 1906; Gaillard, *Tribune méd.*, N. S., xxxix. p. 629, 1907; Reinecke, *Münch. med. Wochensch.*, liv. p. 1522, 1907; Slemons, *Johns Hopkins Hosp. Bull.*, xviii. p. 448, 1907; Brunet, *Münch. med. Wochensch.*, lv. p. 702, 1908, and *Gynæk. Rundschau*, ii. p. 177, 1908; Chirié and Stern, *Bull. soc. d'obstét. de Paris*, xi. p. 19, 1908, and *Tribune méd.*, N.S., xl. p. 261, 1908; and Daunay, *Bull. soc. d'obstét. de Paris*, xi. p. 317, 1908.

Ectasia.—A localised dilatation of a channel in the body which contains fluid, *e.g.* lymph varices, phlebectases, sacculated aneurisms, etc.

Ectopic Pregnancy.

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TUBAL PREGNANCY.

At the beginning of the twentieth century the investigation of the causes and method of implantation of the fertilised ovum in the Fallopian tube had reached a stage beyond which it could scarcely pass until there was an increase in our knowledge of the details of the embedding of the ovum on the endometrium; in other words, the elucidation of the pathology of tubal pregnancy had to wait upon the discovery of the exact mode of commencement of normal uterine pregnancy. As it so happened, the publication of Leopold's (1897), Peters's (1899), von Spee's (1905), Teacher-Bryce's (1908), and Jung's (1908) *Ova* was most opportune, and did much to settle the latter question and make possible the better understanding of the former. The settlement of the problem is not of purely academic interest; the carrying out the details of operative interference depends, in a large measure, upon it; it may mean the saving or losing of a life, maternal especially, but also fœtal.

The *first* question in this problem is concerned with decidual reaction. In an ordinary intra-uterine pregnancy decidual changes are found in a very marked degree in the endometrium, sometimes in the cervix, and very rarely (almost never) in the tube, the ovary, and the peritoneum. These decidual changes consist in enlargement of the stroma cells of the endometrium until they become epithelioid in appearance (the cells enlarge more than the nuclei and come to contain glycogen), in the widening of the lumen of the glands, in the proliferation of their lining epithelium, and in the taking on of a more cubical character by the epithelial cells. All the evidence goes to show that true decidual cells are not formed in the uterus save in connection with pregnancy,

although what may be called decidua-like cells may appear. It is, however, a difficult matter to separate true decidual cells from the cells of Langhans's layer. The following characters will be helpful:—Langhans's cells are generally polyhedral, and are closely packed together; decidual cells are more rounded or oval, and generally show intercellular tissue; the former contain a clearer (less easily stained) protoplasm, with a fine network in it, while the protoplasm in the latter stains better, is granular, and shows no network or only a very fine one; the cell outlines in the former are clear, in the latter less distinct; and, finally, the nuclei of Langhans's cells are larger than those of decidual cells, they have a bladder-like appearance which those of decidual cells do not have till later, and they have a marked chromatin network and nucleolus. It is of great importance to keep these differences in mind when examining the histology of tubes which are the site of ectopic pregnancy, for it is quite evident that in the past Langhans's cells have been mistaken for decidual ones, in other words, fœtal trophoblast cells have been confused with maternal decidual ones. Another matter of some interest has emerged—the fact that early intra-uterine pregnancies have shown that decidual formation follows and does not precede the implantation of the ovum on the mucous membrane: from this, it must be concluded that it is not essential for an ovum to be embedded on pre-existing decidual tissue.

With these facts in mind we are better able to consider the question of decidual reaction and formation in connection with tubal pregnancy. Here, as in normal pregnancy, the formation of decidual cells has been looked for in the uterine mucous membrane, in the tubes, in the ovaries, and in the neighbouring peritoneum. As it is of most importance, the change in the tubes may be considered first. It would appear that, while individual observers differ as to its amount, all are agreed that there is some evidence of decidual reaction in the mucous membrane of the tube which contains the fertilised ovum. Occasionally traces of the same have been noted in the mucosa of the empty tube. As a rule the decidual reaction is slight, being, however, more marked in the folds than in the spaces between the folds. The small degree of change is probably due to the absence of anything resembling the thick mucous membrane of the body of the uterus; indeed, the tubal mucosa is hardly fitted anatomically for the growing of a decidua, at any rate it does not furnish the elements for the compact layer of the same. Conflicting statements have been made regarding decidual changes in the submucous and intermuscular tissues of the tube which enter into the formation of the gestation sac; it is in this relation that great care has to be taken to distinguish between true decidual (maternal) cells and the decidua-like (fœtal) cells of Langhans's layer of the trophoblast; and there can be no doubt that in some cases Langhans's cells have been regarded as decidual, and this remark applies specially to the tissue which has been described as tubal decidua serotina or basalis. Recent observations seem to show, however, that decidual changes take place in the walls of the blood-vessels of the pregnant tube, occasionally in the endothelium, but more constantly in the tunica intima. The decidual cells formed in the vessels require to be carefully distinguished from Langhans's cells, as can usually be done by keeping the characteristic features (enumerated above) in mind. The appearance which has been described as deportation of Langhans's cells in veins is possibly to be regarded rather as formation of decidual cells in the walls of the vessels. Decidual reaction in the case of the general peritoneum or of that covering the tube has been very rarely observed, but then it has not often been looked for. In Penkert's case (*Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 88, 1905), a tubo-abdominal one, chorionic villi were found attached to the omentum, and in the latter there were clumps of typical decidual cells; and similar cells were found in the peritoneum of the appendix vermiformis in a case in which that structure was adherent to the pregnant Fallopian tube of the right side, the reporter (Hirschberg, *Arch. f. Gynaek.*, lxxiv. p. 620, 1904-5) naming the condition "periappendicitis decidualis." These reports, demonstrating the possibility of decidual reaction occurring in the peritoneum, make the case for primary abdominal pregnancy much stronger. Scarcely any observers have noticed decidual cells in the ovary in tubal pregnancy. To complete this survey of decidual reaction in tubal gestation, it must be added that the uterine mucous membrane almost always shows very distinct changes of the nature of the formation of a decidua, although considerable differences exist with regard to its extent, and to the time of its being shed.

The *second* question has reference to the relationship of the gestation sac to the wall of the tube; in this direction distinct progress has to be reported. It is necessary to abandon the view that the fertilised ovum is simply attached to the tubal mucosa, with a part projecting freely into the lumen of the tube. In at any rate the vast majority of cases the ovum is embedded in the tube wall; it is, in fact, submucous in position; it may appear to be in the lumen of the tube, but serial sections show that it is really under the mucous membrane, and that it is, indeed, generally intramuscular. What has been called the decidua reflexa in tubal pregnancy probably is simply the tubal tissues and the trophoblast of the ovum; it ought to be regularly called the

capsularis. That it is not decidua is proved by the presence of muscular fibres in it. It is very likely that as in the uterus so in the tube the fertilised ovum, by the action of its proliferating trophoblast, penetrates the epithelium of the mucous membrane; in the tube it further bores its way down into the muscular layer, an occurrence which is rare in uterine pregnancy, but not unknown although always pathological. Of course it is possible that the ovum may sometimes reach its deep position in the tube wall by entering a diverticulum, but this must be rare, and it is generally conceded that it is by destruction of maternal tissue that the trophoblast penetrates the tubal tissues and carries the ovum in amongst the muscular fibres. It is probably by the same action of the trophoblast upon the maternal blood-vessels that communication is established between the ovum and the blood of the mother. The so-called "deportation of villi," or of pieces of their epithelial covering, is, therefore, not only possible but probable in all pregnancies, whether intra- or extra-uterine; for it has been shown that the action of the trophoblast (especially Langhans's cells) in opening into maternal vessels is the method by which the ovum is brought into contact with the maternal blood in normal pregnancy. Decidual reaction in the vessel walls and the invasion of these walls with trophoblast cells are both regarded as common occurrences, and may be seen in the same tube wall (Schambacher, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlviii. p. 428, 1902-3). At the same time, great care has to be taken, in expressing an opinion on the subject, not to confuse Langhans's cells with true decidual ones. In connection with the embedding of the ovum in the tube wall, it is more correct to speak of the destructive action of the trophoblast than of the villi, for the former has burrowing powers in its early stage when it consists simply of syncytium and Langhans's cellular layer, and before the mesoblast has, by sending projections into it, formed the villi. Further, with the disappearance of Langhans's cells about the sixth week, the destructive or pseudo-malignant action on the maternal structures probably ceases; the later developments of the gestation sac in the tube wall must thereafter be due to other factors. To sum up, it is probable that the phenomena of pregnancy in the tube wall, which differ from those met with in the uterine wall, are due not so much to any difference in the action of the trophoblast or villi upon the tissues of the tube, but rather to the nature and extent of the tissues of the wall; in the tube there is not the thick layer of mucous membrane which exists in the uterus, and connective tissue is scanty, so that the trophoblast comes into contact with and has to make its way into *muscle*.

The *third* question in the problem of tubal gestation relates to the cause and mode of rupture of the wall of the tube. The discovery of the submucous or intra-muscular position of the gestation sac in tubal pregnancy has thrown some light upon this question, and it brings two apparently different occurrences into line, viz. tubal rupture and tubal abortion. The latter is so important that a special paragraph is devoted to it (*vide infra*), but it may be stated here that the problem has been greatly simplified by the recognition of the fact that tubal abortion must necessarily be preceded by rupture, by *internal* rupture, of the gestation sac before the ovum can be free in the tubal lumen or find its way out of the tubal ostium. If internal rupture of the capsule of the sac do not occur, then *external* rupture may take place, or the wall of the tube may give way in such a position as to enable the ovum to pass between the layers of the broad ligament and become *intra-ligamentary*. To take the latter occurrence first, it may be said that the recent work done in this department seems to show that intra-ligamentary rupture is comparatively rare; but Andrews, in his admirable synopsis of the whole subject of tubal gestation (*Journ. Obstet. and Gynæc. Brit. Emp.*, iii. p. 419, 1903; ix. p. 469, 1906), is unable to assign any satisfactory explanation for this rarity. It may possibly be connected with an absence of decidual reaction in the connective tissue of the broad ligament, although this remains to be demonstrated. In respect of external rupture of the tube into the peritoneal cavity, various causes have been alleged. There can be very little doubt that traumatism (*e.g.* a bimanual examination under an anæsthetic) may effect it, and such a possibility must, of course, be borne in mind in connection with the diagnosis or attempted diagnosis of ectopic gestation. In most cases, however, it is not external but internal causes which lead to rupture. Of the causes inherent in the tube itself we may name the destructive action of the trophoblast of the ovum, the hæmorrhage into the tube wall, and contractions of the muscle of the tube. In early ruptures (*i.e.* those before or at the seventh week) the first-named factor (destructive or burrowing action of the trophoblast) would appear to be the common agent; it may act directly and cause perforation of the muscular and peritoneal coats of the tube, or it may lead to the rupture indirectly by causing perforation of a blood-vessel, effusion of blood, consequent stretching and final bursting of the tube. Later ruptures (after the seventh week) are probably to be ascribed more often to such mechanical causes as stretching of the sac wall from hæmorrhage into it, aided or not by contractions of the tube itself, than to the destructive action of trophoblast cells. There is a tendency at present to disregard simple stretching of the tube by the growing ovum as

a cause, or, at any rate, as a common cause of rupture. The great advance that has been made in our knowledge of the whole subject is the proof that has been obtained that tubal abortion is nothing else than a form of rupture, albeit internal rupture of the gestation sac. For this cause tubal rupture is now considered more in detail.

Among the various results which may follow the implantation of the impregnated ovum in the Fallopian tube is the process known as *tubal abortion;* as a matter of fact, it is now known that external rupture of the gravid tube is less frequent than was formerly thought, whilst the shedding of the gestation sac, in whole or in part, from the tube into the peritoneal cavity is much commoner than was supposed. Munro Kerr (*Operative Midwifery*, p. 538, 1908), indeed, regards tubal abortion as a more common occurrence than tubal rupture in cases of ampullar ectopic pregnancy; it is certainly much more often reported than it was at the time when the article on ECTOPIC GESTATION was written for the *Encyclopædia Medica* (Vol. III. pp. 183, 184, 1900). Tubal abortion may be complete, the whole ovum passing from the tube; hæmorrhage into the peritoneum is then inconsiderable, and probably ceases at once: this is comparable to the complete variety of ordinary abortion. There may, however, be an imperfect expulsion of the ovum from the tube, when what has been called the "ostial trickle" or drip-drop of blood from the infundibulum will continue and cause the formation of a hæmatocele. Complete tubal abortion may yield the explanation of some anomalous cases of the abdominal variety of ectopic pregnancy. In the case reported by Seeligmann (*Deutsche med. Wochensch.*, xxxii. p. 879, 1906), for instance, gestation went to the full term, and the placenta was situated on the undersurface of the liver and gall-bladder, while a macerated fœtus, weighing 10 lbs., was found lying in a sac in the abdominal cavity; and the author believed that the ovum at the end of the third month had escaped, with very little bleeding, through the open end of the tube, had not lost its vitality, and had been carried by the peristaltic movements of the bowels to the undersurface of the liver, where it had become attached, and had secured a vascular supply sufficient to enable the fœtus to attain the weight of 10 lbs. If this be so, tubal abortion is not an unimportant occurrence. It is possible that Felix Meyer's case of primary (?) abdominal pregnancy (*Intercolon. Med. Journ. Australas.*, x. p. 145, 1905) may be explained in the same way as Seeligmann's.

At any rate, there can be no doubt about the reality of tubal abortion, for the gravid tube has been, so to say, caught in the act by several operators. Alban Doran, for instance, operated upon a patient regarded as suffering probably from right-sided tubal pregnancy; he found the right tube greatly distended, there was a mass of clot projecting from the ostium, and the peritoneal cavity contained not a drop of blood. The tube contained clot, and in the clot was an amniotic sac without an embryo; under the microscope numerous chorionic villi were found in the coagulum surrounding the sac (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 621, 1906). But a still more clearly demonstrated case was that reported by M. v. Strauch of Moscow (*Zentralb. f. Gynäk.*, xxiii. p. 1294, 1899), and Phillips (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 443, 1906) found a tubal mole in process of abortion during the operation of hystero-salpingotomy for ectopic pregnancy and peritonitis. In a patient whom Galabin (*Trans. Obstet. Soc. Lond.*, xlvii. p. 332, 1906) was examining bimanually under anæsthesia, a mass on the right side suddenly diminished in size, and on abdominal section some days later a fleshy mole was found in the pouch of Douglas; Galabin was of opinion that tubal abortion had occurred in consequence of the bimanual examination. In Karpow's patient (*Monatssch. f. Geburtsh. u. Gynäk.*, xviii. p. 778, 1903) the passage of the gestation sac from the tube into the abdomen seems to have been caused by a fall; at the time of operation a five months' fœtus was found in the epigastric region, and the placenta was in process of extrusion from the ostium tubæ.

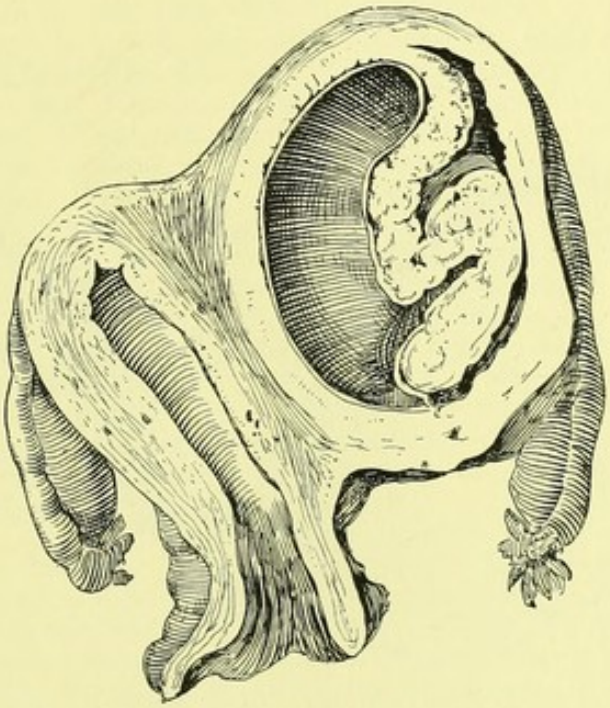
But there is not, as a rule, any history of traumatism to account for the occurrence of tubal abortion, and the question of its pathogenesis must then find another explanation. Werth (*Zentralb. f. Gynäk.*, xxvii. p. 851, 1903) has made the whole matter more easy of comprehension by calling tubal abortion "rupture of the internal capsule" in contrast with rupture of the tube into the peritoneum or broad ligament ("rupture of the external capsule"); and Berkeley and Bonney (*Journ. Obstet. and Gynæc. Brit. Emp.*, vii. p. 93, 1905) speak of three varieties of rupture of the primary gestation sac—intra-tubal, or rupture into the lumen of the tube or tubal abortion, extra-tubal, which may be intra-peritoneal or extra-peritoneal, and intra-mural, when the sac ruptures into the substance of the tube wall. Rupture of the tubal pregnancy when it occurs into the lumen of the tube may be regarded as due to the destructive action of the trophoblast whose villi penetrate the internal capsule (Schambacher, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlviii. p. 428, 1903; von Franqué u. Garkisch, *Zeitsch. f. Heilk.*, xxvi. p. 274, 1905), or to hæmorrhage into the intervillous spaces, due to destruction of the vessel walls by the trophoblast or to blocking of the veins with deported villi (Veit, *Zentralb. f. Gynäk.*, xxvii. p. 849, 1903), or to contractions of the tube. The last-named theory would seem to derive some sup-

port from the specimen shown by M. von Strauch (*loc. cit.*, *supra*), in which the tube showed a deep depression on the outside corresponding to the attachment of the placental pedicle on the inside ; and the occasional occurrence of intussusception of the tube (Mainzer, *Zentralb. f. Gynäk.*, xxvii. p. 921, 1903 ; Kermauner, *Beiträge zur Anatomie der Tubenschwangerschaft*, 1904) shows that the tubal muscle is active. The exact mechanism of tubal abortion, however, can hardly be regarded as satisfactorily settled.

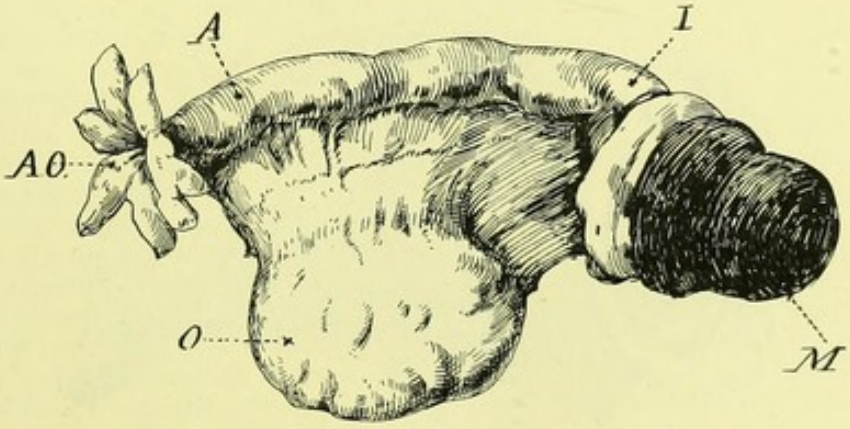
When complete tubal abortion takes place it is probable that in most cases the tube returns to its normal state and the hæmatocele disappears gradually. The occurrence of incomplete abortion, however, causes a continuance of the signs and symptoms of ectopic pregnancy, and the patient probably is sooner or later submitted to operation.

BIBLIOGRAPHY.—A considerable literature has accumulated bearing specifically on the subject of tubal abortion. Some of the works have been referred to above ; a few others may be named here :—Bazy, *Presse méd.*, xiv. p. 693, 1906.—Boursier, *Journ. de méd. de Bordeaux*, xxxii. p. 389, 1902.—Boursier, *Semaine gynéc.*, vii. p. 345, 1902.—Bouvier, *Journ. de méd. de Bordeaux*, xxxiv. p. 69, 1904.—Cartledge, *Med. Age*, xx. p. 289, 1902.—Coe, *Ann. Gynec. and Pediat.*, xix. p. 1, 1906.—Donhoff, *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 1247, 1903.—Edgar, *Glasgow Med. Journ.*, lv. p. 291, 1901.—Fairbairn, *Journ. Obstet. and Gynæk. Brit. Emp.*, x. p. 609, 1906.—Flatau, *Münch. med. Wochensch.*, l. p. 2279, 1903.—Hart, *Trans. Edin. Obstet. Soc.*, xxix. p. 209, 1904 (a paper in which, among other matters, the author suggests that the infundibular form of tubal pregnancy may be mistaken for a tubal abortion taking place). — Hooper, *Intercolon. Med. Journ. Australas.*, x. p. 69, 1905.—Johnstone, *Brit. Med. Journ.*, ii. for 1905, p. 1522.—Lissar, *Thèse.* (Paris), 1903.—Mandl, *Monatssch. f. Geburtsh. u. Gynäk.*, xi. p. 203, 1900.—Orthmann, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlix. p. 549, 1903.—Pichevin, *Semaine gynéc.*, x. p. 337, 1905.—*Ibid.*, xii. p. 89, 1907.—Rayner, *Bristol Med.-Chir. Journ.*, xx. p. 323, 1902.—Spinelli, *Arch. ital. di ginec.*, iv. p. 207, 1901.—Storer, *Boston Med. and Surg. Journ.*, cl. p. 5, 1904.—Watkins, *Amer. Journ. Obstet.*, lii. p. 896, 1905.—Falk, *Zentralb. f. Gynäk.*, xxxi. p. 1404, 1907.—Fitzgerald, *Lancet*, ii. for 1907, p. 1457.—Nynlasky, *Brit. Med. Journ.*, ii. for 1907, p. 1570.—H. C. Taylor, *Amer. Journ. Obstet.*, lvii. p. 837, 1908.—Boldt, *Amer. Journ. Obstet.*, lviii. p. 483, 1908.

The *etiology* of tubal pregnancy now calls for attention. Of the many theories which have from time to time been advanced to explain the occurrence of ectopic gestation, some, such as external or internal wandering of the fertilised ovum, may be dismissed as insufficient to explain the facts, whilst others, such as puerperal atrophy of the tubes (favoured by Dührssen) and the presence of kinks, must be regarded as very doubtful. Some years ago inflammatory changes in the tube were regarded as the most probable causal agency, and it must still be admitted that salpingitis and ectopic pregnancy coexist too often to be explained away (Kermauner, Werth, Gottschalk, and others) ; the increase in the connective tissue of the tube which follows the occurrence of inflammation in an indirect way supports this view. Nevertheless, the prevailing theory at the present time seem to be that of antenatal modifications of the tube or the persistence of fœtal conditions. It is doubtful, perhaps, whether there is much probability in the view put forward by Freund in 1888 that spiral windings of the tube (the persistence of an infantile state) are of etiological importance ; but the more recent theory of implantation of the ovum in a tubal diverticulum (antenatal or acquired) or in an accessory tubal ostium cannot be easily dismissed, and has warm supporters in Micholitsch, Fellner, and Füth. Indeed the occurrence of diverticular implantation cannot be denied, and the only difference of opinion which can arise is with regard to its being *the* cause or only *one* cause of ectopic gestation (Heinsius). There is a general consensus of opinion that the chief cause is delay in passage of the ovum through the tube ; it may be caught in an accessory ostium or in a diverticulum ; it may be obstructed by a polypus or a spiral folding of the tube ; it may be hindered by inflammatory adhesions ; or it may have grown to such a size as to prevent its easy transmission. Webster's theory of decidual reaction (1895) as the determining factor cannot be said to have been strengthened by the discovery of genuine cases of ovarian pregnancy. If only a tissue derived from the Mullerian ducts has the power of growing a decidua, then, unless it can be proved that Mullerian tissue may invade the ovaries, it becomes impossible to account for gestation occurring in these glands. Another argument against this atavistic theory of origin of tubal pregnancy is found in the absence of any animal which normally has tubal pregnancies. It may, however, be found that another theory, as yet little heard of, may be of some importance—the view, namely, that the condition of the ovum itself has some effect in determining the position of its implantation ; the ovum, for instance, may be too large to get through the tube (Sippel) ; twin ova may impede each other's progress (Hitschmann and Lindenthal) ; the ovum may have reached at an earlier date that stage of development in which it can attach itself by the destructive action of its trophoblast, or its progress may have been delayed till that stage was reached (Sippel, 1901) ; or, again, the ovum may be pathological, and, on that account, may adhere more readily to the tubal mucosa. In favour of the last-named theory is the observation that the ovaries which have supplied the ova of ectopic pregnancies have frequently been found to be themselves pathological (*e.g.* cystic). It cannot, however, be claimed for any one theory of etiology that it satisfactorily explains all cases or meets all difficulties. Whether, as has been maintained by Seeligmann (*Zentralb. f. Gynäk.*, xxxi. p. 985, 1907) ectopic gestation

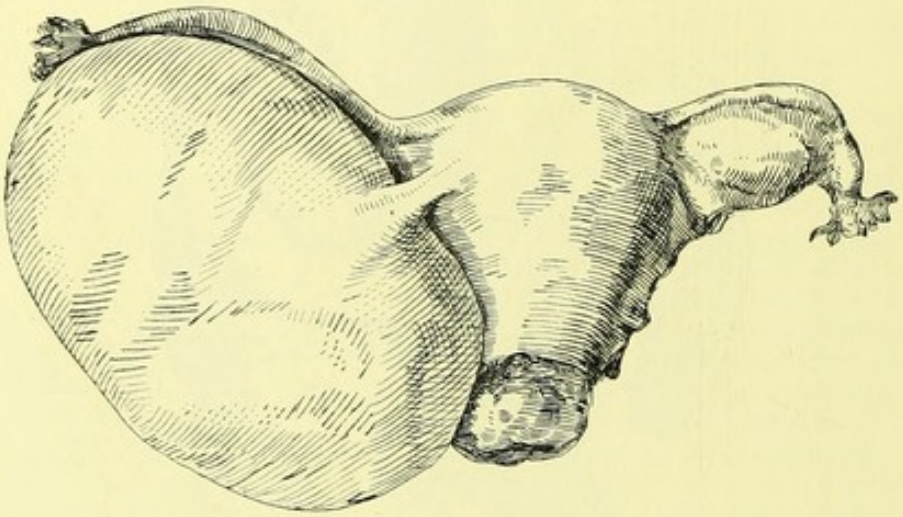


Interstitial pregnancy. Right wall of uterus, fourth month.

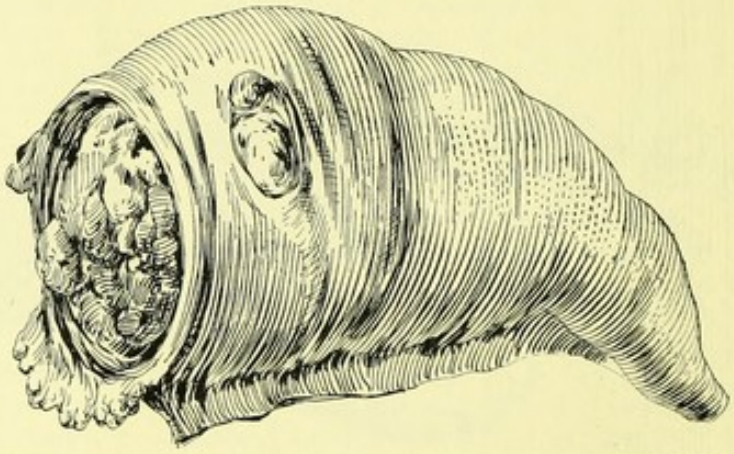


Tubal pregnancy five weeks old in isthmal portion. Rupture and extrusion of a tubal mole.

A. Ampulla.
A.O. Abdominal ostium.
O. Ovary.
I. Isthmus.
M. Mole.
(*After* Eden.)



Ovarian pregnancy. (*After* Martin.)



Tubal abortion. Ovum being extruded through the extremity of the tube.

is becoming more frequent cannot be easily determined; certainly it is more often diagnosed. The following articles bearing chiefly on etiology may be named:—Fellner, *Berl. klin. therap. Wochensch.*, p. 76, 1904; *ibid.*, *Arch. f. Gynaek.*, lxxiv. p. 481, 1904-5; Füth, *Arch. f. Gynaek.*, lxiii. p. 97, 1901; lxxii. p. 398, 1904; Gottschalk, *Zeitsch. f. Geburtsh. u. Gynäk.*, liv. p. 210, 1906; Hitschmann and Lindenthal, *Zentralb. f. Gynäk.*, xxvii. p. 263, 1903; Kermauner, *Beiträge zur Anatomie der Tubenschwangerschaft* (Berlin), 1904; Micholitsch, *Zeitsch. f. Geburtsh. u. Gynäk.*, xlix. p. 42, 1903; Pfaff, *Journ. Amer. Med. Assoc.*, xli. p. 1138, 1903; Roncaglia, *Ann. di ostet.*, xxiv. p. 289, 1902; Runge, *Arch. f. Gynaek.*, lxx. p. 690, 1903; Sippel, *Monatssch. f. Geburtsh. u. Gynäk.*, v. p. 437, 1897; Sippel, *Zentralb. f. Gynäk.*, xxv. p. 289, 1901; Werth, *Zentralb. f. Gynäk.*, xxvii. p. 850, 1903.

Some *varieties* of tubal pregnancy which were at one time regarded as very rare and even unique are now known to be comparatively common. Some of these may be briefly referred to. (1) There is, first, the occurrence of pregnancy in both Fallopian tubes at the same time; cases illustrating this form of plural ectopic pregnancy, which may be called bilateral tubal gestation, have been reported by Kristinus (*Wien. klin. Wochensch.*, xv. p. 1250, 1902), Sandberg and Burford (*Journ. Surg. Gynec. and Obstet.*, xxvii. p. 482, 1905), and others; but, of course, it can never be quite certain that the two pregnancies were of the same age, and as a matter of fact, in several of the recorded cases they have definitely been shown to be of different ages (see Jayle and Nandrot, *Rev. de gynéc. et de chir. abd.*, viii. p. 195, 1904). It is very probable that these cases are generally instances of repeated tubal pregnancy; thus in Haig Ferguson's observation (*Trans. Edin. Obstet. Soc.*, xxiv. p. 37, 1899), the right tube contained a lithopædion, while the left one showed a recent pregnancy of about three months. (2) *Repeated tubal pregnancy* must, therefore, be reckoned as a second rare variety of ectopic gestation, as, indeed, a more frequent occurrence than simultaneous bilateral tubal pregnancy. Ferguson (*loc. cit.*) collected from literature between fifty and sixty such cases; in most of them the second tubal pregnancy occurred on the opposite side, but this was not constant, for Taylor (*Brit. Gynæc. Journ.*, xiv. p. 94, 1898) had noted an instance in which the same tube was the site of the second implantation. Saniter's observation is difficult of interpretation; if it were repeated pregnancy in the same tube, then the relative size of the two embryos would indicate a difference in age of only one month; but it may have been a twin gestation with a difference in the rate of development of the two ova (*Zeitsch. f. Geburtsh. u. Gynäk.*, lv. p. 492, 1905). Since 1898 the number of records of repeated tubal pregnancy has been greatly increased, and in not a few instances the patient has been twice operated upon, twice by abdominal section (*e.g.* Dawson's case, *Journ. Obstet and Gynæc. Brit. Emp.*, iii. p. 301, 1903; Purslow, *Trans. Obstet. Soc. Lond.*, xlvii. p. 181, 1906). In Kokmann's case (*Zentralb. f. Gynäk.*, xxi. p. 1221, 1897) a normal pregnancy and labour intervened between the two tubal gestations. Two ruptured tubal pregnancies in the same patient within a year have been reported by M'Donnell (*Australas. Med. Gaz.*, xxvi. p. 287, 1907). (3) A third variety, which must still be reckoned as of great rarity, is the association of an ovarian pregnancy of one side with a tubal gestation of the other; in Psaltoff's case (*Ann. de gynéc. et d'obstét.*, lix. p. 376, 1903) the ovarian on the left side had an age of five years, while the tubal on the right side did not count more than five months. (4) Another variety is the presence of twins in a tubal gestation sac; and the fœtuses may be of the same or of different ages. Cases have been reported by Child (*Amer. Journ. Obstet.*, lv. p. 94, 1907), Costa (*Ann. di ostet.*, i. for 1907, p. 185), Ferroni (*Zentralb. f. Gynäk.*, xxvii. p. 275, 1903), Heinricius and Kolster (*Arch. f. Gynaek.*, lviii. p. 95, 1899), Le Dentu (*Bull. acad. de méd.*, 3 s. xxxv. p. 214, 1896), and Rutherford (*Lancet*, i. for 1907, p. 881). Under this heading may be placed the still more extraordinary occurrence of a double monster being found in a pregnant tube (Kirchhoff, *Zentralb. f. Gynäk.*, xviii. p. 232, 1894). (5) What must surely be the rarest of complications is a triple ectopic gestation, and yet a case has been reported by Krusen (*Proc. Phila. Co. Med. Soc.*, N. S., iii. p. 292, 1901-2); and Michin has described an instance in which a simple pregnancy occurred in one tube and was followed two years later by a twin pregnancy in the same tube (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 455, 1905). (6) A sixth variety is the simultaneous occurrence of intra-uterine (normal) pregnancy and extra-uterine (tubal) pregnancy. This cannot now be regarded as of great rarity, for Neugebauer has collected together 171 cases, including two seen by himself (*Zur Lehre von der Zwillingsschwangerschaft mit heterotopem Sitz der Früchte* (Leipzig), 1907). Further, the sub-varieties have been shown to be more numerous than was once supposed. For instance, the extra-uterine pregnancy which is discovered during or after the course of the normal intra-uterine one may be of some years' standing; it may be what has been called a *sequestered* ectopic gestation, or one in which the fœtus has died and been converted into a lithopædion or adipocere; and the extra-uterine sac may be a cause of delay and danger during the birth of the intra-uterine fœtus. Another sub-variety is that in which the ectopic gestation is early

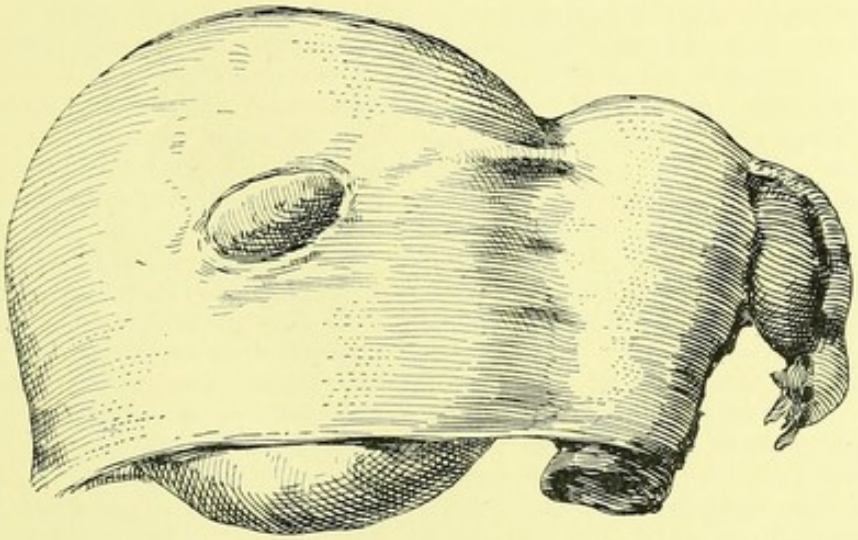
converted into a tubal mole, or bursts into the peritoneum, or is discharged as a tubal abortion into the abdominal cavity ; under these circumstances the intra-uterine pregnancy may go on uninterruptedly or may end as an abortion, the extra-uterine pregnancy may be operated upon and the intra-uterine one may either abort or go on to full term, or both pregnancies may come to an early end with dangerous accompaniments. A third sub-variety is that in which both the extra-uterine and the intra-uterine gestation go on to the full term with living fœtuses. Although this combination constitutes a formidable difficulty and a most dangerous type of case, the skill of the operator has occasionally saved one or other of the children or the mother ; while, in at least one case, the mother and both children survived (*Ludwig*). (7) A seventh variety to which reference must be made is pregnancy in the stump of an excised Fallopian tube. This may well appear to be almost an impossibility, nevertheless some well authenticated cases of stump-pregnancy have been put on record. Morfit (*Med. News*, lxxvi. p. 869, 1900) removed the right tube and ovary for pyosalpinx in a young woman, and two years later he had to open the abdomen again, finding that there had been a pregnancy in the stump of the right tube which had ruptured. Vineberg (*Amer. Journ. Obstet.*, lvii. p. 527, 1908) had to deal with a patient complaining of the discharge of blood from the bowel. She had previously had the left tube and ovary removed by another operator, and now Vineberg found an irregular semi-elastic mass to the left of the uterus. On opening the abdomen he found the mass to be an ectopic gestation sac adherent to the sigmoid flexure, and he performed panhysterectomy ; the right ovary contained a corpus luteum, so there must have been migration of the ovum. Another case of stump-pregnancy was reported by Hinder (*Australas. Med. Gaz.*, xxi. p. 414, 1902).

With the increase which has taken place in our knowledge of the pathology of ectopic gestation has come the possibility of more correctly deciding what the *complications* of the morbid state may be. A pelvic hæmatocele, for instance, must now be generally regarded as a result of an ectopic gestation rather than a complication ; it is probably due, in most cases, to a tubal abortion. On the other hand, it is known that torsion of the tube may occur as a complication of tubal pregnancy (Pestalozza, *Boll. di Soc. Tosc. di Ostet. e ginec.*, i. p. 117, 1902 ; Schauta, *Zentralb. f. Gynäk.*, xxx. p. 160, 1906 ; Santi, *Ginecologia*, iii. p. 333, 1907 ; and Weckerling, *Diss. inaug. Giessen.*, 1907) ; it may be accompanied by uterine fibroids (Holmes, *Amer. Journ. Surg. and Gynec.*, xvi. p. 113, 1902-3), by ovarian cysts (Arnold, *Lancet*, i. for 1907, p 1490), by pyosalpinx (Hitschmann, *Zeitsch. f. Geburtsh. u. Gynäk.*, liii. p. 1, 1904), or by cancer of the cervix (Rech, *Zentralb. f. Gynäk.*, xx. p. 421, 1896). It may also be followed by the development of a chorion-epithelioma (Hinz, *Zeitsch. f. Geburtsh. u. Gynäk.*, lii. p. 97, 1904).

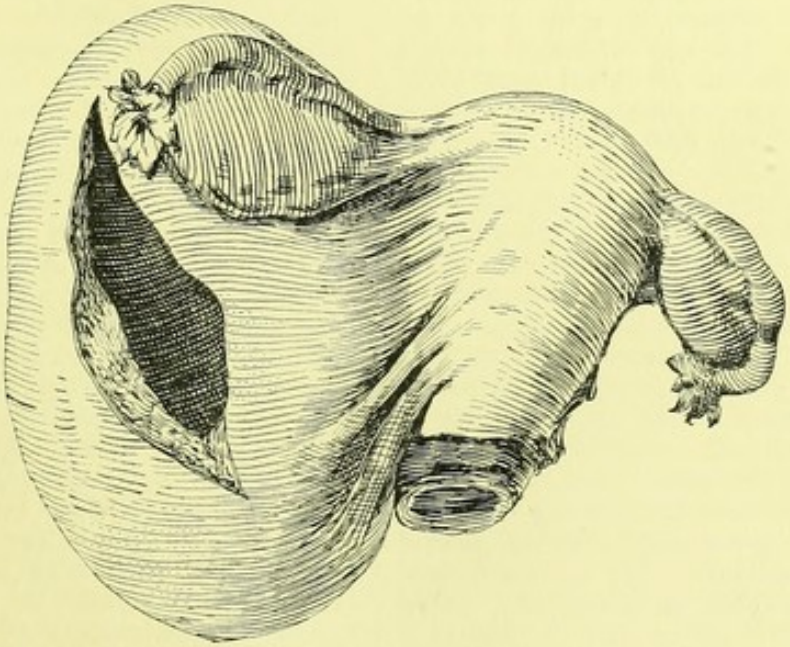
Primary Abdominal Pregnancy.

Whilst it may be said that the evidence in favour of the possibility of the occurrence of primary ovarian pregnancy is conclusive (see p. 140), the same cannot be affirmed of the *primary abdominal* variety. As a matter of fact, the demonstration of the ovarian type has weakened rather than strengthened the claims of the abdominal form, for it is very difficult to exclude the possibility of an early ovarian pregnancy undergoing rupture and becoming secondarily abdominal. Such a case as that reported by Herrenschmidt and Rigollot-Simonnot (*Ann. de gynéc. et d'obstét.*, 2 s. iii. p. 695, 1906) illustrates this possibility, for during the operation of abdominal section a small lacerated spot was seen on one ovary from which blood was issuing drop by drop ; during the handling of the ovary a small body, about the size of a pea, shot out of the opening in the ovary and was lost ; the sac wall showed chorionic villi with syncytium and decidual elements. It is not difficult to imagine the same ejection taking place during a bimanual examination with subsequent attachment of the ovum to the peritoneum. It is doubtful, therefore, whether it will ever be possible to exclude entirely the possibility of an early ovarian pregnancy with rupture, or of an early tubal abortion in cases of alleged primary abdominal pregnancy. At the same time, a number of cases, with a high degree of probability attaching to them, have been recorded during the past few years.

Leaving out of account some cases reported near the close of the nineteenth century (such as those of Ashton, *Ann. Gynæc. and Pædiat.*, v. p. 667, 1891-2 ; Doran, *Trans. Obstet. Soc. Lond.*, xxxv. p. 222, 1894 ; and Porro, *Ann. di ostet.*, xviii. p. 577, 1896), there have been some ten or a dozen specimens examined in the beginning of the present century which have strong claims to be regarded as primarily abdominal. The first case of the century claiming to be of this nature was that reported by V. Atlas of Astrachan, in Russia (*Ejened. Journ. Prakt. Med.* (St. Petersburg), viii. p. 22, 1901 ; abstract in *Zentralb. f. Gynäk.*, xxv. p. 1019, 1901) ; pregnancy went to the full term and was then operated upon. The gestation sac was in the abdominal cavity, and the placenta was attached to the left horn of the uterus and to the left broad ligament. The evidence in Witthauer's case (*Zentralb. f. Gynäk.*, xxvii. p. 136, 1903) was stronger than



Intra ligamentous pregnancy.



Broad ligament pregnancy. (*After* Zweifel.)

in Atlas's: the diagnosis of a tubal abortion was made, there having been amenorrhœa for two months, followed by abdominal pain, uterine hæmorrhage, and the development of a rounded tumour in the pouch of Douglas on the right side. The patient passed into a state of collapse, and the abdomen was opened; one and a half litres of blood were removed, and the healthy Fallopian tube of the right side along with the cystic ovary was taken away; a hæmatoma was discovered in the lower part of the omentum, which was ligatured and removed; when it was examined it was found to consist of an ovum surrounded by old and recent blood clot, and having the omentum rolled round it; there were chorionic villi, but they nowhere came into direct contact with omental tissue, being separated by the clot. The omentum had not contracted any adhesions with the tube, and, as has been stated, the ovary was cystic. Witthauer's opinion was that an ovum from the left ovary had become impregnated and had wandered across to the right side and been caught in a fold of the omentum; but he says nothing about the state of the *left* tube, and does not, therefore, exclude the possibility of a tubal abortion on that side of the body. In Galabin's case, also, the possibility of re-implantation after a hypothetical tubal abortion could not be excluded (*Brit. Med. Journ.*, i. for 1903, p. 664). Linck (*Monatssch. f. Geburtsh. u. Gynäk.*, xx. p. 1257, 1904) regarded his specimen as one of primary abdominal pregnancy, and Mayer's case (*Intercolon. Med. Journ. Australas.*, x. p. 145, 1905) had strong claims for inclusion in the list of very probable instances. In the latter, Mayer found in the abdomen a deformed fœtus, seven inches in length, attached by the cranium to the omentum, but with no other adhesions; the Fallopian tubes were normal, and the ovaries were cystic; the placenta was attached to the upper part of the uterus and of the broad ligaments, and was also fixed to the omentum. Valdagni's case (*Ginecologia* (Florence), ii. p. 164, 1905) was an interesting one: after four months, during which her menstruation was scanty, the patient had a sudden attack of pelvic pain, followed in a few days by a flow of milk from the breasts. A year later a movable ovoid tumour was detected in the right iliac region; the performance of laparotomy revealed that the uterus, ovaries, and tubes were normal, and that the tumour, which was densely adherent to the bowel and omentum, contained a macerated fœtus. Luigi Guidi's case (*Clin. ostet.* (Roma), viii. p. 147, 1906), another Italian observation, was somewhat similar; but the right tube was adherent to the omentum, in which the gestation sac, the size of a walnut and corresponding to four weeks in development, was folded up. Lovrich's observation (*Gynækologia* (Budapest), p. 70, 1907; *Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 704, 1908) was peculiar in the fact that the pregnancy went to the full time, when a spurious labour occurred, followed by the flow of milk from the breasts; six months later abdominal section was performed, and a gestation sac, connected with the left broad ligament by a broad pedicle and containing a mummified fœtus, was removed; both tubes and ovaries were free from any connection with the sac, and the placenta was attached to the left mesosalpinx and extended upwards to the level of the umbilicus. The wall of the sac contained chorionic villi and a glandular tubal structure, whose presence Lovrich was puzzled to explain; he thought it might be a parovarian tubule, or, more probably, an accessory Fallopian tube upon which the ovum had fallen and in whose substance it may have developed. In a case operated on by von Ott and reported by Jarzeff (*Monatssch. f. Geburtsh. u. Gynäk.*, xxviii. p. 144, 1908), dermoid cysts of both ovaries were removed by vaginal section, and with them came away a number of clots and a small fœtus which had been lying in the pouch of Douglas; the left Fallopian tube contained no products of gestation, and the right one appeared healthy and was not removed. Of course the anatomical diagnosis of this case could not be fully established, for the vaginal and not the abdominal operation had been performed. To complete this survey of alleged cases of primary abdominal gestations reference must be made to Otto Gröné's observation (*Zentralb. f. Gynäk.*, xxxiii. p. 45, 1909). It was made in the Malmö Hospital; the case was diagnosed as one of tubal gestation, and the abdomen was opened by Prag. Free blood was found in the pelvis, but neither the tubes nor ovaries showed any indications of pregnancy or of rupture. A bleeding surface the size of a mark piece was noted on the peritoneum anteriorly between the right round ligament and the cæcum; this was excised and the peritoneal edges brought together with sutures. This area represented, according to Gröné, the site of implantation of the ovum, and the microscopic appearances supported this view. Two bodies, one as large as a walnut, were found lying in the pouch of Douglas; one of them was solid and the other porous, and they both showed the cellular constituents of the villi (syncytium and Langhans's cells). No trace of an embryo was discovered.

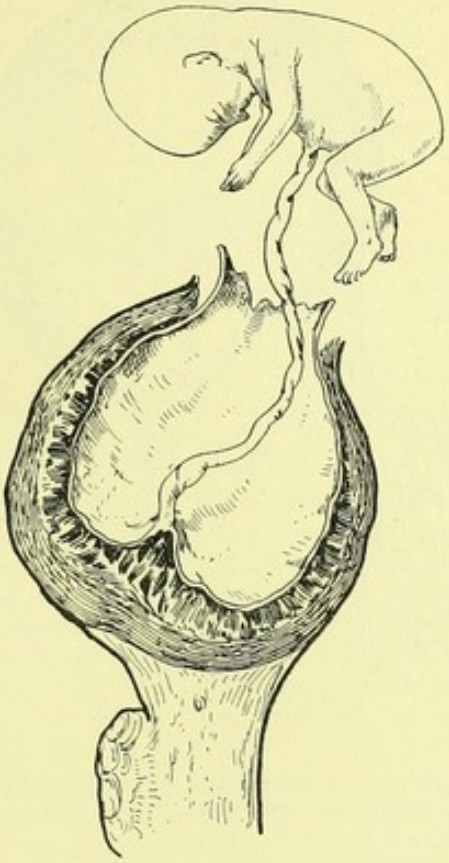
If, now, we sum up the evidence in favour of primary abdominal pregnancy, it is obvious that it cannot be regarded as a clearly demonstrated possibility of ectopic gestation. It seems to be almost impossible to exclude the occurrence of tubal or ovarian rupture or of tubal abortion at a very early stage, with secondary implantation of the ovum, on the peritoneum and the *restitutio ad integrum* of the original site of grafting. The evidence from the occurrence

of similar conditions in the lower animals, *e.g.* Leiserung's case in a cat, and Bruno Wolff's in a bitch, is not conclusive. Primary abdominal gestation must still be regarded as a probable, but as yet unproved, occurrence in the course of extra-uterine pregnancy. The secondary abdominal variety is, of course, well known, and the possibility of the implantation of the placenta, in whole or in part, on the peritoneum has been clearly established.

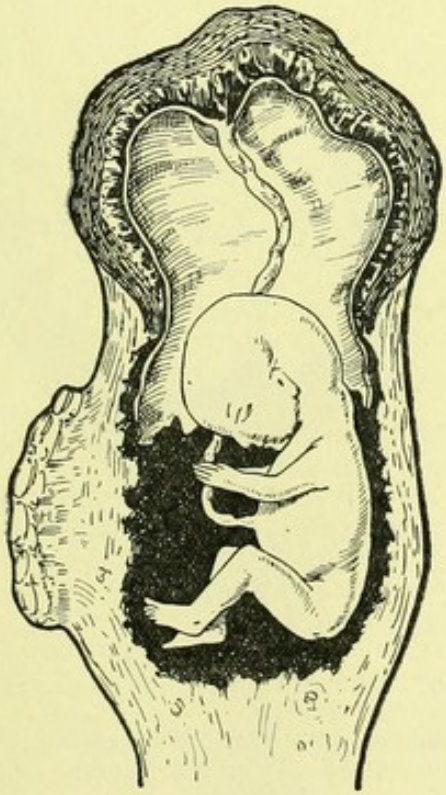
Secondary Abdominal Pregnancy.

Perhaps the most important addition that has been made to our knowledge of the secondary variety of abdominal gestation has been the increased experience which operators have gained in the management thereof. In the early months, before the placenta has become the important organ into which it develops later, the operative interference necessary does not differ in any marked fashion from that required in early tubal or ovarian pregnancy. The embryo may be found, with or without its amnion, rolled up in a fold of the omentum, while a portion of the fœtal sac with the developing placenta remains in the ruptured tube; under these circumstances, the part of the omentum containing the embryo may be ligatured and removed, while the tube is taken away in the usual manner. Again, the fœtal sac may not yet have acquired any firm connections with the omentum, but be only slightly adherent to the intestines, then it will usually be easy to separate it and remove it along with the tube from which it has emerged. The difficult cases are those in which the pregnancy is prolonged to the full term and beyond it; in which the placenta has time to acquire strong vascular connections with the peritoneum, intestines, or even with the liver; and in which the fœtal sac, being intra-peritoneal, and being composed sometimes of nothing save the delicate amniotic membrane, does not lend itself readily to marsupialisation. Then, indeed, the operator requires all his skill and judgment to deal successfully with the emergency which is almost certain to arise at or soon after term is reached, unless, indeed, the fœtus dies, remains uninvaded by microbes, and becomes converted into a lithopædion. In the last-named circumstances the state of affairs may only be discovered at a post-mortem examination made many years later, the patient dying from some other disease (*e.g.* pneumonia or heart disease). In Wallart's case (*Zeitsch. f. Geburtsh. u. Gynäk.*, lix. p. 222, 1907), for instance, the patient died at the age of eighty-five, while in Haultain's (*Journ. Obstet. and Gynæk. Brit. Emp.*, vi. p. 308, 1904) the lithopædion must have lain for forty-one years in the abdomen. But the formation of a lithopædion with subsidence of active symptoms and the disappearance of danger cannot be counted upon, and preparations ought to be made for the operative treatment of full-term abdominal pregnancies. Diagnosis is not the difficulty. J. W. Taylor (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 511, 1906) says: "In many cases the child may be almost seen through the loose abdominal walls, and, as the liquor amnii is usually deficient, the fœtus can be palpated with extraordinary precision and facility." Of course it is possible that the pregnancy may be tubo-ligamentary (*i.e.* the child may have developed between the layers of the broad ligament and consequently outside or behind the peritoneum) or even tubal, but the probabilities are, that if an extra-uterine gestation reaches full term and has the characters described by Taylor it is a secondary abdominal one. What, then, is to be the treatment?

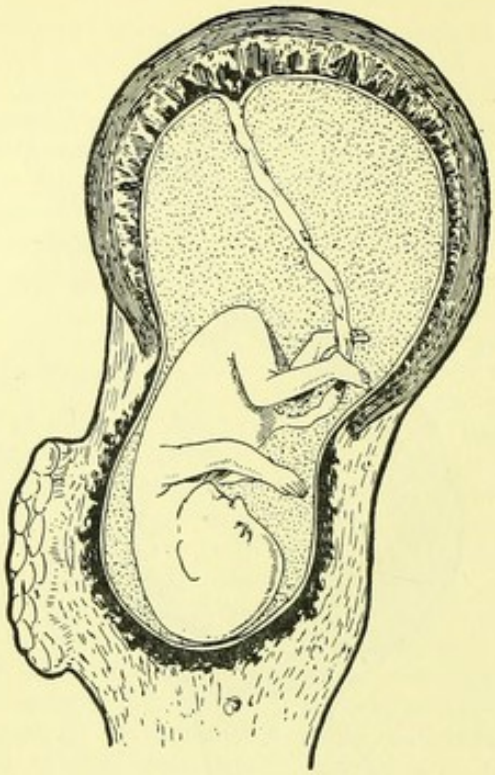
In the first place, it may be well to recognise the difficulties and dangers to be met with when the abdomen has been opened, and Potocki's case will serve as a useful warning (*Ann. de gynéc. et d'obstét.*, 2 s., v. p. 92, 1908). The patient, twenty-three years of age, was pregnant for the first time, and was nearly at the ninth month. At the end of the fourth month she had suffered from intense abdominal pain, lasting for three days; it was thought that she was aborting or was suffering from peritonitis, but no hæmorrhage occurred, and she gradually recovered. About a month later the pain returned, with vomiting and syncope, and after this the patient remained at rest in bed until the full term. The abdomen was markedly irregular in its enlargement; palpation discovered the fœtal parts, which were very easily felt, the head lying in the left flank, while a structure, believed to be the uterus, was on the right side. The fœtal heart was heard in the middle line, above the level of the umbilicus. Full-time extra-uterine pregnancy with a living infant was diagnosed. It was determined to open the abdomen at once. The amnion was found to be slightly adherent to the anterior abdominal wall. When the adhesions were separated the placenta could be seen in the lower part of the amniotic sac with the fœtus lying above it; to the right side was the uterus, congested, and somewhat enlarged. An opening into the gestation sac was made as far as possible from the placenta, and the fœtus was quickly extracted; it was alive, and soon began to cry. The placenta now seemed to be separating of itself, but Potocki, on attempting to trace its connections, was met with a terrific hæmorrhage, which did not cease till he had clamped the uterine and ovarian vessels. Since the wall of the sac consisted of the amnion alone, it could not be marsupialised, and so the whole mass, with the placenta, was separated from its surroundings and removed. The uterus and the left tube and ovary were left



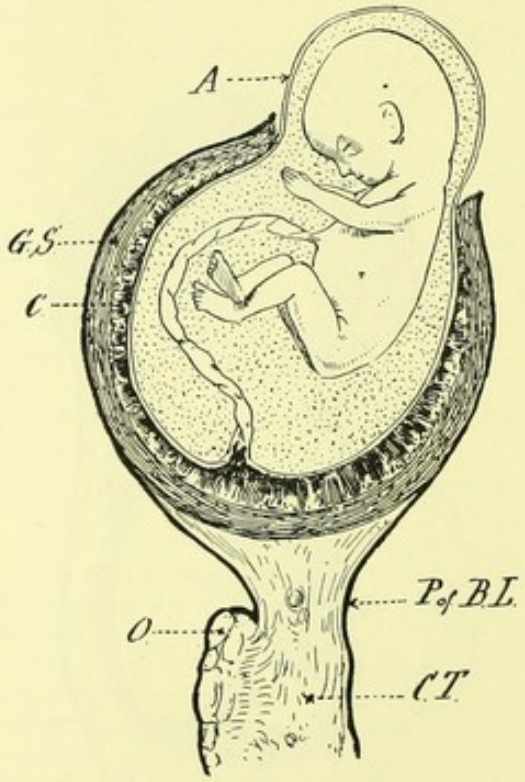
Intra-peritoneal rupture of the tube. Both chorion and amnion turned, and fœtus will not survive. (*After* Giles.)



Intra-ligamentary rupture of the tube. Chorion and amnion both torn. Fœtus will perish. (*After* Giles.)



Intra-ligamentary rupture of the tube. Amnion and placental portion of chorion uninjured. Fœtus may survive. (*After* Giles.)



Intra-peritoneal rupture of the tube. Amnion intact. Placental portion of chorion uninjured. Fœtus may survive. (*After* Giles.)

A. Amnion.
G.S. Gestation sac.
C. Chorion.
O. Ovary.
P. of B.L. Peritoneum of broad ligament.
C.T. Connective tissue.

behind, and the abdominal incision was closed. The patient made a good recovery, and the child, at the age of two and a half years, is alive, but is unfortunately a microcephalic idiot. The placenta, it was found, had been inserted upon the isthmus of the tube.

Keeping Potocki's case in mind, we are better able to recognise the special dangers and difficulties of operating upon full-time abdominal pregnancies. The wall of the sac is so thin and friable that marsupialisation, that convenient resource in some other forms of ectopic gestation, is rendered impossible of performance; the living placenta has vascular attachments which are so extensive as to produce tremendous hæmorrhage if separated at once; and it is not always possible to leave the placenta *in situ*, for, as was seen in Potocki's case, it may begin to come away of itself. It may therefore be thought better to wait till the full term is past and the fœtus dead; but, on the other hand, there is the chance of saving the infant, if the operation be performed at term, and, as Potocki's case shows, the child may not only be born alive but may survive. It is true that the full-time infant of an extra-uterine pregnancy has a smaller chance of being well formed than has one from a normal pregnancy; still, a sufficient number of cases of survival of such infants has now been recorded to prove that their lives are far from negligible (see von Winckel's work *Uber die Missbildungen von ektopisch entwickelten Früchten und deren Ursachen* (Wiesbaden), 1902), and that they may enjoy good health and be mentally well developed. It will probably be found to be the better plan for the sake of child as well as mother to operate at term. The operation should be carefully prepared for, and special attention should be paid to asepsis; no special difficulties are likely to be met with until the operator comes to deal with the placenta and has to decide whether to take it away or to leave it to come away for itself. The risk of almost uncontrollable hæmorrhage accompanies the former procedure, while the latter is attended by the risk of sepsis. J. W. Taylor (*loc. cit.*) has suggested a third plan of treatment. He says that two forms of placenta are met with: one may be called the "ball-like," and is covered nearly everywhere by amniotic reflexion; the other may be named "discoid," and has only one surface free from vascular attachments; the former can generally be removed with safety, the latter cannot. Although some vascular twigs from omentum or intestine may contribute to the supply of the placenta, its chief vessels are always those of the broad ligament (ovarian and uterine), and the plan of treatment, therefore, must consist in finding and securing these before the removal of the placenta is attempted. This, Taylor says, is easy with the "ball-like" placenta, but very difficult with the "discoid." He suggests, therefore, that in the latter emergency the child and cord should be removed, the amniotic sac carefully washed out, and the cavity containing the placenta closed in, and that structure left to be absorbed. Of course the success or failure of this plan will depend entirely on the degree of perfection of the aseptic precautions which can be attained.

A large number of articles discussing secondary abdominal pregnancy have appeared during the past five or six years; only a few of the more important or more easily accessible are named here: — Barozzi, *Gynécologie*, xi. p. 489, 1906; Beale, *Med. Press and Circ.*, N. S., lxxxii. p. 360, 1906; Brothers, *Amer. Journ. Obstet.*, lvii. p. 109, 1908 (a case in which the pregnancy was further complicated by the presence of a fibroid tumour); Garkisch, *Prag. med. Wochensch.*, xxxiii. p. 149, 1908; Hellier, *Journ. Obstet. and Gynæc. Brit. Emp.*, v. p. 438, 1904; Marsh, *ibid.*, ix. p. 438, 1906; Pestalozza, *Ginecologia*, i. p. 42, 1904; Potocki and Bender, *Ann. de gynéc. et d'obstét.*, 2 s., i. p. 581, 1904; Prüsmann, *Zeitsch. f. Geburtsh. u. Gynäk.*, lii. p. 288, 1904; Reed, *Trans. Amer. Assoc. Obstet. and Gynec.*, xviii. p. 239, 1906; Sittner, *Deutsche med. Wochensch.*, xxxii. p. 1200, 1906 (the infant was alive in this case); Weiss, *Zentralb. f. Gynäk.*, xxxii. p. 251, 1908 (both mother and child lived). Articles dealing more particularly with the treatment of these difficult cases are those of Freund (*Samml. klin. Vortr.*, No. 448, 1907), Hellier (*Trans. Obstet. Soc. Lond.*, xlv. p. 366, 1904), Jacomet (*Echo méd. du Nord.*, xi. p. 292, 1907), Tate (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 592, 1906), and Vallois (*Bull. soc. d'obstet. de Paris*, vii. p. 315, 1904).

Ovarian Pregnancy.

Ovarian Pregnancy. — When the *Encyclopædia Medica* was published (in the last year of the nineteenth century) it was permissible to write of ovarian pregnancy as "a possibility denied by many," and to state that "for all practical purposes the tubal variety was the only primary form" of ectopic gestation; but there can be now no longer any doubt about its possibility, and alongside of the tubal form of extra-uterine pregnancy we must at the present day place primary ovarian pregnancy, and perhaps also primary abdominal gestation.

Historical Note.—Although ovarian pregnancy had been suspected by previous writers, to Dr. Catharine van Tussenbroek of Amsterdam belongs the credit of giving the first complete demonstration of its actual occurrence. Her communication took the form of a report on a specimen removed by Dr. Kouwer from a patient, thirty-one years of age, who had had six weeks' amenorrhœa, and who was believed

to be suffering from extra-uterine pregnancy. The right ovary was found, at the operation, to be surrounded with clots, and the abdomen was full of blood. There was no attachment of the tube to the ovary. In the latter was an ovisac, containing a small half-macerated embryo, lying within a corpus luteum. The ovum was surrounded by villi, and these were covered both with syncytium and with Langhans's cellular layer. Dr. van Tussenbroek's paper was published in the *Nederl. Tijdschr. v. Verlosk. en Gynæc.* (Haarlem) (vol. x. pp. 187-214, 1899), and in the French *Annales de Gynécologie* (vol. lii. pp. 537-573, 1899); a translation also appeared in the *St. Louis Courier of Medicine* (vol. xxiii. p. 1, 1900). The publication of this report excited much interest, and attention was again drawn to the subject of primary ovarian pregnancy; some gynecologists remained sceptical, but those who were able to examine the specimen itself were convinced, and the matter was finally decided soon afterwards by the publication of a number of other cases, some of which at least were clearly shown to be of the nature of gestation in the ovary. Reference may here be made to the reports of H. Gilford (*Brit. Med. Journ.*, ii. for 1901, p. 963), of E. O. Croft (*Trans. Obstet. Soc. Lond.*, xlii. p. 316, 1900), of Anning and Littlewood (*Trans. Obstet. Soc. Lond.*, xliii. p. 14, 1902), and of Mayo Robson (*Journ. Obstet. and Gynæc. Brit. Emp.*, ii. p. 11, 1902). The first part of the first volume of *American Gynecology* (1902) opened with an article on ovarian pregnancy by J. F. Thompson, with the report of a case in which an exploratory abdominal incision was made to determine the nature of an extremely tender swelling in the left side of the pelvis; a small tumour of the left ovary was found, with the Fallopian tube projecting clear of its outer end; a tumour about the size of a horse-chestnut was attached to the upper end of the enlarged ovary, and in it was an ovisac containing an embryo of a size corresponding to twenty-five or thirty days. In the same year Mendes de Léon and Holleman (*Rev. de gynéc. et de chir. abd.*, vi. p. 387, 1902) reported a case of ectopic gestation which was possibly ovarian, and in the next year Micholitsch (*Zeitsch. f. Geburtsh. u. Gynäk.*, xlix. p. 508, 1903) met with two cases of ovarian pregnancy in a series of 120 operations for extra-uterine gestation. When, in 1904, Ludwig Kantorowicz (*Samml. klin. Vortr.*, No. 370, 1904) related two new cases of ovarian pregnancy, he was able to state that, altogether, nineteen undoubted instances had been put on record, with ten probable ones and fourteen doubtful. But Kantorowicz's list was incomplete, and, since 1904, a number of additional cases have been observed, including the British ones of J. K. Kelly and Louise M'Ilroy (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 389, 1906), of Hewetson and Lloyd (*Brit. Med. Journ.*, ii. for 1906, p. 568), of Law (a doubtful instance, *Brit. Med. Journ.*, ii. for 1906, p. 866), and of J. Munro Kerr (*Proc. Roy. Soc. Med.*, i., Obstet. Sect., p. 268, 1907-8), and the American ones of J. C. Webster (*Amer. Journ. Obstet.*, l. p. 28, 1904; *Trans. Amer. Gynec. Soc.*, xxxii. p. 122, 1907), who had previously been firmly persuaded of the impossibility of the occurrence of the ovarian variety of ectopic gestation; and of Norris and Mitchell (*Surg. Gynec. and Obstet.*, vi. p. 460, 1908). Weibel's case (*Arch. f. Gynaek.*, lxxxvi. p. 210, 1908) differed from most of the previously reported observations, in that the fœtus had been converted into a lithopædion.

Pathology.—The anatomical and histological evidence necessary for the proof of an ovarian pregnancy consists in the absence of the ovary of the corresponding side of the body, the presence of ovarian tissue in the wall of the gestation sac, the attachment of that sac to the uterus by the ovarian ligament, the complete freedom of the Fallopian tube of the same side and of the opposite side from any participation in the formation of the sac, and the existence of the same topographical relations of the sac as are met with in an ovarian cyst. In the presence of these conditions, which more than fulfil the requirements of Lawson Tait, the diagnosis of a primary ovarian gestation is established. The pathological details of the recorded cases have shown considerable differences. In the van Tussenbroek specimen the gestation sac was within a corpus luteum and had a theca interna consisting of large cells resembling those of the decidua; inside the theca interna was a layer of connective tissue, and within that was the ovum covered with villi possessing both layers, syncytium and Langhans's cellular layer. In J. F. Thompson's case, also, the ovum seems to have been in a corpus luteum, but there were no decidual cells and no trace of an amnion; there was an embryo, 1·2 cm. in length, with an umbilical cord 1·5 cm. long attaching it to the chorion. The case of Anning and Littlewood was also one in which the ovum occupied the corpus luteum. The ovum, however, is not always so situated. In Hewetson and Lloyd's case, for instance, an intact corpus luteum bulged into the gestation sac, from which it was everywhere separated by a layer of ovarian stroma; in Webster's first case (1904) the cavity in which the ovum had developed may have been a Graafian follicle, but, if so, it was not a ripe one, and no formation of a corpus luteum had followed; in Busalla's case (*Arch. f. Gynaek.*, lxxxiii. p. 612, 1907) the original seat of implantation was probably a corpus luteum, but it had burst, and the ovum had implanted itself in the tunica albuginea on the surface of the ovary near the site of the rupture

("epovarial" implantation of Schickele); in the specimen described by Munro Kerr the ovum was embedded in ovarian tissue outside the Graafian follicle (corpus luteum); and in that of Kelly and M'Ilroy the pregnancy had occurred in a Graafian follicle, but was found separated from it by a layer of connective tissue and fibrin. It is evident, therefore, that an ovarian gestation may have its seat in a Graafian follicle or in a corpus luteum, in ovarian tissue outside either, or on the surface of the ovary. In other details there are also differences. The gestation sac may have been converted into a mole (Micholitsch, *loc. cit.*; Gilford, *loc. cit.*), or it may show amnion and chorion and an embryo (Freund, *Deutsche med. Wochensch.*, xxx. p. 1670, 1904), or a chorion containing an embryo (Freund and Thomé, *Virchow's Arch. f. Path. Anat.*, clxxxiii. p. 54, 1906). The villi of the chorion have been found showing both syncytium and Langhans's layer of cells. The presence of decidual cells or of lutein in the immediate neighbourhood of the gestation is far from constant. Webster (*loc. cit.*, 1904), Herrenschmidt and Rigollot-Simonnot (*Ann. de gynéc. et d'obstét.*, 2 s., iii. p. 695, 1906), and van Tussenbroek (*loc. cit.*) have described decidual cells or large cells closely resembling them; but Gottschalk (*Zeitsch. f. Geburtsh. u. Gynäk.*, xlviii. p. 360, 1903), Hewetson and Lloyd (*loc. cit.*), and Kelly and M'Ilroy (*loc. cit.*) found no decidual elements, and Freund (*loc. cit.*) saw neither decidual cells nor a lutein layer. The absence of decidual cells in ovarian pregnancies has a bearing upon the pathogenesis of ectopic gestation in general; for it seems to show (contrary to Webster's contention) that pregnancy can occur without a preceding decidual or genetic reaction. Indeed, ovarian pregnancies apparently prove that the impregnated ovum can be implanted upon a tissue which is not Müllerian in origin, although it has been argued by Webster (*loc. cit.*, 1904) that there may be an occasional extension of Müllerian tissue into the ovary leading to the development (in pregnancy) of localised areas of decidua-like cells. Some of the recorded specimens seem, on the other hand, to support the view that the ectopic gestation can be best implanted on vascular connective tissue (Kelly and M'Ilroy and Munro Kerr, *loc. cit.*)—a view which has been strongly advocated in the past but never fully established. It is very interesting to observe how closely the ovary resembles the uterus in the response it makes to the presence of an impregnated ovum in it, although it differs so completely in its histological characters. *Clinically*, an ovarian pregnancy cannot be differentiated from the other forms of ectopic gestation. Early death of the embryo or the conversion of the gestation into a mole is probably the common result of pregnancy in this organ, and early rupture would seem to be the rule. Menge (*Münch. med. Wochensch.*, No. 49, p. 2452, 1907), however, has recorded a case in which a right-sided ovarian pregnancy went to the full term and was removed by abdominal section, the child in it being alive. Further, to make this remarkable case absolutely unique, a living child had been expelled from the uterus, without causing rupture of the extra-uterine sac, just before the performance of the abdominal section; the mother, Menge adds, was suckling both infants. In Munro Kerr's case, also, there was a coincident intra-uterine gestation; the right ovary, containing a gestation sac of about five weeks, was removed by abdominal section on 13th January 1903, and on 19th August of the same year the patient was delivered of a full-time healthy child (*Operative Midwifery*, p. 545, 1908).

Ovarian pregnancy, therefore, must now be regarded as one of the well proven varieties of ectopic gestation taking its place alongside of tubal and cornual pregnancy. As our knowledge of this variety grows with the multiplication of records and specimens, it is certain that its pathological possibilities will be more clearly appreciated, and it is possible that its clinical characters may be better defined.

Diagnosis.

It cannot be claimed that during the past few years any very remarkable advances have been made in the diagnosis of ectopic pregnancy. Operative successes have indeed made us better acquainted with the varieties and complications of extra-uterine gestation, and the gynecologist is better able to deal with the conditions he may find when he has opened the abdomen; but, previous to operative interference, there must still be considerable doubt as to diagnosis. The recognition of the nature of the morbid state is not difficult when rupture of the tube into the peritoneum has occurred and is accompanied by great hæmorrhage causing profound collapse; we have, of course, to keep in mind the possibility of rupture of a gastric or duodenal ulcer, of a violent attack of appendicitis, and of torsion of the pedicle of an ovarian cyst or uterine fibroid. In such cases, the general surgeon will think first of intestinal states, and the gynecologist of tubal and uterine ones; but both will open the abdomen, and thereafter diagnosis is easy. More difficulty is met with in connection with early ectopic pregnancies in which the symptoms are slight and irregular, and in which such occurrences as tubal abortion, rupture between the layers of the broad ligament, or formation of a tubal mole are taking place. Irregularity in the symptomatology of the first months of pregnancy, leading in many cases to the abandonment of the diagnosis of ordinary pregnancy which had been made by the patient or her

medical attendant, must be regarded as suggestive of the ectopic variety. The occurrence of irregular uterine hæmorrhage accompanied by abdominal pain (often of the colicky type) and sometimes with the discharge of a decidual membrane, along with feelings of sickness and sometimes of syncope, should rouse our suspicions, but very often rather direct our thoughts to threatened or incomplete abortion. Indeed one of the commonest mistakes is to confound an ectopic pregnancy with an abortion and an abortion with an ectopic pregnancy. When, as in one of Munro Kerr's cases (*Operative Midwifery*, p. 560, 1908), there is appendicitis as well as abortion, such a mistake in diagnosis is not difficult to make. Other errors are the confusing of the ectopic pregnancy with retroversion of the gravid uterus, with pyosalpinx, with an ovarian or a uterine tumour, with malformations of the uterus, or with pregnancy in a rudimentary horn, etc. In all these cases the bimanual examination will give a chance of accurate diagnosis; but it must be very carefully and very gently carried out, as the chance of rupturing an ectopic gestation sac during such a manipulation is not imaginary. The use of the uterine sound may be helpful, but it is not free from risk; the curette also is dangerous, and the microscopic examination of the scraping, unless it show villi, does not serve to distinguish an intra-uterine from an extra-uterine pregnancy. The Röntgen rays have been used in diagnosis by Salin, Stein, and others, but with no very certain advantage or results. In many cases the gynecologist will still be in doubt as to his diagnosis when he opens the abdomen. When the ectopic gestation goes on to full term the diagnosis is not nearly so difficult; the previous history of the patient, the disturbance of the pelvic functions of micturition and defæcation, the presence of two tumours in the abdomen (uterine and extra-uterine), the ease with which fœtal parts are felt, and sometimes the occurrence of a "spurious labour" all help the gynecologist to a correct estimate of the condition. The possibility of mistaking hydramnios in a thin-walled uterus for an extra-uterine pregnancy must, however, be borne in mind. Perhaps the most puzzling cases are those in which the fœtus has died and the ectopic sac has shrunken and become "sequestered"; such remains of old extra-uterine pregnancies may be met with in the abdomen in women of any age up to seventy and even eighty. Of course, in making a diagnosis one has to keep the possibility of ectopic pregnancy existing alongside of a normal pregnancy or of some other morbid state, such as an ovarian tumour. Sittner's article (*Deutsche med. Wochensch.*, xxix. pp. 743, 759, 787, 1903) gives a good account of the difficulties of diagnosis in ectopic gestation, and other useful papers are by Sir Halliday Croom (*Practitioner*, lxxii. p. 601, 1903), Eustache (*Journ. d. sc. méd. de Lille*, ii. p. 97, 1903), Fabricius (*Wien. med. Presse*, xlviii. pp. 498, 542, 1907), Grandin (*Amer. Gynec.*, ii. p. 42, 1903), Haultain (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 403, 1906), Lichtenstein (*Münch. med. Wochensch.*, liii. p. 498, 1906), Milligan (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 423, 1906), Pestalozza (*Ginecologia*, i. p. 545, 1904), Reynolds (*Boston Med. and Surg. Journ.*, cxlvi. p. 306, 1902), and by Vineberg (*Journ. Amer. Med. Assoc.*, xxxvi. p. 1305, 1901). There are certain very difficult matters, such as the distinction between an interstitial or tubo-uterine pregnancy and an angular pregnancy (*i.e.* implantation of the ovum in the upper angle of the uterus over the tubal ostium), which the diagnostician can hardly hope to settle prior to abdominal section.

Treatment.

During the past few years the experience of gynecologists has been such as to encourage, more and more, operative methods in dealing with ectopic gestations of all kinds and at all stages. The *expectant plan* of treatment has been less and less used; for while it is quite likely that tubal moles and tubal abortions may in time be absorbed or rendered innocuous by prolonged rest, yet there are risks of no small magnitude during the process, and these operation is generally able to remove; at any rate, the convalescence will be much hastened after a properly carried out laparotomy or vaginal section. If, therefore, an ectopic gestation has been diagnosed, the rule is to operate, and expectant treatment is permissible only while the ectopic gestation remains intact and its diagnosis consequently uncertain.

With regard to the question of which is the *better route* to be followed in operating upon early extra-uterine pregnancy, it cannot be stated that the vaginal has yet been shown to be preferable to the abdominal. Strassmann (*Berl. klin. Wochensch.*, xxxix. pp. 563, 588, 613, 1902) and Orthmann (*Deutsche med. Wochensch.*, xxxiv. p. 192, 1908) are strongly in favour of the vaginal route; and the latter supports his argument with much statistical evidence, maintaining that vaginal section, especially anterior colpo-cœliotomy, gives a sufficiently good survey of the field of operation, allows rapid access to the diseased tube, avoids shock and the after-risk of hernia, and has a shorter convalescence. He admits that the vaginal operation is more difficult, and is only to be employed up to the end of the third month. Bröse (*Zeitsch. f. Geburtsh. u. Gynäk.*, xliii. p. 389, 1900), Child (*Yale Med. Journ.*, x. p. 101, 1903), De Paoli (*Rassegna d'ostet. e. ginec.*, xvi. p. 273, 1907), Ford (*Trans. Amer. Gynec. Soc.*, xxxi. p. 157, 1906) and others have

operated by the vaginal route; but whilst it is true that good results have been obtained, both by posterior and anterior colpotomy, and whilst it must be admitted that an operation begun by abdominal section may require to be terminated by vaginal drainage, still the practice of gynecologists seems to be to employ abdominal section more frequently than vaginal for gestations of all ages.

With regard, next, to details, several matters must be looked upon as still undecided, but we are rapidly approaching the time when a definite policy shall have been settled for all the varieties and possible emergencies of ectopic gestation. Let us consider first the fairly well decided methods to be employed in early pregnancies, and then the less defined plans for the later cases.

In the presence of an early rupture of the pregnant tube with signs of internal hæmorrhage there is, of course, no doubt that the abdomen should be opened, the sac removed and the hæmorrhage stopped. The only matter in dispute is whether this should be done during the continuance of the state of shock or after reaction has come on. While there is some advantage in waiting till the period of shock is past, it is not great, and the weight of opinion, at any rate among operators, is on the side of immediate operation, by the abdominal route, and under light anæsthesia. A saline may be infused during the section. There is no great change in the technique; but it is of service to clamp the broad ligament with pressure forceps outside and inside the ruptured tube before doing anything else. There is no need to remove the ovary unless it be diseased, but it is not yet clear whether any attempt should be made to conserve a *ruptured* tube.

In early ectopic pregnancies in which as yet there are no cataclysmic symptoms pointing to the inundation of the peritoneum with blood from a ruptured tube the indication is still to open the abdomen and remove the gestation sac. The sac may be found in the wall of the tube, partly extruded through the ostium, free in the peritoneal cavity, or attached to the omentum; in any case, its blood-supply is to be secured and itself removed. In the case of tubal moles and even of ordinary growing tubal pregnancies the attempt has been made to conserve the tube by dilating it or by splitting its wall and removing the sac; of course if this be done great care will have to be taken to secure all bleeding points and suture the opening. As a general rule, however, the tube is to be taken away and the ovary left, and the details of the operation are usually quite simple. Where the gestation has become intra-ligamentary the difficulties may be more formidable, and it may be necessary to drain the sac with gauze brought out through the vagina. If the gestation be in the isthmus or in the uterine wall (interstitial) it will always be well to try to save the uterus (Wimmer, *Zentralb. f. Gynäk.*, xxvii. p. 52, 1903); but in some cases this will be found to be impossible, and then subtotal hysterectomy will be needed, as in Bertram Hunt's patient (*Brit. Med. Journ.*, ii. for 1906, p. 777).

The operative treatment of ectopic gestations in the latter half of pregnancy and at or after the full term is a matter about which there is not yet the same crystallisation of expert opinion as exists regarding the management of the earlier cases. Shall we delay operation till the full time in order to give the child a chance? Shall we wait beyond the full term for the death of the fœtus in order to have to deal with a dead instead of a "quick" placenta? Shall we try to remove the placenta at the same time as the infant, or shall we allow it to remain till its vascularity has lessened and then take it away? These are three of the undecided problems in the management of ectopic gestation at or near full term. There seems, however, to be a general inclination to answer the first question in the negative, and I believe that ultimately the second one will receive a similar answer; the reply to the third must depend upon circumstances. If, on opening the abdomen, the operator finds that he can easily secure the blood-supply of the gestation sac, he ought to do so and then remove the sac entire with the fœtus and placenta inside. Potocki (*Ann. de gynéc. et d'obstét.*, 2 s., v. p. 92, 1908), from experience gained in the treatment of some difficult cases, is of opinion that hæmostasis gained by clamping the uterine and ovarian arteries on the affected side should be the first step after the abdomen has been opened. As a general rule, however, the operator opens the sac and removes the fœtus; if the fœtus be macerated and the placenta in consequence be not "living," it may then be good treatment to strip off the latter and close the sac and the abdomen. It may, however, be wiser to stitch the margin of the sac to the abdominal incision (marsupialisation). If the fœtus be alive (or only recently dead) and the placenta consequently "quick," the operator will have to decide whether he will take away the placenta or leave it; if he can secure the vessels of the broad ligament he may take the placenta away, and if it lie *above* the fœtus in the sac he will require to take it away; but if not, he will probably be well advised not to try to separate it, as the bleeding from the site will certainly be very great, and may even be impossible to check. He may remove the fœtus, cut off the umbilical cord close to the placenta, and marsupialise the sac, making an attempt to remove the after-birth in ten or twelve days; or he may entirely close the sac on the abdominal side and open and maintain a communication with the vagina by means of a gauze drain, and hope to remove the placenta

per vaginam. Both these methods, however, entail a long convalescence (Malcolm, *Journ. Obstet. and Gynæc. Brit. Emp.*, iv. p. 435, 1903). The worst cases are those in which the gestation sac is widely adherent to omentum, intestines, and even to the liver; then packing with gauze and marsupialisation of the sac is often the only possible treatment. It must also be borne in mind that the friable nature of the sac sometimes makes marsupialisation very difficult; this is specially true of the tubo-abdominal gestations in which the sac is made up of nothing more than amnion.

There are, therefore, several details in the technique of ectopic gestation operations which must in the meantime be left undecided, but the growing experience of gynecologists will gradually reduce speculation to order and give certain rules where at present there are only tentative recommendations. Of one thing the operator may be certain — that the most hopeless-looking cases are capable in the hands of a skilled gynecologist of successful management. Take, for instance, Döderlein's remarkable record: he operated for tubal gestation; in three days the incision gave way during an attack of coughing and intestine was prolapsed, and he had to reopen the wound and replace the bowel; then signs of strangulation appeared, and for a third time he opened into the abdominal cavity to separate adhesions; and yet the patient recovered (*Zentralb. f. Gynäk.*, xxix. p. 528, 1905).

There is a great literature on the subject of the treatment of ectopic pregnancy. For the ordinary reader the articles in Allbutt's *System of Gynæcology* (2nd ed., p. 635, 1906), and in Munro Kerr's *Operative Midwifery* (p. 566, 1908) will be found of great value; while the *Journal of Obstetrics and Gynæcology of the British Empire* has since 1902 furnished the specialist with carefully made summaries of important articles, British and foreign.

Ectotoxins.—Toxins which diffuse out of bacteria, *e.g.* those of diphtheria and tetanus.

Edestin.—A globulin, insoluble in pure water but soluble in neutral solutions of strong bases with strong acids; it is derived from the seeds of sunflower, hemp, castor-oil bean, etc.

Egmol.—A proprietary preparation, described as an emulsion, containing 40 per cent. of olive oil, with fresh eggs and flavoured with French brandy, and recommended as a substitute for cod-liver oil for those to whom the oil is repugnant.

Ehrlich - Hata Remedy. — Also known as "six hundred and six" (606) and arsenobenzol. *See* SYPHILIS (*Treatment*).

Eichhorst's Corpuscle.—A form of red-blood corpuscle of the microcyte variety, deeply coloured, highly refractile, usually spherical in shape, and about 3 micros in diameter; it is met with in severe anæmia of any kind, including pernicious anæmia, but is not pathognomonic of the last-named disease.

Einhorn's Test.—*See* DIGESTIVE FUNCTIONS, TESTS FOR.

Elastoid Degeneration.—Vitreous degeneration of elastic tissue, as seen in the arteries in the wall of the involuting uterus; in this situation the internal elastic lamina swells greatly, forming a broad hyaline band which at first stains like elastic tissue (with Weigert's stain), and later loses this reaction and becomes folded on itself, and the tissues outside this layer make their way through it and develop a new media and adventitia within it (Goodall, *Studies Royal Victoria Hosp., Montreal*, ii., No. 5, 1910).

Electricity (High Frequency Currents) in Skin Diseases.—High frequency currents have been tried in the treatment of various skin eruptions. The current is applied from a glass or wire-brush electrode. It has no specific action, being merely stimulating to the tissues, and therefore is sometimes useful in obstinate cases of eczema, especially the form associated with lichenification. It has also been used in acne, lupus, and sycosis.

REFERENCE.—LEWIS JONES, *Medical Electricity*, 1904.

Electric Sparking.—*See* FULGURATION.

Electro-Coagulation. — *See* DIATHERMY.

Electrometer, Lippmann's.—*See* HEART, DISEASES OF (*Electro-cardiagrams*).

Electrosols.—*See* DRUGS, RECENT (*Colloidal Metals*).

Electrotherapy.—The treatment of disease by electricity, by X-rays, radium, ions, etc. For recent progress see several papers and leading article in the *British Medical Journal*, vol. ii. for 1910, pp. 512-560. *See also* DIATHERMY.

Embryocardia.—An anomalous condition in which the sounds heard over the heart of the child or adult resemble those of the fœtus as regards rate, and the fact that the first and second sounds are almost identical; and it is met with in cardiac dilatation and weakness (pneumonia, typhoid fever, etc.). A. Morison

has reported a remarkable case of jugular embryocardia, in which "fœtal heart sounds" were heard in the jugular area where the sounds were from 208 to 228 per minute, whilst the systemic pulsation was only 108 to 114; the patient had a double mitral lesion with tricuspid regurgitation (*Lancet*, i. for 1909, p. 19).

Embryotomy or Embryulcia.

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INDICATIONS. — The past three or four years have witnessed not an extension but a restriction of the sphere of application of destructive operations upon the unborn infant. The operation of embryulcia is more and more being restricted to those cases in which the infant is already dead in utero or in which its life is almost negligible (on account of gross malformations or teratological states), and in which there is some serious obstacle to delivery, such as contraction of the pelvis (conjugate of two and a quarter to three and a quarter inches) and neoplasms of the soft or hard canals. The operations of Cæsarean section, of pubiotomy, and of the premature induction of labour have narrowed down the indications for embryulcia in a very marked manner. Especially is it the case that extra-peritoneal (supra-symphysary) Cæsarean section (*q.v.*) is coming to take the place of embryulcia, for it is indicated even when there is reason to dread infection of the uterus. At the present moment it is recognised that the operation of killing a child in order to deliver it is theoretically wrong, and that embryotomy ought therefore to be performed only when there is good evidence that the fœtus is already dead or dying; but, in actual practice, a living infant is still occasionally craniotomised, when it is felt that the risks of performing Cæsarean section are too great.

METHODS.—It is not wonderful, therefore, that few contributions have been made to the technique of embryulcia. An operation which is discredited, which is passing out of use, does not attract attention; inventive genius turns away from it in other directions, and it is left to perish without modification. Nevertheless, some suggestions have been made which are of value. The operation of decapitation, for instance, has been rendered easier and more exact by Jardine's modification of Ramsbotham's decapitator, by which it is converted into a decapitating hook (Jardine, *Clinical Obstetrics*, 2nd ed., p. 500, 1905). But there are two operative procedures, greatly facilitating the extraction of the child in embryulcia, which call for more extended notice; I refer to cleidotomy after craniotomy or basilysis and to tapping the cerebral ventricles through the spine in hydrocephalus; both these methods have taken their place of late years among the valuable means of terminating difficult labours.

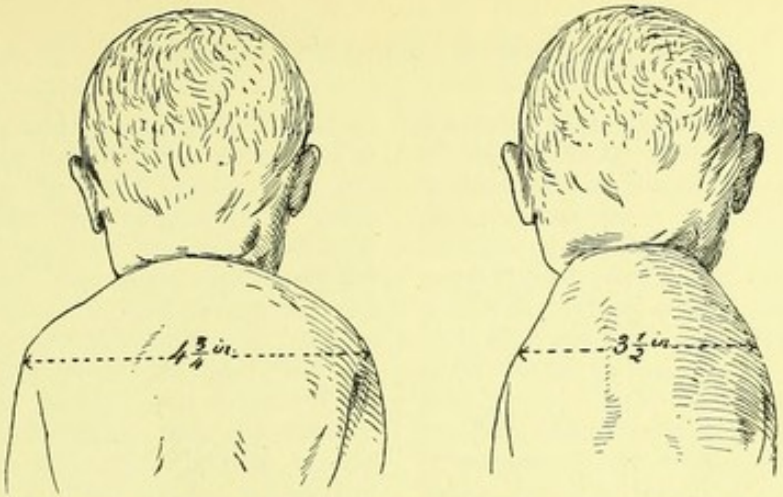
CLEIDOTOMY. — *Definition and History.* — Cleidotomy or division of the clavicles is an operation accessory to craniotomy or basiotripsy, and it has for its object the diminution of the width of the shoulders of the fœtus. It is possible to imagine cases in which it might be performed apart from these other operations, *e.g.* in broad-shouldered anencephalic fœtuses, but in the great majority of instances it is simply a rapid means of ending a difficult craniotomy. No doubt obstetricians in the past, when confronted with such an emergency as impaction of the shoulders after birth of the head (either intact or craniotomised), adopted some plan of procedure for the reduction of the width of the bisacromial diameter; but they do not appear to have specialised the manœuvre into a definite operation, nor to have restricted the embryulcia to the clavicles. Dr. H. R. Spencer (*Brit. Med. Journ.*, i. for 1895, p. 808) introduced the operation of cleidotomy, although he did not give it that or any other specific denomination. He said: "It may be necessary to reduce the width of the child's shoulders. With this object I have found it a useful plan to snip through the clavicles with scissors, then, if necessary, to pass a blunt hook into the axilla, and then to bring down the arms." He went on to say that he had met with several cases (five or six) where craniotomy was not sufficient to extract, and had practised the snipping through of the clavicles. Soon after the publication of Spencer's article Professor Phänomenoff of Kasan (*Zentralb. f. Gynäk.*, xix. p. 585, 1895) described the same operation, giving to it the definite name of cleidotomia ("Durchschneidung des Schlüsselbeins"); and he was led to perform the operation rather because of large size of the fœtus (it weighed 13 lbs.) than of contraction of the pelvic canal. The head of the infant was without much difficulty brought down to the perineum with forceps, but no further progress could be made, and the infant died, so Phänomenoff divided both clavicles near their inner end with a pair of scissors (passed up above the brim), and so delivered

the child. In the same year Knorr (*Zeitsch. f. Geburtsh. u. Gynäk.*, xxxiv. p. 105, 1896) divided both clavicles with Siebold's scissors after having performed craniotomy; he was much impressed with the immediate effect thus produced, a slight pull sufficing to deliver the trunk. Other contributions to the subject were those of Strassmann (*Arch. f. Gynaek.*, liii. p. 135, 1897), H. A. v. Guérard (*Zentralb. f. Gynäk.*, xxii. p. 71, 1898), E. Bonnaire (*Presse méd.*, No. 21, p. 125, 1900), G. Kallinowsky (*Diss. inaug.* (Berlin), 1898), Rieznikoff (*Yuzhno-russk. med. gaz.* (Odessa), v. p. 425, 1896), and Perondi (*Clin. ostet.* (Roma), ii. p. 133, 1900). Ballantyne described a case and gave an account of the operation at a meeting of the Edinburgh Obstetrical Society in 1900 (*Trans. Edin. Obstet. Soc.*, xxvi. p. 24, 1900-01); he has repeated the operation several times since then.

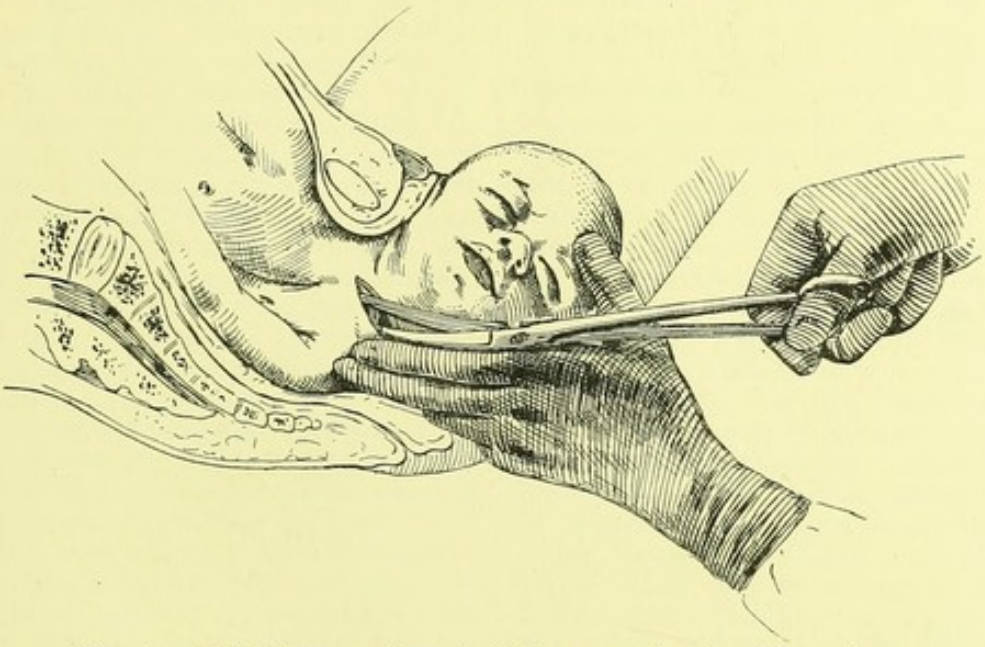
The *indications* for cleidotomy can hardly be said to be as yet clearly defined. It has not been performed on the living infant, but there are circumstances in which it might be justifiable to do so, *e.g.* in the case of monstrosities, such as anencephalus, double terata, etc. It is generally to be carried out as a sequel to the operations of craniotomy, basilysis, and basiotripsy, but it may be required apart from these procedures. The indications may be roughly grouped under five headings:—(1) It is indicated in the case of the broad-shouldered fœtus, where the head also is above the average size (and where, therefore, craniotomy will doubtless have been carried out), or where the head is of normal size or deformed (anencephalus or hydrencephalus), when cleidotomy may be the only operative procedure rendered necessary; (2) it is indicated in cases of contracted maternal pelvis, justo-minor, flatrachitic, or kyphotic, in which the fœtus may be normal in size; in such cases craniotomy is generally performed first and cleidotomy later; in the first and second types of contraction the division of the clavicles must be done at the brim of the pelvis, and in the third, at the outlet; (3) there is a group of cases in which the fœtus is large and the pelvis moderately contracted; in these instances it is the association of two difficulties, neither of which is in itself sufficient to cause great delay, which renders cleidotomy necessary; (4) cleidotomy may be advisable in cases of breech presentation in which the shoulders are impacted; and (5) in all cases in which rapid delivery is called for (as in eclampsia, threatened uterine rupture, accidental hæmorrhage), and in which the fœtus is either dead or very little likely to survive.

Technique.—The operation of cleidotomy can be carried out very easily. The only instrument necessary is a pair of long and strong blunt-pointed scissors. Craniotomy or basiotripsy has been performed, and the comminuted head has been drawn down to the perineum by the cranioclast, basilyst-tractor, or crotchet. Delay now occurs, due to the impaction of the shoulders in the contracted brim of the pelvis. By continued traction the difficulty may possibly be overcome at the risk of injury to the maternal structures, and with the loss of valuable time, and the expenditure of much force. To prevent this delay and these dangers, division of one or both clavicles is enough. If the head be lying with the occiput to the front, it is drawn well forward; the operator then slips his left hand up the vagina over the face of the child till he feels the clavicles projecting from the thoracic wall at the level of the pelvic brim, then he insinuates the scissors, held in the right hand, between his left hand and the child, until he is able to grasp the clavicle of one side between their points, and then with a strong snip he divides the bone near its inner end. The process may be repeated on the clavicle of the opposite side. Munro Kerr (*Operative Midwifery*, p. 506, 1908) uses straight scissors or a symphysiotomy knife, such as Pinard's. The immediate result is an astonishing collapse of the shoulders, and the extraction of the infant's trunk with very little further effort, or, at the most, with the help of traction with a blunt hook upon the axilla. The only case in which Ballantyne met with any difficulty was one in which the fœtus had a marked degree of ossification of all the bones, and particularly of those of the cranium and shoulder-girdle. If the contraction of the pelvis be at the outlet, the procedure is not materially altered, indeed it is simplified; and in the case of the anencephalic fœtus the small size of the head allows the operator's hand easily to reach the infant's clavicles at or above the brim.

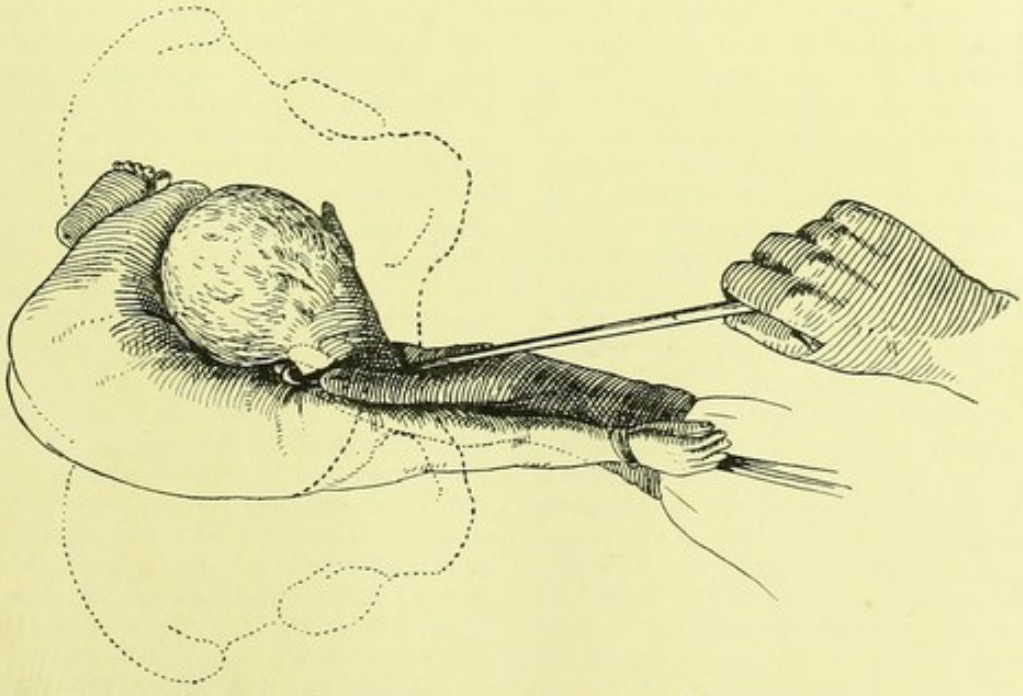
Advantages. — If we compare cleidotomy with the only other procedures possible under the circumstances, it will become at once apparent that it excels them all. It must, for instance, be better than *simple traction* on the craniotomised head of the infant, with the loss of time, the risk of injury to the mother's parts, and the danger of separation of the head from the trunk of the child, which all accompany that method of trying to overcome the delay. Then *cleidotripsy*, or the breaking up of the clavicles and the tissues of the shoulders with a perforator or basilyst, is an awkward procedure, not easy of accomplishment; it is quite unnecessary also, for simple division of the clavicle is all that is needed. *Cleidorrhexis* is a sort of bruising or breaking of the shoulder-girdle carried out of set purpose, and performed by some obstetricians (*e.g.* A. Müller, *Monatssch. f. Geburtsh.*, viii. p. 477, 1898). It is used in cases in which the body



Cleidotomy. Fœtus before and after cleidotomy, showing how the bisacromial diameter is reduced from $4\frac{3}{4}$ to $3\frac{1}{2}$ inches.



Operation of cleidotomy performed with long curved embryotomy scissors.



Method of decapitation with sickle knife of Ramsbotham.

of the child is born and in which the shoulders and head are still at or above the brim, and it consists in carrying the trunk first forward and then backward, until the shoulder-girdle gives way and moulding occurs. *Supra-acromiotomy* is another operative procedure, and has been described by Bonnaire. It consists in a localised embryotomy, by which the skin and muscles covering the projection of the shoulder are divided widely and deeply; but it is not an exact operation, although it may conceivably be useful in cases in which the clavicles cannot be reached. It is quite evident that cleidotomy has advantages over all these competitive procedures. The division of the clavicles at once, and very materially, reduces the bisacromial diameter, by allowing the shoulders to collapse; indeed the clavicles alone keep the shoulders apart. It has been found by experiment that there is a diminution of the bisacromial diameter by 2 and 3 cm. in unilateral and bilateral cleidotomy respectively. This narrowing of the shoulders either permits them to enter the pelvic cavity, or gives room for the passage of a blunt hook upwards, and for the fixing of it in the axilla to make traction. Division of the clavicles is the one thing necessary, and cleidotomy alone of all the proposed plans does this and no more. It is simpler, more rapid, much more elegant, and it is quite as effective as any of the other operative procedures; it is, further, founded upon the correct scientific principle of attacking the parts which are concerned in maintaining the breadth of the shoulders. The cause of delay in labour in these cases is the width of the shoulders in the bisacromial diameter; by cleidotomy this diameter is quickly diminished, and with practically no risk to the mother.

Spinal Tapping (*Paracentesis*).—Like cleidotomy, spinal paracentesis is a scientific and elegant method of overcoming a difficulty in labour which is often attacked by force, ill-regulated, misapplied, and excessive. What cleidotomy does for the delivery of the shoulders after craniotomy or basilysis, spinal paracentesis may do for the extraction of the after-coming hydrocephalic head.

History.—So long ago as 1848 the procedure of tapping the spine for the delivery of the hydrocephalic fœtus was proposed by Vanhuevel (*Presse méd. belge*, i. pp. 279, 343, 1848-9), and it was actually carried out by Tarnier in 1868 (*Traité des Accouchements*, iv. p. 32, 1901), although Hubert (*Cours d'accouchements*, ii. pp. 254, 268, 1878) claims for Lacoux the honour of establishing it as a useful obstetric operation. Charles used the method successfully (*Journ. d'accouch.* (Liège), ii. p. 41, 1881), as did Ira G. Stone in 1897 (*Med. News* (New York), lxx. p. 302, 1897), and Pozzoli (*Lucina* (Bologna), iv. p. 167, 1899), in 1899. Oui (*Arch. de tocol.*, xviii. p. 617, 1891) failed to carry out the manœuvre because of fracture and displacement of the cervical spine, which prevented the passage of the sound through the spinal canal into the cranium. In Great Britain Ballantyne seems to have been the first to report a successful case (*Brit. Med. Journ.*, ii. for 1904, p. 1567), and to put a second one on record soon afterwards (*Trans. Edin. Obstet. Soc.*, xxxi p. 66, 1905-6); but Dougall (*Glas. Med. Journ.*, xvi. p. 25, 1881) seems to have thought of reaching the cranium through the spinal canal in a case of hydrocephalus with spina bifida, using the one complication (the bifid spine) to obviate the other (the hydrocephalus), although he did not put his proposal into effect.

Indications and Technique.—The indications for tapping the fœtal cranium by way of the spinal canal are hydrocephalus (when the breech of the child has presented and been born, the large head remaining above the brim of the mother's pelvis) and any other condition (*e.g.* encephalocele, meningocele, etc.) in which the head is distended with fluid which can be reached by the spinal canal and in which the body of the child is already born. Of course there is another way of dealing with hydrocephalus or encephalocele when the head itself presents. Cases of delay in the birth of the breech due to the presence of a large sacral meningocele might possibly also be treated by spinal paracentesis; under these circumstances the fœtal head would be expelled, and the catheter would be introduced and passed along the spine towards the sacrum instead of in the direction of the head. The technique, as described by Ballantyne, may be given. In the first case, the patient was sent into the Edinburgh Royal Maternity Hospital with her baby born as far as the shoulders. It had been a transverse presentation, and the doctor in attendance had performed version and brought down the feet, but neither his exertions nor those of another medical man who came to his aid sufficed to complete the delivery. When Ballantyne saw the patient she was in a very collapsed state (pulse 140, thready, etc.), there were no pains, and the uterus was as large as it is at the beginning of labour, notwithstanding the fact that the feet and lower part of the trunk were outside the vulva; he made the provisional diagnosis of hydrocephalus or of some other cephalic malformation. With an ordinary scalpel he made a transverse incision over the interspace between the 6th and 7th dorsal vertebræ in the interscapular region; no fluid appeared; so he next took a long silver catheter with several openings in its distal end, and insinuated it into the spinal canal, bending the back of the infant at the time so as to make the spinal curves and those of the catheter coincide; then, turning the point of the catheter forwards as it lay in the cranium, he had the satisfaction of seeing clear fluid running out of

it. Thirty-six ounces of fluid were thus removed, when the birth of the head and shoulders of the infant was completed with perfect ease. In Ballantyne's second case the procedure was even simpler, for the presence of a spina bifida in the lumbar region did away with the necessity of opening into the spinal canal; the catheter was pushed up through the defect in the vertebral column, reached the cranial cavity, and gave egress to the large quantity of fluid collected therein. In the first case the child weighed twelve pounds and in the second more than ten pounds. Both the mothers made good recoveries. It will probably be found to be necessary always to use a catheter made of metal, or to pass a sound up through a soft catheter to make it rigid (as Stone did), for Ballantyne refers to a case in which a rubber catheter was tried and failed to reach the fluid.

Advantages.—The advantages of spinal tapping for the delivery of the after-coming head in hydrocephalus are obvious. There is (1) the advantage of operating upon parts which are external and visible; there is (2) the small armamentarium required, a knife and a catheter; there is (3) the rapidity and completeness of the evacuation of the cranium thus obtained; and there is (4) the avoidance of any further internal interference with hands or instruments when all such interference is necessarily fraught with danger, for it is by no means an easy or a safe procedure to perforate a hydrocephalic head behind the ear or through the occiput when that head is at or above the pelvic brim. By spinal tapping a grave obstruction existing above the pelvic brim is overcome by a simple operation performed outside the vulva.

Emmanuel Movement. — This movement originated in Emmanuel Church, Boston, in 1905, when Dr. Joseph H. Pratt and the Rev. Elwood Worcester entered into conjoint action in the treatment of poor consumptives. Its aim is the moral control of nervous disorders, and it is said to have been approved of by leading neurologists in America. The meaning of the work is stated to be "to bring into effective co-operation the physician, the psychologically trained clergyman, and the trained social worker in the alleviation and arrest of certain disorders of the nervous system which are now generally regarded as involving some weakness or defect of character or more or less complete mental dissociation." Great importance is attached to prayer, and the reason is also appealed to. *See* "Mental Healing" in the *British Medical Journal*, vol. i. for 1910, pp. 1494-1495. This movement is not to be confused with the *Church and Medical Union* (of 1908) or with *The Society of Emmanuel* (of 1905), both of which are described in the *Brit. Med. Journ.* (*loc. cit. supra*).

Emprote.—A proprietary food preparation, described as "a pleasant and sustaining powder, with tonic properties"; an analysis is given in the *Brit. Med. Journ.*, i. for 1910, p. 1239.

Encephalomyelitis. — Encephalitis associated with myelitis.

Endoaneurismorrhaphy. — *See* Aneurism, Surgical Treatment.

Endocarditis. — Attention has lately been directed by Osler and Horder to the existence of a chronic form of infective endocarditis, associated with the presence of organisms in the blood stream, which may run a course of many months accompanied by few symptoms save pyrexia; which is difficult of diagnosis; and which is apparently invariably fatal. The condition must be distinguished on the one hand from malignant, or ulcerative, endocarditis (which is really an acute septicæmia with localisation in the endocardium), and on the other from chronic rheumatic endocarditis, in which protracted fever may occur. The lesion characteristic of chronic infective endocarditis is the presence of large proliferative vegetations on the valves and chordæ tendinea, with none of the ulceration met with in acute cases. According to Horder the essential symptoms on which a diagnosis may be founded are: (1) the presence of valvular disease, (2) the occurrence of emboli, and (3) the detection of organisms in the blood. Any two of these make the diagnosis extremely probable.

Chronic infective endocarditis usually occurs in persons already suffering from a valvular lesion. The disease begins insidiously, sometimes with chills, and when once the fever is established it becomes the dominating symptom —"week after week, month after month, the daily rise of one and a half to two degrees may be the only indication there is of the existing mischief" (Osler). The temperature is remittent, and not very high—102·5° to 103°. Apart from the already existing signs of valvular disease there may be no symptoms referable to the heart until towards the close of the illness. Notwithstanding the infection the murmurs may undergo no alteration. Emboli are common. An interesting peculiarity is the occurrence of ephemeral spots of painful nodular erythema, chiefly on the skin of the hands and feet—the pads of the fingers and toes, the thenar and hypothenar eminences, the sides of the fingers, and the lower parts of the arms are favourite sites. Petechial eruptions are also common. These cutaneous lesions are due to emboli. The patients suffer from progressive anæmia, leucocytosis is scanty or absent, albuminuria occurs in about one-

third of the cases. Dr. Norman Moore draws attention to a peculiarly sanguine frame of mind as characteristic of the disease. Even where, as has happened, the patient has himself been a medical man, it may be impossible to induce him to take a serious view of his condition, although organisms have been demonstrated in his blood. The diagnosis of chronic infective endocarditis is not easy; it may readily be mistaken for tuberculosis or malaria. Osler gives as the most suggestive features: (1) an old-standing valve lesion; (2) the occurrence of emboli (*e.g.* sudden enlargement of the spleen, or pains in the loin and hæmaturia); (3) the cutaneous symptoms; (4) alterations in the murmurs and dilatation of the heart.

Etiology.—This has been carefully worked out by Horder, not only as regards chronic, but as regards acute cases. He attaches great importance to blood cultures in coming to a diagnosis, and states that with a proper technique positive results can be got in 90 per cent. of cases. In 40 cases of infectious endocarditis in which an organism was isolated from the blood during life, streptococci were found 26 times, Pfeiffer's bacillus 5 times, pneumococci 5 times, gonococci twice, unclassified once, staphylococci once. The streptococcus, therefore, is the prevalent organism, and the interesting point brought out by Horder is that it is especially the less virulent strains of the organism which are met with. Horder distinguishes five types of streptococci—*s. pyogenes*, *pneumococcus*, *s. fæcalis*, *s. salivarius*, and *s. anginosus*. The last three are closely allied to the saprophytic streptococci of the alimentary tract; they are of low virulence, not being pathogenic to mice, and yield biochemical reactions which differentiate them sharply from *s. pyogenes*. Horder associates these characteristics of the causal organism with the following clinical facts:—(1) The chronicity and latency of the disease; (2) the occurrence of afebrile periods; (3) the absence of suppuration in embolic infarcts; (4) the scanty or absent leucocytosis; (5) the absence of any visible focus of infection; (6) the enormous number of organisms which may exist in the blood without causing any grave symptoms.

Prognosis.—Chronic infective endocarditis is probably always fatal. Though the organism is of such low virulence, this very fact shows that for it to have gained a lodgment in the body the patient's defensive powers must have been correspondingly poor. The duration of the disease may be several weeks or months after a positive diagnosis has been made by blood culture. *Treatment* by chemical antidotes, by antibacterial serums, and by vaccines, has proved quite unsuccessful. In many cases the opsonic index is high though the patient is obviously going downhill, and this rather militates against the idea that vaccines will do good. Horder advises that a polyvalent antistreptococcus serum should be tried by intravenous injection. As a precaution, oral sepsis should be treated, especially in persons with valvular disease.

REFERENCES.—Osler, *Quarterly Journ. of Med.*, Jan. 1909.—Horder, *Ibid.*, April 1909.

Endotoxins. — Toxins which do not diffuse out of bacteria into a culture.

Engel's Alkalimeter.—An instrument for determining the alkalinity of the blood; diluted blood is titrated with normal solution of tartaric acid till the mixture reacts with lacmoid (litmus) paper, and the amount of tartaric acid used gives the degree of alkalinity (Da Costa, *Clinical Hematology*, p. 96, 1905).

Enesol.—A soluble salt of mercury and arsenic, recommended in the treatment of syphilis; it may be given, in doses of 1 c.cm., as an intra-muscular injection, and is favourably reported on by C. Fraenkel and J. Kahn (*Med. Klin.*, Berl., vi. p. 267, 1910).

Enostosis.—An osseous tumour forming a localised growth within a bone, but not being so completely defined as to be independent of the surrounding tissue; it contrasts with an exostosis.

Enterogenous Cyanosis.—The coexistence of chronic cyanosis and intestinal disorder was first described by Stokvis and Talma, and subsequently by Hymans van den Bergh. In 1908 G. A. Gibson proved that the cyanosis was due to the activity of microorganisms, and gave to it the name of *microbic cyanosis*. In all the recorded cases the cyanosis has been very pronounced, but nevertheless it gives rise to little or no discomfort. It may last for years, and is sometimes associated with clubbing of the fingers; hyperglobulia, however, has not been reported. In all cases, too, there has been a history of chronic gastrointestinal disorder, generally diarrhœa, and often putrid stools. The blood shows the characteristic spectrum of methæmoglobin (q.v. *Encyclop. and Dict. of Med.*, Vol. IX. p. 264), though in one case sulphohæmoglobinæmia is said to have been present. That a connection exists between the cyanosis and the intestinal disorder has been repeatedly proved by the effect of treatment; in one patient the cyanosis disappeared so long as the diet was restricted to milk; in others, cure of the diarrhœa has ameliorated or even abolished the cyanosis. Van den Bergh proved that during the existence of the cyanosis the blood contained nitrites, but while he thus demonstrated the cause of the methæmoglobinæmia, he left the source of the nitrites an open question. Gibson and Carstairs

Douglas confirmed and amplified his observation. They found that while nitrites were present in the blood, they were absent from the intestinal contents, and that the fæces were devoid of power to convert normal hæmoglobin into methæmoglobin. Having thus excluded the possibility of an absorption of nitrites from the bowel, they conjectured that these must have a hæmatogenous origin. Further research showed that an organism of the colon group could be isolated from the blood. Gibson therefore regards microbic cyanosis as a systemic affection arising from the bowel, with the continuous production in the blood of varying amounts of nitrites, which convert part of the hæmoglobin into methæmoglobin.

LITERATURE.—Hymans van den Bergh, *Deutsche Arch. f. klin. Med.*, Bd. 83, p. 86, 1905.—Gibson and Carstairs Douglas, *Lancet*, 14th July 1906.—Gibson, *Quarterly Journ. Med.*, Oct. 1907.

"Enule." — The name given (by Burroughs, Wellcome & Co.) to a brand of rectal suppositories, encased in pure tinfoil, containing accurate doses of drugs, and of such a shape as not to be difficult of retention in the bowel; they may be obtained containing cocaine, gall and opium, glycerine, hazeline, hemisine, morphine, santonin, as well as predigested milk and meat.

Ependymoma. — A cyst lined with ciliated epithelium found in the grey matter of the brain or in a glioma, due to fœtal inclusion of ependymal tissue or of neuroblasts capable of developing into ependyma.

Epicritic Sensibility.—*See* Sensation.

Epiguanin.—A purin or alloxuric body with the formula, $C_6H_7N_5O$.

"Epinine."—A synthetic substance (3 : 4 - dihydroxyphenylethylmethylamine) which has been found to have the same clinical effects as the active principle of the suprarenal gland (raising the blood-pressure, etc.).

Epiploitis.—Inflammation of the omentum.

Epiplopexy.—The stitching of the omentum to the abdominal wall so as to establish a collateral circulation to relieve portal obstruction; Drummond - Morison operation; Chiazzi operation.

Episarkin.—A purin or alloxuric body or base, with the formula, $C_4H_6N_4O$.

Eponymous Terms.—There is a steady increase in the number of diseases, of groups of symptoms, of operations of chemical tests, and of instruments and apparatus distinguished by the placing of the name of the reported discoverer or inventor in front of them; some of them have received the warrant of time and custom, but it is easy to foresee that before long some sort of censorship will be required.

Erepsin. — *See* Digestion (*Intestinal Juice*).

Ergadin. — A proprietary preparation which has been described as a "cod-liver oil caramel." See *Report* in *Lancet*, ii. for 1908, p. 803.

Ergotoxine.—An alkaloid of ergot which produces the effects of ergot (making the uterus contract and raising the blood-pressure); it may be given in tabloid form (B. W. & Co.) alone (in doses of $\frac{1}{100}$ grain), or combined with sulphate of morphine or sulphate of strychnine.

Ernal.—A proprietary preparation consisting of a powder which, when placed in a bath, gives off carbonic acid (for from 20 to 30 minutes) and the odour of pine forests.

"Ersatz" Theory.—Edinger's "offset theory" to explain the varying symptomatology of locomotor ataxia (Germ. *ersatz*, compensation, equivalent, offset); it has been used to explain such an anomaly as the first appearance of inco-ordination and lightning pains in the arms instead of in the legs, as is seen in coachmen and tailors and of early symptoms of disturbance of vision in those who use their eyes much; the theory maintains that while all the nerve tissues are affected by the causal poison, those controlling the groups of muscles most commonly in use first undergo atrophy. *See* Adami, *Pathology*, i. p. 877, 1910.

Erythema Infectiosum and Other Doubtful Exanthemata.—Everybody is agreed as to the existence of three well-defined diseases — scarlet fever, measles, and German measles; there is, however, some reason to think that there are one, if not two, other eruptive fevers which resemble, and may at times simulate, these. The "Fourth Disease" was independently described by Dukes, of Rugby, and Filatow, of Moscow; hence it is known in Germany as "Filatow-Dukesche Krankheit." Its characteristic features are described by Dr. Dukes in his article Scarlet Fever in the *Encyclopedia and Dictionary of Medicine* (Vol. IX. p. 48). Since Dr. Dukes's original papers on the subject appeared, there has been no substantial advance in our knowledge of Fourth Disease, and its existence is still *sub judice*.

A fifth eruptive fever of this type was described by Pospischill in 1904. It is said to have occurred in epidemic form in Vienna. The main characteristics of the eruption are that while on the arms, legs, and trunk it tends to remain macular, on the face the spots coalesce, and give rise to large patches of erythema on the cheeks, over which the skin is hot to the touch, tense, and glistening. The rash is practically the only symptom. There is neither exanthem, glandular enlargement, strawberry tongue, nor desquamation. The incubation period is believed to be from six to fourteen days ; children are most liable.

Apparently erythema infectiosum (as the new disease is called) has not been recognised in epidemic form outside Vienna. It is of interest to note that in 1902 Dr. Ker expressed the opinion that there might be a new disease apart from measles, German measles, and scarlet fever, though he was not prepared to accept Dukes's "Fourth Disease" as demonstrated. Shaw (to whose paper a plate of erythema infectiosum is appended) states that the disease is more like German measles than any other of the exanthemata, and that it may be the disease heralded by Ker.

REFERENCES.—Ker, *Practitioner*, Feb. 1902.—Pospischill, *Wien. klin. Wochensch.*, No. 25, 1904.—Shaw, *Amer. Journ. Med. Sci.*, Jan. 1905.

Erythræmia.—The disease described first by Vaquez in 1892, and afterwards by a number of physicians of note, including Cabot, M'Keen, and Osler (*Lancet*, i. for 1908, p. 143) ; it has been called the *maladie de Vaquez*, Osler's disease, and splenomegalic polycythæmia as well as the rubric at the head of this paragraph. The essential feature is polycythæmia of a very remarkable kind, as many as 12,000,000 or even 13,000,000 red blood corpuscles per cubic millimetre having been counted (hence the name polycythæmia rubra sometimes given to the malady) ; enlargement of the spleen is present and varies in amount ; there is marked cyanosis which speedily attracts attention (face, hands, feet), and when the dusky skin is irritated by a sharp pencil the "white line" resulting is a broad anæmic band ; other occasional symptoms are headache, vertigo, nausea, vomiting, constipation, high-blood pressure, slight albuminuria, and hæmorrhages (hæmoptysis, hæmaturia). From the pathological standpoint the disease is a true polyæmia (*plethora vera*), and post-mortem examinations have revealed in addition hyperplasia of all the tissue elements of the spleen and intense hyperplasia of the bone marrow (myelomatosis rubra). Little is known regarding treatment ; in the meantime it must be mainly symptomatic. Umney's case (*Lancet*, i. for 1909, p. 1243) showed chorea and general thrombosis ending fatally.

Erythrokatalysis.—Phagocytosis of red cells without extra-cellular solution as a form of blood destruction. *See* Blackwater Fever (*Experimental Hæmolysis*).

Erythrol Tetranitrate.—*See* Arterial Hypertonus (*Cause of Hypertonus*).

Erythropyknosis.—Changes in the red blood corpuscles invaded by the parasite of malarial fever, leading to what is known as a "brassy" appearance of them along with crenation of their edges and of some parts of their flat surfaces (Gr. ἐρυθρός, red ; πυκνός, compact).

Eugallol.—*See* Psoriasis (*Drugs, pyrogallol-mono-acetate*).

Eugenics.

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Definition and Historical Note.—Eugenics is the science of well-begetting or good-breeding ; it has to do with the production of fine offspring, especially in connection with the human race ; it encourages parenthood on the part of the worthy, and discourages it on the part of the unworthy ; and so, inferentially, it would refuse the right to propagate, the right to become a parent, to the unfit. In 1883 the late Sir Francis Galton, in his book entitled *Human Faculty* (p. 44), seems first to have used the term *eugenics*, writing, as he then did, of "the investigation of human eugenics, that is, of the conditions under which men of a high type are produced." *Eugenism*, according to the same author, is "the aggregate of the most favourable conditions for healthy and happy existence." It cannot be said that the new science took much hold upon the mind of the nineteenth century, provoking, as it was bound to do, the retort that "people will fall in love, in spite of your eugenics" ; but the early years of the twentieth century have witnessed an active propaganda consisting in the establishment of a Francis Galton Laboratory for National Eugenics in connection with the University of London, in the publication of *Eugenics Laboratory Memoirs*, in the formation of the Eugenics Education Society, and in the appearance (in April 1909) of the first part of the *Eugenics Review*. In Germany there is a somewhat similar movement with a journal entitled the *Archiv für Rassen-und-Gesellschafts-Biologie*, the scope of which is somewhat wider than that of eugenics ; and in the United States of America the consideration of the betterment of the race has proceeded to its logical conclusion, the sterilisation of the unfit, and the State of Indiana has passed an

Act for "the sterilisation by the knife of confirmed criminals, idiots, imbeciles, and rapists, and has fixed the maximum fee of the medical experts consulted" (*Lancet*, ii. for 1907, p. 40). There is, therefore, a world-wide tendency to focus attention upon antenatal matters, and to take thought how what is wrong before birth may be put right, and how what is right may be encouraged. The *British Medical Journal* (vol. ii. for 1901, p. 1363) may here be quoted :— "The way in which, at certain epochs, different minds, starting from very different points, work towards the same conclusion is a remarkable phenomenon. It has given rise to many charges of plagiarism and some bitter controversies as to priority. . . . An instance of the phenomenon is afforded by the interest just now shown in the possibilities of puericulture. French philosophers, whether sociologists or physicians, have been driven to a study of the subject by the hard facts of vital statistics, which show that the population of France has become practically stationary owing to a great decline in the birth-rate. Dr. Ballantyne and other leaders of the Edinburgh school of obstetricians have been brought to the subject by a consideration of the needs of pregnant women for better treatment during the time they are with child. Sanitarians have been led to consider similar questions from an observation of the lamentable results on the offspring of women's labour during the latter months of pregnancy. Now we have Mr. Francis Galton bringing his analytical methods to bear on the question in the ingenious and suggestive Huxley Memorial Lecture which he delivered before the Anthropological Institute of Great Britain and Ireland. . . . The aim of the lecture was to give a scientific basis to the problem of race improvement under existing conditions of civilisation and sentiment." Eugenics, therefore, must be regarded as one of the lines of approach to the great problem of antenatal health and well-being; it emphasises the hereditary aspect of the subject, and would utilise the existence of favourable traits in individuals, and their intensification by regulated marriages for the progress of race-culture. Antenatal pathology and hygiene has its attention directed more immediately to the discovery of the causes of antenatal disease, malformation, and deformity, and to the possible prevention of such by treatment given to the mother during her pregnancy, or to both parents at and before the occurrence of conception. Puericulture studies not only the antenatal side of the question, but also proceeds upon the assumption that much may be done to better the race by improving the sanitary conditions into which babies are born, and by saving the new-born child from erroneous feeding in an unhygienic environment. It is quite obvious that all these different lines of approach have before them the common goal of race betterment and the prevention of race-suicide; but, at present, there is a strange lack of united effort, which is not a good augury of early success.

Scope and Objects.—As has been indicated, eugenics deals with the hereditary side of the problem of race-culture; it studies the laws of heredity, so far as they are known, and endeavours to draw deductions from them which shall be helpful in suggesting the lines along which regulation of marriage should proceed and the degree to which the segregation or sterilisation of the unfit should be insisted upon. In this sense it is preventive medicine applied to the organism in the germinal stage of antenatal life; the best germ cells are to be brought together, and those which carry in them a hereditary blight are to be prevented coming to fruition. It includes, therefore, the subject of germinal therapeutics, as looked at from the standpoint of heredity. But, in a larger sense, it deals with influences which are not strictly hereditary, with alcoholism and syphilis, for instance, which are germinal or fœtal diseases or infections, and with tuberculosis, which "lies very near the line between heritable and non-heritable diseases." The sciences of eugenics and antenatal pathology here overlap to a very marked degree; and both have as their aim the attainment of antenatal health by the discovery of the causes of disease which come into action during the antenatal life of the individual, and by finding out means of preventing them so acting. Such is the "eugenic field" in its widest expanse (see Crackanthorpe, *Eugenics Rev.*, i. pp. 11-25, 1909); but in its more limited range it includes simply *positive* eugenics, or the encouragement of parenthood on the part of the worthy, and *negative* eugenics, or its discouragement on the part of the unworthy, selection and rejection (Saleeby, *Eugenics Rev.*, i. p. 8, 1909). It is a wide field, whether we consider it in its limited or in its more extended aspect. Further, the subject of eugenics can hardly make its influence felt without at once coming into touch, and, it may easily be, into conflict with the law, social customs and institutions, and religion. It is, of course, eminently desirable that emigrants going to a new colony should be healthy members of a good stock, so that their children may worthily carry on the work their parents are about to commence; it is very important that persons predisposed to tuberculosis, or the victims of the craving for alcohol or drugs, or the subjects of epilepsy, deafmutism, congenital blindness, or hæmophilia should not marry or intermarry; but the law, social customs, and the rules of the Church must be altered before a health certificate can be demanded from all intending emigrants or candidates for matrimony, on pain of refusal of permission to embark on the Atlantic Ocean

or on the no less uncertain sea of matrimony. A people which resents interference with the liberty of the subject to such an extent as to demand and secure the conscientious objector's exemption in the case of vaccination, is not likely to allow its rights to choose a mate to be abrogated at the bidding of the Eugenics Education Society. At the same time, the medical profession ought to support those who are endeavouring to make generally known the aims of eugenics. These are: "Persistently to set forth the national importance of eugenics in order to modify public opinion, and create a sense of responsibility in the respect of bringing all matters pertaining to human parenthood under the domination of eugenic ideals; to spread a knowledge of the laws of heredity, so far as they are surely known, and so far as that knowledge might affect the improvement of the race; and to further eugenic teaching, at home, in the schools, and elsewhere." It is when the "eugenist" attempts to go beyond the education of public opinion that an element of doubt obtrudes itself; it is one thing to educate and quite another to coerce. The regular and systematic teaching of heredity and antenatal pathology and hygiene in universities may also be commended; and no objection need be urged against the proposal made by Mr. Eden Phillpotts and seriously supported by Havelock Ellis (*New Age*, 7th March and 11th April 1908), that there should be a State Department for the unborn, although it is difficult to imagine such a bit of Government machinery in being. "The Department would be entirely devoted to the interests of the next generation; it would have nothing to say concerning marriage, but as soon as men and women set about becoming mothers and fathers they would have to reckon with this Department." Here again the idea of compulsion, of strong suasion at least, comes in, and the world is hardly ready for this. With a falling birth-rate and the national anxiety engendered thereby, it is futile for eugenists to insist that "there are circumstances in which the number of the family should be kept within reasonable limits"; but it is perfectly right that, since the supply of babies is lessening year by year, every effort should be made to bring them into the world healthy and keep them in life when they arrive. It is hardly the time to advise a further reduction of the supply. When the laws of heredity are known with such exactness that it can be foretold with reasonable certainty that the offspring of this or that union will be of little or no civic worth, then it may be permissible to advise a self-induced sterility; in the meantime, no such confident predictions can be made whilst, on the other hand, much can be done to prevent abortions and premature labours, and to benefit the unborn infant by helping his mother to keep from alcohol and by saving her from hard work and bad hygiene during pregnancy. With regard to the hope that eugenics may succeed in bringing into the world a large number of truly great men, time alone can tell; but it may be said that the genesis of the great man, of Dante, or Shakespeare, or Goethe, or Carlyle, or Lister, is still a mystery, apparently ungoverned by the known laws of heredity, and inexplicable by the circumstances which immediately precede his birth. He comes unheralded, and most frequently he leaves no trace of his greatness, either in his immediate or his remote descendants.

LITERATURE. — Ballantyne, "Antenatal Therapeutics" and "A Petition from the Unborn," *Brit. Med. Journ.*, i. for 1899, pp. 889-893.—Galton, "Eugenics," *Med. Times and Hosp. Gaz.*, xxxii. p. 321, 1904.—Reid, G. A., *Lancet*, i. for 1904, p. 1685.—Galton, *Nature*, lxxi. p. 401, 1904-5.—Galton, *Amer. Journ. Sociol.*, xi. pp. 11-25, 1905-6.—Editorial, *Lancet*, i. for 1905, p. 1009.—Letter, *Lancet*, i. for 1907, p. 191.—Galton, *Pop. Sc. Month.*, lxxi. pp. 165-178, 1907.—Pearson, *Ibid.*, lxxi. p. 385, 1907.—Hart, D. Berry, *Phases of Evolution and Heredity*, 1910.—Various articles in *Eugenics Rev.*, i. Nos. 1 and 2, 1909, and in *Eugenics Laboratory Memoirs*, Parts i.-vi., 1908-11.

Eugenism.—The aggregate of the most favourable conditions for healthy and happy existence (Galton). *See* Eugenics (*Definition*).

Eulatin.—A compound of amido-benzoic and bromo-benzoic acid with antipyrin, forming a whitish, slightly acid powder; it is recommended by Baedeker (*Therap. Monatshr.*, xxiii. p. 480, 1909) in the treatment of pertussis, and he considers that it acts (through the antipyrin) on the specific organism, whilst the bromide counteracts the neurosis and the benzoic acid aids as an expectorant; F. Zernik has also written on this preparation (*Apoth.-Zeitg.*, xxix. p. 137, 1909).

Evitable Abortion.—Threatened Miscarriage. *See* Abortion (*Treatment*).

Exophthalmometer, Hertel's.—An ophthalmological instrument consisting of a frame carrying two sets of angularly placed mirrors which can be fitted exactly against the outer edges of the orbits; the degree of protrusion of the eyeballs is got by viewing the eye laterally and superposing the image of a millimetre scale on the image of the eye so seen.

Extra-Pharmacopœia.—The aggregate of the drugs which are not yet, although they ultimately may be, included in the Pharmacopœia; they are described in Martindale and Westcott's *Extra-Pharmacopœia* and in the *British Pharmaceutical Codex*.

Fagopyrismus.—Buckwheat poisoning. See *Journ. Amer. Med. Assoc.*, lii. p. 1785, 1909.

Faith-Healing. — Healing by faith-cure, *i.e.* a cure wrought by means of "the prayer of faith" (*vide* Bible, James v. 15). It has been described from the medical standpoint by Sir Clifford Allbutt (*Brit. Med. Journ.*, i. for 1910, p. 1453), by Sir Henry Morris (*Ibid.*, p. 1457), and by Professor William Osler (*Ibid.*, p. 1470); and, from the standpoint of the Church (Anglican and Catholic), by the Rev. Francis Boyd (*Brit. Med. Journ.*, ii. for 1910, p. 464), the Right Rev. Francis Aidan Gasquet (*Ibid.*, p. 465), and the Rev. Herbert Thurston, S.J. (*Ibid.*, p. 467). *See also* leading article in the *Lancet* (ii. for 1910, p. 320).

Familial.—Peculiar to or belonging to the family, *e.g. familial characters* or properties, those which are possessed by the family of one or other parent; *familial inheritance*, the remarkable tendency which exists for certain traits in a family (*e.g.* the Hapsburg lip), to reappear generation after generation notwithstanding constant marriage with a stock which does not possess these particular traits; *familial diseases*, such as albinism, Daltonism, and hæmophilia.

Fasting Cure.—A form of treatment introduced to the public in a book entitled *The True Science of Living*, by Dr. Dewey of the University of Michigan; it is founded on the idea that diseases are due to eating, and consists in abstaining from food for periods of from two to three weeks at a time. See *Lancet*, i. for 1908, p. 1028; Rütimeyer (*Zentralbl. f. innere Med.*, xxx. p. 233, 1909; Penny, *Brit. Med. Journ.*, i. for 1909, p. 1414).

Fat Disease.—*See* DIABETES (*Diabetes and Obesity*).

Fat Phanarosis.—A term applied by G. Klemperer (*Deutsche med. Wochnschr.*, xxxv. pp. 89-92, 1909) to the rendering visible of previously fixed fat in the condition of fatty degeneration of the kidney, spleen, lung, and nervous tissue, as described by H. G. Wells (*Chemical Pathology*, 334 ff., 1907).

Favus.—Favus of the scalp should be treated by X-rays in exactly the same way as described under tinea capitis; but in this disease the application of X-rays is essential if the disease is at all extensive. As the disease itself causes permanent baldness, one does not hesitate to reapply the rays soon should the first exposure not cause epilation.

Felon.—A whitlow under or near the nail; paronychia.

Fermenlactyl Tablets. — A proprietary preparation, described as containing a pure lactic ferment prepared from the special bacillus of Bulgarian milk, and said to prevent intestinal putrefaction by introducing into the bowel bacilli which are antagonistic to those which attack proteins, and so, according to Metchnikoff's theory, to delay senility. *See* Reports in *Lancet*, i. for 1908, p. 650; *Journ. Amer. Med. Assoc.*, lii. p. 397, 1909.

Ferro-Silicon.—An alloy of iron and silicon used in the manufacture of certain grades of steel; it gives off poisonous fumes, and has caused deaths in connection with its transport and storage. See *Brit. Med. Journ.*, i. for 1910, p. 269.

Fibroblast. — A growing connective-tissue cell which enters into the formation of granulation tissue, of thrombi, etc.

Fibroglia Fibrils.—Connective-tissue fibrils present in fibromata (*e.g.* in spindle cell sarcomas or fibro-sarcomas). *See* Adami, *Pathology*, i. p. 711 (*Fibroma*), 1910.

Fibroin.—A simple protein, albuminoid, or sclero-protein, insoluble in neutral solvents, forming a constituent of connective tissue.

Fibrolysin. — Fibrolysin is the name given by Merck of Darmstadt to a preparation of thiosinamine. It is prepared from oil of mustard, and occurs in colourless rhombic crystals of bitter taste and garlic odour. It is a therapeutic remedy that is at present being widely used in cases where it is desired to soften cicatricial tissue. Von Hebra in 1892 published some of the results he had obtained by the therapeutic use of thiosinamine. He employed it in 15 per cent. alcoholic solution as an injection for the treatment of lupus and cutaneous scars. Beneficial results followed, but the treatment was open to this objection, that the injection of the alcoholic solution was exceedingly painful: the drug was unstable and insoluble in water. These drawbacks have been remedied by the modification suggested by Dr. Felix Mendel, of Essen, who, by combining one molecule of thiosinamine with a $\frac{1}{2}$ molecule of salicylate of soda, formed a white crystal powder, to which the name of fibrolysin has been given. This substance is absolutely non-irritant, so that injections of it are consequently painless and are found to be harmless. The preparation is put up in aqueous solution of 15 per cent. strength, in sterile glass ampullæ, each containing 2·3 c.c. This represents ·2 gram (3 grs.) of pure thiosinamine.

PHYSIOLOGICAL ACTION OF FIBROLYSIN.—The injection of fibrolysin into the tissues is followed by a temporary pronounced diminution of the leucocytes in the blood. This

diminution is, however, followed by a great excess of white blood corpuscles. It is also claimed for it that red cicatricial tissue, as for example that resulting from a recent burn, will become paler and turgid and more flexible, so that movement of the part can be carried out more freely. It is also said that the injections of fibrolysin determine greater activity of lymph flow in the scar tissue. Inflammatory bands loosen and soften. Exudation material dissolves and is absorbed. Individual connective tissue fibres appear swollen, their outline blurred, and the nuclei more distinct. This action of fibrolysin is claimed to be specific for fibrous tissue of pathological origin, tending to cause its ultimate disappearance.

From the few facts concerning the action of fibrolysin that have been mentioned, it will be seen that, if it possesses anything like all the properties that are claimed for it, it is a drug whose action is unique, and whose therapeutic application is extremely wide.

Fibrolysin has been used in a great variety of diseases, such as cicatricial contracture following after a burn, Dupuytren's contracture, keloids, œsophageal and pyloric stenosis, post-operative abdominal adhesions, stricture of the urethra, etc., etc.

Method of Administration.—The drug is administered by hypodermic injection. The most satisfactory method is by intra-muscular injection into the buttock. It may be injected between the shoulders or into the biceps muscle. Those who have used this drug and obtained satisfactory results in cases such as Dupuytren's contracture, or contractures following burns, find that the best results are obtained by direct injection into the tissues at the site of the lesion. This latter method is, however, usually more difficult to carry out, and accompanied by slight discomfort. Where the former methods are practised, the injections are accompanied by absolutely no pain or discomfort, apart from the prick of the needle. Intravenous injection may be employed, when it is desired to obtain the effect of fibrolysin with greater speed. Occasionally a patient is met with who possesses an idiosyncrasy towards the drug, and the injection of it is found to be followed by headache, faintness, and drowsiness on the day after the injection. Slight feverish reaction is occasionally met with. In order to obtain its beneficial effects, it is necessary that repeated injections be administered. These may be given every second day, 15, 20, or even 50 individual administrations being given. When a large number of injections are being given, it is advisable, however, that the interval be longer than that above mentioned.

In estimating the true value of fibrolysin, there are certain difficulties that confront one at the outset. The pathologist is somewhat at a loss to explain the specific selective action which the drug is claimed to possess towards fibrous tissue. On the other hand, it is always extremely difficult to exclude the operation of concomitant factors which may contribute towards an improvement of the part under treatment, as, for example, the gradual stretching of the palmar fascia which is brought about by the patient massaging the part to test whether it has become softer or not, and extending the finger to test whether any lengthening in the fibres has taken place. It is still a fact that cannot be gainsaid that certain surgeons of wide experience and undoubted integrity have obtained most astonishing results from the use of this remedy. Thus cases are met with—to return to the illustration of Dupuytren's contracture already taken—where cure has followed its use in this disease after many other remedies had been tried without success.

Sufficient time has not yet elapsed to enable a final judgment to be given on the value of fibrolysin in the practice of medicine. At present all that can be said is this, that in many diseases it would be well to try the efficacy of this remedy before embarking upon more serious treatment.

Fibrosis.—The increased development of connective tissue in an organ or part as the result of chronic inflammatory action, and also from such non-inflammatory processes as strain (seen in vessel walls) and neoplasm-formation.

Filigree Implantation.—Bartlett's method of dealing with large abdominal hernias otherwise incurable; the filigree of silver wire is laid upon the peritoneum, or as near to it as may be (*e.g.* on the transversalis fascia). *See* M'Gavin, L., *Practitioner*, lxxvii. p. 161, 1906; *Lancet*, ii. for 1907, p. 1445.

Films, Blood.—*See* Blood (*Examination of Stained Films*).

Finger-and-Toe Disease.—*See* Cancer ("Etiology," *Green's Theory*).

Fixateur.—Metchnikoff's term for amboceptor or immune body. *See* Immunity.

Fixation of Complement.—*See* Bordet-Gengov Phenomenon; Immunity.

Flailfoot.—The abnormal degree of flexibility exhibited by the foot in cases of infantile paralysis; dangle-foot; arthrodesis causing anchylosis has improved the limb for purposes of locomotion.

Flexner's Serum.—*See* Cerebro-Spinal Meningitis (*Treatment, Curative*).

Fluoroform.—A substance analogous

to chloroform having the formula CHF_3; it is obtainable as an aqueous solution of the gas, and the dose is said to be a teaspoonful; it has been recommended in pertussis.

Fœtal Extract.—Fichera has experimented upon the action of extracts made from fœtuses of from two to six months, and has made injections of these into inoperable malignant growths (36 cases) with good results in ten cases (five cures and five progressing towards cure), with no improvement in eight, and with cessation of the treatment for various reasons in most of the other cases. See *Lancet*, vol. ii. for 1910, p. 1151.

Food Fever.—*See* ACIDOSIS (*Therapeutic Considerations, Eustace Smith*).

Formamint.—A proprietary preparation described as a chemical combination of formaldehyde and milk sugar; it is recommended in infective conditions of the throat (*e.g.* diphtheritic), and it is claimed that the aldehyde set free by the action of the saliva is powerful and immediate. *See* Report in *Lancet* (i. for 1908, p. 433), also Meredith Young's article (*Lancet*, i. for 1908, pp. 924-928).

Formates.—*See* DRUGS, RECENT.

Formic Acid.—*See* DRUGS, RECENT.

Formitrol Pastilles.—A proprietary preparation recommended in septic conditions of the mouth; the pastilles contain formaldehyde (which is set free by the action of the buccal juices), menthol, citric acid, and milk sugar. *See* Report in *Lancet*, ii. for 1908, p. 1375.

Fractures.—The changes which have taken place in recent years in the treatment of fractures may be traced—(1) To the use of the Röntgen ray shadow for revealing more or less accurately the position of the broken ends of a fractured bone before and after treatment. (2) To the introduction of the antiseptic method of treating wounds, whereby, when efficiently carried out, the injured parts can be exposed to view and dealt with directly without undue risk to the patient. (3) To the adaptation of massage and movement to the treatment of fractures which has been worked out by Professor Lucas Championière of Paris (C. W. Cathcart, *Scot. Med. and Surg. Journ.*, 1907, xxi. p. 6). From the above succinct statement, it appears that modern practice is moving from the principle of the necessity of complete immobilisation towards massage and movement, and, so far as some of the more advanced surgery is concerned, towards operative union of broken bones.

Massage and Movement in the Treatment of Fractures is discussed by Cathcart in the above paper, and he states the following conclusions at which he has arrived:—(1) Absolute immobility is not essential to bony union. The ribs unite in spite of the movements of respiration, and wide experience has shown that the slight amount of movement necessarily involved in the daily massage of a fractured limb, and in the daily active and passive movements for a few minutes at least, of the adjacent joints, seems to hasten, rather than hinder, the formation and solidification of the callus. (2) Extravasated blood in joints and among muscles and synovial sheaths leads to adhesions in its neighbourhood, as if it were itself a source of irritation apart from the irritation due to bruising and laceration of these soft parts which accompanies fracture. (3) Massage, and with it occasional movements are beneficial in the treatment of fractures. They not only aid union, but assist in the absorption of effused blood and serum, restrain or prevent adhesions, maintain the nutrition of muscles; and therefore they simultaneously hasten union, and prepare the limb to resume its functions almost as soon as the bones are united. (4) Splints and other retentive apparatus, including extension, are required more to prevent mal-union than non-union. (5) The manipulations necessary for massage and movement can be carried out by any one who will take the trouble to understand the object of the manipulation, and who will be sufficiently gentle and careful in handling an injured and very delicate part without causing pain.

Method of Performing Massage.—In recent fracture the object is to diminish swelling, allay spasm, and soothe pain. The injured limb is placed in a comfortable position and dusted with finely powdered talc, starch, or flour. Massage is begun by gently stroking the limb upwards, using a broad surface of the palm and fingers, beginning from the proximal and working down to the distal part of the injury. Pressure must not be enough to cause pain. Next the muscles overlying, or acting on, the broken fragments should be gently kneaded, and this should be succeeded by a repetition of the upward stroke with which the process began. The whole process occupies from ten to twenty minutes, and then the retentive apparatus is applied. Massage is repeated daily, or at intervals of one or two days, and when the acute stage has passed off the method is modified, because the object now is to disperse effusion, to stimulate the circulation, and to promote nutrition. The stroking movements are firmer and more extensive, and the kneading movements of the muscles deeper. The sitting is brought to a close by a number of stroking movements in every case.

Movement as Part of the Treatment of

Fractures.—We have to consider both passive and active movement. The former are valuable in preventing adhesions; the latter in maintaining nutrition. Both forms of movement require to be used with care so as to avoid displacement of the broken ends; pain or serious discomfort must always be avoided. The patient's voluntary effort may be used in the reduction of displacements due to muscular action. If, for example, in a case of Potts's fracture, the surgeon tries to pull the foot into position the antagonistic muscles (here the peronei) will start into opposition and the patient will be caused severe pain. If, instead of this, the surgeon steadies the foot and encourages the patient to turn the foot inwards, he will be surprised how much ground he can gain, especially if he helps a little in the same direction. The voluntary effort ensures relaxation of the opposing muscles. The same method may be applied in other cases on the principle that when one set of muscles in spasm causes displacement, relaxation of these will be induced by contraction of the opposing set.

Acting on these principles, Cathcart advises the following simplified appliances in the treatment of the various fractures:—*Clavicle.*—Bandage the arm to the side and support elbow for a few days; thereafter only a sling is needed. *Surgical neck of humerus.*—Except in the rare case of persistent abduction of the upper fragment, or when the lower fragment is markedly drawn inward, rest in bed for a few days with the arm steadied; then a sling. *Fracture of olecranon.*—After the initial pain and swelling have subsided, a sling at an angle of 135°, the angle of flexion being diminished as the condition improves. *Colles's Fracture.*—An anterior splint for the first few days. *Impacted extracapsular fracture of the neck of the femur.*—The impaction should not be undone. Rest and extension for a few days will relieve pain, after which no apparatus is required. *Fracture of patella.*—The choice is between operation and massage and movement. In the latter case the knee should be steadied at first in slight flexion by a simple splint; afterwards the limb may be left free in bed with only an encircling strip of plaster round the lower third of the thigh.

The *operative treatment of fractures* has been discussed by a number of surgeons. Vaughan (*Amer. Journ. Med. Sci.*, March 1907) gives as reasons for operating on fractures which are almost certain to get better without operation:—(1) To prevent deformity, especially shortening. (2) To prevent loss of function, especially pronation and suppuration. (3) To obviate delayed union or non-union. (4) To give opportunity to repair injured soft parts. (5) Because as a rule it is the only way to get a perfect result. The dangers attendant on the operation are—(1) Anæsthesia, common to many forms of treatment of fractures. (2) Fat embolus, as likely to occur from efforts to reduce a fracture by the blind as by the open method. (3) Extensive detachment of periosteum. This must be avoided. (4) Infection.

Technique.—Of the various means of holding fragments in position—plates, screws, nails, pegs, bone ferrules, animal sutures, and wire—wire is the best in a large majority of cases. He has recently used iron wire, which is cheaper and stronger than silver, and equally non-irritating. Wire may be used in several ways. (1) Drilling each fragment twice at right angles and using two strands of wire. (2) Drilling each fragment once, and using one loop of wire. (3) In oblique fractures drill fragments while in position, pass wire through and carry several times round fracture. (4) Carry wire circularly round fragments.

Bennett's Fracture of the Base of the Metacarpal Bone of the Thumb.—In 1881 E. H. Bennett of Dublin first directed attention to the fact that fracture through the base of the metacarpal bone of the thumb is a common injury, but his claim to the frequency and importance of the injury was not generally admitted, and little attention was paid to the subject until 1904, when Miles and Struthers reported a series of cases (*Edin. Med. Journ.* 1904, xv. p. 297). They describe the fracture as a chipping off of the palmar projection of the base of the metacarpal bone of the thumb with a varying amount of upward and backward displacement of the rest of the bone, the short palmar fragment retaining its normal relation to the trapezium. The line of fracture varies according as the metacarpal is flexed or extended on the trapezium. It is nearer the dorsal aspect of the metacarpal if the bone is flexed at the time of the accident, nearer the palmar aspect if it is fully extended—the more the metacarpal is extended the smaller will be the fragment chipped off. The fracture is caused by indirect violence, being the result of a blow on the tip of the thumb or, if the terminal phalanx be flexed, on the tip of the first phalanx. The usual history is that the patient fell, and to save himself put out his hand, which brought the thumb violently against the ground. A "stave" of the thumb frequently causes this fracture. *Clinical features.*—The right thumb is more frequently affected, and in many cases the injury seems so trivial that patients do not come under treatment for some days, until the continued pain and weakness makes it evident that they are not merely suffering from a sprain. Crepitus may be present two, three, or four weeks after the injury. The signs and symptoms are constant and not difficult to recognise. Movement is limited, the thumb and little finger cannot be opposed, while abduction is also feeble. The displacement of the main portion

of the metacarpal towards the dorsal aspect of the trapezium produces an abnormal prominence which partly fills up the hollow between the long and short extensor tendons of the thumb. This prominence is easily felt. The only injury with which this fracture is liable to be confused is dislocation of the metacarpal backwards, and from this it is distinguished by crepitus, and by the return of the deformity after reduction.

Treatment.—In recent cases the displacement is readily reduced by traction on the thumb in the abducted and fully extended position, at the same time pressing over the dorsal aspect of the metacarpal. It is, however, difficult to maintain the fragments in apposition. This is best done by a palmar splint reaching from the tip of the thumb across the hand projecting beyond the ulnar side of the wrist. The lower end of the splint is firmly fixed to the tip of the thumb by plaster. The thumb is then fully extended and abducted, and this position is kept up by applying a bandage round the wrist and hand so as to catch the end of the splint which projects beyond the ulnar margin of the wrist, and push it downwards and towards the radial side. The *prognosis* as regards function is good; no practical inconvenience follows some permanent displacement of the metacarpal. *See also* a paper on "Punch fractures" by Burrows (*Brit. Med. Journ.*, 28th Mar. 1908). Robinson (*Boston Med. and Surg. Journ.*, 27th Feb. 1908) found from a radiographic examination of ninety-two fractures of the metacarpal of the thumb that only twenty-eight were of the true Bennett type as described above. In the other sixty-four the fracture was more or less transverse, passing through the shaft near the base, but without implicating the joint or being attended with subluxation. In this type of fracture the maintenance of extension is unnecessary.

Fracture of the Intercarpal Joints.—Schoch (*Deutsche Zeitschrift f. Chir.*, 1907, cxi. p. 53) states that the combination of anterior dislocation of the semilunar bone with fracture of the scaphoid is a typical injury, which he proposes to call "typical intercarpal dislocation fracture" It is caused by severe violence, usually a fall from a height on the hand. The symptoms are swelling of the wrist and pain on passive movement. The carpus is thickened, broadened, and shortened. Beyond the radial border anteriorly there is bony resistance, finger movements are affected, and the median nerve is pressed on. The prognosis is serious. The treatment is first non-operative, then operative reduction. When these are not successful the proximal fragment should be extracted and the semilunar replaced, or the latter with the scaphoid should be extirpated. Vigorous and long-continued systematic movements are required to restore function.

Fracture of the Neck of the Femur.—The Whitman method (Whitman, *New York State Journal of Medicine*, May 1909; Walker, *Annals of Surgery*, 1908, xlvii. 84). In this method of treatment the limb is put up in the abducted position, and fixed in a plaster of Paris spica bandage. The anæsthetised patient is lifted on to a box or pillows about eight inches high, and large enough to support the head, shoulders, and trunk. The pelvis is fixed by abduction of the sound limb to its extreme limit, and traction is made on the injured limb held at the limit of abduction, about 45°. A plaster spica is so applied as to include the pelvis and cross below the edge of the rib; it extends to the foot, and prevents any eversion. Whitman divides fractures of the neck of the femur into complete and incomplete, the latter being (1) impacted, (2) greenstick, (3) diastasis, (4) fracture complete but held together by capsule and periosteum. The last is the most common in the adult, and usually passes for impacted fracture. The principle of Whitman's method depends on the construction of the joint. The normal range of abduction is about 45°, and in this position the outer and upper part of the neck is in contact with the acetabulum; the upper extremity of the trochanter impinges against the muscles covering the ileum; the lower part of the capsule is stretched. These three checks to abduction act at the same time, but in fracture, the deformed neck comes prematurely in contact with the acetabulum, and abduction is restricted. By fully abducting the limb the shaft and upper fragment are adjusted at the normal angle. In a few cases Whitman has also inserted a temporary bone drill through the two fragments by subcutaneous operation. In any case, repair is slow, and a hip-splint which prevents weight bearing, while allowing motion, may require to be worn for a year. By the abduction method a better range of movement is got than by fixing the leg in the line of the body.

Treatment of Ununited Fracture by Bier's Congestive Method. *See* Bier's TREATMENT.

Ischæmic Contracture. — Volkmann's Contracture.—One of the unfortunate sequelæ of fracture is known as ischæmic paralysis and contracture. It is due to the too tight application of bandages, and most of the cases recorded have occurred in children after fracture of the forearm or about the elbow. It has been defined by Harris (*Brit. Med. Journ.*, 26th Sept. 1908) as "a primary muscular contracture from necrobiosis of the muscular tissue dependent on its deprivation of arterial blood." The reason why it is relatively common after injuries about the elbow, is that in such cases there is apt to be considerable effusion of blood, and pressure on all the tissues of the part. The scale may easily be turned against recovery by the application of an over-tight bandage. The injury occurs with peculiar rapidity; there is

pain in the parts distal to the bandage, and swelling and discoloration from congestion. When the bandage is loosened these signs disappear, but the damage may have already been done, and the deformity slowly develops. The deformity produced resembles the *main en griffe* of the neurologists, the wrist being flexed, the proximal phalanges extended, and the distal phalanges flexed. If the contracture is beginning the splints should be removed from the arm altogether, and an attempt should be made to prevent the contracture of the fingers by applying small metal splints to each. Subsequently, the fingers being kept straight, the attempt should be made to overcome the flexion of the wrist. When the contracture is established, the best line of treatment is to shorten the bones, or lengthen the tendons, of the forearm. Greig (*Edin. Med. Journ.*, June 1910) states that the results of operation are not gratifying, and concludes that in ischæmic paralysis prevention is better than cure. For full literature and list of cases *see* Thomas, *Annals of Surgery*, 1909, xlix. p. 330.

Fracture of the Ribs, complicated by Ileus.—Adams (*Annals of Surgery*. li. 1910, p. 102) records two cases of fracture of the ribs followed by paralytic obstruction of the bowels, due, it is believed, to irritation of the sympathetic chain by the displaced fragments. Both patients suffered from acute obstruction, and were operated on; one died. The operation advised for this and other forms of paralytic obstruction is to make an incision close to the umbilicus, and to pass a No. 12 catheter into the lumen of the ileum. The relief required to overcome this state of paralysis is only temporary, and the main object of the operation is to provide for the safe exit of the imprisoned gas. If peristalsis is re-established there is little likelihood of the small opening failing to close spontaneously if the catheter be removed after a few days. One of the chief objections to ileostomy—viz. that if the opening be made high up in the small intestine, the patient may go downhill from inanition before the bowel can be closed; this second operation, moreover, being often delayed on account of the soreness and auto-digestion of the tissue round the artificial opening—is removed if the operation be performed on the above lines.

Freezing.—*See* Lupus Erythematocus (*Freezing*); Nævi.

Freud's Method.—*See* Psycho-analysis.

Fröhlich's Syndrome.—Dystrophia adiposa genitalis, or the group of symptoms often observed in tumours of the pituitary gland; in this group are defective sexual power, hypoplasia of the genital organs, absence of sexual hair, a deposit of fat in large amount, and other features of eunuchism. These phenomena could be experimentally produced in animals by the removal of part of the anterior lobe of the pituitary gland. *See* Pituitary Gland.

Frommer's Dilator.—*See* Accouchement Forcé.

Fulguration.—The electric discharge as seen in nature in the lightning flash; in the form of electric sparking it has been used, after surgical operation, as a local application in the treatment of malignant tumours, having been introduced in 1907 by de Keating-Hart (*Comp. rend. Soc. de biol.*, Paris, lxii. p. 323, 1907; *Marseille méd.*, xliv. pp. 216, 306, 339, 1907; *Rev. de thérap. méd.-chir.*, lxxiv. p. 685, 1907; *Bull. Soc. de dermat. et Syph.*, xix. p. 118, 1908; *Arch. d'electr. méd.*, xvi. pp. 371, 773, 1908; *Arch. internat. de chir.*, iv. p. 3, 1908-9; *Arch. Roentg. Ray*, xiii. p. 132, 1908-9; *Anjou méd.*, xvi. p. 129, 1909; *Bull. et Mém. Soc. de chir. de Paris*, N. S., xxxvi. p. 820, 1910) and named fulguration by Pozzi; the results of fulguration have hardly fulfilled expectation, although the procedure has been tried in many places by clinicians (*Brit. Med. Journ.*, ii. for 1909, p. 1174.)

Funiculitis, Endemic.—Under this name Aldo Castellani (*Brit. Med. Journ.*, ii. for 1909, p. 780) has described a suppurative condition of the spermatic cord occurring in Ceylon (*Ceylon Med. Rep.*, 1904-7; *Lancet*, ii. for 1908, p. 15); the same disease was met with in Egypt by F. C. Madden and denominated "cellulitis of the spermatic cord" (*Lancet*, i. for 1907, p. 505); and the names "corditis" or "phlebitis of the cord" have also been given to it. The symptomatology resembles that of strangulated inguinal hernia; there is severe pain in the lower part of the abdomen, along the cord and the epididymis, and a large cylindrical swelling is found there running into the external inguinal ring; the skin covering the swelling is œdematous, and the swelling itself is hard and firm and cannot be reduced, gives no impulse on coughing, and a dull note on percussion; if not operated on the condition becomes rapidly serious, and general septicæmia develops, followed by death in a few days. A chronic type has been described by D. K. Coutts (*Lancet*, i. for 1909, p. 227). In its pathology the disease is characterised by inflammation and infiltration of the whole spermatic cord, often extending to the epididymis but not to the testicle; the other lesions found were those of septicæmia. A diplostreptococcus was found by Castellani in the pus of the veins of the pampiniform plexus, and the same micro-organism was

detected in the blood; the germ was Gram negative in preparations from the tissues and Gram positive in preparations from cultures; and it very closely resembled the streptococcus pyogenes. The disease may be due to the extension of a mild or latent urethral infective process by way of the vas deferens, and may be predisposed to by sudden chill or traumatism. Madden's operation for this disease consists in making an incision down to the inflamed cord and removing the latter between ligatures (the upper one being put on as high as possible); sometimes an elongated hernial sac may then be found in an inflamed state which can be ligatured off at the internal inguinal ring; the gutter which is thus left in the inguinal region should be packed with gauze, and the whole allowed to granulate up from the bottom; the testicles, although not themselves affected, had better be removed, for their functions must necessarily be abolished, and their removal simplifies the subsequent treatment and improves the prospect of recovery.

Gabbett's Staining Method.—A method of staining the tubercle bacillus in sputum; the chief peculiarity is the use of Gabbett's methylene blue solution (methylene blue, 2 grams; sulphuric acid, 25 c.c.; water, 75 c.c.), which leaves the bacilli as bright red rods and the other organisms and cells blue. *See* Webster, *Diagnostic Methods*, p. 20, 1909.

Galenical.—Pertaining to Galen or to his followers or practice; or to vegetable as distinguished from chemical remedies; or, more recently, to remedies prepared according to an official formula—*e.g.* Galenical preparations of the calcium salts, etc.

Gall Bladder and Bile Ducts, Diseases of. — The principal advances which have been made in our knowledge of this group of diseases have been in the direction of bringing into prominence the relation which some of them bear to chronic interstitial pancreatitis. The credit of this work rests chiefly with Mayo Robson and Cammidge, the latter of whom has introduced a method of examining the urine which gives information as to the condition of the pancreas. The Cammidge reaction, and the questions of chronic pancreatitis are discussed in the article on DISEASES OF THE PANCREAS, and only the main points related to diseases of the biliary passages will be referred to here.

The common bile duct opens into the lumen of the duodenum about 3 inches from the pylorus by an orifice (the ampulla of Vater) common to it and the duct of Wirsung. In 60 per cent. of cases (Robson) the bile duct passes through the head of the pancreas in its course to the ampulla, and in some cases, instead of the duct of Wirsung and the bile duct opening separately, the pancreatic duct opens into the bile duct. Mayo Robson believes that the above relationship of the common bile duct to the head of the pancreas affords an explanation of many cases of so-called catarrhal jaundice: according to him the disease is frequently due to swelling of the head of the pancreas compressing the common duct in its course through it. Chronic catarrhal jaundice may also be caused by interstitial pancreatitis. The diagnosis between this condition, and malignant disease of the pancreas, which it closely resembles, can be made by the Cammidge reaction and by examining the stools for neutral fats. Unlike cancer, the condition is curable by cholecystenterostomy.

Another result of the close relationship of the biliary and pancreatic ducts is the liability of infection to spread from the bile duct to the pancreas. If an infective cholangitis occurs, as is often the case when impacted gall-stones are present, chronic, subacute, or even acute pancreatitis may be produced. So commonly is pancreatic inflammation associated with common duct cholelithiasis of old standing, that when the diagnosis is in suspense between cholelithiasis and cancer of the head of the pancreas, great help may be derived from an examination of the urine for Cammidge's pancreatic crystals, and of the motions for excess of neutral fats. The presence of these is in favour of pancreatitis and against malignant disease.

REFERENCES.—MAYO ROBSON, *Edin. Med. Journ.*, Dec. 1905; *Lancet*, 19th March to 2nd April 1904. *See also* under PANCREAS.

Bland Sutton, in the second edition of his Lectures on Cholelithiasis (*Gall-Stones and Diseases of the Bile Ducts*, London, 1910), states during the last five years our knowledge of diseases of the gall bladder and bile ducts has undergone a complete change. The opinion that many diseases associated with gall-stones are due to ascending infections is wide of the mark. The majority of the disturbances which come under the cognisance of the surgeon in connection with the canal system of the liver are descending infections, from contaminating elements eliminated from the blood of the portal circulation and discharged into the outflowing bile. The best known instance of descending infection is afforded by typhoid fever. Ulceration of the gall bladder as a sequel to typhoid has been known since the days of Murchison, and numerous cases of operation for perforation of the gall bladder in this disease are on record. The presence of typhoid bacilli in the bile, however, assumed a new importance when it was found that after an attack of typhoid they might persist in the gall bladder for long periods, and retaining their pathogenicity, be excreted in the fæces

and prove a source of infection to other persons. *See* TYPHOID FEVER.

It has been shown that micro-organisms serve as nuclei round which cholesterin may collect to form gall-stones. Streptococci, pneumococci, *b. coli*, and especially *b. typhosus*, act in this manner. Their action is a twofold one; they set up catarrh of the gall bladder, which leads to the production of cholesterin; clumps of bacilli then form nuclei, around which this collects. The facts on which the statement that bacillary infection of the gall bladder is a cause of gall-stones are:—(1) The frequency with which gall-stones occur in persons who have suffered from typhoid fever or cholecystitis or from other causes. (2) The isolation of organisms from the nuclei of gall-stones. (3) The experimental production of calculi by the introduction of attenuated cultures of *b. coli* into the gall bladder. It seems that a low degree of virulence is essential to the production of gall-stones; if the organism is virulent, suppurative cholecystitis ensues.

Primary cancer of the gall bladder is less rare than used to be supposed. It is almost invariably associated with gall-stones (95 per cent. of the cases). The gall-stones are believed to be a predisposing cause of cancer, and this fact is one of the principal reasons why it is advisable to excise the bladder (cholecystectomy) during operations for the removal of gall-stones. Bland Sutton says on this point: "Since I have had every gall bladder which has been removed in my practice examined microscopically, I have been astonished at the frequency with which it is the seat of cancer." The symptoms of cancer of the gall bladder are obscure. Patients usually seek advice either on account of a local swelling less acute than a cholecystitis, and yet accompanied by obvious impairment of the health, or with signs suggestive of malignant disease of the liver. Bland Sutton regards the fact that diseases of the gall bladder are caused by descending infections, together with the relation of cancer to gall-stones and cholecystitis, as supporting the idea of the micro-parasitic origin of some forms, at least, of cancer. "More than half the total number of cases [of cancer] which attack mankind arise in the alimentary tract. This supports the idea that the hypothetic parasite of cancer is conveyed by uncooked food or water. It is conceivable that cancer of the gall bladder is caused by some infecting agent obtained from the alimentary canal by the blood and eliminated by the liver and lodged in the gall bladder, where it stimulates the epithelium to unnatural growth. Infection of epithelium causes it to multiply: this is exemplified in the gall bladder. Its mucous membrane under normal conditions contains few glands, but when it is chronically inflamed, mucous glands become abundant and of large size. In cases of fistulæ between gall bladder and intestine the mucous membrane becomes thick and resembles that of the intestine. These mucous glands are important, for they are the chief sources of the calcium found in mixed biliary concretions. It is undeniable that gall-stones are a common complication of cancer of the gall bladder, and many writers have maintained that they are the cause of the cancerous change. I have never accepted this opinion, preferring to believe that the pathological conditions of the epithelium lining the gall bladder which cause it to produce cholesterin in abundance, increase its vulnerability to the micro-organism of cancer. For this reason, among others, the surgeon acts in the best interests of his patient when he removes gall bladders when they are so disordered as to require surgical interference" (*op. cit.*, pp. 147-148).

Bland Sutton tabulates operations on the bile passages thus:—*A. Gall bladder and cystic duct:* (1) Cholecystotomy; (2) Cholecystectomy; (3) Cholecystenterostomy; (4) Cholecystendysis (removal of calculi, followed by suture of gall bladder); (5) Cystecotomy. *B. Common bile duct:* (1) Choledochotomy; (2) Duodeno choledochotomy; (3) Choledocho-duodenostomy; (4) Choledochectomy; (5) Choledocho-enterostomy. *C. Hepatic ducts:* (1) Hepaticotomy; (2) Hepato-duodenostomy. *D. Intrahepatic ducts:* (1) Hepato-hepaticotomy; (2) Hepato-choliangio-jejunostomy. Cholecystectomy is performed for cholecystitis, mycosis, primary cancer, calculi in the bladder, or in the cystic duct. It has the advantage over cholecystotomy of being equally safe, and of being unattended by such sequelæ as biliary and mucous fistulæ, suture sinuses and abscesses, and the formation of gall-stones on buried sutures. Details concerning the performance of the above series of operations, as well as the precise conditions in which each is applicable, will be found in Mr. Sutton's book, which also contains a bibliography of recent literature.

Some of the arguments against cholecystectomy are fairly stated by Deaver (*Amer. Journ. Med. Sci.*, April 1908). His objections consist of (1) the inadvisability of removing a functionating structure; (2) the desirability of retaining the gall bladder as a means of drainage in septic conditions of the liver and biliary passages. He doubts whether sufficient drainage takes place by the common duct into the duodenum, and in any case considers it unsurgical in the extreme to drain one infected organ into another; (3) the ultimate results of the operation, particularly the occurrence of post-operative adhesions. The indications for cholecystectomy, according to Deaver, are:—Hydrops of the gall bladder, cancer, chronic empyema, when calculi cannot be removed otherwise—*e.g.* if embedded in the mucous membrane. The gall bladder should not be removed in acute catarrhal calculous or non-calculous

cholecystitis when the cystic duct is patulous; nor even always in acute suppurative calculous or non-calculous cholecystitis. In but comparatively few cases of chronic calculous or non-calculous cholecystitis is ablation indicated unless hydrops, fibrosis, or calcification of the wall of the organ exists. It will be seen that Deaver's argument does not touch what seems to be the most important factor in deciding between the conservative and more radical operations—viz. the frequency with which cancerous changes are found in excised gall bladders. If this observation of Mr. Sutton's is generally confirmed, the propriety of ablating the gall bladder for all cases will hardly be questioned.

Gamete.—A sexual element, spermatozoon or ovum; the fertilised ovum due to the union of the gametes is called a zygote. *See also* PROTOZOA.

Gametoid Theory of Cancer.—The idea that malignancy may be due to cells of the tumour entering upon a sexual phase (reduction of number of chromosomes in nucleus) and living as parasites upon the parent organism (C. E. Walker, *Lancet*, i. for 1907, p. 430).

Ganglioneuroma.—A neuroma containing large cells of the neuron type; other names are the neuroma proper or the neurocytoma; it is to be distinguished, according to Adami (*Pathology*, i. p. 753, 1910), from the glioma, the ependymoma, and the neurinoma.

Gaskells' Bridge.—*See* HEART, DISEASES OF.

Gastric Ulcer.—The Lenhartz method of treating gastric ulcer has had a considerable vogue, especially in Germany. It was introduced in 1904, and has as its special features these objects:—(1) To nourish the patient sufficiently to improve his general condition, and thereby promote the healing of the ulcer. (2) To limit the size of the meals, and thereby avoid distension of the stomach. (3) To prevent the action of the excess of hydrochloric acid on the ulcer by supplying enough albuminous food to "fix" the acid.

The details of the treatment are as follows:—Concentrated foods—eggs, milk, raw beef juice, are given by the mouth in small amounts at intervals of an hour. Slow mastication is secured by feeding with a teaspoon, and never allowing the patient to feed himself. An icebag is applied to the epigastrium if there is any hæmorrhage, and bismuth subnitrate is administered. A "cure" lasts for two weeks, and the patient is kept absolutely at rest for four weeks. The following schedule of diet is given by Lambert:—Eggs to be beaten and kept on ice. Feeds every hour, milk and egg alternately.

Day.	Eggs. Per dose.	Milk. Per dose.	Sugar.	Scraped Beef.
1	2 drachms	4 drachms	...	...
2	3 ,,	6 ,,	...	...
3	½ oz.	1 oz.	20 grams added to eggs	...
4	5 drachms	1½ ,,	,,	...
5	6 ,,	14 drachms	30 grams	...
6	7 ,,	2 ozs.	40 ,,	36 grams in three doses
7	4 ,, also 1 soft-boiled egg every four hours	2¼ ,,	,,	70 grams with 100 grams boiled rice in 3 doses
8	,,	2½ ,,	,,	,,
9	,,	3 ,,	,,	,, plus 40 grams rusk
10	,,	,,	,,	,, plus chicken 50 grams and butter 20 grams

11-14 Interval of feeding 2 hours. Milk given in 6 oz. doses with ½ oz. raw egg. Butter increased to 40 grams, and various additions made (broiled chop, toast, and other cereals instead of rice).

Lambert's series of cases warrants him in concluding that the original claims of Lenhartz are correct: "First, that the cure is at least equally as efficient as the older method, and that it does not deplete the patient; second, that the cure is more rapid, as well as more certain; third, that the vomiting and bleeding stop more quickly, and relapse less frequently, than in the Leube cure (starvation and rectal feeding); fourth, that the pain ceases promptly and that morphine is never needed; fifth, that the food supply is sufficient throughout; sixth, that it is possible to treat the anæmia earlier with iron and arsenic than in the Leube cure; and seventh, that it is possible to return to a full diet and to the patient's usual occupation earlier than in the older cure."

Ewald, whose authority on all matters connected with gastric disorders is indisputable, does not, however, think that the Lenhartz treatment gives better results than the classical method of rest, starvation, and rectal feeding.

REFERENCES.—LAMBERT, *Amer. Journ. Med. Sci.*, Jan. 1908.—EWALD, *Deutsche med. Wochensch.*, p. 361, No. 9, 1908.

Gastroelytrotomy.—*See* ACCOUCHEMENT FORCÉ.

Gastrostaxis.—Hæmorrhage or oozing of blood from the gastric mucous membrane in cases in which no ulcer of the stomach is present, and in which there is no evidence of the presence of any other disease (*e.g.* anæmia, toxæmia, purpura, etc.) in which bleeding is

likely to occur; the morbid state is said to have a symptomatology closely resembling that of gastric ulcer; but the existence of gastrostaxis as an independent disease has been doubted by some authorities (*e.g.* C. Bolton, *Brit. Med. Journ.*, i. for 1910, p. 1221). *See also* W. Hale White, *Brit. Med. Journ.*, i. for 1910, p. 1347, for evidence as to its occasional occurrence; H. J. Paterson (*Lancet*, i. for 1910, p. 712) for the theory that it may be due to latent appendicular disease; and E. C. Hort (*Lancet*, ii. for 1907, pp. 1744-1747) for an analytical statement of different forms of gastric hæmorrhage.

Gastrosuccorrhœa.—An excessive production of gastric juice.

Gastrotoxin.—Gastrotoxic serum prepared by injecting an emulsion made from the gastric mucous membrane of one animal (*e.g.* a guinea pig) into the peritoneal cavity of another animal (*e.g.* a rabbit) and taking the latter's blood serum. Bolton found that such a serum produced gastric ulcers (*Lancet*, i. for 1908, pp. 639, 1330-1333).

Gelignite.—A variety of gelatine dynamite, which when needed for blasting purposes has to be thawed, and the thawing should be done in hot water away from a naked flame if explosions are not to occur. For accidents arising in this way see *Lancet*, i. for 1910, p. 757.

Gemmation.—*See* Protozoa.

Genoform.—*See* Indoform.

Geotropism.—Geotropism, or more correctly *positive* geotropism, is a tendency to grow towards the centre of the earth as exhibited in the vegetable world by roots, etc.

Geril Bread.—A proprietary food preparation, being a dark brown bread of close texture necessitating thorough mastication, and recommended in constipation, diabetes, and some other maladies. An analysis (*Brit. Med. Journ.*, i. for 1910, p. 146) shows 7·55 per cent. of protein, and 9·7 per cent. of reducing sugar, etc. See also *Lancet*, i. for 1910, p. 308.

Giemsa Stain.—A bloodstain in which Grübler's azure ij., which is a combination of equal parts of methylene azure and medicinal methylene blue, is made up with eosin B.A. in methyl alcohol, and has thereafter glycerine (C.P.) added to it. *See* Webster, *Diagnostic Methods*, p. 456, 1909. There is also a Giemsa Azur-eosin solution which is used for staining the spirochæta pallida (*ibid.*, p. 588).

Giesshübler Water.—A mildly alkaline water, recommended in gastric catarrh and other allied conditions. *See* Report in *Lancet*, i. for 1908, p. 650.

Gigli's Method.—*See* Symphysiotomy and Pubiotomy.

Gingamint.—A proprietary preparation having an antacid and stomachic effect in dyspepsia; it is made in tabloid form and contains sodium bicarbonate, ammonium bicarbonate, gingerin, saccharin, and oil of peppermint. See *Lancet*, ii. for 1907, p. 905.

Glassworkers' Cataract.—There is some evidence that cataract is commoner in glassworkers than in the population generally, a frequency which has been ascribed to the glare of the molten glass (*Brit. Med. Journ.*, i. for 1909, p. 28).

Glaxo.—A proprietary food preparation containing, according to the *Lancet* Laboratory analysis, exactly the same food elements as cow's milk, leaving out of account the water, but the constituents have been modified to increase their digestibility. For report and analysis see *Lancet*, i. for 1908, p. 947.

Gliadins.—Proteins insoluble in water, in absolute alcohol, and in other neutral solvents, but soluble in relatively strong (70 to 80 per cent.) alcohol; also known as protamins and alcohol-soluble proteins; instances are found in gliadin itself (from wheat), in zein, and in hordein.

Glidine.—A proprietary food, described as a pure vegetable protein food prepared wholly from wheat, containing lecithin and practically free from carbohydrates; it is further stated that it may be considered as a lecithin-albumen, and that the lecithin is present in organic combination with albumen as it exists in nature; it is tasteless and odourless and may therefore be added to ordinary articles of diet. An analysis (*Lancet*, i. for 1909, p. 247) showed that it contained over 90 per cent. of protein, associated with the phosphorus of lecithin, and that the mineral matter amounted to 0·30 per cent., and consisted apparently entirely of phosphates. It is recommended in tuberculosis and wasting diseases. It forms a loose compound with iodine (*iodo-glidine*), and it has been stated that iodine may be thus given without the risk of iodism.

Gliosarcoma.—A glioma, occurring most commonly in connection with the retina (when it is malignant and liable to form metastases); it is composed of small round cells mostly without processes, with here and there

intercellular glial fibrils; glioma sarcomatosum. *See* Adami, *Pathology*, i. pp. 757, 773, 1910.

Glossina Morsitans.—Another species of tsetse-fly (in addition to *g.* palpalis) which has been regarded as capable of transmitting the trypanosoma gambiense. *See also* SLEEPING SICKNESS.

Glossina Palpalis. — The tsetse-fly. *See* SLEEPING SICKNESS.

Glucaphen.—A proprietary food preparation described as containing the proteid ingredients of milk and wheat combined with suitable small doses of glycerophosphates. For analysis, see *Lancet*, vol. i. for 1909, p. 1465.

Glutamic Acid.—An amino-acid which has been produced synthetically; also known as amidoglutaric acid ($C_5H_9NO_4$).

Glutaric Acid.—A crystalline dibasic acid ($C_5H_8O_4$).

Glutelins.—Simple proteins occurring in the seeds of cereals, readily soluble in very dilute acids and alkalies but insoluble in all neutral solvents.

Gluten Bread.—*See* DIABETES (*Diet*).

Gluten Meal.—A proprietary food preparation, whose analysis is published in the *British Medical Journal* (i. for 1910, p. 1241.

Glutoform.—An antiseptic, known also as *glutol;* it is formaldehyde gelatin.

Gluzinski's Test.—A test for carcinoma of the stomach based upon variations in the amount of free hydrochloric acid in the stomach contents—viz. in the fasting stomach, forty-five minutes after a test breakfast, and four hours after a full meal. *See* Webster, *Diagnostic Methods*, p. 89, 1909.

Glycoproteins.—Conjugated proteins (*i.e.* those in which "the protein moiety is united to some molecule or molecules of another order otherwise than as a salt"), in which the non-protein part is a substance or substances containing a carbohydrate group other than nucleic acid, *e.g.* mucins and mucoids, amyloid, etc.

Goldhorn's Stain. — Polychrome methylene blue; used in staining the spirochæta pallida, etc.

Gonorrhœa.—*Vaccine Treatment.*—Eyre and Stewart (*Lancet*, 1909, ii. p. 76) advise autogenous vaccines; failing this, a polyvalent vaccine made from five or ten stock cultures. The initial dose is followed by an exacerbation then rapid lessening of the discharge. They summarise their results thus:—"I. *Acute Gonorrhœa.* — 1. Gonococcus vaccine is markedly toxic and exerts a profound influence over the disease. 2. For routine work (hospital out-patients, etc.), vaccine treatment is not devoid of danger, and requires the exercise of considerable caution. 3. A stock vaccine, comprising a dozen different strains, gives results only slightly inferior to those observed when using a vaccine prepared from the patient's own organism. This is not the rule in most other diseases. 4. Small doses, repeated at short intervals, are more effective than large doses at lengthened intervals. 5. Small doses of vaccine (from 1,000,000 to 10,000,000 cocci) are safer and more satisfactory than the large doses (from 50,000,000 to 100,000,000) which are often prescribed. 6. After an injection of from 500,000 to 2,000,000 the negative phase is either absent or extremely transient. 7. An inoculation of from 5,000,000 to 10,000,000 causes a negative phase of usually not longer than forty-eight hours' duration, followed by a positive phase of from three to five days. 8. Vaccine in *small* doses serves the double purpose of *raising and steadying* the opsonic index. A steady index just above normal is found to be the most favourable condition for rapid recovery.

"II. *Simple Chronic Gonorrhœa.*—1. Where the gonococcus has ceased to be the infecting organism, these cases are on a par with other chronic inflammatory states, but are frequently more difficult to cure owing to environment and local conditions. 2. Chronic cases, where the gonococcus is the sole infecting organism, have a better prognosis from the point of view of treatment by vaccine than a mixed infection or one of staphylococcus only.

"III. *Chronic Gonorrhœa with Complications.*—1. The estimation of the opsonic index is helpful to diagnosis, and is a useful means of determining approximately the opsonic state of the blood. Chronic gonococcus infections, however, present clinical features which themselves afford valuable indications during the course of vaccine treatment. 2. Where the gonococcus alone is the infecting organism, if the opsonic index cannot be obtained as frequently as is desirable, routine injections of from 1,000,000 to 2,000,000 cocci every three to five days, are safe and satisfactory; a lapse of five to seven days after doses of 5,000,000; an interval of eight to ten days after inoculation of 10,000,000. Larger doses than these are seldom desirable. 3. Treatment by small and gradually increasing doses at frequent intervals should at all times be observed; the use of large doses is even more dangerous than in acute cases, and may be followed by

disastrous consequences. 4. In orchitis small doses of vaccine quickly relieve pain and cause a more rapid abatement of symptoms than is obtained by the usual routine treatment alone. 5. In iritis the severe pain, which is a marked and obstinate feature, is relieved in forty-eight hours after an injection, and disappears in from three to four days; cure is much hastened. 6. In arthritis the treatment is of considerable value."

Treatment of Gonorrhœa by Bier's Method.—Miles has applied the principle of Bier's method to the treatment of gonorrhœa affecting the anterior urethra. He employs a glass cylinder about 7 ins. long and 2 ins. in diameter, closed at one end, and with a small lateral tube near the blind end. Over the open end is fitted a conical rubber flange, with a thick rubber ring let into its narrow free edge. The bell is exhausted by a metal pump attached by a tube to the lateral tube. After the patient has passed water the flange is applied around the penis as far back as possible, and then the bell is passed over the penis and the wide end of the flange is passed over it, so as to make an air-tight joint. Air is aspirated by three or four strokes of the pump. The penis at once passes into a state of priapism and some drops of pus exude from the meatus. The vacuum should not be great enough to cause pain. In from ten to fifteen minutes air is allowed to enter the bell, and after a five minutes' interval a vacuum is again established. Two or three applications constitute one sitting, lasting about an hour. The bell should be used once daily, not oftener. The results, as regards the discharge, are to increase the polymorphonuclear leucocytes and the intracellular cocci—local leucocytosis and phagocytosis. The method is more cleanly than that by injections; it is also available in phimosis, when injection cannot be used. Pain on micturition is relieved by the second day; frequent micturition becomes less. Chordee does not occur. The purulent discharge ceases in about fourteen days, and the gleet usually in another week. Complications were almost absent in the 300 cases treated in this way. Epididymitis occurred twice only, the average percentage being from 11 to 30 per cent. among hospital, and 3 to 8 per cent. among private patients. There was no case of acute prostatitis, abscess, cystitis, or periurethral abscess. Gonorrhœal arthritis occurred twice; in one of these patients the great majority of the gonococci were extracellular—evidence that the opsonic power was unusually low. Internal treatment with sandalwood oil or copaiva seems to be of additional benefit.

The treatment is applicable only to acute anterior gonorrhœa; when posterior urethritis was also present the effect of applying Klapp's bell over the perineum was tried in conjunction with the penis tube, but the results were indefinite (*Edin. Med. Journ.*, June 1910).

Gordon's Paradox Flexor Reflex.—*See* REFLEXES.

Goundou.—A disease of the nose in which osteoplastic periostitis causes bony swellings producing marked disfigurement; it is believed to be due to a fly entering the nose and perhaps depositing its larvæ there; it is common on the Gold Coast, but Shircore has reported a case in Nyassaland, British Central Africa (*Brit. Med. Journ.*, i. for 1910, p. 503).

"Gouttes de Lait" Congresses.—Congresses which are held from time to time on the Continent, with a view to extending the work of the institution known as the *Goutte de lait* (literally, drops of milk), which is represented in this country by the infant's milk depôts established by municipalities in several large towns; the first International Congress was held in Paris in 1905, and the second in Brussels in 1907; the purpose of the *Goutte de lait* is to give advice to mothers, to encourage breast-feeding, and to distribute milk to those infants who are unable to get breast milk, or who can only get partly fed in that way, but there is a tendency to widen the scope of the work so as to include all the questions relating to the protection of child-life (prevention of infantile mortality) and to make the *Goutte de lait* really a school for mothers; a medical practitioner is in attendance to weigh and examine the babies once a week, and the mothers are encouraged to let them be so examined by having milk in bottles supplied to them, and by receiving advice regarding their own health, etc. The *Goutte de lait* is one of the means employed in puericulture.

Granose.—A proprietary food preparation in the form of biscuits said to consist of the "entire kernels of choice wheat." For analysis, *see* report in *Brit. Med. Journ.*, i. for 1910, p. 1242.

Grape Nuts.—A proprietary food preparation, described as a "fully cooked, predigested breakfast food." An analysis (*Brit. Med. Journ.*, i. for 1910, p. 1240) showed protein, 11·2 per cent., fat 0·6 per cent., water 5·1 per cent., ash 2·0 per cent.; and carbohydrate, by difference, 81·1 per cent.; the calorie value was given as 3·84. It has an agreeable flavour.

Graves' Disease.—PROGNOSIS.—In this disease there is a reduction of the polynuclear leucocytes, and an increased proportion

of lymphocytes. Kocher regards a marked lymphocytosis as an unfavourable sign. TREATMENT.—A number of attempts have been made to prepare a specific remedy for this disease, but the results, on the whole, have not been particularly successful. The preparations which have been most widely used are Moebius's antithyroidin, rodagen, and thyroidectin. Moebius's serum is obtained from sheep and rams from which the thyroid gland has been removed; thyroidectin is the dried serum of thyroidectomised sheep, while rodagen is the dried milk of thyroidectomised goats, with 50 per cent. of milk sugar added as a preservative. Fresh thyroidectomised goat's milk has also been used. A great number of reports of cases treated with one or other of these preparations have been published, and in a considerable number favourable results are claimed. The remedies are in all cases given by the mouth; Moebius's serum is too irritating to be used subcutaneously. Rodagen is given in doses of two grams thrice daily; as a rule it produces no bad symptoms, but it may cause the pulse to become excessively slow, so that its effects must be carefully watched. It is an expensive remedy. The rationale of the use of these drugs is that the serum of a thyroidectomised animal contains substances which should normally be neutralised by the secretion of the thyroid; hence they can neutralise the excessive thyroid secretion which is supposed to cause the symptoms of exophthalmic goitre.

Of greater interest, however, are the attempts to produce a thyrotoxic serum. Murray tried to do so by injecting thyroid into animals, and by feeding, but his results were inconclusive. The most extensive work in this direction has been done by Beebe. He injects the nucleo-proteids of the thyroid, not the whole gland, because if the whole gland be used the serum which is obtained is not purely thyrotoxic, but hæmolytic as well. Rogers has used Beebe's serums clinically. He obtained favourable results with serum from fresh thyroids of patients with exophthalmic goitre, from nucleoproteid, and from thyroglobulin of the same, but not with that derived from normal human thyroid. In their later papers, Beebe and Rogers express a preference for a serum made by injecting both the nucleo-proteid and thyroglobulin into rabbits, dogs, and sheep. The serum obtained is cytotoxic, and perhaps antitoxic. Their statistics include 90 cases, with 23 recoveries, 52 improvements, 11 failures, and 4 deaths. In a favourable case a reaction follows the injection of the antiserum:—1. At times an "early reaction" occurs with faintness, cyanosis, and other rather alarming symptoms. This is rare. 2. The other reaction is more constant, and occurs about 12 hours after the serum is injected. There is redness and œdema at and around the site of injection, with fever and tachycardia. A second dose of serum should not be given until this reaction has subsided.

LITERATURE.—KOCHER, *Arch. klin. Chir.*, Bd. 87, p. 131.—HALLION, *Presse méd.*, 1st Nov. 1905.—MURRAY, *Lancet*, 11th Nov. 1905.—ROGERS and BEEBE, *Journ. Amer. Med. Assoc.*, 17th Feb. and 1st Sept. 1906. A number of reports of cases treated with Moebius's serum will be found in the files of the *Münch. med. Wochensch.* of 1905 and onwards.

Grawitz's Basophilia.—A degeneration of the red cells of the blood (*punctate basophilia of Grawitz*), characterised by the appearance in the body of the cell of granules staining with the basic dyes; the condition is met with in lead-poisoning (where it may be the only change noted in the blood), in pernicious anæmia, in leukæmia, and in the toxæmia of malignant states. *See* Webster, *Diagostic Methods*, p. 471, 1909.

Gray's Tonic.—A tonic recommended in nervous exhaustion and general debility, containing glycerine, gentian, taraxacum, phosphoric acid, sherry, and carminatives; it is free from iron. See *Lancet*, ii. for 1907, p. 905.

Green Days.—*See* DIABETES (*Diet*).

Green Tumours.—*See* CHLOROMA.

Griserin.—A mixture of *loretin* (a quinoline derivative) and sodium bicarbonate; it has been recommended as an iodoform substitute.

Grocco's Sign of Pleural Effusion.—THE PARAVERTEBRAL TRIANGLE OF DULNESS.—In March 1902 Grocco of Florence described as a new sign of pleural effusion a triangular area of dulness on the sound side of the chest. It is bounded below by the base of the lung, internally by the vertebral spines, and externally by the hypotenuse of this right-angled triangle. Since Grocco made known his discovery, a number of observers have corroborated it, and most clinicians appear to ascribe considerable diagnostic significance to the presence of this triangular dull area. Thayer and Fabyan regard it as a constant and characteristic sign of fluid, and an important addition to our means of diagnosis. They were able to demonstrate its presence in thirty out of thirty-two cases. The breath-sounds over the dull area are faint; there may be ægophony. Ewart lays considerable stress on the fact that when the patient lies on the affected side the triangle of dulness disappears, and returns again when the erect posture is assumed. The triangle is usually larger on the left side—that is, in the case of right-sided effusions—than on the right. The most probable explanation of the phenomena is that offered by Baduel and

Siciliano, viz. that the fluid lying against and pressing anteriorly over the bodies of the vertebræ acts as a mute in suppressing the sonorous vibrations of the spine. This deadening of the resonance is naturally appreciable for a certain distance beyond the median line over the area occupied by the transverse processes and the first part of the ribs. It is more marked and extends over a wider area at the base, where the fluid, collecting in the sinus of the pleura, comes into wider contact with the vertebræ and pushes farther around towards the affected side. The displacement of the contents of the mediastinum—aorta, azygos vein, œsophagus, and heart—may play a part, especially in effusion on the right side of the chest, in producing this dulness as well as in bringing about a certain degree of compression of the lung on the opposite side.

REFERENCES.—Fabyan and Thayer, *Amer. Journ. Med. Sci.*, Jan. 1907.—Ewart, *Lancet*, ii. p. 216, 1905.—Baduel and Siciliano, *Riv. crit. di clin. med.*, vi. p. 411, 1905.

Group - Action. — *See* Immunity (*Agglutination*).

Grouse Disease.—A form of avian coccidiosis due to *Eimeria* (*coccidium*) *avium*, which has a destructive effect on the epithelium of the duodenum and cæca in grouse chicks setting up diarrhœa; the cæcal droppings contained spores (schizogony and sporogony occurring in the intestine), and these were a source of infection on the moors, aided probably by the larvæ of *Scatophaga;* other parasitic protozoa have been found in the intestine of the grouse, but they do not appear to be very harmful to the birds. *See* papers by Fantham summarised in the *Brit. Med. Journ.*, i. for 1910, pp. 59 and 1252.

Guacamphol.—An insoluble guaiacol compound (camphorate), having the advantage over guaiacol of being tasteless.

Guaco.—A plant from Caraccas, Venezuela, reputed to possess remedial qualities in cases of snake-bite, black scorpion bite, and in hydrophobia. See *Lancet*, i. for 1908, p. 1084.

Guaiacose.—A proprietary preparation containing somatose and calcium guaiacol-sulphonate; it is recommended in wasting diseases and convalescence for its nutritive and antiseptic properties. For analysis see *Lancet*, ii. for 1908, p. 1375.

Guaiac Reaction. — *See* Digestive Functions, Tests for.

Guaialin. — A formaldehyde derivative which does not liberate formaldehyde even on boiling; according to Soltman it has practically no action as an intestinal antiseptic.

Guaiamar. — A soluble guaiacol compound, being guaiacol-glycerin-ester, recommended in doses of from 3 to 15 grains in phthisis and as an intestinal antiseptic.

Guanase.—The ferment by whose action guanin is converted into xanthin when finely divided pancreas acts upon the guanin for some hours at 40° C.

Guipsine. — An alkaloid (volatile and liquid) prepared from fresh mistletoe, under the supervision of Leprince, and said to constitute its active principle; it is recommended in cases of arteriosclerosis, hæmoptysis, gout, etc., for the relief of arterial hypertension. See *Lancet*, i. for 1909, p. 925.

Gull's Renal Epistaxis.—A form of hæmaturia in which no definite lesion has been discovered; it has been termed renal hæmophilia, angioneurotic hæmaturia, and renal aneurism.

Hæmagglutinins. — *See* Immunity (*Agglutination*).

Hæmamœbiasis.—Malaria or paludism, so called from the parasitic organism (*Hæmamœba vivax*, etc.) present in that disease.

Hæmatol.—An organic preparation of iron.

Hæmatopan.—An organic preparation of iron (from blood), along with about 40 per cent. of malt extract, possessing a pleasant taste and smell.

Hæmatose.—An iron preparation, being a compound of albumin with naphthol green; it is insoluble in the stomach, but its iron is split off by the action of the intestinal secretion. *See* Fortescue-Brickdale, *Guide to the Newer Remedies*, p. 72, 1910.

Hæminol.—An organic preparation of iron.

Hæmoalkalimeter. — *See* Blood (*Alkalinity*).

Hæmochromatosis with Diabetes.—Bronzed Diabetes.—Hæmochromatosis is a rare disease. Up to 1906 only 35 cases had been reported. Futcher gives as the three cardinal symptoms manifested in the most advanced stages:—1. Pigmentation of the viscera and usually also of the skin. 2. Cirrhosis of the liver, almost invariably of the hypertrophic type and accompanied by striking pigmentation of the organ. 3. Diabetes mellitus, which dominates the clinical picture in the latest stage of the disease. It is due to the final development of a pigmentary cirrhosis of the pancreas, thus interfering with its glycolytic function.

Bronzed diabetes was originally described by Hanot and Chauffard in 1882, and the majority of French clinicians look on the diabetes as primary: the diabetic alteration of the blood causes a destruction of the red cells, with deposition of blood pigment in the skin and viscera. In 1899 v. Recklinghausen described a general pigmentation of the viscera under the name hæmochromatosis. The tissues contained two varieties of pigment: hæmosiderin, which contains iron, and is found in the glands, liver, pancreas, and skin; and hæmofuscin, which is iron-free, and is found in some of the other viscera. The deposit of hæmosiderin in the cells of the liver and pancreas leads to cirrhosis, and when the islands of Langerhans are seriously involved, to diabetes. The ultimate cause of hæmochromatosis is unknown. It may be due to a toxic hæmolysis or to a disturbance of iron metabolism leading to retention in the system. It is also a disputed point whether the cirrhosis is due to the deposit of hæmosiderin or to the action of the hypothetical toxic agent which causes hæmolysis.

Clinically, the disease seems generally to be recognised when diabetes has developed. Futcher describes the appearance of his second case thus: "One was immediately struck by the remarkable pigmentation of the skin. This was most marked over the face, neck, and hands, where the skin had a very dark brown colour. The skin of the whole body was much more pigmented than normal, and there was intensification of the colour in the axillæ. . . . There was no pigmentation of the sclerotics, nor of the buccal mucous membrane." A portion of skin removed showed the presence of hæmosiderin in the sweat glands.

REFERENCES.—Opie, *Trans. Assoc. Amer. Physn.*, p. 253, 1899.—Futcher, *Ibid.*, p. 278, 1906. Both these papers have bibliographies.

Hæmoclastics.—Bodies which act on red blood cells, causing their dissolution and the setting free of their hæmoglobin; hæmolytics.

Hæmoconien.—*See* Hæmokonia (*Encyclop. and Dict. Med.*, Vol. IV. p. 35).

Hæmofuscin. — *See* Hæmochromatosis.

Hæmoglobinuria, Paroxysmal.—Some interesting light has been thrown by Eason on the pathology of this disease, and his work suggests a possible line of treatment. He found, in the first place, that the blister serum of a hæmoglobinuric patient, taken in the intervals between the paroxysms, partially dissolved normal blood corpuscles *in vitro*, interfered with the formation of rouleaux, and lessened the amount of fibrin deposited on standing. Serum obtained during a paroxysm lysed both normal corpuscles, and those of the patient himself; the latter were more markedly affected than the former. The amount of hæmolysis produced was greatly influenced by temperature; it did not occur at 37° C., at room temperature it was definite, and at 1° C. it was extreme. Serum which was heated to 56° C. for half an hour lost its power of producing hæmolysis; in this respect it is comparable to an ordinary hæmolytic serum (see Immunity, p. 192), its activity depending, presumably, on its containing a thermostable amboceptor and a thermolabile complement. Shortly after Eason's work was accomplished Donath and Landsteiner recorded some quite independent experiments, which confirmed his observations, and showed, in addition, that a low temperature was essential for the union of amboceptor and red blood corpuscles. Eason's next series of experiments showed that hæmoglobinuric serum lysed corpuscles when it was allowed to act on them first at a low temperature, then at body temperature. During the period of low temperature the amboceptor unites to the corpuscles, but the complement cannot link itself to the amboceptor; in order that it may do so, a higher temperature is needed. As in the case of ordinary hæmolytic serums, inactivated hæmoglobinuric serum may be activated by the addition of fresh normal serum containing complement. According to these observations the paroxysmal hæmoglobinuria is due to the existence in the blood of a potential toxin, consisting of hæmolytic amboceptor and complement, the potential toxin only becoming active under special conditions of temperature. Atmospheric cold and stasis of the peripheral circulation reduces the temperature of the blood locally sufficiently to permit of the union of amboceptor and corpuscles, and the further union with complement (= hæmolysis) rapidly occurs when the blood returns to the internal organs.

By immunising guinea-pigs (the serum of which does not hæmolyse human blood corpuscles) with the inactivated serum of a hæmoglobinuric patient, Eason obtained an anti-amboceptor serum. The antiserum neutralised (*in vitro*) the lytic action of the original hæmoglobinuric serum, and also that of the serum of a second hæmoglobinuric patient. The observation shows that the hæmolytic amboceptor of paroxysmal hæmoglobinuriacs is a specific body, and suggests that it may prove feasible to procure an antitoxin.

LITERATURE. — Eason, *Edin. Med. Journ.*, xix. p. 43, 1906; *Scott. Med. and Surg. Journ.*, May 1906; *Journ. Path. and Bact.*, 1906. — Donath and Landsteiner, *Münch. med. Wochensch.*, 1590, 1904.

Hæmolysis. — *See* Immunity (*Antibacterial Action*).

Hæmopsonins.—*See* Immunity.

Hæmo-renal Salt Index. — The ratio obtained by comparing the electrical resistance of the blood and of the urine; in health this is equal to three, four, or five whole numbers—viz.

$$\frac{\text{Electrical resistance of blood}}{\text{Electrical resistance of urine}} = \frac{900}{225} = 4,$$

and the higher the number the healthier (*ceteris paribus*) the state of the patient; an increase in the index meant that the urine contained more salts and the blood fewer salts or was richer in corpuscles, whilst a diminution in the index indicated sluggish renal action. *See* Dawson Turner, *Lancet*, i. for 1907, p. 58.

Hæmostasin.—One of many names for the active principle of the medulla of the adrenal gland.

Hæmostasis, Momberg's Method.—Momberg has proposed as a method of checking hæmorrhage in operations on the lower half of the body to apply a constricting band round the waist so as to compress the abdominal aorta (*Centralbl. f. Chir.* 1908, No. 23). A rubber tube the thickness of the finger, stretched to its full extent, is gradually applied until the pulsations of the femoral artery can no longer be detected. The procedure was first tried on two healthy persons for five minutes, and no evil effects resulted. An anæsthetic is not required for the application of the ligature, but after it has been on for one quarter to half an hour considerable pain is caused. It is said that for operation a smaller quantity of anæsthetic than usual is required, and that patients come out of its influence quickly when the ligature is relaxed on account of the detection of the anæsthetic by the released blood. At the German Surgical Congress, 1909, Momberg stated that he knew of thirty-four cases in which it had been employed without giving rise to any complication. The first result of applying the tourniquet is in some instances to increase the rate of the pulse, and, again, on removing the tourniquet there may be disturbance of the circulation.

Momberg's method has been used in amputations at the hip, operations on the pelvis, excision of the rectum, prostatectomy, and the like, and so far as preventing hæmorrhage is concerned, appears to be very successful. It is not, however, as safe a procedure as its inventor would have us believe. While in most cases the changes in the pulse rate on applying and removing the constriction are comparatively slight, in some cases they are serious. Thus Rimann reports a case (*Zeitschift f. Chirurgie*, May 1909) of collapse and heart-failure on the application of the tourniquet during the course of an operation for cancer of the rectum; and another in a healthy woman, where the tourniquet caused the blood pressure to fall rapidly from 115 mm. Hg to zero. Both recovered when the tourniquet was removed. Gross (*Rev. de Chirurgie*, May 1910) lost a patient after the operation was completed from collapse produced by removal of the tourniquet. Apart from collapse, paralysis of the bladder and rectum, cramps in the legs, hæmophysis, epistaxis, and hæmorrhage from the intestine have been observed. So far as can be gathered from the reported cases it seems at present that Momberg's method labours under several disadvantages, and though undoubtedly it will prove most valuable in selected cases, it cannot come into very general use. It should not be used in persons suffering from arteriosclerosis; the constricting band should be applied and removed very slowly; the legs should be elevated and bandaged before the tourniquet is used, and the bandages should be slowly removed after the tourniquet is taken off. Although Momberg's method has been employed for operations lasting over an hour, it is probable that other methods of hæmostasis would be safer in prolonged operations. It is said to be of advantage to employ the Trendelenburg position along with Momberg's method.

Hæmothymia.—The term proposed by T. Claye Shaw for the condition of irresistible craving or lust for blood which is a prominent motive for murder in certain cases, leading the unfortunate and dangerous possessor of it to attack selected or in some instances indiscriminate victims (*Lancet*, i. for 1909, pp. 1735-1738).

Hæser's Coefficient.—The multiplier (2·33) by which the two last figures of the specific gravity of the urine are multiplied in order to get the approximate number of grams of total solids in every 1000 c.c.

Haines' Coefficient.—The multiplier (1·1) by which the last two figures of the specific gravity of the urine are multiplied in order to get (as the result) the number of grains of solids in each fluid ounce.

Haines' Solution.—A test solution for the detection of glycosuria; it contains sulphate of copper (30 grains), water (half an ounce), glycerine (half an ounce), and liquor potassæ (half an ounce); a small quantity is boiled, and then a few drops of the suspected urine are added, and it is again boiled, when a yellowish or reddish precipitate indicates the presence of sugar.

Hamartoma.—Albrecht's name for an angioma, which is simply a swelling composed of blood-vessels, and shows no independent growth of the vessels.

Hammarsten's Test.—A chemical test for bile pigments, the reagent being a mixture of one part of a 25 per cent. nitric acid and nineteen parts of 25 per cent. hydrochloric acid; before use one part of the reagent is mixed with four parts of alcohol; a few drops of urine added to the mixture cause a green colour if bile pigments are present. *See* Webster, *Diagnostic Methods*, p. 316, 1909.

Hammerschlag's Method.—An areometric method of ascertaining the specific gravity of the blood by means of a mixture of benzol and chloroform. *See* Webster, *Diagnostic Methods*, p. 387, 1909.

Hanoline.—A proprietary preparation recommended as a detergent, especially for removing grease and grime (*Lancet*, ii. for 1908, p. 1375).

Harmaline.—An alkaloid (one of two, the other being *harmine*) found in the seeds of *Peganum harmala* (the wild rose, *πήγανον ἄγριον*, of Dioscoridés); its formula is $C_{13}H_{14}N_2O$, and its pharmacological action is similar to that of quinine (even in the detail of inducing sustained tetanic contraction of the uterus). *See* J. A. Gunn, *Trans. Roy. Soc. Edin.*, vol. xlvii., Pt. ii., pp. 245-272, 1909-10.

Harris's Urine Segregator.—*See* Bladder, Female (*Catheterisation*).

Hay Fever.—In 1902 Professor W. P. Dunbar, the Director of the State Institute for Hygiene, Hamburg, working at the cause of hay fever, disproved the bacterial theories of the origin of the disease which were then prevalent, and confirmed the correctness of Blackley's much earlier observation, viz. that the paroxysms were excited in susceptible persons by inhaling grass pollen. He showed that pollen collected in such a manner as to ensure its sterility retained the power of causing attacks; that pollen does not act merely as a mechanical irritant; that its effects are due to a toxalbumin. Pollen capable of producing hay fever has been obtained from 25 kinds of grasses, and from the privet, lily of the valley, rape, thistle, and some other plants. The pollen of roses, limes, and wormwood, which have been accused of producing the disease, is inactive. North American autumnal catarrh is due to the pollen of ragweed and golden rod, two common weeds of that continent; it is also caused by the pollen of asters and chrysanthemums. The toxalbumin was prepared by precipitation with alcohol from a salted-out extract of crushed pollen. It is so active that $\frac{1}{40000}$ mg. (the amount contained in one or two grams of pollen) may bring on an attack in a susceptible person. It resists heat, requiring a temperature of 150° C. to destroy its properties.

When hay-fever toxin is applied to the conjunctiva, nose, or throat, it produces (in susceptible persons) lachrymation, photophobia, sneezing, irritation of the nose, coryza, cough, dyspnœa, stridor; when rubbed into the skin there is a local redness or urticaria; subcutaneous injection may produce a severe attack of hay fever, with asthma, cyanosis, urticaria, and œdema—the last named persisting after the respiratory symptoms have subsided. Normal persons are insusceptible, but Semon points out that in persons who are liable to causeless attacks of sneezing a mild grade of reaction may occur. From this toxin an antitoxin (*pollantin*) can be prepared by actively immunising horses. An antiserum has been obtained strong enough to neutralise 60 times the dose of toxin required to produce marked reaction. It can only be standardised by using hay-fever patients as test-subjects. By injecting this antitoxin passive immunity limited to about 24 hours is obtained. The obvious drawbacks to repeated injection render this method of using it impracticable. Owing to the short duration of passive immunity active immunisation is desirable, but on account of the unpleasant results of injections of toxin it cannot be employed for this purpose.

Dunbar points out, however, that as the patient during the hay-fever season is constantly exposed to infection, active immunity will be acquired naturally; during this time he advises the use of pollantin as a prophylactic, therefore his method of treatment is a combination of active and passive immunisation. He advises the daily instillation of one drop of liquid pollantin, or a mass of dry pollantin equal to the size of a pin's head, into each conjunctival sac, and into the nose. This should be done in the morning, before the patient is exposed to infection. If an attack occurs during the day the dose may be repeated. It is of importance during the treatment that the patient should do his utmost to ward off attacks, by avoiding unnecessary exposure to pollen, and that the treatment should be persisted in, not desisted from, because there has been freedom from hay fever for a few days. He gives the following results of this treatment (1908):—696 cases with excellent results, 381 cases with partial success, 163 cases with no success.

Semon finds that it is impossible to foretell which cases of hay fever will respond to treatment. Various surgical procedures have been employed, such as the correction of intranasal abnormalities (*see* Submucous Resection), partial and total turbinectomy, and resection of the nasal branch of the fifth nerve (as suggested and practised with some success by

Eugene S. Yonge). Bilateral excision of the tubercle of the nasal septum has also been tried.

LITERATURE.—Dunbar, *Deutsche med. Wochensch.*, No. ix., 1903; *Berl. klin. Wochensch.*, 15th June, 22nd and 29th July 1903.—Article "Hay Fever," Osler and M'Crae's *System of Medicine*, vol. iii., London, 1908.—Semon, *Brit. Med. Journ.*, 28th March, 18th April, 18th July 1903.—Yonge, E. S., *Hay Fever and Paroxysmal Sneezing*, 1910.

Heart, Diseases of.

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In no department of medicine has there been greater advance in recent years than in the study of diseases of the circulation. Progress has come from work along two main lines, viz. investigations into the anatomy and physiology of the heart, and the application to clinical work of new methods, particularly in the direction of obtaining graphic records of the movements of the several chambers of the heart.

Graphic Methods.—For clinical purposes, Dr. James Mackenzie's clinical polygraph is one of the simplest instruments. Two forms are in use:—1. A Dudgeon's sphygmograph with an additional writing lever actuated by a tambour, which is connected by a rubber tube to a hollow metallic cup or receiver 1½ ins. in diameter and ½-an-inch deep. This receiver is applied over the jugular vein when a record of the venous pulse is desired. For recording the liver pulsations a larger receiver is employed. A time marker may be attached to the sphygmograph. With this instrument simultaneous tracings of the venous and radial pulses, timed in fifths of a second, can be secured on an ordinary smoked paper. 2. The ink polygraph is a more elaborate instrument, and is used when tracings have to be taken over a longer period of time than a sphygmograph allows of. In the ink polygraph the writing points are ink cisterns with pens attached, fixed to the levers of two tambours; the record is made on a continuous roll of paper. One tambour is connected with a receiver for the venous or liver pulse; the other is connected with a third tambour, which is adapted to fit on a splint strapped over the wrist so that a spring in the splint rests against the radial artery. When the tambour is slipped into position on the splint it impinges against the spring, so that it conveys the movements of the pulse to the tambour furnished with a pen, and this records the movements on the roll of paper. The ink polygraph is furnished with a time marker recording fifths of a second, and an arrangement for varying the speed at which the strip of paper travels.

A full account of the use of these instruments will be found in Dr. Mackenzie's *Diseases of the Heart* (London: 1908). He also gives a full description of the characteristics of the various tracings which may be obtained. Here we shall only refer to the radial and venous tracings, as these afford the most generally useful information as to the action of the heart, and the events in the circulation.

The jugular pulse is recorded while the patient lies down, the shoulders being slightly raised on a pillow, and the head turned a little to the right. The hollow receiver of the polygraph is applied to the neck just above the inner end of the right clavicle with sufficient pressure to exclude the outer air. The receiver may need to be moved about to get the best trace.

The normal venous pulse (Fig. 1) shows three main waves:—The *auricular* wave and fall (*a* and *x*), the *carotid* wave (*c*), and the *ventricular* wave (*v*).

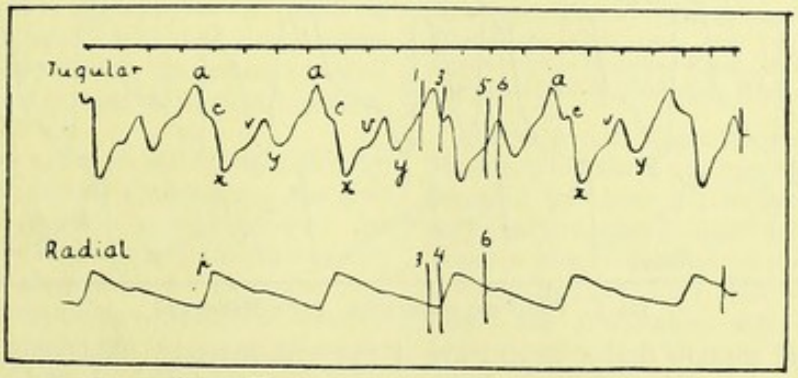

Fig. 1.—Normal venous pulse. (After Mackenzie.)

The auricular wave is due to the systole of the auricles, and is followed by a fall (x) as they relax. After the auricles relax blood is stored up in them during the period of ventricular systole, and this storage of blood causes the lever to rise and produce the wave v, which terminates as the auriculo-ventricular valves open and allow the stored-up blood to escape into the ventricles. The termination of the wave v, therefore, marks the moment of opening of the tricuspid valve. The carotid wave (c) is due to a communicated impact from the carotid artery, and marks the time of ventricular systole. The notch on the wave v just before its termination corresponds in time with the closure of the semilunar valves. The interval of time between the auricular and carotid waves is extremely important from the clinician's point of view. It is known as the a-c interval, and its normal duration is one-fifth of a second. Prolongation of this period is an evidence of depression of the conductivity of the heart muscle.

The radial trace (Fig. 3) may be divided into two parts, a systolic and a diastolic interval. The systolic period includes the so-called percussion and predicrotic waves (p and r). According to Mackenzie, the former is instrumental. With the closure of the semilunar valves the pressure falls to the bottom of the aortic notch (n) but the fall is interrupted at the beginning of the diastolic period by the dicrotic wave (d).

The relationship between the jugular and radial tracings is shown in Figs. 1 and 2. At the commencement of a tracing, before the paper is set in motion, it is customary to allow the levers to record vertical strokes; these afford a fixed point from which measurements can afterwards be taken.

Analysis of a Tracing.—When the venous pulse consists merely of a series of irregular undulations (Fig. 2) it is often impossible by

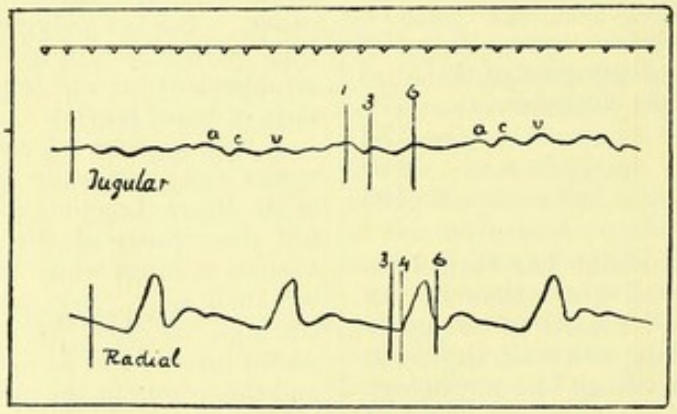

FIG. 2.—(After Mackenzie.)

simple inspection to localise the various events occurring in it. In such a case the radial tracing is used as a guide. Make a perpendicular stroke at the beginning of a radial pulse, and then a second, one-tenth of a second in front of it (4 and 3, Fig. 2). Stroke 3 indicates the time of the carotid pulse. With a pair of compasses mark off the distance from the beginning of the tracing to 3, and measure a similar distance in the venous pulse: a perpendicular at this point will cut the carotid wave. The auricular wave is one-fifth of a second before this (1, Fig. 2). The aortic notch corresponds in time with the undulations on the ventricular wave, just before the termination of the latter, so that a perpendicular through it may also be used as a guide (6, Fig. 2).

Ventricular Form of Venous Pulse (Fig 3).—In this form of pulse tracing the auricular wave

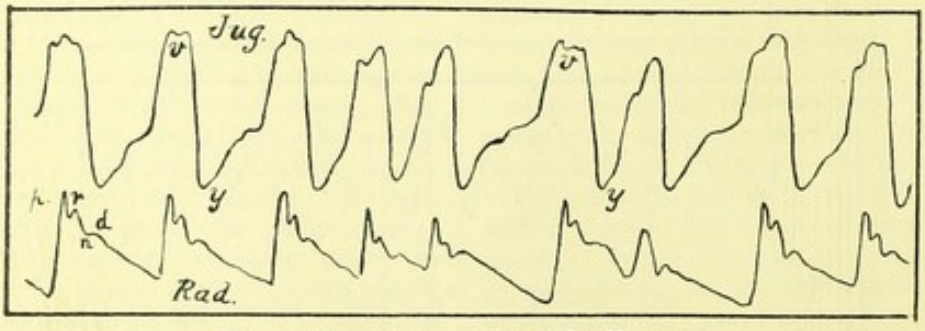

FIG. 3.—Ventricular venous pulse. (After Mackenzie.)

has disappeared, and we now find a large wave synchronous with systole, and a fall synchronous with diastole. Mackenzie looks on this as evidence that the rhythm of the heart is

originating at some place other than the mouths of the veins. The rhythm of the heart in which a ventricular venous pulse is obtained is called the "nodal rhythm," and its onset is characterised by (*a*) a change in the venous pulse from the auricular to the ventricular type, (*b*) disappearance of all other evidences of auricular systole, *e.g.* the cessation of a previously existing presystolic bruit, and (*c*) continued irregularity.

Electro-Cardiograms.—The galvanometer has been applied to the study of the movements of the heart by G. A. Gibson and Einthoven, whose independent investigations were carried on, and published, almost simultaneously. Gibson employed Lippmann's capillary electrometer, connecting the acid with the basil region of the præcordia, and the mercury with the apical. In the case examined a condition of heart-block was present, there being three or four auricular systoles to each ventricular systole. The usual diphasic movements of the mercury occurred preceding the apex beat, and between these, smaller oscillations were also detected, evidently due to auricular contractions, since they corresponded with the venous pulsations which had already been found in venous tracings, and with the movements of the auricles seen on the fluorescent screen.

Einthoven's work was more elaborate; he employed a string galvanometer, and recorded its movements on a travelling photographic plate, on which, too, ordinates and abscissæ, representing electric potential and fractions of a second respectively, were also represented. He thus obtained tracings which he called electro-cardiograms, or, when the galvanometer was at a distance from the patient (in the physiological laboratory) and connected with him by a long stretch of wire, "telelectrocardiograms." The tracings obtained differ from those got by other means, and for a full account of these the original must be referred to. Briefly, they show five oscillations, of which the first is auricular, the remainder being due to contractions of the ventricles. The curves vary according to the state of the ventricles: thus in hypertrophy of the right ventricle the upward wave is exaggerated; in hypertrophy of the left ventricle, the downward wave is increased. Extra-systoles yield a typical curve. In heart-block the dissociation of auricular and ventricular movements is well brought out. The *a-v* interval in electro-cardiograms is about ·175 sec.

Ortho-Diagraphy of the Heart.—The difficulty and uncertainty of exactly determining the size of the heart by percussion is well known. In ordinary skiagrams, and in using the fluorescent screen, the angle at which the rays are projected renders it impossible to record or observe the dimensions of the organ accurately, but by an apparatus known as the ortho-diagraph, it is claimed that an absolutely faithful outline of the heart can be traced. As a special and rather cumbrous appliance is required it is sufficient to describe the principle underlying the ortho-diagraph.

In the ordinary use of X-rays a magnified and distorted image of the heart is projected on the plate or screen. If, however, instead of using the divergent rays from the tube, only one ray, namely, that which is perpendicular to the plane of projection, is used, and if means be provided to conduct this ray round the object (the ray always being kept perpendicular) it is apparent that a true, non-magnified, shadow will be cast. This end is attained as follows:—A fluorescent screen and an X-ray tube are fixed to two parallel metal arms rigidly united to one another. The distance between the arms is such that the thorax can be interposed. The fluorescent screen is perpendicular to the central ray of the tube, and projecting through the screen is a pencil so adjusted as to lie accurately in the axis of the central ray. The whole arrangement is counterpoised on a framework, and is readily movable in all directions. The patient is seated between the tube and screen, on which the shadow of the heart is thrown. The outline of the shadow is now traced on the thorax or on a sheet of paper with the pencil, and as in doing this the observer only utilises the central ray which falls on the point of the pencil, and which moves with the movements of the latter, a true outline of the heart is obtained. The ortho-diagraph was devised by Professor Moritz, and Levy-Dorn's pattern is that generally employed.

Freund states that in ortho-diagrams the heart of an individual remains of constant size under different conditions of rest and exercise. It enlarges under the influence of diphtheria toxin. Dilated hearts are not reduced by baths, but may become normal under the action of digitalis.

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Recent Anatomical and Physiological Work.—Of the two opposing theories of the cause of the beat of the heart—the myogenic and the neurogenic—the former is that which is most widely held at present. According to the myogenic theory, the contractions of the heart are automatic, and do not depend on nervous stimuli. During the past four or five years, however, the neurogenic theory has

received renewed support, and at present the question as to which is correct remains an open one. The subject is a complicated one, and would require a lengthy discussion to do it justice. For admirable summaries of the arguments for and against, the oration to the Medical Society of London by G. A. Gibson, who inclines to the neurogenic hypothesis (*Edin. Med. Journ.*, July 1907), and an article by Gossage on the "Automatic Rhythm of the Heart" (*Brit. Med. Journ.*, vol. ii. p. 1818, 1907) should be referred to.

Much of our present knowledge of the action of the heart is based on Gaskell's work, which demonstrates that heart muscle possesses the five-fold function of (1) *generating stimuli* to contraction; (2) receiving such stimuli — *excitability*; (3) conveying such stimuli from one fibre to another—*conductivity*; (4) contracting—*contractility*; and (5) maintaining a certain degree of tonic contraction, even where active movement has ceased—*tonicity*.

Conductivity.—The nature of the conducting system of fibres has been elucidated by the labours of Stanley Kent and His (jr.), Gaskell, Keith and Flack, Tawara, Erlanger, and others. The conducting fibres consist of the remains of the primitive cardiac tube, and have the power both of originating and conducting impulses to contraction. The auriculo-ventricular bundle —the bridge which conveys impulses from the auricles to the ventricles—was described in 1893 by His and Kent, and its structure and ramifications were carefully worked out by Tawara, whose observations were published in 1906. Keith and Flack discovered a remnant of the sinus venosus (the "sino-auricular node") near the mouth of the superior vena cava, and this probably is the point from which the auricular contractions originate. In structure it resembles the auriculo-ventricular bundle; it contains nerve fibrils. Lower down the auriculo-ventricular bundle begins in the auricle in front of the coronary vein and passes forwards on the right side of the interauricular septum to a nodal point ("the node") above the attachment of the mesial flap of the tricuspid valve. From this nodal point the fibres run down in two main bundles, one to each ventricle, which subdivide to form a sub-endothelial network and trabeculæ, and end in the papillary muscles. They are insulated from the rest of the heart by a connective tissue layer. The left main trunk can often be seen in the hearts of elderly persons as a whitish band, measuring about a quarter of an inch in breadth, below the pars membranaceæ septi. The fibres of the bundle and its branches differ histologically from the rest of the heart muscle in showing a less development of sarcoplasm and a more reticular arrangement (Purkinje's fibres). They ultimately lose their connective tissue sheath, and become directly continuous with the heart muscle. The auriculo-ventricular bundle is accompanied by nerve-fibrils and a special branch of the coronary artery.

The wave of contraction normally passes from the auricles to the ventricles by way of the auriculo-ventricular bundle. It has been ascertained by experiment upon animals that the time required for the transmission of an impulse from auricles to ventricles along the *a-v* bundle is one-fifth of a second. The impulse can be checked more or less completely by compressing the bundle more or less forcibly. When this is done, an interesting series of phenomena follows. Slight pressure causes a progressive lengthening of the intervals between the contractions of the auricles and those of the ventricles (the auriculo-ventricular period), until eventually the ventricles fail to respond to one of the exciting waves. In the next cardiac cycle, owing to the fact that the longer period of rest has increased the excitability of the ventricles, the auriculo-ventricular period is unusually brief, lengthening out again as before in the succeeding cardiac cycles. As the compression of the *a-v* bundle is increased, the omission of ventricular beats occurs more frequently; thus at first there may be failure on the part of the ventricle to respond to every eighth auricular systole (8 : 1 rhythm), while with further compression we get a series of 7 : 1, 6 : 1, ... 2 : 1 rhythms, in the last of which only every alternate auricular contraction is followed by a ventricular contraction. On still further compressing the bundle, only every third or fourth auricular wave stimulates the ventricles to contract—in other words, rhythms of 1 in 3, 1 in 4, ... develop. These stages of partial block are explained by the progressively increasing irritability of the resting ventricular muscle, eventually reaching such a pitch that a mere fraction of the normal stimulus is adequate to provoke a contraction. When a 1-in-3 rhythm is reached, however, complete heart-block is usually established, the ventricles asserting their independent rhythm, and becoming completely dissociated from the auricles. When this condition of heart-block exists, stimulation of the accelerator nerve of the heart increases the rate of both chambers; stimulation of the vagus or its paralysis by atropine, on the other hand, only affects the auricles.

When, instead of compressing the *a-v* bundle gradually, it is suddenly and forcibly clamped so as to produce heart-block, the typical sequence of events is somewhat different. The ventricles stop, the auricles continue their beat undisturbed, and distend the relaxed ventricles with blood. After a pause lasting up to eighty seconds or more, the ventricles begin to contract again, and take up their own independent rhythm. The pause following sudden tightening up of the clamp may be so long as to induce

respiratory convulsions. When partial block is transformed into complete block the same momentary check in the ventricular beat occurs. Partial block can be transformed into complete block by (*a*) stimulating the auricles to beat more rapidly, which results in a less effective though more frequent auricular wave; or (*b*) stimulating the vagus, and thereby inhibiting the auricles altogether.

Erlanger summarises the results of his investigations as follows:—

"1. In the dog, the impulse which normally causes the ventricles to contract is conducted through the auriculo-ventricular bundle of His.

"2. By compression of this bundle all stages of heart-block may be obtained. These include (*a*) an increase of the intersystolic pause; (*b*) an occasional ventricular silence; (*c*) regularly recurring ventricular silences—for example, one silence in ten, nine, eight, seven, six, five, four, three, and two auricular beats; (*d*) a two-to-one rhythm; (*e*) a three-to-one rhythm; (*f*) complete heart-block.

"3. As a rule, the ventricles take on a constant slow rate at the moment complete heart-block is established. Occasionally, usually when the block becomes complete suddenly, there results a marked preliminary slowing of the ventricular rate. The auricular rate does not change.

"4. When the block is complete, stimulation of the vagus nerve has no, or but a minimal, effect upon the rate or force of the ventricular beats, whereas the auricles still react normally.

"5. When the block is complete, stimulation of the accelerator nerve increases the rate both of the auricles and ventricles.

"6. When the block is complete, the rate of ventricular beats may not be materially affected by variations in the general blood-pressure, nor by asphyxia, nor by interference with the coronary circulation."

The close analogy which exists between experimental heart-block in animals and heart-block as met with in man from disease of the auriculo-ventricular bundle is one of the most striking proofs which has ever been afforded of the value of physiological investigations as applied to practical medicine.

Irregular Action of the Heart.—Mackenzie classifies irregular action of the heart as:—(1) Sinus irregularities; (2) extra systoles; (3) nodal rhythm; (4) irregularities due to failure of the conducting power of the primitive bundle; (5) depression of the contractility of the ventricles—pulsus alternans. Hering's classification is very similar:—(1) Pulsus irregularis respiratorius; (2) pulsus extrasystolicus; (3) pulsus irregularis perpetuus; (4) pulsus transmissorius; (5) pulsus alternans. In discussing these various forms of irregularity, we shall depart from the order given, and take up, in the first place—

1. *Irregularities due to Failure of the Conducting Power of the Primitive Bundle.*—Under this head comes the very interesting and important condition known as heart-block, with its symptoms, bradycardia and Stokes-Adams disease. The phenomena of heart-block have engaged the study of so many observers, that it is impossible to enumerate all those who have helped to elucidate the subject. Mention must be made, however, of the work of Mackenzie, G. A. Gibson, Schmoll, Hay, W. T. Ritchie, and A. G. Gibson, whose noteworthy contributions to the clinical aspects of the question have formed a fitting complement to the anatomical and physiological investigations referred to in the preceding paragraph.

Minor degrees of depression of conductivity can only be recognised by taking simultaneous tracings of the jugular and radial pulses. The signs by which it is recognised are (1) prolongation of the *a-c* interval beyond the normal $\frac{1}{5}$-sec.; and (2) the occasional dropping out of a radial and carotid wave (Fig. 4).

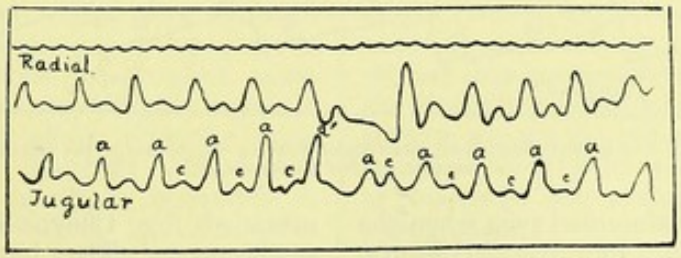

Fig. 4.—Showing gradual lengthening of the *a-c* interval up to *a'*, where the impulse fails to cross to the ventricles and provoke a contraction. Ensuing *a-c* interval shorter, owing to resting ventricle having regained its contractility. (After Mackenzie.)

By the term *heart-block* is meant an interruption in the wave of contraction which normally passes from the auricles to the ventricles. When the wave is blocked, instead of the auricular and ventricular contractions occurring in harmoniously co-ordinated sequence, they become dissociated and independent of one another. The ventricular contractions begin to take place much less frequently than those of the auricles, and, as a result, bradycardia is established. This bradycardia, when, as is often the case, associated with syncopal or epileptiform attacks, is known as Stokes-Adams disease. The Stokes-Adams symptom-complex

is now known to be invariably due to heart-block, and to have for its pathological basis a lesion of the conducting fibres between auricle and ventricle.

Clinically, heart-block reveals itself by a persistently infrequent pulse. The infrequency is due to the dropping out of ventricular beats, owing to blocking of impulse descending the *a-v* bundle. The ventricular systole may only drop out at rare intervals, or it may drop out at every 2nd, 3rd, 4th, ... beat, giving rhythms of 2 : 1, 3 : 1, 4 : 1, . . . , just as in experimental block referred to above. When the pulse-rate is as low as about 30, the probability is that there is complete dissociation of the ventricular and auricular rhythms, and that each set of chambers is beating independently.

The exact relationship of the auricular and ventricular beats is only to be determined by the aid of tracings. Thus, in Fig. 5 it is seen

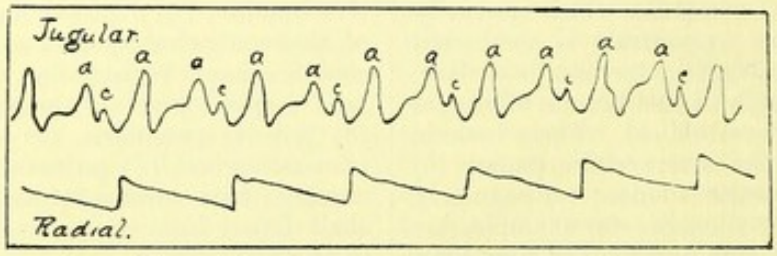

FIG. 5.—The ventricle only responds to every alternate auricular systole. Ventricular rate 48, auricular rate 96. (After Mackenzie.

that only every second auricular wave is followed by a ventricular contraction. Fig. 6 shows the tracing obtained in complete heart-block ; the ventricles pursue one rhythm, the auricles another. In some sphygmograms of the radial pulse in heart-block the auricular waves appear as a series of notches in the descending line of the tracing (Mackenzie).

G. A. Gibson points out that on auscultation it is often possible to hear the faint sounds produced by the auricles during the intervals between the ventricular beats. Ritchie has shown that (as in experimental block) the paralysing effect of atropine on the vagus affects only the auricles ; in an observation of this kind the auricular rate rose to 275, while the ventricles continued to beat at 36. The independent rhythm of the two sets of chambers can be demonstrated on the fluorescent screen, or by the electrometer (Gibson). The blood-

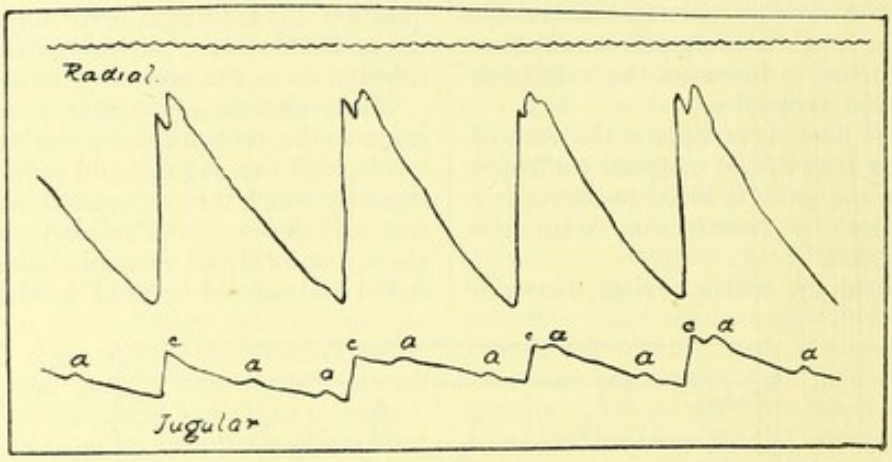

FIG. 6.—Complete heart-block, the auricles pursuing one rhythm (*a*) the ventricle another. (After Mackenzie.)

pressure may be well maintained even when the pulse is very infrequent. In a case of Gibson's, with a rate of 25, the maximum pressure reached 270 ; in another the maximum was 230, the minimum 75.

The syncopal attacks which go to make up the Stokes-Adams syndrome have already been described, and need only a brief mention here. They vary greatly in frequency and severity. They may consist merely of a dazed feeling of short duration, with some restlessness or faintness ; from this, up to serious or fatal syncope attended by Cheyne-Stokes respiration, all grades occur. They have the common feature, however, of being attended by a cessation of the pulse lasting for several seconds, and when the beat returns it may for some time be less frequent than prior to the seizure. Whether this temporary abrogation of the action of the ventricles is the cause or effect of the seizures was for long in dispute ; it is now, however, agreed that in these cases the stoppage of the pulse precedes, and is the cause of, the attack. Syncopal attacks may supervene either in partial

or complete block, and also perhaps when the heart is acting normally. As we have seen, experimental complete block, whether sudden or gradual, is attended by a temporary cessation of the ventricular beat, and it is reasonable to suppose that in disease the same thing takes place. When the conductivity of the *a-v* fibres is lowered by disease, any alteration of the auricular rhythm, such as may occur reflexly by way of the vagus, may be enough to irritate the independent ventricular rhythm and at the same time to cause a syncopal attack. The hypothesis that syncopal attacks are due to the transformation, from whatever cause, of partial into complete block is inadequate to explain their occurrence in cases which already present the phenomena of total block. It may be, as Hay and Schmoll suggest, that in these cases there is some direct interference with the operation of the intra-ventricular stimuli—*i.e.* the independent stimuli which arise in the ventricle itself, and regulate its independent contraction. Syncopal attacks are sometimes heralded by an aura; Jellinek and Cooper suggest that these pre-seizure sensations may be due:—(1) To extra-systoles; (2) to slight short seizures preceding more prolonged ones; (3) to the pumping in of blood into comparatively empty blood-vessels after an extra-systole has failed to open the aortic valves.

The morbid anatomy of heart-block has now been fairly well worked out. In all cases a lesion of the auriculo-ventricular bundle is present. A. G. Gibson quotes the records of thirteen cases, and among the conditions found were fibroid change, gumma, atheroma, arterio-sclerosis, anæmic necrosis, cartilaginous tumour, round-celled sarcoma, and atheroma of the arteries. A remarkable acute case is reported by Jellinek, in which there was (gonorrhœal) septic endocarditis and septic necrosis of the bundle. The essential feature, therefore, is a lesion implicating the auriculo-ventricular fibres.

The prognosis of heart-block with syncopal attacks is uncertain, as the patient may die in a seizure. Patients with bradycardia alone may live for many years. Slight forms of depressed conductivity show that the myocardium is becoming involved. Mackenzie regards these cases as peculiarly susceptible to the action of digitalis, which he believes to lower the conductivity. The drug should therefore be given with caution.

2. *Sinus Irregularity* (Mackenzie), *Respiratory Irregularity* (Hering).—As has been stated, the normal rhythmical stimulus to the contraction of the heart arises in the primitive cardiac tissue at the mouth of the great veins. Under certain circumstances the stimuli may occur at irregular intervals of time, the normal sequence of events in the cardiac cycle being otherwise undisturbed. The characteristic of this form of irregularity (which is of vagus origin) is that the diastolic intervals vary in duration, but on auscultation the intervals between the first and second sound of the heart remain the same, while the individual beats of the pulse are of equal strength. Sinus irregularity is common in children, in young adults after fevers, and when the respiration is slow. It is the form of irregularity which is met with in tuberculous meningitis. Sinus irregularity is not of serious import, and requires no treatment.

3. *Extra Systoles* (Mackenzie), *Pulsus extra-systolicus* (Hering).—In this form of irregularity there is a premature contraction of the auricle or ventricle in response to a stimulus from some abnormal point in the heart, the fundamental sinus rhythm being otherwise maintained. The irregularity shows itself by a premature beat, followed by an abnormally long pause. The premature beat is feeble; it may be so weak as not to reach the wrist. Hence an extra-systole is recognisable clinically as an "intermission." The pause which follows an

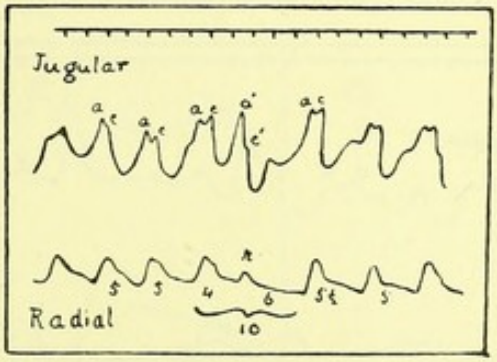

FIG. 7. — Auricular extra-systole at (a'). The numbers represent tenths of a second and the irregular period (r') equals two normal periods (Mackenzie).

extra-systole may be of such a duration that the intermission is exactly equal to two pulse periods, in which case it is said to be "compensatory." The pause in *ventricular extra-systole* (*vide infra*) is usually compensatory; in *nodal* or *auricular extra-systole* it is generally shorter (non-compensatory), and in consequence the succeeding pulse beats do not fall into the rhythm we are counting. On auscultation an extra-systole is heard as two short, sharp sounds, or sometimes only a single sound, followed by a long pause.

Extra-systoles may occur quite irregularly, or may be interpolated in regular succession alternating with normal beats, or after every second, third, or fourth beat, etc. (Pulsus bigeminus, etc.). If an extra-systole so feeble as to be imperceptible at the wrist occurs after every beat the pulse at the wrist appears very infrequent, and the condition may be mistaken for bradycardia, from which, however, it can be distinguished by auscultating the heart.

An extra-systole may originate from the

auricular fibres of the *a-v* bundle, from the node, or from the auriculo-ventricular bundle itself; that is, it may be an auricular, a nodal, or a ventricular extra-systole.

For the differentiation of these forms simultaneous tracings of the jugular and radial pulse are required.

(*a*) *Auricular Extra-Systole.*—In the jugular trace each extra-systolic carotid pulse is preceded by an auricular wave, showing that the extra-systole of the ventricles has been preceded by an extra-systole of the auricles (Fig. 7).

(*b*) *Nodal Extra-Systole.*—In this form the auricles and ventricles contract both simultaneously and prematurely. This is shown by a premature auricular wave in the venous trace coinciding in time with a premature radial beat. The auricular wave nearly obliterates the carotid wave, which, of course, also almost coincides in time with the radial beat (Fig. 8).

(*c*) *Ventricular Extra-Systole.*—In the simplest form (Fig. 8) a ventricular systole is interpolated between two normal beats. In the venous trace a corresponding carotid wave is interpo-

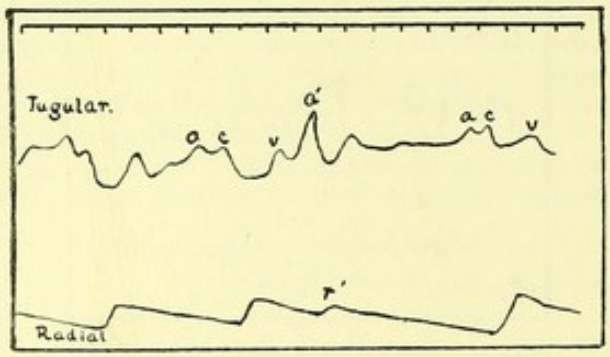

FIG. 8.—In the nodal extra-systole (*a'* and *r'*), the auricular and ventricular systoles are premature and simultaneous (Mackenzie).

lated, but there is no auricular wave, since the extra-systole is not initiated by a contraction of the auricles.

A more common form than the above, however, is a ventricular extra-systole, which, instead of being followed by a normal beat, is followed by a long pause. This points to failure of the auricular contraction succeeding the extra-systole (the "post-extra-systolic" contraction) to initiate a contraction of the ventricles. In the venous trace, therefore, the premature ventricular systole is shown by a carotid wave. This is succeeded at the normal time by an auricular (post-extra-systolic) wave, which, however, has no carotid wave following it, and no corresponding wave in the radial tracing (Fig. 10).

As we have seen, the auricular wave normally precedes the ventricular contraction. It is therefore obvious that a premature ventricular contraction may coincide in time with the auricular wave. In such a case the tracing resembles that of nodal extra-systole in showing simultaneous auricular and radial waves. The condition is distinguished from nodal extra-systole that in ventricular extra-systole the normal auricular rhythm is maintained, whereas in nodal extra-systole the auricular wave is premature.

Mackenzie regards extra-systoles as due to affection of the *a-v* bundle. He finds that its conductivity is impaired (lengthening of the *a-c* interval), and that, *post mortem*, degenerative changes can be detected in it.

Clinically, extra-systoles are met with in four groups of cases (Wenckebach):—(1) In healthy persons, with no organic disease of the heart; in neurasthenics. (2) In toxic conditions, *e.g.* tea and tobacco poisoning; in infections, *e.g.* pneumonia. The early occurrence of extra-systoles in the course of this disease is a bad sign. (3) In cases of arterio-sclerosis and high blood-pressure. (4) In organic heart disease.

4. *Nodal Rhythm* (Mackenzie), *Pulsus irregularis perpetuus* (Hering).—Under this head are included continued irregularity of the heart (such as occurs in most cases of heart failure) and paroxysmal tachycardia. In nodal rhythm the ventricles and auricles contract simul-

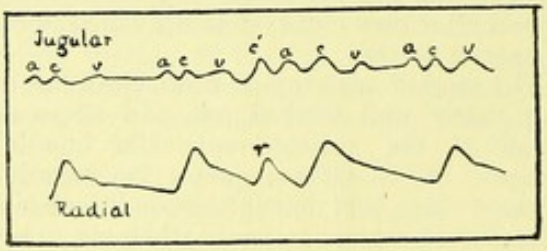

FIG. 9.—Ventricular extra-systole (*r'*) interpolated between two normal beats. *c'* is the corresponding carotid wave. (Semi-diagrammatic, modified from Mackenzie.)

taneously, and Mackenzie believes that the stimulus to contraction originates at the node of the *a-v* bundle. The heart's action is always irregular and generally rapid. The radial tracing shows this irregularity, while in the venous trace, instead of the normal sequence of auricular and carotid wave, there is a single wave due to auricular contractions coinciding in time with the radial beat (Fig. 3). The nodal rhythm is very embarrassing to the heart; clinically it shows itself by irregularity of the pulse, by disappearance of a pre-existing presystolic murmur, and usually by signs of heart failure. The rhythm may develop suddenly or gradually; it is sometimes sudden in onset and of transient duration (paroxysmal tachycardia). Most cases of nodal rhythm occur in persons who have suffered from rheumatism or cardio-sclerosis; there is evidence of fibroid change in or near the *a-v* bundle (Keith). Nodal rhythm is one of the most serious forms of cardiac arrhythmia; it is due to changes which cannot be cured, and the prognosis depends on how the circulation

is carried on under the new conditions, and how the heart responds to treatment.

5. *Irregularity due to Depression of the Contractility of the Ventricle* (Mackenzie), *Pulsus alternans* (Hering).—The four forms of arrhythmia already described depend on abnormalities in the stimuli which lead to contraction, but are not necessarily associated with any failure of contractility. In the long run, however, heart failure means inability of the heart to maintain its power of contraction, and failure of contractility alone may cause irregularity. Normally, after each contraction of the muscle fibres they are so exhausted that a brief period of repose is needed to restore their function; if the renewed stimulus occurs too soon the ensuing contraction is short and feeble. Depression of contractility is shown by pain (angina) and by *pulsus alternans*—large beats followed by small ones. The explanation of this phenomenon is that after the large beat the period of rest is insufficient to rest the muscle, and the next beat is feeble; owing to the short duration of the feeble beat the subsequent period of rest is longer, and so on. The rhythm of the beats in pure pulsus alternans is quite regular; on the other hand, when, as is often the case, it is combined with extra-systoles, it becomes extremely irregular. Pulsus bigeminus (an extra-systole interpolated after each beat) is distinguished from pulsus alternans by the fact that the beats occur in couples, not in regular rhythmical succession.

Clinical Diagnosis. — It must not be supposed that for the clinical diagnosis of the various forms of cardiac arrhythmia graphic methods are essential. On the contrary, as Hering points out, the modern classification has a great advantage over the older one in point of simplicity. Only five possibilities require to be considered, and some of these can at once be eliminated. Even when combination of different forms of irregularity occur, difficulty is not likely to arise, for in most cases the combination proves to be an association of extra-systoles with one of the other four varieties. Certain combinations do not occur, *e.g.* continued irregularity with delayed

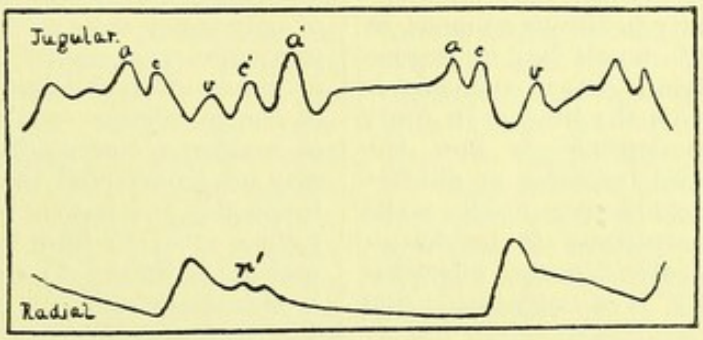

Fig. 10.—A long pause after the extra-systole r'. The auricular stimulus a' provokes no ventricular contraction (Mackenzie).

conduction or pulsus alternans, and delayed conduction with pulsus alternans.

Extra-Systoles, the most common form of irregularity, are characterised (in many cases) by the subjective sensation of thumping in the præcordial region, and by the sharp drum-like tone of the sound they produce. When in an otherwise regular pulse a premature beat suddenly occurs, it is an extra-systole. An intermission is most likely to be an extra-systole, and, if accompanied by a "bump" in the præcordial region, is certainly one. It is distinguished from a missed beat from failure of the ventricles to contract by auscultation; in the extra-systole the characteristic sharp sound is usually audible, but in a true missed beat no sound is produced. This difficulty in differential diagnosis is most likely to occur in cases of bigeminal pulse, when the question may arise, whether or not every third beat is being missed from failure of the ventricle to contract. In true bigeminal pulse, due to extra-systole, every second beat is accompanied by a sharp first sound.

Respiratory (*Sinus*) *Irregularity* is easily recognised by the fact that only the time intervals, not the force of the beats, vary. The arrhythmia depends on the respiratory movements, and ceases when the patient stops breathing. When the breathing is irregular (as in meningitis) it is less easy to make out the association between the pulse and the respiration. The chief practical point is to decide whether or not respiratory arrhythmia is caused by a cerebral lesion.

Continuous Irregularity (*Nodal Rhythm*) is characterised by its persistence, and by the great variations in the force and time of the pulse beats. The venous pulsations in the neck synchronise with the apex beat. Irregularity of this type diminishes, but does not disappear, under the influence of digitalis.

Bradycardia due to lowered conductivity is easily recognised. When the pulse is about 30, there is probably complete dissociation between auricular and ventricular action. More than this cannot be said without the aid afforded by tracings. The differences between an occasional missed beat and the intermissions of extra-systole have been referred to.

Pulsus alternans is not common; it has to be distinguished from continued pulsus bigeminus (*v. supra*). It is not always easy to discern the difference in force between the two beats by the finger. Pulsus alternans becomes more marked when the heart acts quickly, as after exercise; less marked when the heart is slow, as under digitalis.

Significance of the Various Forms of Arrhythmia.—The chief practical point is to distinguish the mild forms of irregularity (respiratory arrhythmia and extra-systole) from those which are serious (lowered conductivity, continuous irregularity and pulsus alternans).

Respiratory arrhythmia is never in itself serious; it may signify organic brain disease.

Extra-systole, if due to tea or tobacco, or if associated with subjective sensation of a jog in the region of the heart, is of functional origin. Occurring in cardiac disease, extra-systoles do not add to the gravity of the condition. Possibly when they develop in the course of pneumonia or acute rheumatism they may point to the myocardium becoming implicated (Mackenzie).

Continued irregularity is always ominous, as it shows that the heart muscle has undergone organic changes. When it sets in suddenly it may gradually embarrass the heart. In heart disease the prognosis depends on how the circulation is maintained (presence or absence of cyanosis, dropsy, etc.) in spite of the nodal rhythm, and on the response to treatment. In pneumonia and other acute infections continuous irregularity is a very bad sign (Mackenzie).

A mild degree of lowered conduction should be accepted as a warning that myocardial changes have begun. It is necessary to use caution in administering digitalis under these circumstances, on account of the effect of the drug in depressing conductivity. Patients suffering from bradycardia may live for many years. When syncopal attacks occur, the prognosis is uncertain, as the patient may die in a seizure.

Pulsus alternans is always a serious sign, especially in cases of arterio-sclerosis, and in acute infections (Mackenzie).

LITERATURE.—This is very extensive, and only a few of the papers can be mentioned. Acknowledgment must specially be made of the debt which the compiler of this section owes to Dr. MACKENZIE'S *Diseases of the Heart* (Lond.), 1908. A full classified list of references will be found in this book.

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Heart, Surgery of.—*Operative Treatment of Mediastino-pericarditis.*—In 1902 Brauer proposed operation for cases of mediastino-pericarditis in which the pericardium was bound down to the ribs and sternum, and the movements of the heart interfered with. Up to 1906 Paschkis (*Centralbl. f. Grenzgebiete d. Medizin u. chirurgie*, 1906, Bd. ix. s. 1) found records of only seven cases so dealt with. The operation is useless in cases of adherent pericardium—*i.e.* fibrous union of the parietal and visceral layers of the membrane—and perhaps the difficulty of making a correct diagnosis in this respect may have prevented the operation being more frequently undertaken, because in all cases the results seem to have been good. Only one patient is known to have died, and that of broncho-pneumonia, ten months after operation. The symptom complex consists of subjective and objective signs of cardiac insufficiency, plus more or less systolic retraction of the thorax, absence of apex beat, diastolic collapse of the jugular veins, increase of the area of cardiac dulness, sometimes the pulsus paradoxus, reduplication of the sounds, and usually evidences of old pleurisy. The usual operation for cardiolysis consists in raising a skin flap, resecting periosteally the ribs from the 3rd to the 5th, from the left sternal margin to the anterior axilla, replacing the flap and draining. As above stated no bad results followed; patients under observation for so long as eighteen months enjoyed good health and freedom from cardiac symptoms.

Suppurative Pericarditis.—There can scarcely be any question as to the propriety of draining the pericardial sac when pus is present in it. The difficulty, however, is one of diagnosis, for few acute intra-thoracic diseases are so liable to escape detection as purulent pericarditis. According to Elliot, the disease had been operated on forty-seven times up to 1900 (*Annals of Surgery*, xlix., 1909, p. 60), and he tabulates twenty-three cases which occurred between that date and the time of publication of his paper. What adds to the gravity of the prognosis is that in most

cases purulent pericarditis is not primary, but secondary to some other forms of suppuration, and occurs merely as a manifestation of a generalised septicæmic or pyæmic infection. The fact that recovery has occasionally followed operation in the primary cases certainly warrants operation whenever the condition is diagnosed, unless the patient is actually moribund. When the clinical signs suggest pyopericardium an exploratory puncture should be made. The risk of wounding the heart is slight. Probably the safest site is close to the ensiform cartilage opposite the 7th costal cartilage, as this is below the reflection of the left pleural sac, which lies under cover of the sternum at the 5th, and usually at the 6th costal cartilage. Some, however, advise puncture just within the outermost limit of præcordial dulness, on the ground that the effusion displaces lungs and pleura, and that here there is less chance of wounding the heart. Sometimes pus though present cannot be withdrawn by the needle, and it may at times be justifiable to operate without the confirmation of exploratory puncture. Operation proper consists merely in incision and drainage, and various routes have been suggested with the object of minimising the risk of wounding the left pleura. Thus, for instance, trephining the lower end of the sternum has been advised; others again raise a flap containing the 4th, 5th, and 6th costal cartilages, which allows space for the ligature of the internal mammary artery, and the reflection of the angle of the pleura. Allingham suggests the epigastric route, an incision being made to the left of the median line just below the costal insertion of the rectus, and working up through the costo-xiphoid space in the diaphragm, the peritoneum being pushed down. According to Elliot, the simplest method is to remove the inner part of either the 5th or 6th costal cartilage through an oblique incision parallel to its long axis. The opening is deepened into the anterior mediastinum by the division of the perichondrium and the underlying plane of the triangularis sterni. The contiguous pleural reflection is then if possible pushed outward; if the pleural cavity has been obliterated, the underlying pericardium may be opened without danger of pleural penetration. The pericardium is best divided by scissors between two pairs of forceps, and the opening enlarged by the finger. Pus is allowed to escape slowly. Irrigation with weak saline is advisable. The edges of the pericardium should be sewn to the skin if possible; a rubber drain, or a strand of gauze should be inserted. If recovery takes place it is usually complete, the patient showing no signs of cardiac irregularity.

Wounds of the Heart.—Suture of wounds of the heart has become established as the best means of treating this grave injury. Papers on the subject, with collected lists of published cases of suture, have been written by Lenormant (*Gaz. des Hôpitaux*, Paris, 13th Sept. 1906); Vaughan (*Jour. Amer. Med. Assoc.*, 6th Feb. 1909); Hill (*Med. Record, New York*, 19th Sept. 1908), and others. Vaughan states that the kind of operation is often determined by the external wound, and, begun as an exploration, its subsequent steps are guided by the necessities which arise during its progress. This probably accounts for the large number of resections of cartilages or parts of ribs rather than the formation of a well-planned flap of skin, muscle, and ribs. The best method is one that will (*a*) freely expose the heart, (*b*) not open the pleura, (*c*) leave the chest wall unimpaired. The chief methods are:—1. *Operation through an interspace.* This is suitable for a long chest with wide spaces. Space may be gained by the resection of one or two ribs or cartilages. 2. *Resection of one or more cartilages with or without a portion of rib.* 3. *Flap methods*—(*a*) Make a transverse incision from the right side of the sternum in the third space across the sternum to the line of the left costo-chondral junction, and a corresponding incision in the fifth space; unite the left ends by a vertical incision. Divide the sternum and cartilages along these incisions after tying the internal mammary artery. Turn the flap to the right, making a hinge of the right chondro-sternal joints. (*b*) Another flap method is to divide the 4th and 5th cartilages near the left sternal border and to divide the 3rd and 5th interspaces laterally nearly to the nipple line. The flap is raised by its inner border, the pleura stripped off if practicable, and the ribs broken or cut near the costo-chondral junction. (*c*) A flap can be made in the reverse manner, with an internal hinge. The pleura is probably always opened when this is done, as indeed is also the case in the preceding operation. In 133 operations, 60 involved resection of one or more ribs or cartilages; 71 a flap; 2. incision of an interspace. The size of the wound found varied from one-fifth to two and a quarter inches; silk is most frequently used as a suture, next comes catgut. The suture may be continuous or interrupted, and it does not seem to matter whether or not the stitches enter the cavity of the heart. Tumultuous action of the heart has sometimes interfered with the introduction of the stitches; it can be overcome by holding the heart in the hand, or introducing one or two deep tension sutures to steady the organ. In severe cases massage of the heart (*vide infra*) has been used, occasionally with success, to revive a pulseless organ. On the whole, judging by the results after drainage and non-drainage, it is better to avoid drainage, unless infection is probable, or hæmostasis has been unsatisfactory. Among the disadvantages of drainage

are the irritation or inflammation excited by the gauze or tube, and the bad effects on the collapsed lung of keeping the pleura open. The results of Vaughan's collected series may be tabulated thus:—

	Cases.	Recoveries.	Percentage.
Pericardium drained .	48	25	52
„ not „ .	44	25	57
Pleura drained .	72	30	41
„ not „ .	21	13	60
Pericardium and pleura drained .	42	21	50

The mortality over all is about 65 per cent.; about 20 per cent. of the patients are really moribund when operated on. The mortality rate is slightly lower after gunshot wounds than after stabs. Lenormant's statistics lead to the same conclusion—46 per cent. of recoveries from bullet wounds, and 34 per cent. from stabs. The site of the wound is mentioned in 124 cases quoted by Lenormant:—Left ventricle 58; right ventricle, 49; apex, 5; interventricular septum, 3; left coronary artery, 1; origin of the pulmonary artery, 1; wounds of the left ventricle gave 45 per cent. of recoveries, of the right, 28·5 per cent. The majority of bullet wounds completely traverse the heart; in one instance an intracardiac bullet was removed, and the patient recovered. Lenormant's figures are also absolutely against drainage, and he urges the need of the stringent antiseptic precautions. Hill concludes a description of three successful cases by the following rules:—1. Every wound of the heart should be operated on immediately; operation has reduced the mortality of the injury from 90 to 60 per cent. 2. When position of the external wound and the symptoms suggest heart injury, the wound should be explored. 3. Never probe the wound. 4. Unless the patient is unconscious, give an anæsthetic. 5. The flap method gives free access. 6. Steady the heart with the hand before suture, or if the hole is large enough, introduce the little finger, which will stop bleeding and facilitate the passage of the stitches. 7. When the hæmorrhage is so profuse as to preclude suturing, with the right hand gently lift the heart out of the pericardium and introduce the left hand from below, and compress the inferior vena cava between the index and the fingers, and, pressing up, displace the inosculation of the superior cava. The heart will stand complete compression for a minute and a-half, and incomplete compression for four minutes. 8. Catgut should be used, as the wounds heal quickly. Sutures should be interrupted, introduced and tied during diastole, should not involve the endocardium, and should be as few as possible compatible with closure of the wound. 9. The pericardium should be cleansed by sponging, not by irrigation, lest tension be produced in it. 10. Until every aseptic precaution has been taken, the mechanical stoppage of the heart from accumulation of blood in the pericardium should be prevented by aspiration, as diminished resistance from want of blood and want of cleanliness, from hurry of preparation largely contribute to the 40 per cent. of deaths due to infection. 11. The pleura may be closed and the pericardium drained—never the reverse, because of the ease of infection of the pleura. Tubes are better than gauze as drains. 12. A needle may be removed at once; a knife blade, not until all preparations for suture are made.

Massage of the Heart in Chloroform Syncope.—This has occasionally been practised with success. The heart has been reached through the thoracic parietes, and from the abdominal cavity. In the latter case the diaphragm has been divided by some operators, whilst others have massaged the heart through the diaphragm. Lenormant (*Revue de Chirurgie*, Mar. 1906) prefers this method—the diaphragm being relaxed during syncope offers no resistance to the manipulation. In three-fourths of the successful cases this route has been followed. The technique of the manœuvre consists in compressing the heart rhythmically from 30 to 60 times per minute. At the time of Lenormant's paper four out of twenty-five cases in which massage of the heart had been practised, recovered, and four others were restored for a time. In the remainder the heart did not respond. Details of the thoracic and trans-diaphragmatic operations may be found in a paper by Manclaire and Zelas (*Archives Internationales de Chirurgie*, 1906, No. 1), but as these are unsuccessful, they should be given up in favour of the sub-diaphragmatic method—after supra-umbilical medium laparotomy the left lobe of the liver is pushed aside by the right hand, by which the central part of the diaphragm is grasped. The left hand is placed on the anterior wall of the thorax, and the heart compressed between them. This method has at its credit six successes, two temporary successes, and two failures. The thoracic route has one success, five temporary successes, and seven failures. The trans-diaphragmatic route has four failures, and no successes.

Hebephrenia.—*See* DEMENTIA PRÆCOX.

Hebosteotomy.—*See* SYMPHYSIOTOMY AND PUBIOTOMY.

Hebra's Prurigo.—A symptom-group of cutaneous changes beginning in infancy and continuing usually throughout life, characterised by sub-epidermic papules, more or less constant itching, with resultant lesions affecting chiefly the lower limbs. See *Encyclopedia*

and Dictionary of Medicine, Vol. VIII. pp. 328-329.

Hectine.—A sort of French equivalent to Ehrlich's 606 for syphilis, said to have been introduced (by Mouneyrat) prior to it, and to be equally efficacious and far less dangerous; arsenic enters into its composition (see *Brit. Med. Journ.*, ii. for 1910, p. 1929). *Hectargyre*, the invention of Dr. Salmon, is another French preparation of a similar kind.

Heine-Medin's Disease.—*See* POLIOMYELITIS ANTERIOR ACUTA.

Hemidystrophy.—A morbid condition, often congenital, in which the two sides of the body differ in appearance; it differs from both hemihypertrophy and hemiatrophy in its irregularity.

Hemiparesis.—*See* CEREBELLUM, TUMOURS OF.

Heredity.

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IN two directions advances have been made during the past five or six years in our knowledge of the phenomena of heredity: Mendel's law regarding the inbreeding of hybrids has been brought to the light and applied in various relations, and Galton and Karl Pearson have attempted to solve the problems of heredity from the statistical side.

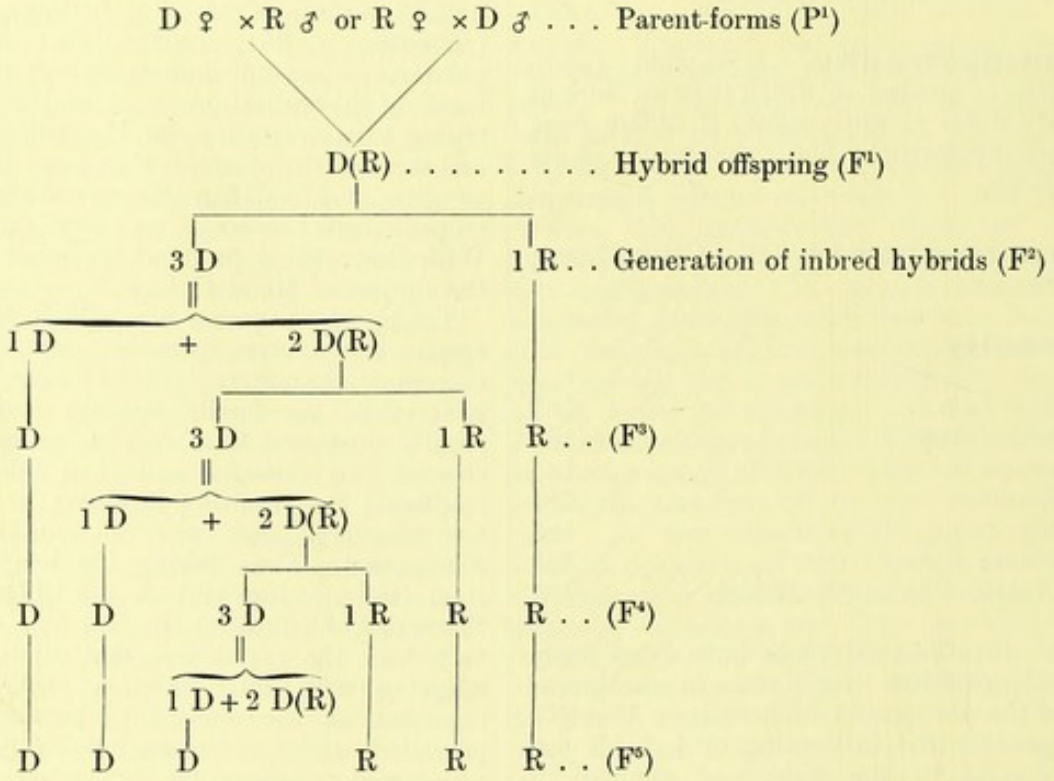
MENDEL'S LAW.—There is no more extraordinary page in the annals of science than that on which is written the story of Mendel's discovery. In a paper "which is a model of lucidity and expository skill" (Bateson), Gregor Johann Mendel, Abbot of Brünn, gave to the world in 1866 the results of experiments in hybridisation which he had been patiently conducting for eight years; the plant experimented upon was *Pisum sativum*, the edible pea, and the work was done in the large garden of the cloister at Brünn, of which Mendel was Prälat or Abbot; he published another paper in 1869 on Hieracium-Hybrids; and he died, early in 1884, without having seen the slightest notice taken of his work, but with the firm belief that his time would come. The scientific world, however, had to wait till the dawn of the twentieth century before it heard of Mendel's Law, for it was not till 1900 that De Vries, Correns, and Tschermak, independently of each other, rediscovered it and confirmed it by experiment; since then, W. Bateson has done much to make it known in Great Britain, and has experimented afresh along similar lines. So Mendel's article was exhumed from the *Proceedings of the Natural History Society of Brünn*, where it had lain buried for thirty-four years.

The Law referred to is one of inheritance in hybrid varieties, a fact and a limitation which is at the present time in some danger of being lost sight of. "It must be clearly noted," writes Prof. J. Arthur Thomson (*Heredity*, p. 381, 1908), "that Mendelian phenomena are not known except in certain cases of hybridisation . . . the danger is of trying to universalise the Mendelian formula, and some of the attempts that have been made to give a Mendelian interpretation to discrepant facts seem to us very far-fetched." With this caution in mind, we must approach the subject of Mendel's Law.

Taking the common pea, which, in its subspecies or varieties, possesses constant differentiating characters, allows easy artificial pollination, has fertile hybrids, and can be readily protected from foreign pollen, Mendel crossed two varieties and then inbred (self-fertilised) the resulting hybrids; in this way he discovered the laws of dominance and segregation. Thus, taking the length of the stem (tall or dwarfish) as the differentiating characters, he crossed the tall and the short varieties; the result was that all the hybrid offspring were tall; tallness, therefore, was regarded as the *dominant* character, for it prevailed, whilst shortness, because it was the suppressed or apparently suppressed character, was called *recessive*. So, T crossed with S gave T, or D × R gave D. Self-fertilisation of the hybrid plants was now permitted, with the result that the next generation were not all alike tall, but showed the two original forms in the proportion of three talls to one short, or three dominants to one recessive (in percentages, 75 to 25). This is the law of *segregation* or splitting, viz. that the cross-bred plants when self-fertilised produce plants with the dominant character in the proportion of three to one with the recessive. If, now, the short-stemmed plants (recessives) were self-fertilised they bred true, that is to say, they never again produced tall ones, but only dwarfs. Further, if the tall-stemmed plants (dominants) were allowed to be self-fertilised, they produced one-third dominants, which thereafter always bred true, *i.e.* produced nothing but tall (dominant) plants; the other two-thirds, on the contrary, when self-fertilised gave rise to a mixture of dominants (talls) and recessives (shorts) in the proportion of

3 : 1 or 75 per cent. to 25 per cent. Mr. R. C. Punnett (*Mendelism*, 1905) puts the results concisely thus: "Wherever there occurs a pair of differentiating characters, of which one is dominant to the other, three possibilities exist—there are recessives which always breed true to the recessive character; there are dominants which breed true to the dominant character, and are therefore pure; and thirdly, there are dominants which may be called impure, and which, on self-fertilisation (or inbreeding, where the sexes are separate), give both dominant and recessive forms in the fixed proportion of three of the former to one of the latter." The characters (in the case referred to above, tallness and shortness) which thus segregate or dissociate from each other are described as *allelomorphic*.

Professor J. Arthur Thomson (*Heredity*, p. 340, 1908) gives a useful schematic representation of these phenomena, which is reproduced below. D stands for the dominant character and R for the recessive (whatever these may be), and D(R) means that the dominant character is present whilst the recessive is *apparently* absent.



Mendel and those who after a lapse of forty years have rediscovered this law of inheritance in hybrid varieties advance the following theory to explain the phenomena which have been referred to above. It is assumed that the hybrid offspring (F^1) contain material representatives of the unit characters (*e.g.* tallness and shortness), although they themselves show only one (viz. tallness), the parent with the dominant character having been prepotent. But the first generation of inbred hybrids (F^2) show both tall and dwarf plants. To explain this, it is argued that the germ cells of the hybrid offspring (F^1) divide themselves into two groups (two kinds of egg-cells and two kinds of pollen-grains), one group with the potential quality of tallness and the other with that of shortness or dwarfness; the two groups are supposed to be practically of equal size, and therefore, when self-fertilisation takes place, the chances of an egg-cell being impregnated by a pollen-grain with tallness, or by a pollen-grain with shortness, are equal. If, now, there are eight egg-cells, four with the potential quality of tallness and four with that of shortness, and if there are eight pollen cells similarly arranged; then, in fertilisation, two egg-cells with tallness will be fertilised by two pollen-grains with tallness, two egg-cells with shortness will be fertilised by two pollen grains with shortness, and the remaining four egg-cells (two with tallness and two with shortness) will be fertilised by the remaining four pollen-grains (two with shortness and two with tallness); the result will be two fertilised egg-cells with tallness, two with shortness, and four with both tallness and shortness. But since tallness is dominant, the last-named four will show it alone, the quality of shortness being latent in them; in other words, there will be six with tallness and two with shortness, or three dominants to one recessive, 2 D + 4 D(R) + 2 R. This explanation is both simple and satisfactory, and it is known as the theory of gametic segregation. It is

clear, therefore, why there are "pure" gametes and "impure" gametes: to the former group belong the 2 D and 2 R, whilst to the latter belong the 4 D(R); the former always breed true among themselves, whilst the latter split up again in the proportion of 3 D to 1 R, shortness (the recessive unit character) reappearing over and over again in succeeding generations, and always in the proportion of one to three.

It is unnecessary, in a short article such as this, to enter into the elaborations of the Mendelian theory; they are most interesting, but very complicated, and are in danger of being made too subtle. It is only necessary to study the results of breeding pure types with *impure* dominants in order to demonstrate this complexity and bring into play this subtlety. Suffice it to say that Mendel's Law has received confirmation in several plants other than the common pea, in maize, for instance, in wheat and barley, in stocks, in nettles, and in mirabilis jalapa; and it has been extended to some animals, *e.g.* mice, rabbits, snails, poultry, and cattle. In mice, for instance, the coloured coat would appear to be a dominant, and the albino a recessive character. These discoveries open up a wide and most attractive field for experimentation and speculation, and suggest that there may be characters in the human subject which will be found susceptible to arrangement as dominants and recessives. It must be admitted, however, that no secure evidence of Mendelian phenomena in man have yet been noted: for the white negro is a *rara avis*, and he ought to be common if Mendelism be true of the human subject; and the suggestion that the presence of congenital cataract may be a dominant character seems to be highly paradoxical. It will take many years, however, before the far-reaching consequences of Mendel's Law have been investigated, and it is more than likely that results of considerable practical importance may flow from its application in various novel directions (*e.g.* in the elucidation of the differentiation of sex, as tentatively worked out by Berry Hart).

LITERATURE.—The already copious literature of this subject will be found in Bateson's *Mendel's Principles of Heredity* (1909), and in J. Arthur Thomson's *Heredity* (1908). The following articles may be consulted by the medical reader:—Bateson, *Brit. Med. Journ.*, ii. for 1906, pp. 61, 106; i. for 1908, pp. 1132, 1195, 1252; Mudge, *Brit. Med. Journ.*, ii. for 1908, p. 523; Berry Hart, *Trans. Edin. Obstet. Soc.*, vol. for 1908-9; *Proc. Roy. Soc. Edin.*, xxix. p. 607, 1909; *Phases of Evolution and Heredity*, London, 1910.

Galton and Pearson's Work.—The law of Mendel brings mathematics into the sphere of biology and heredity; but in the work of Sir Francis Galton and Karl Pearson mathematics dominates biology to such an extent as to cause the latter to pass almost entirely out of sight. If the reader will consult Pearson's *Grammar of Science* (1900), or take into his hand any part of the journal *Biometrika*, he will be persuaded that the above statement is no great exaggeration. Sir Francis Galton's Law of Filial Regression or Correlation, that tendency towards mediocrity, towards sustaining the same average level from generation to generation, is expressible as a formula; whilst the law of Ancestral Inheritance can hardly be expressed in any other way. The latter law, as stated by Galton, is as follows: "The two parents between them contribute *on the average* one half of each inherited faculty, each of them contributing one quarter of it. The four grandparents contribute between them one quarter, or each of them one-sixteenth; and so on, the sum of the series $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\ldots$ being equal to 1, as it should be. It is a property of this infinite series that each term is equal to the sum of all those that follow: thus $\frac{1}{2}=\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\ldots$, $\frac{1}{4}=\frac{1}{8}+\frac{1}{16}+\ldots$, and so on." Pearson states the law more completely in mathematical form when he says, "Each parent contributes on an average one quarter or $(\cdot5)^2$, each grandparent one-sixteenth or $(\cdot5)^4$, and so on; the occupier of each ancestral place in the nth degree, whatever be the value of n, contributes $(\cdot5)^{2n}$ of the heritage." The medical man who may wish to study these matters without entering far into problems of algebra and mathematics will find a clear exposition in Thomson's *Heredity* (pp. 309-335), already quoted from. It may be noted, however, that Mendel's law and that of Ancestral Inheritance do not harmonise. At the same time it is not wise to make too much of this or to argue from it that all Galton's and Pearson's results must go to the wall; "for the Mendelian formulæ," as Professor Thomson says, "apply to the progeny of known crosses or hybrids, while Galtonian formulæ apply to intra-racial heredity."

Herpes Zoster.—Whilst Herpes Zoster, where the lesion is in the ganglia on the posterior roots of the spinal nerves, causing a vesicular eruption on the body, neck, or extremities, and in the Gasserian ganglion, causing an eruption on the face in the distribution of the three divisions of the 5th nerve, is a well-recognised condition, a less well-known form is that caused by a lesion in the geniculate ganglion of the 7th nerve. In this case one gets a vesicular eruption on the outer aspect of the auricle, associated with pain in the ear, deafness or noises in the ear. The auditory symptoms are due to the swollen geniculate ganglion, as it lies in the aqueduct of Fallopius, pressing on the adjacent auditory nerve. As there is often considerable swelling of the outer ear, and after the vesicles burst the ear is covered with crusts, the true cause

of the condition is apt to be overlooked. This is especially so from the associated auditory symptoms, the inflamed condition of the auricle being put down to a secondary infection from a middle ear discharge.

REFERENCE.—Ramsay Hunt, *Amer. Journ. Med. Sci.*, Aug. 1908.

Herpetomonas.—*See* Protozoa.

Heterochylia.—A form of hyperchlorhydria of nervous origin in which the degree of acidity varies with the nervous symptoms.

Heterolysins.—Lysins which are active in another species, in contrast to isolysins where the activity is seen in the same species.

Hexamethylene - tetramine. — The chemical name for urotropin, known also as formamine and hexamethylenamine: $(CH_2)_6N_4$.

Hexone Bases. — Kossel's name for the nitrogen—containing amino-bodies, histidin, arginin, and lysin, for the reason that they all contain six carbon atoms (viz. histidin $= C_6H_9N_3O_2$; arginin $= C_6H_{14}N_4O_2$; lysin $= C_6H_{14}N_2O_2$).

Hirschsprung's Disease. — Idiopathic dilatation of the colon, or megacolon, or ectocolon, causing chronic constipation of a most inveterate type; it was first described by Hirschsprung in 1886, but isolated cases had been reported by other observers before that year, and Finney (*Ann. of Surg.*, xlvii. p. 1062, 1908), writing in 1908, was able to pass in review over two hundred references to the subject. The outstanding pathological change is dilatation and hypertrophy of the large intestine; the sigmoid flexure is the part most often affected, thus in ninety cases summarised by Löwenstein (*Centralbl. f. allg. Path. u. path. Anat.*, xviii. p. 929, 1907) and Lorenz (*Diss. inaug.*, Leipzig, 1909) there were eighty-five in which the sigmoid flexure was involved; the transverse colon was not so often affected, and the ascending colon still less frequently. Many theories of causation have been advanced, but none of them explains all the cases; in many instances it is certainly either congenital or the result of congenital anomalies. The intestine itself as well as the mesentery is usually elongated. The diagnosis of the morbid state is made from the symptoms (constipation or coprostasis, long periods intervening between successive actions of the bowels, a tympanitic note over the abdomen, upward displacement of the heart and lungs, obliteration of the liver dulness, etc.), and by the use of bismuth and the Röntgen rays. Medical treatment is almost of no use; but surgery holds out a hope of benefit, even of cure, thus in forty-one cases which were operated upon, cure followed in sixteen and improvement in six (Lorenz). Various surgical procedures have been tried. Resection seems to offer the best chance; the affected loop may be excised, the cut ends closed, and then a lateral anastomosis effected; or an anastomosis may be made between the transverse colon and the descending loop of the sigmoid flexure; or a preliminary enterostomy (ileostomy, cæcostomy) may be done, followed by a colocolostomy some months later, and then by complete excision (Finney); plication (coloplication) and replication of the surface of the intestine may be done, especially when the dilatation is marked, and when resection and anastomosis are impossible (Freeman, *Ann. Surg.*, xlvii. p. 1063, 1908); or appendicostomy with washing out of the colon through the tube every day may be practised with relief of symptoms, as in one of Spencer's cases (*Brit. Med. Journ.*, ii. for 1910, p. 545). One is justified in trying these more or less extensive operations, for the prognosis of the condition is bad, the mortality being 69 per cent. according to Murphy (Kelly and Noble's *Gynecology*, ii. p. 386, 1908). A well-written account of the disease is from the pen of D. P. D. Wilkie (*Edin. Med. Journ.*, n.s., iii. pp. 203-230, 1909).

Hirudin.—The active principle of the salivary secretion of the leech, which has the power of preventing clotting of the blood.

Histidin.—A protone body obtained by hydrolysis from sturin (the protamine got from the sperm of the sturgeon), thus $C_{36}H_{69}N_{19}O_7 + 5\ H_2O = C_6H_9N_3O_2$ (histidin) $+ 3\ C_6H_{14}N_4O_2$ (arginin) $+ 2\ C_6H_{14}N_2O_2$ (lysin).

Histolysis.—The process of dissolution of a tissue (Gr. *ἱστός*, a web or tissue, and *λύσις*, a setting free), as seen normally in the atrophy of the thymus after the second year of life, in that of the milk teeth later, and in that of the uterine musculature after labour, and abnormally in various degenerations and infiltrations.

Histoplasmosis.—An infectious disease of Central America resembling the kala-azar of India; it is due to the invasion of the endothelium of the smaller lymph, and blood-vessels, and capillaries, by a micro-organism (*Histoplasma capsulatum*), showing resemblances to the Leishman-Donovan body of kala-azar, but differing from it in the form and arrangement of its chromatin nucleus, and in not possessing a chromatin rod; the mode of infection and portal of entry are unknown; the clinical features are splenomegaly, emaciation, irregular pyrexia, leucopenia, and anæmia; and it has proved very fatal. See

Journ. Exper. Med., Lancaster, Pa. xi. pp. 515-531, 1909; *Brit. Med. Journ.*, i. for 1910, p. 1074.

Holadin.—A proprietary preparation described as an extract of the entire pancreas, presenting all the constituents both of the digestive and the internal secretion; it is recommended in intestinal indigestion, in diabetes, etc.

Holzknecht Units.—*See* RÖNTGEN RAYS AND RADIUM (*Dosage*).

Homax.—Hoff's malt extract. For analysis see *Brit. Med. Journ.*, ii. for 1909, p. 1478.

Homogentisic Acid.—Hydroquinon acetic acid, one of the substances causing the colour of the urine in alkaptonuria; it is so called because it can be prepared synthetically from gentisic aldehyde.

Honeycomb Lung.—A rare morbid state of the lung, following broncho-pneumonia in children, due to dilatation of the bronchioles, resulting from weakening of the walls, and consisting in the presence in the lung of numerous pus-containing cavities. *See* C. R. Box, *Lancet*, i. for 1907, pp. 16-19.

Hordein.—A gliadin or prolamin of the simple protein group, obtained from barley. *See* GLIADINS.

Hormonadin.—A proprietary preparation described as the internal secretion of the pancreas for therapeutic use in certain disorders of metabolism attributed to faulty pancreatic functioning.

Hormone-Secretin.—*See* DIGESTION (*Pancreatic*).

Hormones (ὁρμάω, to arouse, or excite). —This term has recently been used to describe certain internal secretions of the body, particularly in reference to a particular type of mechanism correlating the activities of various organs. The modern view of Hormones is well explained by Starling. "In the normal life of the higher animals, which must be considered as a continuous series of reactions to changes in the environment, ending only with the death of the animal, those reactions which are carried out through the intermediation of the nervous system, play such a preponderant part that we have almost forgotten the possibility of other means of coadaptation among the different organs of the body. Yet in the lowest organisms, before the appearance of any central nervous system, it is by chemical means that any co-ordination of function is determined, either among the different organisms of a colony, or among the various cells making up a multicellular organism such as the sponge. In this case the mechanism which determines the movement of phagocytic cells towards an irritant, the chase of food, the escape from noxious environment, or the approach of sexual cells has been given the name of chemiotaxis. Since the application of these chemical stimuli depends on their diffusion through the medium bathing the cells, the process is necessarily a very slow one." The need for quick reactions led to the development of a nervous system about which the whole history of the evolution of the higher types centres. But the development of the special nervous system adapted for quick response to changes in the environment "has not abrogated the more lowly and primitive method. . . . Where the necessity does not exist for a specially rapid reaction, as, for instance, in the adaptation of the activities of the digestive glands to the presence of food in the alimentary tract, one might expect to find, as we have found, that the connection between the part of the body receiving the stimulus, and the part of the body which has to react to the stimulus, should be by chemical means." Of these chemical messengers or hormones as they may be termed, we know those which determine the activity of the gastric glands, the pancreas, the liver, and the intestinal glands. The suprarenal bodies manufacture adrenalin which, travelling over the whole body, seems to be a necessary condition for the excitation of any sympathetic nerves. The thyroid in the same way manufactures some substance necessary for the proper growth of the tissues; the fœtus appears to secrete into the blood of the mother some substance which excites the growth of the mammary glands. "It is probable that with increasing knowledge the list of these messenger substances will be largely extended, and that, with their isolation, we shall have at our command means of influencing the growth and activity of the majority of the organs of the body. It is worthy of note that these substances do not belong to the group of physiologically active agents of complex and indefinite chemical composition, such as the ferments and toxins, but are in all probability well-defined chemical substances, highly unstable in most cases, but capable of analysis, and, in some cases at any rate, of artificial synthesis. They are comparable in many respects to the . . . drugs of our pharmacopœia. The practice of drugging would seem therefore to be, not an unnatural device of man, but the normal method by which a number of the ordinary physiological processes of the organism are carried out."—*Recent Advances in the Physiology of Digestion*,

pp. 88-91 (London), 1906. *See also* DIGESTION, p. 117.

Hunger Days.—*See* DIABETES (*Diet*).

Hydrobilirubin. — A reddish-brown pigment found in the fæces and in the urine (in fever); its formula is $C_{32}H_{40}N_4O_7$, and it is closely allied to urobilin.

Hydrocenosis.—The reduction of a dropsy either by medicinal means or by operation (paracentesis); it is derived from the Greek ὕδωρ, water; and κενός, empty.

Hydropyrin. — A proprietary medicine, stated to be sodium acetyl-salicylate, and claimed to be preferable to aspirin on account of its neutral reaction, greater solubility, and the absence from it of irritative action. For report, see *Brit. Med. Journ.*, i. for 1909, p. 960.

Hygiama. — A proprietary food preparation, described as "a perfect food," to be given mixed with milk and boiled; an analysis showed protein 21·7 per cent., fat 8·9 per cent., water 4·1 per cent., ash 3·6 per cent., and carbohydrate (comprising both starch and a reducing sugar) 61·7 per cent.; the calorie value was 4·25. *See* report in *Brit. Med. Journ.*, i. for 1910, p. 1240.

Hygiene, Antenatal. — *See* EUGENICS.

Hygromedry. — A term signifying medical hygroscopy or the quantitative estimation of the water vapour given off from limited areas of the skin; the instrument employed is called a hygromed or medical hygroscope. *See* H. E. Wetherill, *Hygromedry* (Philadelphia), 1906.

Hylic Tissue.—One of the two subdivisions of the tissues of the adult body (the other being the lepidic), viz., those which arise from the "pulps" of the embryo (*e.g.* the chief mass of the neuroblast, the notochord, and the mesenchyme), (*see* Adami, *Pathology*, i. pp. 700-704). From the hylic tissues arise the *hylomas*, (*q.v.*).

Hylomas.—Tumours arising from tissues derived from the embryonic pulp (Gr. ὕλη, raw material or matter); the term is employed by Adami to differentiate between his two great groups of tumours—the lepidomas (tumours arising from *lepidic* or "lining membrane" tissues), and those under consideration arising from the *hylic* tissues; the hylomas include growths of epiblastic origin (neuroma, glioma, gliosarcoma), of hypoblastic origin (chordoma), and of mesenchymal origin (fibroma, lipoma, chondroma, osteoma, myxoma, leiomyoma, angioma, myeloma, sarcoma, with its varieties, and rhabdomyoma). *See* Adami, *Pathology*, i. pp. 700-705, 1910.

Hypamnios.—Scanty amount of liquor amnii in pregnancy or at the time of labour; oligohydramnios.

Hyperchlorhydria. — The most common of all forms of indigestion—acid dyspepsia—is that which is associated with abnormal acidity of the gastric contents. Hyperchlorhydria, or hypersecretion, has been the subject of many communications during the past five or six years, and there is much diversity of opinion as to its nature. For some, the fault is a secretion of hyperacid gastric juice, and it is stated that the presence of more than ·2 per cent. of HCl one hour after Ewald's test breakfast is evidence of hyperacidity. It appears, however, that in some persons a higher percentage than this may be unaccompanied by symptoms, and that in others symptoms may exist with a lower percentage. According to Bickel's latest researches, the fault is more often quantitative than qualitative, and the percentage of acid secreted remains at a uniform level. The main justification for retaining the term hyperchlorhydria is the definiteness of the symptom-group.

It is most common in youth or middle age, and among the chief causes which predispose to it are mental worry and overwork, especially in persons of a nervous disposition, indiscretions in diet, abuse of alcohol and tobacco; it is also related to gastric ulcer and duodenal ulcer, to chlorosis, and to chronic constipation. The chief symptoms are heartburn, acid eructations, and severe epigastric pain. The pain comes on from two to four hours after a meal, and often radiates to the back; it is relieved by the ingestion of food, especially bland albuminous food, such as milk, and by alkalies. Vomiting is rare; the appetite remains good, chronic constipation is the rule.

In point of diagnosis, the principal matter is to exclude gastric ulcer. It must be remembered that hyperchlorhydria exists as a symptom of ulcer, so that the difficulty may be very great. The pain of gastric ulcer is said to be more directly influenced by the bulk of the food taken; it also begins sooner as a rule. The stools should be examined for "occult bleeding." Looking at the question of diagnosis from another point of view, some deny that hyperchlorhydria is ever an independent disease; thus Cohnheim, for example, classifies cases under the following heads:—(1) Acid gastritis; (2) ulcer and stenosis of the pylorus; (3) chronic constipation; (4) gastric crises of tabes; (5) neurasthenia—and

considers that each case should be treated according to its cause.

TREATMENT OF HYPERCHLORHYDRIA.—Two different lines of dietetic treatment, each have their advocates. In one the carbohydrates are limited; in the other a mixed diet, with abundant carbohydrates, is given. Russell, who limits the amount of carbohydrates, explains the symptoms in the following way:—When the equilibrium between the amount of gastric secretion required to digest a meal and the quantity of food in the stomach is upset, and there is, in consequence, excess of HCl, the result is that the proteid elements of the food are digested with exceptional alacrity and pass out of the stomach, while the carbohydrate elements are retained. The retained unaltered starch keeps up the gastric secretion, while presenting no constituent with which the acid can combine. At this stage, the gastric contents are extremely acid, and contain only a residue of unaltered starch. The perpetual recurrence of this state of matters ultimately leads to catarrh and atonic dilatation. Russell advises the administration of alkalies, the restriction of the diet to the actual requirements, and the limitation or exclusion of unaltered starches, especially bread and potato. In bad cases he gives a purely proteid diet (raw eggs) for a day or two. When the paroxysms are severe, immediate relief is given by withdrawal of the acrid stomach contents.

On the other hand, those who advocate a mixed diet, with liberal carbohydrate, do so on the ground that proteids tend to provoke a more active secretion of gastric juice than do the starches. The following points may be noted:—Pawlow's work has shown that the extractives of meat are *par excellence* among exciters of gastric secretion (*see* DIGESTION). Hence soups, beef extracts, beef tea, and underdone beef should be excluded from the food. In the same way, the food should be bland, and should not require much mastication, in order that the stomach may be stimulated neither by the food itself, nor reflexly by the act of chewing. Alcohol and spices are forbidden. The meals should not exceed three in the day, and no food should be taken between meals, unless there is pain, when a little milk may be allowed to fix the free hydrochloric acid. Fat checks the secretion of gastric juice, hence it should enter liberally into the diet; it also checks the tendency to constipation which is so common. Soluble carbohydrates, particularly solutions of sugar, lead to a very scanty production of acid. A dry diet is inadvisable. Among the articles of diet permitted are eggs, butter, boiled meats, steamed fish, milk, the milder forms of cheese, especially cream cheese, oysters, sardines, cream, most vegetables and farinaceous foods, both of which must be well boiled. Starchy food should be taken as early during a meal as possible. Jams, jellies, and creams are allowable.

Drugs.—Alkalies are always given. Carbonate of magnesia is best, on account of its laxative action. A teaspoonful should be taken when the discomfort begins. The irritability of the stomach is relieved by bismuth or nitrate of silver. Boas prescribes sodium citrate after meals in place of sodium bicarbonate. Bickel recommends atropin to diminish the gastric secretion. Large doses of olive oil are advocated by Cohnheim. He gives it either in a single dose of 2-3 ozs. by the stomach tube every morning, or in ½-oz. doses before each meal.

REFERENCES.—RUSSELL, *Brit. Med. Journ.*, 18th April 1903.—BICKEL, *Arch. f. Verdauungsk.*, Bd. xiii. Hft. 6, 1907.—BOAS, *Deutsche med. Wochensch.*, p. 135, 1907.—STRAUSS, *Diätbehandlung innerer Krankheiten* (Berlin), 1908.—COHNHEIM, *New York Med. Journ.*, 12th Oct. 1907.—SALISBURY, *Therapeutic Record*, 15th Jan. 1906.

Hypermyotrophy. — *See* ARTERIAL HYPERTONUS.

Hyperpiesis.—*See* ARTERIO-SCLEROSIS (*Definition*).

Hypertrichosis. — Hypertrichosis in females may be successfully cured by X-rays, but the hair requires to be repeatedly brought out by the rays before it ceases to regrow. A reaction from X-rays is to be avoided, as that greatly increases the subsequent atrophic condition of the skin; but at the best, some atrophy of the skin is bound to be produced before the hairs are permanently destroyed. This method of treatment should only be undertaken by an expert.

REFERENCES.—JUTASSY, *Fortsch. a. d. Geb. d. Röntgensk.*, ii. p. 194, 1898-99.—KEINBOCK, *Verhandl. d. deutsche derm. Gesellsch.* (Breslau), 1901.

Hypnoidal State and Hypnoidisation.—Hypnosis, as a means of psychotherapy, has proved to have limitations; many patients hesitate to place themselves under its influence, having exaggerated fears of being too much under the power of the hypnotiser; some patients can only with difficulty be hypnotised or not at all, and not a few of the members of the medical profession altogether distrust this form of treatment, or are sceptical of its benefits. For the above reasons attempts have been made to make use of a sort of intermediate mental condition, the sub-waking or hypnoidal state; this, on the one hand, touches on the waking state, and, on the other, merges into hypnosis and sleep. Boris Sidis has pointed out that this is a state of suggestibility in which mental life can be affected

with ease; and he has called it the *sub-waking* or *hypnoidal* state, naming the induction of it *hypnoidisation* (*Journ. Abnorm. Psychol.*, iv. pp. 151-171, 1909-10, and other references). In this state "consciousness becomes somewhat vaguer than in the waking condition, memory is more diffused, so that experiences apparently long forgotten come in bits and scraps to the foreground of consciousness; emotional excitement subsides, voluntary activity is changed to passivity, and suggestions meet with little resistance." It is a rest-state, one in which there is both mental and physical relaxation, and its depth changes very rapidly, far more so than that of sleep. Sidis (*Journ. Abnorm. Psychol.*, iii. pp. 63, 170, 1908-9) has shown experimentally that it exists also in animals; and he regards it as "the primitive rest-state out of which sleep has arisen in the later stages of evolution," as the "primordial sleep-state."

There is no very firmly fixed rule for hypnoidisation, the principal object being (again to quote Sidis) "to bring about conditions of monotony and limitation of voluntary movements." The patient takes a comfortable position, relaxed and recumbent, and listens to some monotonous sound, *e.g.* "the buzzing of an inductorium"; the most suitable time is late at night or early in the morning when there is naturally a predisposition to sleep; and additional adjutants may be found in the warm bath and in gentle massage. "When respiration and pulse become reduced, sensory-motor reaction diminished, sensory hypoæsthesia becoming occasionally hyperæsthesia, with occasional disturbances of pulse and respiration, with sudden apparently unaccountable starts, with tendencies of retention of position of limbs, and now and then with a slight tendency to resist actively any change of posture of limbs or of body without the actual presence of catalepsy, the whole feeling tone becoming one of acquiescence and indifference, while memory with amnesic gaps begins to find the lost links, and even to become hypermnesic—when we observe all those symptoms we know we have before us the subconscious hypnoidal state" (Boris Sidis).

The way in which the hypnoidal state is related to psychotherapy is complex and somewhat obscure; the fact that we can in it get access to subconscious experiences lost to the patient's personal consciousness makes it valuable in tracing the origin and development of the symptoms of the psychopathic malady, but Sidis maintains that this is not in itself a cure, and must be combined with "a systematic course of direct and indirect suggestion, by mediate associative and immediate associative suggestion, by substitution, disintegration, and synthesis, both in the waking and in the hypnoidal state." In this way the physician can help to transform his patient's mental life. In fact, "the treatment is a highly complex process of disintegration and integration of mental systems"; and an important element is the access which is "gained through the agency of the hypnoidal state to the stores of potential subconscious reserve energy, which, by a liberation of energy, bring about a reassociation and synthesis of the dissociated mental systems underlying the symptoms of the disease." The tapping, so to speak, of the reserve energy is a vital part of the process of cure, and it is thought that some of the value of the Weir Mitchell rest cure may be derived from an empirical use of the sub-waking hypnoidal state. In a sentence Sidis affirms that "the hypnoidal state helps us to reach the inaccessible regions of dormant energy, it helps to break down inhibitions, liberate reserve energies, and repair the breaches of mental activity; the painful systems become dissociated, disintegrated, and again transformed, reformed, and reintegrated into new systems full of energy and joy of life." Freud's method of psychoanalysis may perhaps owe some of its success to hypnoidisation. Instances of mental states treated by hypnoidisation have been given by various writers, including Sidis himself (*Journ. Abnorm. Psychol.*, iv. pp. 162-170, 1909-10) and Donley (*Journ. Abnorm. Psychol.*, iii. pp. 148-160, 1908-9; iv. pp. 172-181, 1909-10); among these alcoholism stands out prominently along with various obsessions, of which the latter author records several interesting examples. One of these was the case of a woman who complained of a peculiar constantly repeated and involuntary hacking and clearing of the throat; various drugs, local applications, and electricity had been tried without success for four years; and she could give no explanation of her trouble. When in the hypnoidal state she was able to inform Dr. Donley that five years previously she had suffered from a sore throat, and had been told that it might be necessary to burn out or to cut out her tonsils; she had been much frightened at the idea, thought for a time of nothing else, and began to notice a tickling feeling in her throat which she tried to relieve by hacking; in time the hacking became an uncontrollable impulse, although there was little, if any, abnormal feeling in the throat. Whilst in the hypnoidal state she was encouraged to recall the complete experience in as great detail as possible; she was then told, with much emphasis, says Donley, that her tonsils were perfectly healthy, that no cutting or burning ever was or ever would be required, that the tickling sensation in the throat arose from the constant fixation of attention upon this part, that she would feel no more desire to hack because her supposed reason for hacking had ceased to exist, and

that when she should open her eyes she would feel better than she had in a great many years. A cure followed, although there were two slight recurrences easily removed by waking suggestion. Other instances might be given, but the above will serve to indicate the type of case which is suitable for such treatment, and the method of using the hypnoidal state.

LITERATURE.—In addition to the articles already mentioned, reference may be made to YUNG, *Arch. de Psychol.*, viii. pp. 263-285, 1908-9; and to SIDIS, *Month. Cycl. and Med. Bull.*, ii. p. 473, 1909; *Boston Med. and Surg. Journ.*, cxli. pp. 242, 287, 323, 356, 1909.

Hypnone.—A hypnotic of the ketone group, said to be unreliable in action and apt to cause headache. *See* Fortescue-Brickdale, *Guide to the Newer Remedies*, p. 142, 1910.

Hypoalimentation.—A term employed by Merklin (vide *La Clinique Infantile, Ann.*, ix. pp. 41-53, 1911) to designate the troubles in infants due to insufficient feeding, and regarded by him as more exact than inanition; the troubles include wasting, retarded growth, vomiting, constipation, crying, oliguria, slow sucking (bradyphagy), etc.

Hypochlorite Treatment.—The treatment of inoperable cases of cancer by means of hypodermic injections of a solution of the hypochlorites of potassium and sodium made near to but not into the tumour. *See* Becker's article in *Brit. Med. Journ.*, i. for 1909, p. 274.

Hypochromatosis, Nuclear.—The condition of the nucleus of a cell in which there is a reduction in the number of chromosomes; the process by which it is produced is therefore termed a hypochromatic mitosis and is the converse of hyperchromatic mitosis (in which the number of chromosomes is in excess of that which is normal for the species).

Hypogenesis, Polar.—Cessation of growth and development at one of the growing points in the embryo, *e.g.* arrested growth at the superior pole giving rise (as is supposed) to the cyclops monstrosity, and the same defect at the inferior pole causing the sireniform monstrosity (sympus); the converse condition is polar hyperplasia leading to superior and inferior dichotomy (dicephalus, etc.).

Hypopharyngoscopy.—The inspection of the hypopharynx (laryngeal part of the pharynx) lying behind the lamina of the cricoid cartilage. *See* P. Tetens Hald (*Lancet*, i. for 1907, pp. 1421-1424).

"Hypoplastic Constitution."—The morbid state, often due to congenital infection (syphilis, tuberculosis), characterised by excessive deposit of fat, under the skin, an infantile condition of the genitals, persistence of the thymus, and various anomalies of development (open foramen ovale, uterine malformations, etc.); Bartel has given the results of 100 *post-mortems* performed in cases of this condition (*Lancet*, ii. for 1908, p. 339).

Hypostatic Albuminuria.—A form of functional albuminuria which is present only when the patient is in the recumbent position; it is sometimes, but not always, associated with enlargement of the spleen.

Hysterorrhaphy.—Ventral suspension of the uterus. *See* UTERUS, PROLAPSUS AND RETRO-DEVIATIONS OF (*Operative Treatment*).

Ichthoform.—A combination of ichthyol with formaldehyde, forming an odourless, tasteless, insoluble powder; it is recommended as an intestinal antiseptic, in doses of 15 to 30 grains (for adults).

Ichthyol Substitutes.—On account of its unpleasant taste and smell there are objections to the use of ichthyol, and these have been met by such substitutes as ichthalbin, ichthoform, and desichthyol (ichthyol deodorised by superheated steam).

Idants.—The name given to the loops of the aster of the nucleus of the ovum (Weismann) or other cell; the chromatin bodies.

Ids.—A term used in Weismann's theory of heredity to signify combinations of determinants or biophoric groups (aggregates of molecules each controlling or determining one particular cell area of the body); each id or unit of germ-plasm contains the full complement of determinants necessary to give origin to the complete individual, and each comes into the ovum from a different ancestor. For a criticism of this theory cf ids, *see* Adami, *Pathology*, i. pp. 134, 135, ff.

Ilosvay Reagent.—The Griess-Ilosvay reagent or simply the Ilosvay reagent is a means of detecting the nitrites in water, saliva, etc.; it consists of half a gram of sulphanilic acid dissolved in 150 c.c. of dilute acetic acid and treated with one-tenth of a gram of naphthylamin dissolved in 20 c.c. of boiling water; on standing a blue sediment falls which is separated and dissolved in 150 c.c. of dilute acetic acid, forming the reagent; a few drops added to the fluid to be tested and heated, show a red colour if nitrites be present.

Immune Body.—A synonym of amboceptor. *See* IMMUNITY.

Immunity.

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IN only a few of the diseases due to bacterial invasion is a soluble toxin formed. In most instances we have a rapid proliferation of the organisms within the body, and their action by the production of intracellular toxins. In the former group of infections, cure may be brought about by a simple neutralisation of the toxin circulating in the blood (as in diphtheria); in the latter series, what is essential is the destruction of the bacteria themselves.

ANTIBACTERIAL ACTION.—This may be considered under three heads:—(1) Bactericidal action, including lysogenic action in general; (2) agglutination; (3) opsonic action.

(1) *Bactericidal and Lysogenic Action.*—Pfeiffer discovered that if an animal was immunised by inoculation with dead cholera bacilli, and if, thereafter, a lethal dose of living bacilli was introduced into the peritoneal cavity, the organisms were killed within a relatively short period. He further showed that on injecting into a normal animal living cholera vibrios along with anti-cholera serum, which had been heated to 58° C., and had, in consequence, lost its bactericidal power *in vitro*, the same destruction of the organisms took place. He inferred that the inactivated anti-cholera serum did not in itself contain the bactericidal element, but that it merely, in some way or other, enabled the tissues of the non-immune animal to cope with the bacteria. The nature of the defensive mechanism was further elucidated by Bordet, who found that, while no bactericidal action occurred in a mixture of heated anti-cholera serum and vibrios, the addition of fresh serum from a non-immune animal caused bacteriolysis, but that if the fresh serum had been previously heated it lost this power. Bordet thus proved that two substances are concerned in bactericidal action —one, in the fresh serum, which is thermolabile, and one, in the immune serum, which is thermostable. The thermolabile body is called the *complement* (*alexin*), the thermostable body the *amboceptor*, *copula*, or *immune body*. In what follows we shall adhere to the terms complement and amboceptor. The amboceptor is a specific substance—a mixture of fresh serum with inactivated anti-cholera serum being bactericidal to cholera vibrios only.

Bordet also pointed out that the phenomena following the inoculation of one species of animal with the red blood corpuscles of another species present many analogies to the above, and it is on this account, as well as because blood corpuscles form a very convenient means of investigation, that so much work has been done on hæmolytic sera. If an animal A be immunised by repeated inoculation with the corpuscles of another species B, the serum of A acquires the power of dissolving B's corpuscles. The action is specific, or nearly so; that is, the corpuscles of other species are not, as a rule, affected. This hæmolytic serum can be inactivated by heating to 58° C., and can again be activated by adding fresh normal serum, but not by adding normal serum which has been heated. Hæmolytic serum, therefore contains thermostable amboceptor and thermolabile complement; normal serum contains complement only.

The relations of amboceptor and complement have been still further studied by Ehrlich and Morgenroth. The following experiments illustrate the methods employed in researches of this nature:—A mixture of sheep's corpuscles and inactivated hæmolytic serum was centrifuged, the fluid (A) decanted, and the corpuscles (B) washed:—(1) A + sheep's corpuscles + fresh normal serum = no hæmolysis; therefore the amboceptor originally present in the hæmolytic serum has been removed from it. (2) B + fresh normal serum = hæmolysis; therefore the amboceptor of the inactivated hæmolytic serum has transferred itself to the corpuscles. Having thus demonstrated that the amboceptor interacts with corpuscles, the next step is to ascertain whether complement does so also. A mixture of fresh goat's serum and sheep's corpuscles was centrifuged, the fluid pipetted off (C), and the corpuscles washed (D):—(3) C + inactivated hæmolytic serum + sheep's corpuscles = hæmolysis; therefore C still contains complement. (4) D + inactivated hæmolytic serum = no hæmolysis; therefore the corpuscles have not attracted complement. There are thus two partners in the work of hæmolysis and bactericidal action —the specific amboceptor present only in the serum of an immunised animal, and the complement present in the serum of both normal and immunised animals.

Is there only one, or are there many,

amboceptors concerned in such phenomena? Ehrlich has shown that the latter is the true state of affairs, and that it is possible by immunising animals with cells, both from different organs and from various species, to obtain a great variety of specific cytotoxic sera, each with its own amboceptor. But when we come to ask the same question concerning the complement, we do not get so clear an answer. Ehrlich holds that complements, like amboceptors, are multiple; while Bordet adheres to the view that the complement is single. This and many other problems as yet await solution, and the complexity of the issues is too great to admit of any summary which would be at once brief and comprehensible. All observers are agreed as to the actual facts mentioned above, and at this we may leave the matter. The essential facts of hæmolysis hold good for the organisms of typhoid and dysentery as well as cholera, and we are justified in believing that other antibacterial serums act in a similar manner.

(2) *Agglutination.*—The phenomena of agglutination were brought into general notice by the work of Durham, Grüber, and Widal, which established the value of the agglutination test in the diagnosis of typhoid fever. When an antibacterial serum is added to an emulsion of the corresponding organism, the bacteria no longer remain diffused through the emulsion, but aggregate together in clumps. Under suitable conditions the phenomenon can be rendered visible to the naked eye. To a test-tube full of the slightly turbid bacterial suspension the antiserum is added, and owing to the agglutination which takes place the bacteria settle down to the bottom of the tube, leaving the supernatant fluid clear. If agglutination does not occur the suspension remains turbid. Agglutination can also be observed under the microscope in hanging-drop preparations, or by staining smears. The phenomenon of agglutination depends on the presence in the antiserum of bodies termed agglutinins.

Agglutinins are specific within certain limits, but they also show what is called "group action," *i.e.* an agglutinin not only clumps its specific bacillus, but also, though to a less degree, allied species. Thus, a typhoid serum may agglutinate typhoid bacilli in a dilution of 1/1000, paratyphoid bacilli in a dilution of 1/100, *b. coli* in a dilution of 1/30, and the cholera bacillus in a dilution of 1/10, while normal serum clumps all alike in a dilution of 1/10 (Citron). Agglutinins are probably distinct from immune bodies, because serums which are strongly bactericidal may be feebly agglutinative, and *vice versâ*. They present, however, certain analogies to immune bodies—they are thermostable, and they become used up in the process of agglutination. They probably contain an agglutinating and a combining (haptophore) group (Receptor of third order, *vide infra*). The nature of agglutination is little understood. Apparently the bodies of bacteria contain agglutinable substances which give rise to, and are in their turn acted on, by agglutinins. Such *agglutinogens* are not all of one kind; some appear to reside in the flagellæ, others in the bodies of organisms (Theobald Smith). The agglutinins called forth by the flagellæ appear to act in much higher dilutions than the others, a fact which mayexplain the greater sensitiveness to agglutination of motile bacilli than of non-motile bacilli.

Besides bacterial agglutinins, *hæmagglutinins*, having an analogous action on blood corpuscles, exist.

(3) *Opsonic Action.*—The most important recent advance in connection with the relations of what we may call cellular and humoral immunity is due to the researches of Sir E. A. Wright and his collaborators on opsonins. They estimated the phagocytic power of the leucocytes by counting the organisms ingested by these cells when equal parts of a standard bacterial emulsion and blood were incubated together at 37° for 15 minutes. They further devised methods whereby the respective parts played by corpuscles and serum in the rôle of phagocytosis could be determined, and proved that "blood-fluids modify bacteria in a manner which renders them a ready prey to phagocytes." To this influence they gave the name *opsonic action*, and to the constituents of the serum which so act, *opsonins* (*ὀψωνίω*, prepare victuals for). The method adopted (*vide infra*) is to centrifuge blood, pipette off the serum, and wash the corpuscles. Serums and corpuscles can then be tested separately against a standardised bacterial suspension. Working with an emulsion of *staphylococcus pyogenes aureus* and his own corpuscles and serum, Wright found that the number of organisms ingested fell when the serum had been kept for four or five days, or heated to 60° to 65° C. for 10 minutes. When the serum was first allowed to act on the bacteria and then heated, and the mixture thereafter exposed to the action of the corpuscles, phagocytic action was unimpaired. It follows that serum contains some substance which so affects bacteria as to render them a ready prey to phagocytes. This opsonic power of the blood is exerted towards staphylo- and streptococci, B. pestis, M. Melitensis, diplococcus pneumoniæ, B. coli, Shiga's bacillus, D. intracellularis meningitidis, B. anthracis, B. typhosus, B. tuberculosis, and the cholera vibrio. It is not exerted towards Löffler's bacillus or B. xerosis.

The opsonic action of serum is greatly increased by the process of immunising against an organism. The nature of opsonins is un-

certain. They are of two main types: the opsonins of normal serums, and the opsonins of immune serums, which differ from those of normal serums in withstanding heat, and in being specific. The latter, therefore, may be regarded as true antibodies, comparable to agglutinins.

By comparing the number of bacteria ingested in (*a*) a mixture of *normal corpuscles*, *bacterial suspension*, and *normal serum*, and (*b*) *normal corpuscles*, *bacterial suspension*, and the *serum of a patient suffering from a bacterial disease*, a ratio, called the OPSONIC INDEX, is obtained. In cases of localised infection with staphylococcus aureus—*e.g.* sycosis, boils, etc. —Wright invariably found this ratio lower than normal—from ·1 to ·87, 1·0 being normal. The inoculation of such patients with a vaccine of dead staphylococci is followed, first, by a temporary fall in the index ("negative phase"), and then by a more prolonged rise ("positive phase") to, or above, normal. Coincidentally with the rise in the opsonic index there is a great amelioration of the lesion due to the bacterial invasion. In connection with the subject of bacterial invasion, Wright lays great stress on what he terms the *bacteriotropic pressure*, *i.e.* the mass effect exerted on the invading bacteria by the protective substance contained in the body fluids. This does not stand at the same level throughout the organism. In fatal typhoid or Malta fever, for instance, the agglutinating action may be as much as 200 times greater in the circulating blood than in the spleen pulp. Bacteria live and multiply in these regions of lowered bacteriotropic pressure. Thus in the case of an abscess the opsonic power of the pus serum was found to be only one-sixth of that of the blood. Wright's work on opsonins has chiefly been made use of and extended in connection with tuberculous infection. Tubercle may be either localised or general, and attended with constitutional disturbance. In localised tubercle the opsonic index is low; in the generalised form it may be either low or high, up to as much as twice normal. When the infection is acute the opsonic index rises and falls within wide limits, because the patient is inoculating himself with successive doses of tubercle, and in consequence negative and positive phases are alternating with one another. The question naturally arises, Is the low opsonic index in localised tuberculous and staphylococcal infection a cause, or a result, of the bacterial invasion? Wright is of opinion that it is an evidence of failure of the defences of the organism, and that to it the infection is due.

(*Precipitines.*—When an animal is immunised with the serum of a different species, precipitines appear in the serum of the former, and confer on it the power of causing a precipitate, or cloudiness, in the serum used for immunisation. The reaction is so delicate that $\frac{1}{1000}$ c.c. of the serum used for immunisation can be detected. The reaction is, within limits, specific. It is always most marked towards the serum of the particular species used, but serums from allied species give a similar though less marked reaction. Thus an anti-human serum gives a slight precipitate with the serum of the anthropoid apes.)

THEORIES OF IMMUNITY.—Two theories, Ehrlich's and Metchnikoff's, fall to be considered.

1. EHRLICH'S SIDE-CHAIN THEORY.—Although many criticisms have been levelled at it, the "side-chain" theory may be said to receive general acceptance in its main outlines as a working hypothesis of the nature of immunity. It must be remembered that it is a theory only, and that it will probably require modification in the future. Some of its details are open to question, yet as it, more than any other, offers a fairly coherent explanation of many of the phenomena of immunity, it deserves some consideration here.

Ehrlich looks on the neutralisation of toxin by antitoxin as a chemical, not a physiological process, and in this the majority of observers agree with him. In standardising diphtheria toxin against a standard serum of which a given quantity was able to neutralise 100 minimum lethal doses of toxin, certain anomalies occurred:—(1) A less quantity of toxin than 100 M.L.D. neutralised the serum, and (2) to a neutral mixture of toxin-antitoxin more than one extra M.L.D. of toxin had to be added in order to kill a guinea-pig within the conventional time. Ehrlich explained these discrepancies by showing that in crude toxin some of the toxin molecules underwent modification to toxoids, which, though almost non-poisonous, could still combine with antitoxin. Their combining affinity might be equal to, greater than, or less than, that of toxin. Where a crude toxin *plus* toxoid of low affinity is used to neutralise antitoxin, and more toxin is subsequently added to the neutral mixture, the first molecules to be set free will be the loosely combined non-poisonous toxoids, and until these are all liberated no free toxin will be present, and no poisonous effect produced. Variations in the number of M.L.D. of crude toxin required to neutralise completely a standard antitoxin depend on the relative amount of toxin and toxoid present, while the fact that more than one M.L.D. is needed to convert a neutral into a lethal mixture arises from the presence in the neutral mixture of loosely combined non-poisonous toxoids, which go on being liberated, and having their places taken by the added toxin, which is thus rendered innocuous. From the above observations Ehrlich assumed that the toxin (toxoid) molecule consists of two

groups, one a combining (*haptophore*), the other a poisonous (*toxophore*) group.

Ehrlich conceives of living cells as possessed of constitutions analogous to the ring of the Benzene molecule, to which, as a centre, outlying molecules are attached. Those outlying molecules (*side-chains* or *receptors*) are supposed to subserve the nutrition of the cell by combining with food molecules, oxygen, etc., circulating in the blood. They are, also, the mechanism by means of which toxins act on the cell; the haptophore group of the toxin molecule combines with a corresponding side-chain and brings the toxophore group into relation with the cell. In consequence the cell may die, or, short of that, the side-chain may be destroyed. In the latter event the cell produces new side-chains to replace those which have been damaged, and at last, as the result of repeated doses of poison, these side-chains are manufactured in excess of the cell's needs, and are thrown off into the blood. When the haptophore group of a toxin molecule combines with a free side-chain the toxophore group is impotent, as it can no longer link itself to, and damage, the tissues. Antitoxin is simply blood serum containing large numbers of free side-chains.

The side-chain theory also explains the facts of hæmolysis. When an animal receives a large dose of heterologous blood cells it may be killed. It is supposed that death is caused by the union of the red blood corpuscles, or their products, with certain somatic cells. Should the dose be insufficient to kill the animal, immunity is gradually developed (sometimes supersensitisation, *vide infra*), and, as has been shown, an immune serum containing complement and amboceptor can be obtained, the amboceptor, it will be remembered, having the power of linking itself to red corpuscles. Like antitoxin, this immune serum owes its properties to containing side-chains which the attack of the injected red blood corpuscles had stimulated the body cells to cast off in excess. These side-chains constitute the amboceptor, which attach themselves to red blood corpuscles on the one hand and complement on the other, whereby the latter is enabled to lyse the former. Amboceptors, therefore, have two affinities—*cytophile* and *complementophile*. The action of complement is conceived of as resembling that of a ferment; it must also possess two groups—*haptophore*, by which it anchors itself to amboceptor; *zymophore*, by which it destroys the cells. By a well-known simile, the cell is a lock, the amboceptor a key, the complement the hand which turns the key. Many hands may do this, but only one key will fit the lock.

Ehrlich supposes that three varieties of side-chain exist. (1) *Receptors of the first order.* These are single haptophore groups by which toxins or food molecules become anchored to the cells. Antitoxin molecules are receptors of the first order. (2) *Receptors of the second order.* The side-chains consist of two groups—one haptophore, and the other possessed of some other property—digestive, agglutinative, precipitating, etc. (3) *Receptors of the third order.* These consist of two haptophore groups, to one of which the food molecule anchors itself, while the other has an affinity for some molecule possessed of digestive properties. Amboceptors, which need for their bactericidal or hæmolytic action the co-operation of complement, are receptors of the third order.

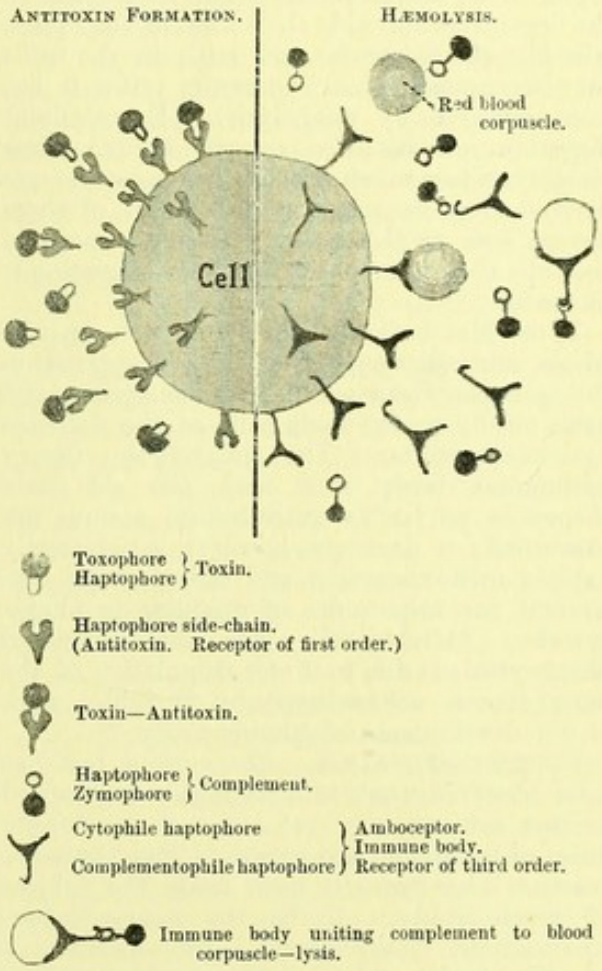

Fig. 1.

The mechanism concerned in immunity is that through which food is assimilated by the cells, and on which the normal nutrition of the tissues depends.

2. Metchnikoff's Theory of Phagocytosis (*see Encyclop. and Dict. of Med.*, Vol. IV., p. 344).—According to this theory resistance to bacteria depends on phagocytosis. In man there are two main varieties of phagocytes—the polynuclear leucocytes (*microphages*), and certain large cells of the tissues which have the power of ingesting bacteria (*macrophages*). Insusceptibility to a disease results from phagocytosis sufficiently active to destroy bacilli,

moderate susceptibility goes along with a local leucocytosis and inflammation with destruction of the invading organisms, great susceptibility with slight, or absence of, leucocytosis. During the immunisation of a susceptible animal absence of phagocytosis may be replaced by active phagocytosis (positive chemotaxis). This Metchnikoff explains as being due to stimulation of the leucocytes.

The digestion of bacteria by phagocytes is due to ferments (cytases) which are normally present in the cells, but escape into the serum when the cells are injured. In the serum these cytases constitute the complement. The amboceptor of an antibacterial serum fixes itself to the organisms and aids the action of the cytase whether the latter be met with in the cells (in phagocytosis) or in the serum (after it has been set free by phagolysis). Extracellular digestion of bacteria cannot occur unless phagolysis has taken place. Amboceptors are derived from leucocytes, but not all of them are set free in the serum; if they remain in the cells the power of intracellular digestion is increased.

Thus Metchnikoff's theory is not, on the whole, contradictory to Ehrlich's; he approaches the question from a different standpoint, and looks chiefly on the body cells as the defences against bacteria. The phagocytic theory harmonises fairly well with the side-chain theory in so far as antibacterial serums are concerned; it does not, however, satisfactorily explain antitoxic action, and fails to take into account the importance of opsonins in phagocytosis. Metchnikoff's view that increased phagocytosis is due to direct stimulation of the leucocytes is contradicted by Wright's work on the development of opsonic action.

SUPERSENSITISATION.—The curious fact has been observed, that animals highly immunised against tetanus may yet succumb to minute doses of toxin, and the nature of this "paradox reaction" has recently been made the subject of much study. Under the names *Supersensitiveness*, *Anaphylaxis*, and *Allergie*, a number of phenomena of this paradox nature have been described, and the results of these investigations have been applied to the interpretation of some of the clinical manifestations of disease, and to the practical ends of diagnosis.

Theobald Smith observed that whereas a normal guinea-pig suffers no harm from the injection of 5 c.c. horse serum, a guinea-pig which has been previously treated, a fortnight or so earlier, with a minimal dose ($\frac{1}{10000}$ to $\frac{1}{1000}$ c.c. is enough) in most cases succumbs to a subsequent dose of 5 c.c. (Theobald Smith's phenomenon). Richet proved that second injections of the poison of actinia—a marine animal which grows near the roots of sponges, and causes sponge divers' disease—were much more toxic than first injections; if the animal survived, however, the symptoms were of shorter duration. He coined the word Anaphylaxis to denote supersensitiveness of this kind. Pirquet employs the word Allergie in much the same way. By it is meant the altered reactivity of an infected animal to a second infection with the same poison; the expression is evidently wider in its connotation than Anaphylaxis.

The exact mechanism by which supersensitisation is brought about is not known. The condition, once established, persists for a long period of time, and may follow the injection of minute doses of either heterologous serums or bacterial toxins. Supersensitiveness is specific; the substances which evoke it (allergens—Pirquet) are thermostable. The condition of supersensitiveness is characterised by:—(1) Shortening of the normal incubation period of the particular infection; (2) diminished duration of the symptoms produced; (3) susceptibility to doses of infective agents which would not affect normal individuals.

Clinically, Anaphylaxis is of importance in the following conditions:—

(1) *Serum Disease.*—In a considerable proportion of patients treated with diphtheria antitoxin (54·6 per cent. according to the statistics of the Belvedere Fever Hospital) the symptoms collectively known as "serum disease" ensue. They are due to the horse serum used as a vehicle, not to the antitoxin itself. The leading symptoms are pains in the joints and urticarial, erythematous, or measly rashes, with fever. They are often heralded by adenitis. Serum disease never follows a first injection immediately; there is an incubation period of about nine days, during which there is a leucocytosis, and during which, presumably, antibodies are being formed. The events of an attack of serum disease may last for a number of days. What has been described may be termed a "normal reaction;" when, however, repeated doses of serum are given, the symptoms no longer pursue the normal course: (1) The reaction sets in without the intervention of the normal latent period; it may occur on the 4th or 5th day ("accelerated reaction"), or within a few hours of injection ("immediate reaction"). (2) Whereas a normal attack of serum disease runs a course of a good many days, or even several weeks, accelerated or immediate attacks are of shorter duration; the symptoms may be so severe, while they last, as apparently to endanger life, or they may consist merely of local rashes at the seat of injection. A further important point must be noted: time is required for the development of supersensitisation. Hence the accelerated or immediate reaction is only seen when an interval of at least ten days has elapsed between first injection and that which gives rise to the

symptoms. On the other hand, when once the condition has become established it may persist for many years, hence any second injection of a serum, even after a long period of time has elapsed, may provoke an abnormal reaction. The practical deduction, therefore, is to avoid reinjections after the tenth day as far as possible, and if a second injection is required, to give it within a week of the first. Injections in rapid succession do not cause an altered reaction. Patients who have previously escaped serum disease may react to the later injections (after the tenth day). No matter how threatening the symptoms, serum disease is probably never fatal, hence, when serum is required, it should never be withheld on account of the possibility of reaction. Serum disease is least likely to occur in bad cases of diphtheria.

(2) *Vaccinia and Variola.*—A primary vaccination runs a definite course—papulation and areolation on the 4th-6th day, the papule growing daily until the 8th-11th day. In secondary vaccinations the insertion often "takes" earlier, and the reaction subsides more quickly. Pirquet finds that in serial daily vaccinations of the same person the later insertions show evidences of the development of anaphylaxis. Insertions made after the appearance of the primary areola never become areolated; they become papular immediately, and attain their maximum development within twenty-four hours. It is a not infrequent experience, that after performing a secondary vaccination in an adult the point of insertion begins to look angry and to show small vesicles about the 2nd or 3rd day—to appear as though it were going to "take" satisfactorily—but at the end of a week all the reaction has died away. Such accelerated, abortive reactions are apparently due to anaphylaxis.

(3) *Tuberculosis.*—The various specific tuberculin tests (*e.g.* Calmette's oculo-reaction—*vide infra*) depend on the existence of anaphylaxis. The antibodies which the tuberculous focus has called into being, and which are distributed throughout the body, combine with the inoculated toxin and cause a local reaction—cutaneous, subcutaneous, or ocular, as the case may be.

(4) *Hay Fever.*—In susceptible persons an attack of hay fever may be produced at any time of the year in a few moments by inoculation with a small dose of pollen (*vide* HAY FEVER).

(5) *Syphilis.*—In reinfections in monkeys the incubation period is curtailed. Syphilitics in all stages show local reactions to syphilitic virus.

DIAGNOSTIC ASPECTS OF IMMUNITY.—Citron's classification gives a good idea of the scope and present possibilities of immunity-diagnosis.

I. SERUM DIAGNOSIS, including (*a*) *the diagnosis of infectious diseases*, and (*b*) *the diagnosis of bacteria* by specific protective substances in the serum, also applicable to the detection of heterologous albumins. The protective bodies which are made available for diagnostic purposes are:—

1. Agglutinines (*e.g.* typhoid fever—Widal reaction—and typhoid bacilli).
2. Precipitines (*e.g.* specific blood tests).
3. Antitoxines (*e.g.* serum of convalescents from diphtheria untreated by antitoxine—of no practical importance).
4. Amboceptors (*e.g.* sero-diagnosis of syphilis—complement fixation).
5. Opsonines.

II. ACTIVE IMMUNISATION.—Not much used. An actively immunised animal does not react to the specific infection. The nature of a doubtful infection may be determined (*a*) by the response of an actively immunised animal to it; or (*b*) by actively immunising animals with it, and then noting their reactions to known infections.

III. ANAPHYLAXIS.—The specific tuberculin tests.

Of these methods of diagnosis, the specific blood tests (I. 2), the sero-diagnosis of syphilis (I. 4), the opsonic index (I. 5), and the tuberculin tests (III.) merit further description.

1. *The Biological Blood Test* (Uhlenhüth—Wassermann—Schütze).—This depends on the development of precipitines. Defibrinated human blood or blood serum is injected into the peritoneal cavity of a rabbit at intervals of two or three days until six doses have been given; the animal is bled a week after the last injection. The immune rabbit serum is then a specific precipitant for human serum, but not for the serum of domestic animals. Decomposing blood, menstrual blood, and blood which has been heated to 60° C. give the reaction. The immune serum used should be tested against human blood in order to ascertain whether it is active. A very dilute solution of the blood-stain in 1·6 saline solution is prepared, and filtered until it is clear. To 4 or 5 c.cm. of this solution in a test-tube there is added ·5 c.cm. of the immune serum, and the whole is kept at a temperature of 38° C. Precipitation begins within from a few minutes to half an hour; first a faint cloudiness develops, which becomes more dense and ultimately gives a flocculent precipitate. As in the case of the agglutination test, the time of appearance and the dilution required are important. Heterologous serums other than human blood may give a faint haziness, so that the test cannot be regarded as positive unless at the end of an hour a true flocculent precipitate has formed with much diluted blood on the addition of two or three drops of antiserum.

2. *Serum Diagnosis of Syphilis.*—The serodiagnosis of syphilis which is associated with the name of Wassermann is based on the principle of complement fixation. The method is too complicated to be carried out except in a laboratory; it is said by those who have practised it to be as reliable in the diagnosis of previous or active syphilis as is the Widal test in typhoid fever. The test depends on the fact that when syphilitic virus is mixed with the serum of a syphilitic patient the antibodies in the latter unite with the virus and with complement. The complement is thus fixed, and is not available for uniting with any other antibodies. If, on the other hand, a non-syphilitic serum (containing, therefore, no antibodies) is mixed with syphilitic virus there is no fixation of complement, which is consequently free to combine with any other antibodies. The diagnosis of a syphilitic serum, therefore, depends on the recognition of the complement, and the presence or absence of free complement is determined by adding to the mixture of virus, complement, and suspected serum, inactivated hæmolytic serum and red blood corpuscles. If free complement is present lysis will occur; if the complement has been fixed there will be no lysis. To carry out the test the following are required—(1) Antigens, obtained by extracting the liver of an hereditary syphilitic fœtus with salt solution. (2) Antibodies as contained in the suspected serum—blood serum, cerebro-spinal fluid, etc. (3) Complement — fresh guinea-pig's serum 1 : 10. (4) Hæmolytic serum, from a rabbit highly immunised against sheep's corpuscles, inactivated by heating. (5) Washed sheep's corpuscles. In carrying out the test a complete system of controls is required. Citron employs ten, and gives the following scheme for their employment:—

		Result	Expected
1. ·2 c.c. syphilitic antigen + ·2 syphilitic serum + ·1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	no hæmolysis	
2. ·2 c.c. syphilitic antigen + ·1 syphilitic serum + ·1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	partial	,,
3. ——— ·2 syphilitic serum + ·1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	complete	,,
4. ·2 c.c. syphilitic antigen ——— + ·1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
5. ·2 c.c. syphilitic antigen + ·2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
6. ——— ·2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
7. ·2 c.c. extr. normal liver + ·2 syphilitic serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
8. ·2 c.c. extr. normal liver + ·2 normal serum + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
9. ·2 c.c. extr. normal liver ——— + 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,
10. ——— ——— 1 complement	+ 2 lysing doses hæmolytic serum + 1 c.c. 5 per cent. sheep's blood	,,	,,

In the tubes 3, 4, 6, 9, and 10 the absent substance is replaced by 1 c.c. ·85 saline solution

Results estimated thus. Tubes 1 = no hæmolysis and 2 no hæmolysis = syphilis + + + +
1 = no hæmolysis and 2 partial hæmolysis = syphilis + + +
1 = no hæmolysis and 2 hæmolysis = syphilis + +
1 = partial hæmolysis and 2 hæmolysis = syphilis +
1 = almost complete hæmolysis and 2 hæmolysis = syphilis (?)
1 = complete hæmolysis and 2 hæmolysis = no syphilis

Value of Wassermann's Reaction. — Non-syphilitic persons never give a positive reaction; a large proportion of syphilitic persons give it. A positive reaction, therefore, is proof of syphilis; a negative one renders it unlikely, but does not disprove it. Syphilitic patients may give a negative reaction (1) during the primary stage of the disease; (2) during the second stage, in rare cases only; and (3) during the later stage, if thorough treatment has effectively driven away all symptoms. In general terms, a positive reaction is given in about 80 per cent. of syphilitic cases. Time is required for the development in the patient's serum of antibodies, hence the reaction may be negative at first, and appear after six or eight weeks have elapsed. The secondary cases which do not react are generally in the early eruptive period. In tertiary cases the reaction is very constant. Tabes, general paralysis, and aneurism give a high percentage of positive results. In general paralysis both blood serum and cerebro-spinal fluid give the reaction; in tabes the blood serum commonly gives it, but the cerebro-spinal fluid rarely does so. A positive reaction from the cerebro-spinal fluid is said to be almost pathognomonic of paralysis.

Under mercurial treatment a positive reaction may become negative. The longer the syphilitic virus has been active, and the oftener relapse has occurred, the more constant is the reaction. The earlier mercurial treatment is instituted, and the more effectively it is carried out, and the shorter the time since the last course was undergone, the fewer the antibodies in the serum and the less marked the reaction.

Wassermann's test, therefore, promises to afford a means by which the efficacy of treatment can be estimated, and the need for its renewal determined. Since the original test was introduced, it has been simplified in various ways. Some of these newer modifications are discussed under the rubric Syphilis.

Complement Fixation in the Diagnosis of Other Diseases.—The method has been used in the diagnosis of typhoid fever, cerebro-spinal meningitis, gonococcal infections and other diseases. In these cases bacterial extracts made from cultures are used as antigens. In Wassermann's method the original feature was the use of an extract of an organ. The following diagram, modified from Citron, will render the method clear (Fig A. B.).

Fixation of complement may also be used to identify bacteria, or antigens, as well as anti-

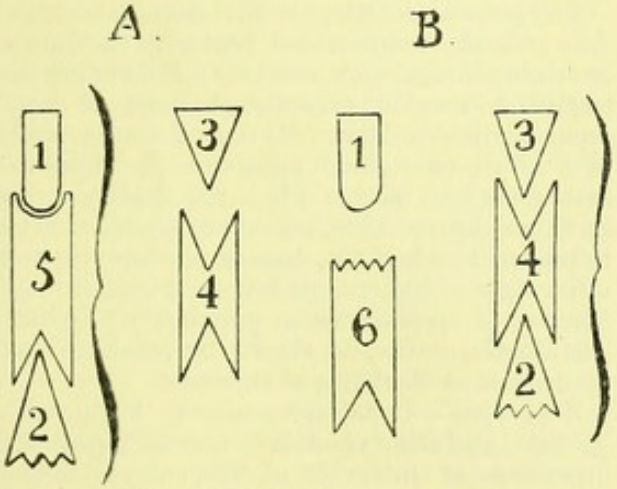

Diagram illustrative of complement fixation in diagnosis.
1 = Typhoid bacilli. 2 = Complement. 3 = Red blood corpuscles. 4 = Hæmolytic amboceptor. 5 = Typhoid amboceptor. 6 = Cholera or other amboceptor.
A. Fixation of complement to typhoid amboceptor and bacilli; no hæmolysis.
B. No fixation of complement to cholera amboceptor and typhoid bacilli; free complement links itself to hæmolytic immune body = hæmolysis.

bodies, using in this case a known antibody, just as in other cases a known antigen is employed. The method of complement fixation is important as being the most delicate of all the immunity tests, and as being applicable to soluble albumins as well as bacterial antigens.

3. *The Opsonic Index.*—The chief diagnostic importance of the opsonic index is in connection with tuberculosis.

Technique.—1. *Preparation of the Bacterial Emulsion.* (*a*) Emulsions of tubercle bacilli are prepared by thoroughly grinding up a mass of dead culture (which can be procured commercially) in an agate mortar with 1·5 per cent. saline solution, and then centrifuging. Alternatively, the emulsion prepared by grinding in the mortar may be stored in small sealed tubes, and used as described under. (*b*) In either case the bacilli should be sterilised by heating for half an hour on three consecutive days. (*c*) Emulsions of pyogenic cocci are made by rubbing up a little of a twenty-four hours' culture with normal saline, and centrifuging so as to deposit clumps of bacilli. A slightly opalescent suspension results. 2. *Washed Leucocytes.* A few drops of the observer's blood are allowed to drop directly into a test-tube of 1·5 per cent. sodium citrate dissolved in normal saline. The mixture is thoroughly centrifuged, and the supernatant fluid pipetted off; more saline is added, the mixture is again centrifuged, and the fluid removed; then the process is repeated a second time. After this the upper layer of corpuscles, which is rich in leucocytes, is pipetted off into a watch-glass for use. 3. *Blood* is collected in a pipette, with a specially curved end; the ends are sealed and the tube is hooked by its curved end to the centrifuge. On centrifuging, the corpuscles collect at the straight end, the tube is broken across, and the serum pipetted off. Having made these preparations, we mix equal parts of serum, washed corpuscles, and bacterial emulsion, using as a measure a capillary tube with a mark made by an oil pencil about an inch from one end, and provided at the other with a rubber teat. The serum is drawn up to the mark, then an air bell is allowed to enter, next the emulsion is sucked up, and another air bell, then the corpuscles. The contents of the tube are then blown out on to a slide, thoroughly mixed, and re-aspirated into the tube once more. The ends of the tube are then sealed, and the whole is incubated at 37° C. for fifteen minutes. A control preparation with normal serum is also made in the same way. From the contents of the tubes films are made on slides which have been rubbed once or twice with the finest emery paper (to facilitate an even smear), and stained with Leishman's stain for cocci, or, after fixing with corrosive sublimate, with carbol fuchsin and methylene blue for tubercle bacilli. The number of bacteria ingested by 50 polynuclear leucocytes is counted, and an average struck. From this the index is obtained, *e.g.*—

Patient's serum + corpuscles + bacteria. Average bacteria per leucocyte, 1·5.

Normal serum + corpuscles + bacteria. Average bacteria per leucocyte, 3. Opsonic index $\frac{1\cdot5}{3}$ or ·5.

The chief criticism which has been brought against the value of determinations of the opsonic index concern the limits of its experimental error. Wright claims that in his laboratory the error seldom exceeds 5 per cent.; others report much less favourably. At present this aspect of the question is still undecided. Rivière points out that it is as necessary to include a sufficient number of ingested bacteria in the count as to enumerate 50 or 100 leucocytes. At least 150 bacteria

should be counted, irrespective of the number of phagocytes containing them. The emulsion used ought therefore to be thick enough to give a phagocyte index of 2.

Diagnostic Significance of the Opsonic Index.—For tuberculosis Wright lays down the following rules:—

1. "Where an isolated blood examination reveals that the tuberculo-opsonic power of the blood is low, we may, according as we have evidences of a localised bacterial infection or of constitutional disturbance, infer with probability that we are dealing with tuberculosis, in the former case with a localised tubercular infection, in the latter with an active systemic infection."

2. "When an isolated blood examination reveals that the tuberculo-opsonic power of the blood is high, we may infer that we have to deal with a systemic tuberculous infection which is active, or has recently been active."

3. "Where the tuberculo-opsonic power is found normal, or nearly normal, while there are symptoms suggestive of tuberculosis, we are not warranted, apart from the further test described below, in arriving at a positive or negative diagnosis."

4. "Further test:—When a serum is found to retain in any considerable measure, after it has been heated to 60° C. for 10 minutes, its power of inciting phagocytosis, we may conclude that 'incitor elements' have been elaborated in the organism either in response to auto-inoculations occurring spontaneously in the course of tubercular infection, or, as the case may be, under the artificial stimulus supplied by the inoculation of tubercle vaccine."

5. If the opsonic power of the fluids from the focus of invasion differs from that of the blood, tubercle is indicated; if it is the same, the infection is non-tuberculous.

6. Some observers (Stewart, Peel, Ritchie) regard single estimations as inconclusive, as both tuberculous and non-tuberculous cases fall within and without normal limits. The effect of a small dose of tuberculin on the index is of diagnostic value. In tuberculous subjects a "negative phase" follows, succeeded by a "positive phase"; in the non-tuberculous the negative phase is absent. (Lawson and Stewart.)

The determination of the opsonic index in other than tubercular and pyogenic infections has so far given results of more scientific than practical interest. The amount of time which opsonic work demands militates greatly against its general adoption, even by those who have laboratory facilities at their disposal. Further reference will be made to the subject under the headings of some of the various bacterial diseases.

4. *Specific Tuberculin Tests.*—These furnish the only instances of reliable diagnostic reactions dependent on the phenomena of anaphylaxis. Analogous tests for typhoid and other infections have not proved trustworthy. The tests in question are three in number:—(1) Subcutaneous inoculation of Koch's old tuberculin. (2) Pirquet's cutaneous reaction. (3) Calmette's oculo-reaction. The introduction of the two latter has done much to supersede the determination of the opsonic index in the diagnosis of tubercle.

1. *Koch's Subcutaneous Tuberculin Reaction* (1890).—Old tuberculin (Meister, Lucius & Brüning), the glycerine extract containing the toxins of the tubercle bacillus, introduced by Koch in 1889, is employed. Subcutaneous injections of small quantities give rise in tubercular persons to (*a*) general reaction—fever, malaise; (*b*) focal reaction at the lesion; (*c*) occasionally to a local reaction at the point of injection—"*stich-reaction.*"

The general reaction is the most important. As a rule the temperature begins to rise in six or eight hours, and reaches a maximum in twelve hours; in exceptional cases it may occur earlier or later. A rise of temperature of 1° F. is considered positive. The focal reaction may be visible when the disease is on an exposed part—thus, a patch of lupus becomes hyperæmic; when the disease is deeply seated other signs of hyperæmia may be detected—*e.g.* increase of crepitations in pulmonary mischief. The local reaction is shown by swelling and tenderness at the point of injection.

Technique.—It is customary to begin with $\frac{1}{10}$ mgr., and if no reaction occurs to repeat the injections at intervals of four days. Some increase the dose if the first injection is negative, giving in succession $\frac{1}{10}$ mgr., 1 mgr., 5 mgrs., and 10 mgrs. Others, instead of increasing the dose, continue with $\frac{1}{10}$ mgr.-$\frac{1}{5}$ mgr., even when the first injection has been negative, because the susceptibility to tuberculin rises with successive doses, and even healthy persons may react to large quantities. If a doubtful reaction is got, the dose of $\frac{1}{10}$ or $\frac{1}{5}$ mgr. should be repeated. In children it is advisable to restrict the dose to $\frac{1}{10}$ mgr., repeated if necessary. When the test is being applied the rectal temperature should be taken every two hours. It is generally agreed that when applied in the manner described the test is very reliable, and not dangerous, provided that the following contra-indications be kept in view:—

1. The test should not be used when tubercle bacilli can be demonstrated.

2. Fever invalidates the test. This is the most serious practical drawback, as a temperature of 99° F. in the rectum is sufficient to render it worthless.

3. It is contra-indicated in patients suffering from heart or kidney disease, epilepsy, diabetes, arterio-sclerosis; when hæmoptysis has occurred,

or where there is a suspicion of miliary tuberculosis.

This is regarded as the most certain and delicate test for tuberculosis. Some healthy persons react, probably because they harbour obsolete tubercle, and this detracts to some extent from its clinical value.

2. *Pirquet's Cutaneous Reaction.*—For this, old tuberculin diluted with 2 parts of normal saline and 1 part 5 per cent. carbolic-glycerine is employed. A drop is placed on the skin, and the epidermis is scarified through it. A control scarification through normal saline should be made an inch or two distant. It is important to make the two abrasions equal in depth and extent, so that no doubt may arise as to the result; and to attain this the best instrument to use for vaccination is a small dental burr, the effect of which can be exactly regulated. A positive reaction shows itself in from six to eight hours, and attains its maximum in twenty-four hours. According to the intensity of the reaction a papule surrounded by a varying degree of erythema develops. There is sometimes vesiculation, and occasionally slight pigmentation is left behind after the papules disappear. The clinical value of the cuti-reaction is detracted from by the fact that a large number of apparently healthy adults (80 per cent. according to some observers) respond to it, presumably because it reveals obsolete tubercle. It is, therefore, of clinical value only in children under five, some say under two, years. *Statistics:*—For adults, collating Mainini, Wollf, and Goebel, we find 84 positive reactions in 96 cases of tuberculosis; 137 reactions in 195 suspects; and 101 reactions in 128 clinically normal persons. In children, Goebel, Ferrand and Lemaire, Bing, and Pirquet give 95 positive reactions in 128 tuberculous patients; 44 reactions among 68 suspects; and 21 reactions among 93 clinically non-tuberculous.

The cuti-reaction is devoid of risk, and there are no contra-indications to its use.

Moro's salve reaction is simply a modification of Pirquet's test, and presents no advantages over the original method. An ointment consisting of 5 c.c. old tuberculin and 5 grams anhydrous lanolin is rubbed into the skin; a positive reaction is shown by the occurrence of slight dermatitis.

3. *Calmette's Oculo-Reaction.*—Although this test is associated with the name of Calmette, who has done most to popularise it and extend its use, he was actually anticipated in his publication of the method (19th June 1907) by Wollf-Eisner, who independently described it on 8th and 15th May 1907 at meetings of the *Berliner Medizinische Gesellschaft.* Hence in Germany it is also known as the Wollf-Eisner reaction. The test consists in the instillation of a drop of a weak solution of tuberculin into one conjunctival sac; a positive reaction is shown by a mild attack of conjunctivitis.

Wollf-Eisner employed a 10 per cent. solution of tuberculin, while Calmette employs a $\frac{1}{2}$-1 per cent. solution, and in order to avoid the irritating action of glycerine on the conjunctiva he uses exclusively dried tuberculin precipitated by 95 per cent. alcohol, dissolved in sterile distilled water. In Wollf-Eisner's method serious conjunctivitis is rather liable to occur, and now the general custom is to use only the weaker—·5 per cent.—of Calmette's solutions. Citron states that a reaction with 1 per cent. tuberculin points with a high degree of probability to tuberculosis. A reaction with 2 per cent. renders it probable, and no reaction with 4 per cent. solution negatives tubercle, unless the patient is cachectic (*vide infra*). He advises that a 2 per cent. solution be dropped into the right eye; if no reaction follows, then 4 per cent. solution is inoculated on the opposite side—if, on the contrary, there is a reaction, the second instillation is made with 1 per cent. solution.

If the reaction is positive the first signs appear in from three to five hours after instillation. There is evident congestion of the palpebral conjunctiva, which quickly becomes œdematous; the caruncle swells and becomes reddened and covered with fibrinous secretion. The vascular engorgement becomes gradually more accentuated, and is accompanied by lachrymation. After six hours the fibrinous exudate increases and collects in shreds in the conjunctival sac. The maximum reaction is attained in from six to ten hours. There is no pain, little discomfort, no chemosis, and no pyrexia. In children the phenomena usually begin to subside in the course of twenty-four or thirty-six hours; in adults they may last a little longer. Three grades of reaction are distinguishable:—(1) slight, which may pass unnoticed unless the inner canthus is carefully compared with that of the opposite eye; (2) moderate, giving the appearances of a mild acute conjunctivitis; (3) violent, resembling purulent ophthalmia. The last is rare when a ·5 per cent. solution is used. The Calmette test is of great value; its sole disadvantage is the undeniable, though slight, risk of damage to the eye. This will be referred to later. Campbell has collected statistics up to April 1908. The 4219 cases in his series give these results:—

Tuberculous cases .	1675	1426+	249−	=85 % positive.
Suspected tuberculosis	557	289+	268−	=52 % positive.
Non-tuberculous cases	1987	169+	1818−	=91·5 negative.

Comparison of the Tuberculin Tests.—It is unanimously agreed that all three tests fail in advanced tuberculosis, in general miliary tuberculosis, and in tuberculous meningitis. This fact probably explains the 15 per cent. or so of negative results in tuberculous patients.

As regards the relative value of the tests, it is not easy to compare the statistics of different writers, but it seems certain that both the subcutaneous injection, and the cutaneous inoculation of tuberculin are more delicate than the oculo-reaction. They may reveal latent or obsolete tubercle in persons clinically healthy. This is less likely to occur with the oculo-reaction, which is practically, therefore, the most useful of the three.

Relation of the Intensity of the Reaction to the Severity of the Disease.—As has been said, advanced cases give no response, and on the whole the intensity of the reaction is inversely proportionate to the grade of infection. Wolff-Eisner distinguishes between marked, mild, and delayed cuti-reactions, associating the first with mild and incipient tuberculosis, the second with advanced cases, and the third with the absence of clinical tuberculosis.

Danger to the Eye in the Oculo-Reaction.—That a certain risk attaches to the conjunctival test cannot be disputed. It is greatest when strong solutions are employed, and many of the reports of disaster come from Germany, where a 10 per cent. solution was originally advocated. Before the test is applied, the eye should be carefully examined, and the test should only be proceeded with *if the eye appears perfectly healthy and free from any evidence of previous disease. In old people, and in scrofulous children special care is required, and the tuberculin should not be used stronger than* $\frac{1}{4}$-$\frac{1}{2}$ *per cent.* Patients from trachoma districts should not be subjected to the Calmette test. The test is also useless if a diagnostic injection of tuberculin has been given within the previous six months. It is probably a wise precaution to irrigate the conjunctival sac with sterile saline solution before applying the test. The ensuing conjunctivitis should be treated with boric lotion, and the application of a mild antiseptic ointment (Hydrarg. ammon. grs. v. ad ℥i.) to the edges of the lids. In view of the fact that a sharp attack of conjunctivitis may follow, the test is not suitable for out-patient and dispensary practice, unless effective supervision can be carried out. The permission of the patient should be obtained before the test is applied.

Reapplication of the Tests.—In connection with the subcutaneous injection of tuberculin the increasing sensitiveness of the patient with each dose was referred to. In the oculo-reaction the same occurs. Second instillations into the same eye sometimes provoke reactions in persons who have failed to respond to the first test. The diagnostic meaning of these second reactions is doubtful; they may occur in healthy as well as tuberculous persons. The supersensitiveness, however, is probably local, hence if a second test be thought advisable the tuberculin should be dropped into the opposite eye. It is claimed that where this is done a reaction can be obtained in a certain proportion of tuberculous patients who previously gave no response to the test.

It has been found impracticable to differentiate between infections with the bovine and human bacillus by the use of bovine and human tuberculin.

Attempts to adapt the cutaneous and oculo-reactions to the diagnosis of typhoid fever have also failed. Mallein applied in this way is said to give reliable results in cases of glanders in man.

Therapeutic Use of Bactericidal Serums.

The fact that for bactericidal serums to act complement is essential, is fundamentally important. Let us suppose, for the sake of argument, that by inoculation we can greatly increase the amount of amboceptors, and that we can inject these into the body of a person invaded by the organism in question, we have still to face the fact that (beyond the small quantity which the immune serum contains) there is no more complement than before, and that the amboceptors are only available for the destruction of bacteria in so far as they can be complemented. There is also some reason to believe that excess of amboceptors over available complement is harmful. For under these conditions some of the amboceptors may be anchored to bacteria, and others to complement, whereupon the only way in which the available complement can come into relation with bacteria is by amboceptor uniting to amboceptor, and this is impossible. So far, it has not proved practically possible to increase complement. For one thing, little is known about complements, and the search for a suitable one has been largely at random. Again, to inject complement may simply result in the formation of anti-complement, which will neutralise what already exists. Anti-bacterial serums originally contain the complement of the species from which they were derived, but complement is an unstable body and liable to disappear through lapse of time. It does not follow that the complement present in man will be able to link itself to the amboceptors injected; these, therefore, may prove useless. The whole question of complementing anti-bacterial serums seems to be a crucial point in their future usefulness.

LITERATURE. — The literature of immunity is enormous, and only a few of the chief sources can be given. Current literature is recorded in Baumgarten's *Jahresbericht*.—Koch and Flugge, *Zeitsch. f. Hygiene u. Infections; Centralb. f. Bakteriologie u. Parasitenkunde.* The bibliography in Muir and Ritchie's *Manual of Bacteriology*, 4th ed. (Edin.), 1907, and the list of references in Ritchie's article on "infection" in Clifford Allbutt's *System of Medicine*, vol. ii., 2nd ed. (Lond.), 1906, should be consulted:—Opsonines—Wright and Douglas, *Proc. Royal Soc.*, lxxii. p. 357,

1903; lxxiii. p. 128, 1904.—Wright, *Lancet*, ii. p. 1398, 1905 (references).—Hektoen, *Journ. Amer. Med. Assoc.*, 12th May 1906 (references).—Bowditch Potter, *Ibid.*, 24th Nov. and 1st Dec. 1906.—Fordyce, *Internat. Clinics* (Phila.), vol. i. ser. 18, 1908 (references). A series of papers will also be found in the *Trans. Assoc. Amer. Physn.*, vol. xxii. 1907. Supersensitisation—Review by Pirquet, *Ergeb. d. inner. Med. u. Kinderheilk.*, Bd. i. 1908, gives references.—Richet, *Presse méd.*, 21st March 1908. Serum Disease—Currie, *Glasgow Med. Journ.*, March 1908. Immunity Diagnosis—The best general article is by Citron, in Brugsch and Schittenhelm's *Lehrbuch klinischer Untersuchungs-Methoden* (Berlin), 1908. Sero-Diagnosis of Syphilis—The files of the *Deutsche med. Wochensch.*, the *Münch. med. Wochensch.* and the *Berl. klin. Wochensch.* for 1907 and 1908 contain a number of papers on the subject, of which may be mentioned those by Citron, *Deutsche med. Wochensch.*, 10th July 1907, and *Berl. klin. Wochensch.*, 25th Oct. 1907.—Wassermann and Meier, *Deutsche med. Wochensch.*, 8th Aug. 1907.—Fornet, *Ibid.*, 10th Oct. 1907.—Wassermann, *Berl. klin. Wochensch.*, 16th Dec. 1907.—Bab, *Münch. med. Wochensch.*, 12th Nov. 1907. Specific Tuberculin Tests—During 1907 and 1908 a great many papers have appeared on the ophthalmo- and cutaneous-reactions. Only a few need be mentioned.—Calmette, *Presse méd.* (Paris), 19th June 1907.—Wollf-Eisner and Teichmann, *Berl. klin. Wochensch.*, 21st Jan. 1908.—Pirquet, *Deutsche med. Wochensch.*, 23rd and 30th May 1907.—Wollf, *Berl. klin. Wochensch.*, 10th Feb. 1908.—Comby, *Presse méd.*, 10th Aug. 1907.—Campbell, *Montreal Med. Journ.*, April 1908, gives a list of references to oculo-reaction. Riviere's article in *Tuberculosis in Infancy and Childhood* (Lond.), 1908, contains a general review of the tests for tuberculosis, and gives literature. Oculo-Reaction in Typhoid—Chantemesse, *Deutsche med. Wochensch.*, No. 39, 1907.—Kraus, *Wien. klin. Wochensch.*, 11th Nov. 1907. In Glanders—Martel, *Berl. klin. Wochensch.*, 2nd March 1908.

Inadequacy, Thyroid. — *See* Eclampsia (*Theories*).

Inbreeding.—Breeding in and in, or from animals of the same or of closely related parentage.

Incision, Pfannenstiel's. — *See* Cæsarean Section (*Methods, Supra-Symphysary*).

Indoform.—A proprietary preparation, said to be a salicylic acid preparation without the damaging secondary effects of that drug; Frerichs found that it consisted of a mixture of salicylic acid, acetyl salicylic acid, and a trace of a formaldehyde combination; it has been recommended in gout, sciatica, rheumatism, influenza, etc. See *Brit. Med. Journ.*, i. for 1909, p. 960.

Indolacetic Acid.—One of the decomposition products of the aromatic radicals (others being skatol, phenol, paracresol, etc.), which may be detected in the urine.

Infant Feeding.

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All recent work on the rearing of infants has led to the conclusion that maternal nursing is infinitely preferable to any form of hand feeding. The more closely the natural process of suckling is studied, the less probable does it appear that any really satisfactory substitute will ever be found. At the same time, some advances in artificial feeding have been made.

Digestion of Casein of Milk.—The views of Van Slyke and Hart are now generally accepted here and in America. The essential point brought out by their work is that the amount of digestion which milk requires depends on the activity of the gastric juices. In the stomach of the newly-born infant it probably undergoes comparatively little digestion, and passes quickly into the bowel, whereas in older infants it offers considerable resistance to digestion. Milk stands alone among foods in possessing this quality, which results from the reactions of casein towards rennin and hydrochloric acid. In explaining these reactions the nomenclature of Van Slyke and Hart will be followed.

Casein is a proteid which contains phosphorus, and exists in milk in combination with lime as *calcium casein* (otherwise known as caseinogen, etc.). On entering the stomach calcium casein is acted on by rennin, hydrochloric acid, and pepsin. Rennin and pepsin exist in the gastric juice from birth; hydrochloric acid appears soon after birth. Rennin can only act on calcium casein if (as is normally the case) ionisable calcium salts are present in the milk plasma. (To digress for a moment from the main argument, we may here state that the effect of sodium citrate in inhibiting rennin action depends on the power of the citrate to diminish the ionisable calcium.) The first action of rennin is to convert the soluble calcium casein into insoluble *calcium paracasein*, a soft curd which, in the absence of hydrochloric acid, is not further affected by pepsin, but passes readily into the intestine. If, however, free hydrochloric acid be present in the stomach, it reacts with the calcium paracasein and converts the latter into *free paracasein*, which is a firmer curd, and is digested by pepsin. If the hydrochloric acid be present in larger amount, a further reaction ensues, paracasein hydrochloride being formed from the free paracasein. This is a denser curd than either of its precursors; it, also, is digested by pepsin.

Several matters of practical interest arise out of the above statement as to the digestion of milk.

1. It brings into prominence the part which milk plays in developing the gastric functions. At each stage of the stomach's development milk will fully tax the powers of the organ, and exercise them to the utmost. We thus see why the milk of the parent animal, though its composition remains practically the same throughout lactation, is as suitable a diet at the end of that period, when the offspring is beginning to be capable of digesting ordinary food, as it is at birth, when the digestive powers are extremely feeble.

2. It also throws light on the functions of curd formation, the object of which would appear to be to exercise the motor as well as the secretory functions. In this connection Chapin's work may be referred to. He draws attention to the relation which exists between the variations in the milks of different species, and variations in the development of the stomachs of the offspring. According to him, the milk of any animal is specially adapted for developing the stomach of its young in a normal manner—*e.g.* the dense curd of cow's milk is designed to assist in the development of a stomach fitted to deal with the vegetable diet on which the animal subsists.

3. A mechanism of this kind would seem to compensate for slight variations in modifications of milk ; it also explains, to some extent, how cow's milk, notwithstanding the gross difference between its curd and that of human milk, is so well borne by most infants. It may, perhaps, account for the fact that in some cases whole milk is tolerated better than a dilution, because if much hydrochloric acid is present in the stomach it may convert all the casein of dilute milk into casein hydrochloride, whereas if whole milk be given the acid is insufficient to do so—in the former case a dense, though small curd forms, in the latter a softer, though larger one.

4. If milk which has soured, but has not reached the stage of curdling, be swallowed, rennin action takes place as above, and then both lactic and hydrochloric acid are available to react with the calcium paracasein, paracasein lactate and hydrochloride being formed. The excess of acid leads to the production of large quantities of tough curd. In milk which has soured completely and formed a curd outside the stomach (*e.g.* buttermilk), casein lactate, not paracasein lactate, is formed. The curd of casein lactate is light, and undergoes no further change when it comes in contact with rennin and hydrochloric acid. Thus, buttermilk is a digestible food, partially soured milk a very indigestible one.

Causes of Cow's Milk Disagreeing.—It is now thought that in the past too much importance has been attached to the proteid of cow's milk as a cause of difficulty in infant feeding. Holt has drawn attention to the dangers which result from excess of fat, and quantities which were formerly advised are now looked upon as harmful. Probably it is never desirable to order a milk mixture containing more than 3 per cent. to 3·5 per cent. of fat. Czerny and Keller represent the extreme school of opinion in this respect. They deny that there is any evidence that the proteid of cow's milk is either more difficult to digest, or less perfectly assimilated, than that of human milk, and they blame the fat of cow's milk for nearly all the difficulties which arise in connection with hand feeding. They go so far as to attribute many cases of marasmus to this component of milk ; their views will, however, be found more fully referred to elsewhere (*see* Infantile Atrophy).

Another aspect of the failure of cow's milk to promote normal growth in some cases has recently been much studied in Germany. Attempts have been made to show that it acts as a heterologous albumin, and thus may in some cases be positively harmful. This, however, has never been proved, and the evidence is rather against it. It is, however, probable that a young animal derives from its mother (particularly during the colostrum period of lactation) vital products of the nature of enzymes, which it cannot obtain from any other source. The special importance of maternal nursing during the colostrum period is very strongly insisted on by some workers from the biological point of view.

The Addition of Alkalies to Milk.—From the chemical point of view, human milk is faintly acid, not alkaline, as formerly stated. That the addition of alkalies (lime water and sodium bicarbonate) renders cows' milk more digestible has long been recognised, but a clear appreciation of their action has only recently been arrived at. Their action is twofold : they combine with calcium casein to form compounds on which rennin has no action ; they neutralise the hydrochloric acid of the gastric juice, and thus inhibit peptic digestion. Lime water is much more powerful in rennin-inhibitory action, and sodium bicarbonate in acid-neutralising power. Fifty c.c. of lime water equal 3 grs. of sodium bicarbonate in acid-neutralising power, and 35 grs. of sodium bicarbonate in inhibiting rennin. Thus, if it be desired to diminish rennin action without eliminating gastric digestion by hydrochloric acid and pepsin, lime water should be chosen ; if it be desired to cut out gastric digestion altogether, sodium bicarbonate should be used. Lime water is generally added in the proportion of 1-5 ozs. to the pint of milk, sodium bicarbonate in the proportion of 1-2 grs. to the oz. Milk thoroughly alkalinised by the addition of 2 grs. of sodium bicarbonate to each ounce probably

to a large extent escapes gastric digestion. Lime water is therefore most useful in intestinal indigestion (colic, and passage of loose stools with mucus and "curd"); sodium bicarbonate in gastric indigestion, with vomiting of curd.

METHODS OF FEEDING.—Turning to the newer methods of feeding which have come into vogue, it may be said that even in America percentage feeding has, to some extent, lost ground, and that there is less tendency now than a few years back to insist on the need for an exact correspondence between the proportions of proteid, fat, and sugar, in milk modifications with what is found in human milk. This change of opinion has arisen largely through its having been realised that milk is naturally of variable composition.

The importance of securing a milk which is free from bacterial contamination is as strongly held as ever, and while all admit the superiority of fresh over-cooked milk, it is at present practically impossible to secure sterility except by some process of heating. Boiling, pasteurisation at 156° F. for 20 minutes, and sterilisation in a water-bath at 212° F. for periods of from 5 minutes to 45 minutes, all have their advocates; the first and the last are perhaps the most widely used, as being free from the uncertainty of pasteurisation. "Buddised" milk—*i.e.* milk which has had added to it as much hydrogen peroxide as it will decompose when subjected to a temperature of 120° F. for 3 hours—has been introduced by Dr. Budde; it is stated that milk so heated remains sterile, and does not present the disadvantages of boiled milk. This milk is now on its trial, and it is very doubtful whether it will really prove superior or even equal to ordinary boiled or sterilised milk.

The work of the Royal Commission on Tuberculosis (*see* TUBERCULOSIS) has drawn renewed attention to the conveyance of the contagion of tuberculosis by milk. In the opinion of the commissioners the danger of such transmission does exist. Some clinicians believe that abdominal tuberculosis is frequently caused by infected milk; others believe that the risk is very small. In any case, the disadvantages of the use of milk sterilised by heat are so trifling in comparison with even the remote possibility of infection with tuberculosis, that it is unjustifiable to feed young infants with raw milk unless one is assured that it is derived from cattle which have passed the tuberculin test. In random samples of commercial milk the percentage which contain living tubercle bacilli is considerable—7·8 per cent. in Manchester (1901-1906); 13·05 per cent. in Sheffield (1902-1906); 1·5 per cent. in Liverpool town milk, and 6·5 per cent. in Liverpool country milk (1906-1907).

Thermal Death-Point of Tubercle Bacilli in Milk.—Boiling kills the organism. It may survive exposure to 158° F. for half an hour, especially if a pellicle is allowed to form on the milk, in the meshes of which the bacilli become entangled. Russell and Hastings found that a temperature of 140° F. maintained for 20 minutes ensured their destruction, provided the milk was in a closed vessel and that no pellicle was allowed to form.

Feeding with Undiluted Milk.—This, which is more commonly known as "Budin's Method," has attracted considerable attention since the appearance of the late Professor Budin's work, *Le Nourrison* (English translation by Maloney, *The Nursling* (London), 1907). The feature of the method is the use of cow's milk, undiluted and unmodified in any way except by the process of sterilisation. In Budin's hands it was extraordinarily successful, and although others have not been so fortunate in their experience, it is probable that some of the failures have been due to neglect of the details on which Budin insisted. Budin's method is only suitable for healthy infants. In most cases Professor Budin was able to supervise the feeding of his cases from birth onwards, and thus was dealing with a class of patients different from those attending dispensaries and hospitals in this country, most of whom already suffer from digestive disorder at the time they come under treatment. Another point which is sometimes overlooked is that Budin himself advised that the milk should be diluted with water in the case of premature, weakly infants. Overfeeding is the most fertile source of difficulty in Budin's method, and in adopting this method of feeding the following rules must be adhered to:—

1. The milk must be sterilised at 212° F. for 45 minutes in a Soxhlet's or similar steriliser. After the first few months the period is shortened, and when the infant is 8 or 9 months old 5 to 10 minutes is ample.

2. The quantities given must be small. On an average a quantity of milk equal to one-seventh of the body weight is given daily—to a baby weighing 7 lbs. 15 ozs. As a general rule it is best to begin at birth with 10 feeds of 1 oz. each.

3. The amount of food required is judged of solely by the weight curve. So long as the baby gains 4 or 5 ozs. every week the daily ration should not be altered. If the weight be stationary, or fall, 2 or 3 ozs. of milk should be added to each day's feeds.

The advantages of Budin's method are (1) simplicity; (2) economy; (3) normal development and absence of rickets. There is no special liability to scorbutus. The dyspepsia which is said to occur after a month or two is almost certainly due to overfeeding, and can be avoided. The chief disadvantage is the cost

of the steriliser. In all probability one of the chief reasons why babies tolerate sterilised undiluted milk so well is that the prolonged heating precipitates the lime salts, and diminishes the amount of curd formed.

The Use of Sodium Citrate.— In 1893 A. E. Wright pointed out that the addition of sodium citrate to milk prevented curd formation, and in 1904 Poynton drew attention to the application of this property to infant feeding. Since his paper appeared citrated milk has been much used, and is generally recognised as of the greatest value in many cases. Sodium citrate often relieves the digestive disorder—colic, flatulence, and the passage of green mucous stools containing "curd"—which ordinary diluted milk causes; it also enables a baby to take a stronger milk mixture than would otherwise be possible. *In vitro* 1 gr. of sodium citrate to 1 oz. of milk greatly diminishes, and 2 grs. abolishes, curding on the addition of rennin and 5 drops 1 per cent. HCl. The action is believed to be due to the precipitation of the soluble calcium salts of the plasma, or to their conversion into a non-ionisable form. Sodium citrated should be prescribed in a solution (grs. viii.-grs. xvi. ad ℥i.), to each 4 ozs. of which a drop of chloroform is added to prevent the growth of moulds. A teaspoonful is added to each ounce of milk given. In bad cases 2 grs., in mild ones ½ a grain, may be added; the amount of citrate should be gradually diminished as the patient improves.

Buttermilk.—Buttermilk has been used in Holland as a food for infants since the eighteenth century, and latterly its use has extended to other countries. It is most valuable in many forms of chronic gastro-intestinal disorder, particularly when there is excess of fat, or "curd" in the stools. (The whitish masses of so-called "curd" which are often seen in the motions of infants suffering from diarrhœa are in reality soaps. They are not evidence of difficulty in digesting casein, but rather prove that the food as a whole, particularly the fat, is disagreeing.) Contrary to what might be anticipated, there is seldom any difficulty in persuading infants to drink buttermilk. Only buttermilk which is not more than twenty-four hours old should be used, and the difficulty of obtaining a regular daily supply is one of the few drawbacks to its employment.

Buttermilk has the following average composition:—

Proteid, 2·6 per cent.; fat, ·6 per cent.; sugar, 3 per cent.

It contains about ·7 per cent. of lactic acid, and swarms with lactic acid bacteria. Buttermilk requires preparation before being used as a food for an infant. One ounce of cane-sugar is dissolved in thirty ounces of buttermilk; four or five ounces of the sweetened milk are stirred into a cream with half an ounce of flour, and the rest of the milk is added. The whole is then boiled, and during the time it is on the fire it must be constantly stirred to prevent the formation of a gritty curd. The last point is absolutely essential, or the mixture will be spoiled. It is then given in the usual quantities and at the usual intervals.

Buttermilk differs from fresh milk in these respects:—(1) Its proteid and sugar are low, and it is almost devoid of fat. (2) Its casein exists in the form of casein lactate, on which rennin has no action. (3) It is strongly acid. (4) It contains many lactic acid bacteria. An explanation of its usefulness has been sought in each of these peculiarities. It is not well borne when given raw, and it seems to act as well when it is alkalinised as when it is acid, hence the two last-named peculiarities do not come into question. It probably owes its value to the absence of coagulable casein and to its poverty in fat. Czerny and Keller regard it (when prepared for use as above) simply as a cereal food, and think its proper sphere of usefulness is in cases of malnutrition from cow's milk (*Milchnährschaden*).

Buttermilk may be tried with fair prospect of success in any form of subacute or chronic gastro-intestinal disorder, or in the convalescence from acute diarrhœa. As the stools improve, in the course of a few weeks, ordinary milk should be substituted first, little by little. It is necessary to make the change gradually.

Infantile Atrophy.—To the account of the symptoms of infantile atrophy from the pen of the late Dr. Henry Ashby in the *Encyclop. and Dict. of Med.*, Vol. I., p. 324, there is nothing to add, and his discussion of the general causation of the disease requires little amplification. The pathology of atrophy was unsettled when he wrote his paper; it is still far from being definite. Nevertheless some important work has been done on the subject by Czerny, Keller, and others, chiefly of the Breslau school. It is admitted that the anatomical changes described by Baginsky (atrophy of the gastro-intestinal mucous membrane) do not adequately explain the disease, and that bacteriology has also failed to demonstrate any clear connexion between bacterial infection of milk and atrophy. Czerny and Keller attach considerable importance to cow's milk in the production of marasmus. They group disturbances of nutrition under three main heads:—Disturbances from alimentation, disturbances from infection, and disturbances from constitutional defect. Looking at the subject from this point of view, atrophy is merely the ultimate result of one of these causes; we discard such description of clinical phenomena as "follicular enteritis," "acute diarrhœa," "gastro-enteritis," "cholera infantum," etc., because a patient may show signs of one of

these at one time, of another later, and because any one of them may result from each of the above sets of causes. The general idea is to group together under one general rubric, "nutritional disturbances," all the various clinical types of gastro-intestinal disorder which ultimately tend to produce atrophy, and to try to trace exactly the different causes which lead to this.

The most important form of nutritional disturbance is that described by Czerny and Keller as "milk injury" (*Milchnährschaden*). The child, dieted on cow's milk, becomes restless, his sleep is disturbed, his motions become greyish instead of yellow and are dry and crumbly; he becomes pale, wasted, his belly is blown out with gas. Ultimately the picture of extreme atrophy develops, complicated by intractable diarrhœa, and by infections of all kinds. According to Czerny and Keller this condition may arise even when the quality of the milk is beyond reproach, and when all attention is paid to its sterility. It depends on some chemical peculiarity of cow's milk. Czerny and Keller deny that the casein plays any part. They think that there is no evidence that this is less digestible than that of human milk. The masses of so-called "curd" in the stools do not consist of undigested casein, but of soaps. Neither will Czerny and Keller admit that undigested casein is specially prone to undergo abnormal decomposition in the intestine and thus prove deleterious. If the fæces of such cases are examined they are found to contain quantities of the soaps of fatty acids, and it is found that the child's nutrition improves when the amount of fat in the food is restricted, and is replaced by carbohydrate.

This is one of the chief results of Czerny and Keller's work. When an infant, hitherto fed on cow's milk, often in excessive quantity, begins to manifest the above symptoms and to lose weight, the indication is, not (as is usually done) to increase the daily ration or to render the casein more digestible, but to cut down the fats and add some starch. In mild cases it is sufficient to reduce the amount of cow's milk considerably, and to substitute for what is withdrawn a cereal decoction—*e.g.* oatflour gruel. In bad cases milk should be withdrawn altogether for a time, and a purely cereal diet given. The substitute which Keller especially recommends is a malt extract prepared according to a method he has devised. This is sold under the name of *Loefflund's Malz-Suppe Extrakt*. It is used in the following way:—Fifty grams of flour are beaten up with $\frac{1}{3}$ litre of milk, and the mixture is strained. One hundred grams of Loefflund's malt extract are dissolved in $\frac{2}{3}$ litre of warm water, and this is added to the milk and flour. The whole is heated to boiling point, with continuous stirring. This is given in the ordinary quantities. Keller believes that buttermilk, as ordinarily prepared for an infant (*see* INFANT FEEDING), is useful simply as a food poor in fat and rich in cereal.

The diagnosis of "milk injury" as a cause of marasmus depends largely on the history. In regard to prognosis, auscultation of the heart is important. "As long as both sounds are clearly heard, even when the child is restless, life is not in immediate danger. As soon as the sounds become difficult to hear, and cease to be clearly defined, or if the first sound is fainter than the second, the infant is dangerously ill, even although from its general appearance it may appear to be doing well."

The present writer's opinion is that marasmus of this kind is not nearly so common in this country as it seems to be among Czerny and Keller's cases. Undoubtedly, however, cases of the kind do occur, and the adoption of the line of treatment suggested—diminution of the quantity of milk, and the substitution of a cereal decoction or a malted food, or a buttermilk mixture—sometimes proves extremely satisfactory.

METABOLISM IN INFANTILE ATROPHY.—Even when there is great failure of nutrition, nitrogen is well absorbed from the intestine. What is more remarkable is that along with a progressive loss of weight there is usually a positive nitrogen balance—*i.e.* intake of N exceeds output. This assimilation of protein, despite a falling body weight, is referable to the fact that though the body is losing weight it is building up new cells; Camerer has observed that even weakly wasted children grow in height. These facts go in the direction of showing that we cannot base a theory of marasmus on faults in the proteid element of the food.

The ill effects of an excessively fatty diet are supposed to be connected with ACIDOSIS (*q.v.*). Acidosis may be relative (decrease of alkali in the tissues), or absolute (increase of acid); in either case it is measured by the amount of ammonia-nitrogen in the urine. When acids are formed in the tissues or absorbed from the intestine, absolute acidosis results; when acids, still in the intestine, are neutralised there by alkalies withdrawn from the tissues for the purpose, there is relative acidosis. Keller found that in children gastro-intestinal disturbances and marasmus were associated with increased ammonia-nitrogen in the urine; he ascribes this to an increased excretion of fixed alkali by the intestine. "The primary event is the excretion of fixed alkali by the intestine, brought about by the fat taken as food. The alkalies are got rid of either unchanged or as soaps, but besides this they also serve to neutralise the increased phosphoric acid, the cause of which is the

simultaneous increase in the amount of calcium phosphate combining with fat to form a calcium soap. The importance of relative acidosis in chronic disturbances of nutrition in infants lies in the loss of alkali. For the growth and health of the child's organism the retention of alkali is as important as the retention of nitrogen, phosphorus, or other mineral substances. If it is withheld or a loss takes place, the condition of the body can neither improve nor remain normal. Under these circumstances, owing to the endeavour of the body to keep its relative composition unchanged, failure of increase in weight, or loss of tissue substance occurs; and since growth in height can take place even when the body weight is not increasing, or is actually decreasing, eventually the case presents the clinical features of an atrophy which is alimentary in origin." (Czerny and Steinitz.) (Compare also Herter's work on Infantilism, *infra.*)

LITERATURE.—Czerny and Keller, *Des Kindes Ernährung, Ernährungs-störungen, und Ernährungstherapie* (Leipzig), 1906-1909, *passim.*—Czerny and Steinitz, Art. "Metabolism in Diseases of Children," in *Metabolism and Practical Medicine*, by Carl van Noorden, vol. iii. p. 833 (London), 1907.

The Thymus and Thyroid Glands in Marasmus.—The thymus gland is atrophied in cases of marasmus, but there is no evidence that marasmus is due to interference with the function of the organ. Stokes regards the condition of thymus merely as an index of the general nutrition; the state of nutrition of an infant may be estimated by a microscopic examination of the thymus at autopsy. No benefit is obtained by treating marasmus with thymus. Maclennan found that after extirpation of the thymus animals were more vigorous and voracious than the controls, and put on weight more quickly. Others have seen no action on growth from removal of the organ. No experimenter has ever stated that thymectomy causes atrophy.

Some important observations by J. W. Simpson must be referred to, because they mark a definite advance in the treatment of marasmus. In examining the thyroid in ten cases of marasmus, he found that many of the vesicles were devoid of colloid, that some showed cell-proliferation, and that the fibrous tissue, particularly the intra-vesicular fibrous tissue, was increased. This led him to try the effect of treating marasmus with thyroid, and in some instances the results were most striking. The drug was given in doses of $\frac{1}{3}$-$\frac{1}{2}$ gr. of B. & W. tabloids thrice daily. No other change in the treatment was made. Thyroid treatment should be tried in all cases of marasmus; sometimes it acts remarkably well, in others it fails absolutely, but as the remedy is harmless, and often brilliantly successful, it ought certainly to be administered to all atrophic babies.

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Infantilism. — The term infantilism should be restricted to a group of cases which have as their common and most important feature a failure of the primary and secondary sexual characters to appear at their proper time. Dr. John Thomson, who emphasises this point, divides cases of infantilism into three groups:—(1) Idiopathic infantilism. (2) Cachectic infantilism. (3) Infantilism due to gross lesion or defect of some important internal organ. The condition is therefore merely a symptom, or symptom-complex, which may be due to more than one cause. It is usually associated with stunted growth, but not necessarily so. The essential characteristic is the persistence of sexual immaturity, and this may go along with normal growth, or even giantism, as well as with dwarfing. A case of combined giantism, acromegaly and infantilism has been reported by Launois and Pierre Roy. Their patient was a giant, the primary and secondary sexual characters were undeveloped, the epiphyseal cartilages were persistent, and there was enlargement of the lower jaw. Pagniez states that a case of this kind may pass through three stages: infantilism, with persistence of the epiphyseal cartilages; rapid growth, producing a giant; cessation of growth, fusion of the epiphyses, and the development of the signs of acromegaly. Conversely, dwarfs are not necessarily infantile; many of them—*e.g.* cases of sexual ateleiosis (Hastings Guilford), of which General Tom Thumb was an instance—show normal sexual development.

(1) Idiopathic infantilism. This group of cases comprises what is known as the Type Lorain (after the French physician who first drew attention to them) or anangioplastic infantilism, because they are supposed to be due to vascular hyperplasia. Patients of the type Lorain are small in stature, but have to some extent lost their childish proportions. They have the frames of adults in miniature, or, perhaps more correctly, the frames of miniature adolescents. The bones are small and slender; the genital organs are undeveloped, and the mental powers childish.

(2) Cachectic infantilism. The principal diseases which give rise to cachectic infantilism are Pott's curvature of the spine, tuberculosis, syphilis, biliary cirrhosis, and cardiac affections. Some (*e.g.* Gilbert and Rathery) would class these cases along with the preceding. It is, of course, a matter of daily observation that children with heart disease, hunchbacks, and

hereditary syphilitics suffer from retarded development.

(3) Infantilism from visceral defect or disease. This is the most interesting group. In it several varieties can be differentiated. (*a*) *Thyroid infantilism.* This has been especially studied by Hertoghe. Persons suffering from infantilism due to thyroid inadequacy undergo an arrest of development proportional to the age at the onset of the malady, and they manifest more or less of the symptoms and appearances of mild myxœdema. Their faces are rounded, the eyes puffy, the nose is broad, the abdomen large, and the contour of the bones concealed by a thick layer of fat. The temperature tends to be subnormal; there is often constipation. The disposition is childish. (*b*) *Pancreatic infantilism.* The first case of this kind was reported in 1902 by Dr. Byrom Bramwell. At the age of $18\frac{9}{12}$ the patient had the stature and development of a child of 11; his intelligence was good. For 9 years he had suffered from chronic diarrhœa. The pancreatic secretion was shown to be absent (1) by the presence in the stools of undigested fat, which diminished on the administration of pancreatic extract; (2) by the low excretion of urinary phosphoric acid on a milk diet, the output being increased by the administration of pancreatic extract; (3) by giving Sahli's capsules of iodoform enclosed in a glutoid envelope, which is only dissolved by the pancreatic secretion. On treatment with pancreatic extract the diarrhœa ceased; growth, which had been in abeyance for 8 years, recommenced, and development of the primary and secondary sexual characters took place. Unfortunately treatment with pancreatic extract is not always successful in cases which to all appearance resemble that described by Dr. Bramwell. (*c*) *Intestinal infantilism.* This has recently been exhaustively studied by Herter. He describes as intestinal infantilism a class of case with the following characters:—Arrest of bodily development; maintenance of the mental power; marked abdominal distension; moderate anæmia; rapid onset of physical and mental fatigue; various digestive disturbances, especially fat-diarrhœa. The keynote of this form of infantilism is the persistence into later childhood of the intestinal flora which are normal in infancy. The fæcal fields consist of Gram-positive organisms, instead of, as is normal, Gram-negative organisms. The urine gives evidence that abnormal intestinal putrefaction is taking place—high ethereal sulphates, indicanuria, indolaceturia, and excess of phenol. The calcium, magnesium, and phosphorus balances show a loss. In the fæces much fat is lost, which should normally be absorbed. Herter's explanation of the pathology of the condition is, briefly, as follows:—The retarded development is not due to an error of metabolism, but to defective digestion and absorption. The patients are intolerant of carbohydrates—the digestion is always disturbed when these are taken freely; they have little power of absorbing fat; their protein absorption is also rather bad. In consequence, nutrition is impaired, while, on account of the loss of calcium and magnesium, the growth of the skeleton suffers. The malassimilation is due to chronic inflammatory processes in the small intestine and colon, brought about by the presence of an unsuitable flora, which also gives rise to abnormal putrefaction and toxæmia. The characteristic feature of the intestinal flora is the persistence of the infantile type. *Treatment.*—The chief indications are dietetic. Carbohydrates should be given in small quantities, beginning with about 20 grams in the day; starches and dextrinised preparations (biscuits) are best. Sugars and soluble carbohydrates, such as malt and Mellin's food, are objectionable. Lactose is the best of the sugars. Potatoes are not well borne. Fats should be restricted until the stools no longer show any loss. Proteins.—Milk is the chief constituent of the diet; meat should be sparingly and cautiously used. Gelatin ought to be added to the diet. About 1 oz. per day can be absorbed. Gelatin has some caloric value (120 cal. per oz.); it is a partial substitute for portein fat and carbohydrate; it is unable to support certain forms of bacterial life associated with this disease; it is incapable of undergoing putrefaction based on the presence of the tyrosin molecule. Calcium lactate, magnesium lactate, and acid sodium phosphate should be given.

In any case of infantilism a radiograph of the carpus should be taken; if the epiphyseal cartilages have disappeared, growth is probably impossible; if they persist it may occur. Thyroid ought to be tried in all cases, even if there are no signs of thyroid inadequacy.

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Infiltration Anæsthesia.—*See* Anæsthesia (*Local*).

Infundibular Extract. — *See* Pituitary Gland.

Inoscopy.—A procedure recommended by Jousset for the detection of tubercle bacilli in exudates; coagulation is allowed to take place

(to enclose the bacilli in the fibrinous network), then the coagulum is washed and treated with a mixture (containing pepsin, sodium fluoride, glycerine, etc.) to digest the fibrin; twenty-four hours' stay in the incubator makes the fluid homogeneous, and it is then centrifuged and smears made from the sediment; the smears are fixed in the flame and stained with carbol fuchsin. *See* Webster, *Diagnostic Methods*, p. 585, 1909.

Intermediate Body.—A synonym of amboceptor or immune body. *See* IMMUNITY.

Intermenstrual Fever.—*See* MENSTRUATION, MORBID.

Intermenstrual Pain.—*See* MENSTRUATION, MORBID.

Intermittent Claudication.—*See* ARTERIO-SCLEROSIS.

Internal Secretions.—*See* HORMONES.

Intestines, Surgery of the.

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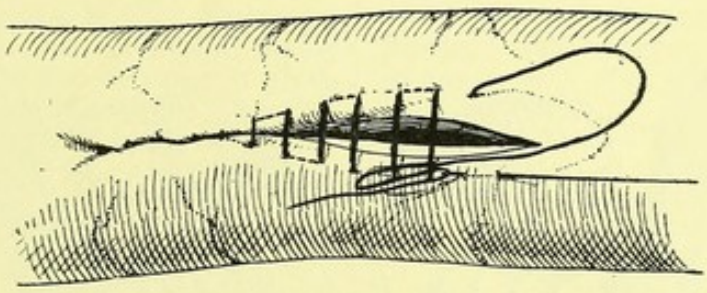
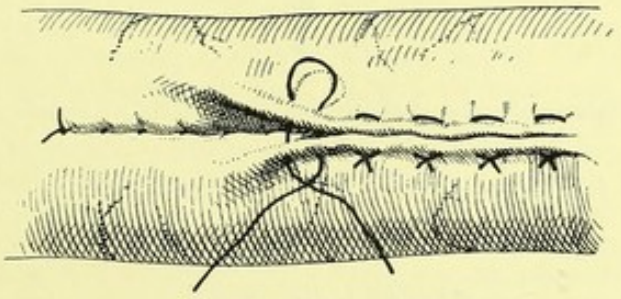
THE intestines may come into the province of the surgeon either on account of morbid conditions arising in themselves, or because they have been injured in the performance of operations upon other abdominal or pelvic viscera. The latter conditions may be considered first.

Intestinal Injuries.—If the intestine has been injured during the performance of an abdominal section (*e.g.* an ovariotomy or an operation on the liver or stomach), the wounded part should at once be brought outside the abdomen and surrounded with sterile gauze, or if this be impracticable, it should be surrounded with gauze pledgets *in situ*. The injury should then be repaired in one or other of the ways to be described immediately, the bowel should be cleansed with pledgets soaked in normal saline solution, and the part returned to the abdominal cavity (if it has been dealt with outside). Of course, if fæcal matter has escaped into the peritoneal cavity, that also must be removed by swabbing or by irrigation (but preferably by the former) before the main operation can be resumed.

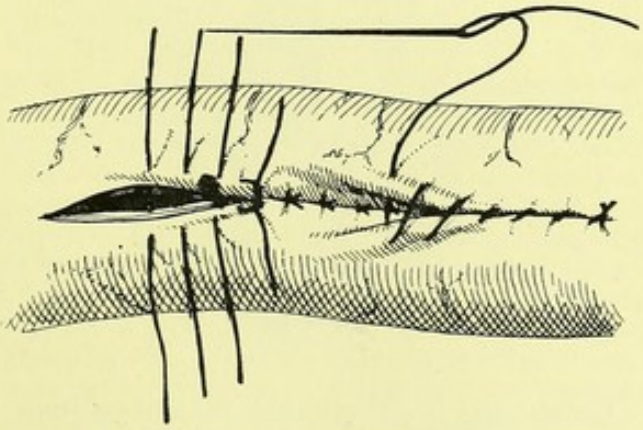
The mode of repair (*enterorrhaphy*) will depend upon the nature and extent of the injury, as well as to some extent upon the part of the bowel affected. For instance, a small longitudinal tear is easily dealt with: the affected portion of the bowel is emptied of its contents by stripping it on each side of the opening; then two clamps are put on to prevent fæces making their way into it again (Murphy's intestinal clamps, or the clamps of Doyen or Makins may be used, but for a small wound the fingers of an intelligent assistant will suffice as clamps); next the edges of the tear are approximated by sutures. Fine silk is strongly recommended, although some surgeons use catgut and others linen thread. If the injury involve only the muscular and peritoneal coats it can be satisfactorily closed with a continuous Lembert (or Dupuytren) suture; but if the lumen of the bowel be opened into, or if the tear be a long one, it will be wise to close it with a double row of sutures. The edges are approximated and the peritoneal surfaces invaginated by a row of interrupted Lembert sutures; these are tied and cut short, and then by means of a continuous Lembert suture (or Dupuytren's suture) the first tier of sutures is completely buried. As seen from the inside of the bowel, the repaired wound shows a longitudinal projecting ridge. The latter mode of suturing is also employed for transverse wounds of the bowel, unless they are extensive, when another plan altogether (end-to-end anastomosis) will be rendered necessary. The same principle of closing the opening applies in irregular wounds and in those involving a comparatively small loss of tissue (*e.g.* small necrotic areas). The Lembert suture is carried out as follows:—The silk, held in a curved needle, is passed across the line of the wound; it is introduced through a fold of the wall picked up on one side of the tear (about $\frac{1}{8}$th inch distant from it) and carried over to a corresponding fold on the opposite side; the amount of tissue involved is the serous coat and the muscular one, but not the mucous; by drawing the two ends of the suture together the margins of the wound are now turned in and peritoneum brought into contact with peritoneum; about ten sutures to the inch should be inserted to secure safety; and none should be tied till all have been passed. Such is the ordinary Lembert suture; but occasionally the continuous Lembert (or, more accurately, the Dupuytren suture) may be employed; in this case the operator begins by transfixing the sound tissue beyond the end of the tear and ties a double knot there; then he picks up a fold on the one side of the wound, transfixes it, and passes obliquely across to do the same to a fold on the opposite side, then back again obliquely, and so on till the whole wound is drawn together; the suture is then made taut, and the second last suture is firmly knotted to the end of the



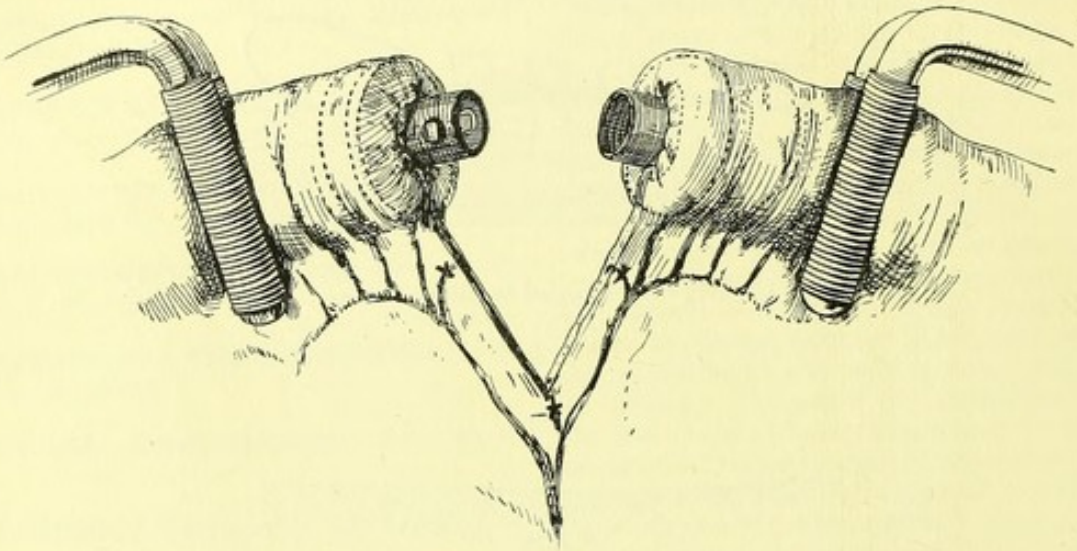
Cushing's right-angled continuous suture.



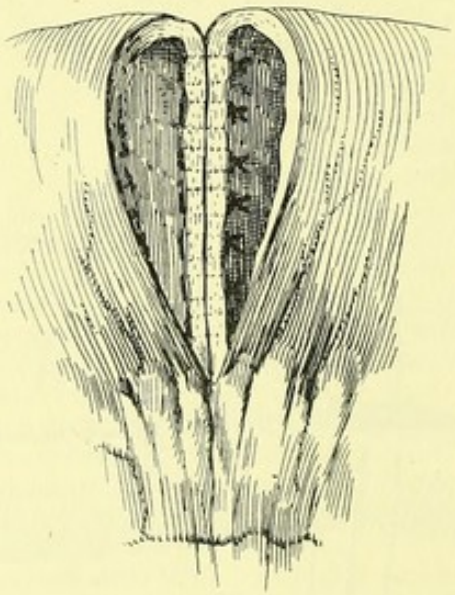
Halsted's mattress stitch.



Dupuytren's suture (Lembert type).



Section of end-to-end anastomosis. Murphy's method.



Connell's sutures. Knots within the lumen of bowel.

thread. Some American surgeons specially recommend Cushing's "right-angle" suture; in it (a continuous suture also) the thread is not carried obliquely from one side of the wound to the other, but transversely; progress is made by carrying the suture for a short distance in the wall of the bowel parallel to the tear, then crossing over and carrying it again in the substance of the bowel for a similar distance on the other side, and so on. The only case in which it is permissible to transfix all the intestinal coats (including the mucous) is when the tear is a large one, and it is necessary to bring together the middle point temporarily and so close the wound in two parts; sometimes, also, one may use the through-and-through suture when it is intended to bury it under a second row of tier sutures, but there is always a certain risk of fæcal contents invading the tissue of the bowel wall in such cases by capillary attraction. The Connell suture passes through all the coats, and by an ingenious procedure the knots, when tied, are within the intestinal lumen. Wounds in the mesentery should always be carefully closed (by an ordinary continuous silk or fine catgut suture), for, if left unmended, a small loop of bowel may be caught in the opening and obstruction set up, possibly with a fatal result. In all enterorrhaphy operations the peritoneum at the mesenteric attachment must be carefully adapted, preferably by overstitching.

But there are wounds (irregular and extensive) and injuries (involving large areas) of the intestine that simple enterorrhaphy will not suffice to make good; for these some form of *intestinal anastomosis* will be required. Further, anastomosis enters into several other operative procedures which may be rendered necessary by diseased conditions of the bowel itself (tumours, obstruction, etc.). To the description of such anastomosis-operations I now pass.

Intestinal anastomosis consists essentially in the establishment of a permanent fistulous communication between one section of the bowel and another—*e.g.* between the section of the bowel lying above an obstruction or large wound and that lying below it; its purpose is to throw the affected segment of the intestine out of action, and it may be accompanied or followed by resection of that portion or not; in the latter case it will be not a radical but a palliative operation. The procedure is not new, for it was carried out by Maisonneuve, but its practical and successful application only dates from Senn's time. The anastomosis may be end-to-end or lateral (side-to-side), and it may be carried out by sutures alone, or by sutures aided by such a mechanical device as the Murphy button. The decalcified bone bobbin, the potato bobbin, and the Laplace and O'Hara forceps are not now much used.

End-to-end anastomosis by sutures may be first described; it will be considered as part of an enterectomy or intestinal resection operation (*e.g.* for a tumour or for obstruction). The affected part of the bowel is first exposed (by abdominal section), drawn well out of the abdomen, and placed upon and surrounded by sterilised gauze; it should then be emptied of its fæcal contents by stripping—*i.e.* pressing the fingers along it after the upper clamp (Doyen's, for instance) has been fixed in position; next, the lower clamp should be applied; and both clamps should be quite beyond the diseased part, and they should not interfere with the circulation in the mesentery. For the actual suturing Halsted's interrupted mattress suture has been strongly recommended: on one side of the wound this suture (which is really a double Lembert) is united by a loop, the two free ends on the other side are the ones which are to be tied. The plan has been thus described. Before the bowel is resected the Halsted sutures are put in position, but not tied. Five of these "presection" sutures are usually employed on each side of the part of the bowel which is to be removed, about $\frac{1}{8}$ of an inch beyond the line of section. Of the five one is put on each side of the mesentery, one at the apex of the bowel, and one on each lateral aspect. They are placed just beyond the vessels from the mesentery which supply the part of the bowel which is to be removed. The next step is to tie (with fine silk) the vessels in the mesentery which supply that part of the intestine, taking care not to tie those which supply the parts in which the presection sutures are embedded. Then with straight, blunt-pointed scissors, the intestine is cut straight across at the two pre-determined places, just inside the loops of the Halsted sutures, and, at the same time, a triangular piece of mesentery (containing the ligated vessels) is excised. The ends of the bowel are now brought into apposition, and the presection sutures of the one side are tied to those of the other, thus fixing the two ends of the intestine in five places. The next step is to pass a large number of Halsted sutures so as to bury these five presection ones, and make the union quite firm and secure; these pass quite round the intestinal circumference, and must not include any of the vessels from the mesentery at the base of the bowel lest they cut off the blood supply and cause gangrene. Finally, the edges of the wound in the mesentery are brought together by a continuous suture, care again being taken not to include any of the vessels which supply the intestine.

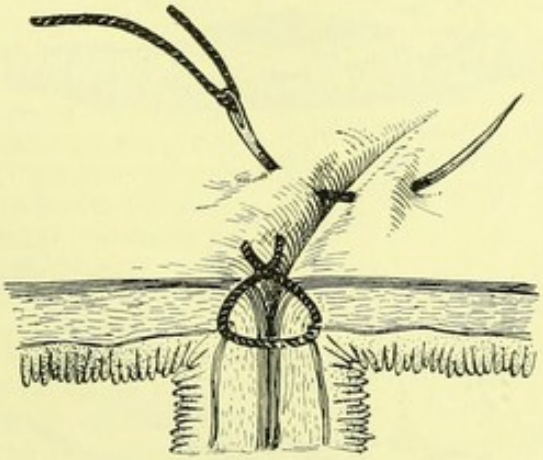
Other operators excise the portion of bowel marked off before passing any sutures. Under these circumstances the first suture transfixes all the coats just at the mesenteric edge, and then by continuous suturing the two pieces of intestine are approximated and united; these

sutures are then buried below a second row, which are Lembert ones, and may be either ordinary interrupted Lemberts or a continuous one. If this plan be followed exact approximation of the intestinal ends is difficult, and to make it easier preliminary guide sutures may be inserted at intervals immediately after the first suture has been introduced at the mesenteric margin. The final step here also will be the suturing of the mesentery.

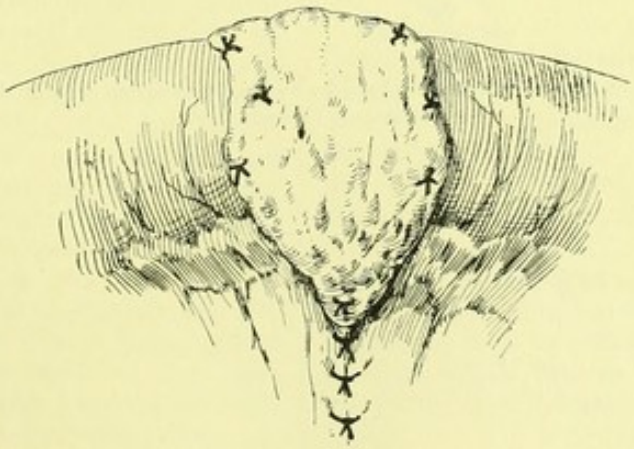
Another method of end-to-end anastomosis is by means of the Murphy button (or some similar device). The bowel is clamped and emptied of its contents in the way already described; the mesenteric vessels of the affected part are tied, but no presection sutures are passed; then the bowel is resected along with a wedge-shaped portion of the mesentery. Then round each of the two ends of the divided bowel a purse-string silk suture is passed in order to pucker in their edges. The suture is introduced on the aspect of the bowel farthest away from the mesentery, passes through all the layers of the intestinal wall, and goes right round till it comes out again at the antimesenteric surface near to its point of entrance. The female part of the Murphy button is then grasped by a pair of forceps and inserted into the distal end of the bowel; it is fixed in position by drawing the purse-string suture tight around it, and tying it firmly. The same thing is done with the male part of the button and the proximal end of the intestine. Then the two halves of the Murphy button (with the two ends of bowel attached to them) are held by the operator whilst his assistant removes the forceps by which they have been introduced; the male half is then pushed slowly into the female till they come closely together, bringing the two ends of bowel also into complete apposition. The final step is the fixation by a continuous Lembert suture passing round the bowel (burying the button), and by the suturing of the divided edges of the mesentery. The mode of action of the Murphy button is to cause necrosis of the portion of intestinal wall caught within its bite; this sets loose the button which is discharged ultimately *per anum*. Of course, if the pressure-necrosis be a little too much leakage from the bowel may take place, and danger at once arise.

Lateral (*side-to-side*) *anastomosis* differs in some particulars from the end-to-end method, but resembles it in being carried out either by sutures alone or by suturing reinforced by the use of the Murphy button or other mechanical contrivance. In cases of enterectomy it takes longer to do the anastomosis by the lateral than by the end-to-end method, for there are three separate acts of suturing: the two ends of the divided intestine have to be closed, and next these two blind sacs have to be laid, side by side, openings made in them, and then united by sutures. But the time required is not three times as much, for the closing of the two ends is rapidly done, and the plan has the advantage of giving a wound which will be entirely surrounded by peritoneum, thus avoiding the dangerous mesenteric border area. The side-to-side plan is specially useful where the anastomosis has to be established between the small intestine and the large, or between two pieces of bowel which differ much in calibre. As in the end-to-end method Halsted's mattress sutures may be used. The early steps of the operation (clamping, emptying the bowel, ligation of mesenteric vessels, and resection) are the same, save that the clamps are put on farther away from the excision lines to give room for invagination of the ends. The invagination is done by means of forceps, and the openings are closed with a single row of Halsted sutures; the mesentery belonging to the invaginated part is turned in with it. Then the two blind ends are placed side by side, their free (or antimesenteric) surfaces being in contact, and fixed together by a row of Halsted sutures which are row-tied; a second row is now introduced (nearer to the operator), but not yet tied; next an opening is made in each bowel between the two rows of sutures, bringing the lumen of the one into communication with that of the other; and finally, the second row of sutures is drawn taut and tied, and the edges of the mesentery united by a continuous suture. Of course, if it is not intended to resect the affected portion of intestine, then the closing of the two ends will not be needed, and the two parts of bowel to be united by anastomosis will simply be brought into lateral contact, and a communication established as above. Lateral anastomosis may also be done by the aid of the Murphy button (an oblong one); the communication is closed over the button with Lembert sutures as usual. In some cases an *end-to-side anastomosis* may with advantage be performed; then the Halsted suture or the round button is used; it is specially in cases of *enteric exclusion* (exclusion of a portion of the bowel "from the fæcal circuit") that this mixed method of anastomosis is likely to prove of value. There are two varieties of exclusion: in one (unilateral or partial as it is called) the intestine is simply divided (not resected), the proximal part of the distal end is closed, and the distal end of the proximal part is implanted by end-to-side anastomosis (sutures or Murphy button) upon the intestine, below the point of tumour or disease; in the other (complete or bilateral) both ends of the excluded portion of bowel are closed, and the normal bowel on both sides made continuous by end-to-end anastomosis. In the former plan there may be some regurgitation of fæces into the excluded segment, but they are expelled again by peri-

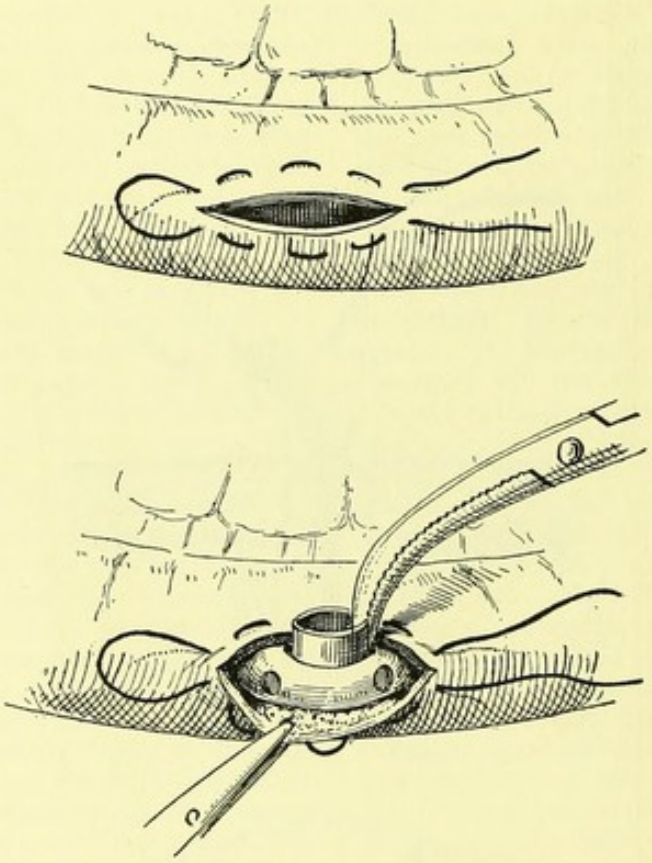
Intestinal sutures.
A. Lembert. *B*. Czerny Lembert.



Section showing Lembert interrupted stitch.



In end-to-end anastomosis, the line of suture is covered by a flap of omentum.



Section of lateral anastomosis, and showing manner in which Murphy's button is introduced.

staltic or antiperistaltic action; in the latter, an artificial opening must be made (if there be no existing fistula) with the skin surface for draining the segment, but on a later occasion another operation may be done and the excluded segment entirely removed, or it may even be found to be possible to reinstate it in the intestinal tract.

Another operative procedure which is sometimes undertaken in cases of intestinal obstruction is *enterotomy* (Nélaton's operation), or the opening of the bowel above the seat of occlusion and the evacuation of the contents. Since it is customary not only to incise the bowel but also to establish a fæcal fistula with the cutaneous surface, the name *enterostomy* would be more exact than enterotomy. The operation is for the small intestine what colotomy is for the large. The opening in the abdominal wall is made either in the right iliac region or in the middle line below the umbilicus, and may be from two to three inches in length. A distended loop of bowel is drawn into the opening with its free border projecting, and the skin incision is narrowed by some through-and-through sutures at each end so as to fix the bowel in position. Next with fine silk sutures the intestine is attached very carefully to the skin; the sutures pass through the skin and through the peritoneal and muscular (not the mucous) coats of the bowel. If there be no urgency the rest of the operation may be postponed, but if the symptoms of obstruction be marked the opening of the bowel must be at once proceeded with. The area to be incised is determined upon, and a purse-string suture passed round it; an opening within the area thus circumscribed is made, a tube (*e.g.* a Paul's rectangular glass tube) introduced, and the purse-string suture is tightened and fixed round the groove in the tube; and, finally, the tube should be packed round with sterile gauze and a long and thin india-rubber tube placed in it to carry off the bowel contents (which are fluid) to a suitable receptacle. Many modifications are in use in performing enterotomy, and the plan described is that recommended by Treves and Hutchinson (*Operative Surgery*, pp. 280-285, 1909); but if time be not pressing, a useful procedure is to unite the peritoneum in the wound to the skin surface before bringing the loop of intestine out, for then in the later stages peritoneum is brought into contact with peritoneum and a firmer union established.

Other surgical procedures affecting the intestines are described in the *Encyclopedia and Dictionary of Medicine*, under the headings Appendicitis, Colotomy, Hernia, Surgical Diseases of the Intestines, etc.

Invertase.—*See* Digestion (*Intestinal Juice*).

Iodalbacid.—A medicinal substance in which iodine is combined with a protein.

Iodalia.—A medicinal substance in which iodine is combined with sugar and tannin.

Iodalose.—An alkaline-iodide substitute, in which the iodine is combined with peptone.

Iodan.—A solution of iodine in goose-grease, recommended as a substitute for the alkaline iodides.

Iodcasein. — An iodoform substitute, forming a yellow, insoluble (in water) powder; it is composed of iodine and casein.

Iodide Substitutes.—The disagreeable results which may follow the internal administration of alkaline iodides have led to the introduction of various substitutes supposed to obviate these results; among the substitutes may be named certain protein combinations, such as iodalbin and iodalia, some saturated oils, such as iodipalin and iodipin, as well as the propane combination (iothion), iodival, and sajodin.

Iodipalin.—A substitute for the alkaline iodides, in the form of an oil saturated with 10, 20, or 30 per cent. iodine. *See* Fortescue-Brickdale, *Newer Remedies*, p. 19, 1910.

Iodival.—A substitute for the alkaline iodides, being a compound of valerianic acid and urea, containing one atom of the halogen element in place of a hydrogen; it contains 47 per cent. of iodine. *See* Fortescue-Brickdale, *Newer Remedies*, p. 21, 1910.

Iodofan. — An iodoform substitute, forming a reddish-yellow, crystalline powder which has no odour; it is an "addition product of formaldehyde and iododioxy-benzene ($C_6H_3.I.(OH)_2$) in which iodine is in the ring." (*See* Fortescue-Brickdale, *Newer Remedies*, p. 14, 1910.

Iodoformogen.—An iodoform substitute in which the iodoform is combined with albumin; it is a yellowish, nearly odourless powder, which can be sterilised by heating. *See* Fortescue-Brickdale, *Newer Remedies*, p. 11, 1910.

Iodoformol.—An iodoform substitute, being a hydriodide of ethyl-hexa-methylene-tetramine (ethyl-urotropin), and acting as a powerful antiseptic; but it is easily decomposed with the production of iodoform vapour. *See* Fortescue-Brickdale, *Newer Remedies*, p. 11, 1910.

Iodoform Substitutes. — On account of its unpleasant odour, its not being aseptic, and its tendency to set up dermatitis or symptoms of general poisoning, various substitutes have been suggested to take the place of iodoform, such as iodoformin, iodoformol, aristol, iodol, iodofan, sanoform, loretin, isoform, sozo-iodol compounds, and nosophen. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 9-17, 1910.

Iodoformum Bituminatum. — An iodoform substitute in which tar is mixed with the iodoform in order to conceal its smell.

Iodogenol. — A substitute for the alkaline iodides, in which the iodine is combined with peptone.

Iodoglidine. — A substitute for the alkaline iodides, in which the iodine (10 per cent.) is combined with vegetable albumin. *See* Report in *Lancet* (i. for 1909, p. 247).

Iodomaisin. — A substitute for the alkaline iodides in which the iodine is combined with the protein (maisine) contained in gluten derived from maize; the dose is $1\frac{1}{2}$ to 2 grains daily in the conditions for which iodine is indicated. See *Lancet* (i. for 1906, p. 1191).

Iodoserum. — A substitute for the alkaline iodides, said to be formed by the action of iodine on blood-serum and to be fitted for intravenous or subcutaneous injection. *See* Fortescue-Brickdale, *Newer Remedies*, p. 19, 1910.

Iodotannol. — An iodoform substitute, said to be a mixture of iodine with tannin.

Iodurase. — A proprietary preparation in which iodides are associated with a special form of yeast (levurine) in order to guard against iodism.

Iodyloform. — An iodoform substitute, described as a yellowish-brown, odourless powder, with antiseptic properties; it is composed of iodine and gelatin.

Iola Food. — A proprietary food preparation, being a palatable jelly free from acid, starch, and fat. See *Lancet* (i. for 1908, p. 947).

Ionic Medication in Gynecology. — There are certain gynecological diseases of an obstinate nature, such as chronic cervicitis, chronic endometritis, and membranous dysmenorrhœa, for the relief of which the medical man is poorly supplied. He is recommended by the current text-books to try the effect of douches, of plugs, of caustics, and of curettage; but he often finds little permanent benefit to accrue from such means, even if used for considerable periods of time. Dr. Samuel Sloan suggests that he try the employment of ionic medication, and encourages him by a record of cases in which this new therapeutic agent has been most beneficial.

To quote from Dr. Sloan's article (*Proc. Roy. Soc. Med.*, June 1908), "Ionic medication is the application of electro-chemistry to therapeutics. To students of recent advances in physical chemistry, chemical affinity comes simply to mean electric attraction and electric repulsion of the atoms or molecules in solution. These atoms or molecules have each a charge of electricity, some of them being positive and some negative. Being electrically charged and capable of moving in virtue of this charge, they are called ions or movers. Let an electric current be passed through such a solution, and at once, from a restless state of activity, the ions proceed to arrange themselves so that the − ions may move towards the + pole and the + ions towards the − pole; like charges repelling and unlike attracting. The ions moving towards the + pole are called anions, that is anode-goers; those towards the − pole kathions, that is kathode-goers. Hydrogen and all metals are kathions; iodine, chlorine, etc., are anions. In the case of compounds the bases are kathions and the acids are anions. Thus, in the case of a solution of sulphate of copper, the sulphuric acid, being an anion, will drift towards the + pole; whilst the copper will move towards the − pole. Any solution capable of conducting a current of electricity through it is called an electrolyte; and the passage of the current brings about decomposition of the electrolyte. The motions of the ions constitute the current, each atom carrying with it an equal quantity of electricity. The human body is an electrolyte in virtue of the salines of its tissues. The principal saline being NaCl, the body acts electrically as a solution of chloride of sodium." These ionic movements can, therefore, be produced in the human body, and their production can be regulated and employed for therapeutic purposes. When the changes are at the poles only, electrolysis results; and electrolysis, as is well known, has proved of some service in the treatment of fibroid tumours of the uterus: the nascent oxygen and acids of the tissue electrolyte which are set free at the + pole have a caustic or an antiseptic effect, whilst at the − pole (when it is made the active one) the sodium hydroxide which is liberated has a softening and solvent effect on the tissues. In the case of fibroid tumours the + pole is usually made the active and intra-uterine one. Dr. Sloan, however, does not recommend simple electrolysis, but what is called ionic migration.

In this phenomenon there is a further "transfer of the ions of the applied solution or soluble electrode from one pole in the direction of the other, of zinc or copper, as the case may be, from the + pole, and of iodine, sulphuric acid, or salicylic acid, as the case may be, from the − pole." A solution of cupric chloride is placed on one side of a mucous membrane (*e.g.* that of the vagina or uterus), whilst on the other side is the chloride of sodium of the tissues; an electric current is now passed, with the result that there is an actual transference of ions. The result can be expressed by means of Dr. Sloan's diagram, the copper being applied at the + pole—

Mucous membrane.

	+ + + | + + + + +	
+	Cu Cu Cu | Na Na Na Na Na	−
	− − − | − − − − −	
	Cl Cl Cl | Cl Cl Cl Cl Cl	

Before current.

Mucous membrane.

	+ | + + +	
+	Cu | Cu Cu Na Na Na Na Na	−
	− | − − −	
	Cl Cl Cl Cl Cl | Cl Cl Cl	

After current.

This ionic medication has been employed in cases of chronic cervicitis with very good results; "the discharge, from having been muco-purulent and copious, has become milky and of small amount, whilst the gaping os has become normal in size, with the everted mucous membrane drawn in, and erosions have rapidly healed. Improvement in the general health has followed the amelioration of the local septic condition. In a case of membranous dysmenorrhœa the amount of membrane has gradually decreased until none has been found. In uterine hæmorrhage and in bacteruria ionic medication has proved beneficial." A glass speculum is used and a 1 per cent. solution of cupric chloride; the cervical and intra-uterine electrodes (spirals of copper wire) are inserted through the speculum, the neutral electrode (a large clay one) being applied to the hypogastrium or sacral region, or preferably to the hands (no rings being worn). A special vulvo-vaginal electrode has been contrived by Sloan and described by him in the present year (*Proc. Roy. Soc. Med.*, May 1909); it allows the physician to apply at one and the same time the ionic solution to the whole of the genital surface from the vulva to the orifices of the Fallopian tubes. The current is got from a battery of from fifteen to twenty Leclanché cells of good size; a rheostat is needed to regulate the current and a galvanometer to register the quantity used. An average dose is 15 ma. for 15 or 20 minutes. In subacute cases Sloan prefers to begin with iodine instead of copper as the ionic agent; then the negative pole is made the active one and the electrode is of carbon; and the solution is a 2 per cent. one of iodide of potassium, combined with ·2 per cent. solution of liquor iodi. In some of Dr. Sloan's earlier cases considerable pain, and, in some cases, some pelvic cellulitis followed the ionic medication; but he thinks these results can be, with care, eliminated. It will be interesting to find whether this novel plan of treatment helps the gynecologist to overcome the exceedingly troublesome cases of chronic cervicitis and endometritis of a septic nature for which it has been proposed.

Ionisation in Skin Diseases.—The treatment of skin diseases by electrolysis with zinc and other metals is quite a recent one. Leduc was the first to try it, in 1903, and since then Lewis Jones and others have worked at the subject. For the treatment are required an ordinary continuous current battery with a galvanometer, connecting wires, a flat pad on the negative pole, and a zinc electrode at the positive pole. The zinc is covered with several layers of lint, and is dipped in a 2 per cent. solution of zinc sulphate in distilled water. The negative pole, with the pad electrode, is applied to any convenient part of the patient, and the zinc electrode, moistened with the zinc sulphate solution, is placed on the diseased area, and a current of from 5 to 10 milliampères allowed to pass for about 10 minutes. In a solution of zinc sulphate ($ZnSO_4$) the salt is partly divided up into zinc atoms, which carry a positive charge of electricity, and SO_4 atoms, which carry a negative charge of electricity. When the current is passed, the zinc ions move from the positive towards the negative pole, and the SO_4 ions in the opposite direction. Therefore, when the current is turned on, the zinc ions immediately start to move towards the negative pole, and are thus carried into the tissues and deposited there. The difference between this method of introducing a drug and the hypodermic injection is that by electrolysis the zinc is introduced into the actual lymph-spaces and protoplasm of the cells.

Rodent Ulcer.—Rodent ulcer is the disease in which the best results have been obtained by this method. After one application a small rodent disappears in about three weeks. If any disease is left, the treatment may be repeated in a month. Rodents of considerable size have been reported as cured by this method. The great disadvantage of the method is the pain, which is very considerable, and although the application of cocaine is said to prevent that, unfortunately it does not always do so.

Various drugs may be applied similarly to the zinc sulphate. It must be remembered that the correct electrode must be used with

each drug. Alkalies, alkaloids, and metals are used with the positive pole, whilst acids, chlorine, bromine, and iodine come off at the negative pole.

RINGWORM.—It has been attempted to introduce copper and salicylate of soda ions for the cure of ringworm of the scalp, but as individual hairs are apt to escape, the results so far have not been encouraging.

WARTS.—Warts may be cured by the application of magnesium ions.

REFERENCES.—LEWIS JONES, *Roy. Soc. Med.*, March 1908; *Brit. Med. Journ.*, 16th Feb. 1906.—LEDUC, *Arch. d'électricité med.*, p. 734, 1903.—ARTHUR, *Med. Electrology and Radiology*, Aug. 1906.—TAYLOR, *Med. Electrology and Radiology*, Aug. 1906.

Iontophoresis, Zinc.—The carrying of minute particles of the zinc electrode into the tissue by means of the galvanic current; it was introduced in the treatment of external eye disease by Wirz in 1908, *e.g.* in corneal ulcer. See *Lancet*, ii. for 1910, p. 484.

Ipsolateral.—A term meaning on the self-same side, *e.g.* when optic neuritis is on the same side of the body as the brain lesion causing it; it is thus used by Sir Victor Horsley in the form of the noun (*ipsolaterality*). See *Brit. Med. Journ.*, ii. for 1909, p. 877.

Isolysins.—Lysins active in the same species, cf. HETEROLYSINS.

Isomaltose. — A carbohydrate, which has, in very rare cases, been discovered in the urine.

Issaeff Resistance Period.—A phenomenon in non-specific immunity. Issaeff found that a peritoneal leucocytosis could be induced by injecting into the abdomen non-toxic things such as saline solutions, serums, etc.; that the resulting leucocytosis was at its height twenty-four hours later; that if the animal were then given what would otherwise have been lethal doses of various pathogenic spirilla no ill results followed; and that the leucocytosis lasted for some days. A practical application of the phenomenon has been the use by surgeons of intraperitoneal inoculations of nucleins, saline solutions, etc., the day before laparotomies, in order to lessen the dangers and damage of subsequent infection. *See* Adami, *Pathology*, i. p. 501, 1910.

Jaundice.—CONGENITAL FAMILY CHOLÆMIA; CHRONIC ACHOLURIC JAUNDICE.—Attention may be called to a rare form of chronic jaundice, which has been the subject of several recent papers. Its leading characteristics are its chronicity, its tendency to affect several generations or members of a family, the absence of bile pigment from the urine (whence the name "acholuric jaundice"), and the association with it of blood changes suggestive of pernicious anæmia, and chronic splenic enlargement.

Hawkins and Dudgeon state that—"It is certain (1) that a child may be born jaundiced or may become jaundiced soon after birth; (2) that the jaundice may persist with little or no variation for many years, at any rate till middle life; (3) that the spleen in these cases is always enlarged; (4) that there is considerable anæmia, with a low colour-index, poikilocytosis, and the presence of nucleated red cells; (5) that nevertheless the patient has good or fair health, can stand intercurrent diseases; and, if a woman, is able to bear children; (6) that bile pigment is present in the stools as in health, that it is not present in the urine, but that any darkening of the urine which may be present is due to urobilin; (7) that nevertheless bile pigment is present in the serum; (8) that this condition tends to appear in more than one member of a family, and in successive generations."

The sexes seem to be equally affected; in some cases at least the jaundice is congenital. The disease does not necessarily shorten life. The jaundice attains about the same degree as ordinary catarrhal jaundice, and is unattended by gastric disturbance, itching of the skin, or clubbing of the fingers. The disease is not due to syphilis or alcoholism. The enlargement of the spleen is comparatively moderate; its lower end may reach the level of the umbilicus, but this is the outside limit. Enlargement of the liver is less marked, and there is no evidence of cirrhosis. All observers have found changes in the blood, and as these are of importance in relation to the nature of the disease, Hawkins and Dudgeon's report on their four cases may be quoted in full: "Red cells vary from 2,590,000 to 3,676,000, the average being 3,090,000, rouleaux formation is poor or absent, microcytes are numerous, polychromatophilia is marked, poikilocytosis is well marked; granular degeneration was well marked in one case. In these four cases respectively, 1 megaloblast, 7 normoblasts and 27 megaloblasts, 15 normoblasts and 10 megaloblasts; 5 normoblasts and 1 megaloblast were seen in counting 500 leucocytes. In two cases 'ghosts' were very numerous. The hæmoglobin varies from 35 to 70 per cent., the average being 44 per cent.; the colour-index varies from ·58 to ·9, the average being ·69. Fibrin formation was absent in one case, slight in another; blood platelets were very numerous in one case, scanty in another. The leucocytes vary from 3800 to 6120, the average being 4880, with no real alteration in relative proportions, though there was slight excess of polynuclear neutrophiles in one case (adult)

and slight lymphocytosis in another (aged 7). In three cases the serum was strongly tinged with demonstrable bile pigment." In the cases reported by Hutchison and Panton similar changes were found, with, in addition, the presence of a few neutrophile myelocytes. In the series of cases described by Buchan and Comrie under the name "congenital anæmia with jaundice and enlargement of the spleen" the blood changes were more profound, nucleated reds, abnormal mitoses, and a fair proportion of myelocytes being present.

Though the disease is perhaps best described as "family acholuric jaundice," isolated cases, without hereditary antecedents, and cases associated with bile pigment in the urine have been reported. In a very remarkable series of cases placed on record by Buchan and Comrie, which apparently come into this category, four successive infants in one family were affected. The first-born child (male) was in all respects normal. The second (male) was jaundiced at birth, developed splenic enlargement and marked changes in the blood within the first few weeks, and then made an absolute recovery by the time he was nine months old. The third child (female) had jaundice, splenic enlargement, and anæmia from birth, and died when two days old. The fourth child (female) also suffered from jaundice and anæmia, and died when a week old. The leading features of Buchan and Comrie's cases were—(1) Profound anæmia. (2) Active hæmopoiesis leading to the appearance in the blood of large numbers of premature or fœtal types of cell. The active hæmopoiesis was taking place in the bone marrow, and also to an abnormally marked degree in the liver. (3) Destruction of the red cells was going on, as was evidenced by the presence of phagocytes containing blood pigment in the spleen, and phagocytes engulfing red cells in the circulating blood. (4) Obstructive jaundice was present, as evidenced by distension of the biliary canaliculi.

There are two main hypotheses as to the nature of acholuric jaundice with anæmia. (1) On the one hand the jaundice may be primary, due perhaps to defective development of the larger biliary passages, with consequent absorption of the bile by the hepatic lymphatics, and splenic enlargement and blood changes secondary to the cholæmia so produced. (2) On the other hand the anæmia may be the cause of the jaundice. In this event we have a primary hæmolysis, producing anæmia, and causing hæmolytic jaundice. The second hypothesis is that which has most in its favour. There is no proof that the serum in these cases is endowed with abnormal hæmolytic power, but there is some evidence that the red corpuscles are abnormally fragile. Both Hawkins and Dudgeon, and Hutchison and Panton found that lysis of the cells occurred in a solution of sodium chloride up to ·6 per cent., whereas normal corpuscles are not lysed except by solutions weaker than ·4 per cent. Hawkins and Dudgeon also found that the serum of their cases contained hæmagglutinins.

As regards the treatment of the condition, the only point worth noting is that, unlike pernicious anæmia and splenic anæmia, it shows no improvement under arsenic.

LITERATURE.—Several of the following papers contain fairly complete bibliographies :—Hawkins and Dudgeon, *Quarterly Journ. of Med.*, Jan. 1909.—Hutchison and Panton, *Ibid.*, July 1909.—Buchan and MacGibbon, *Scott. Med. and Surg. Journ.*, Sept. 1906.—Buchan and Comrie, *Journ. Path. and Bact.*, xiii. p. 398, 1909.—Benjamin and Sluka, *Berl. klin. Wochensch.*, 26th Aug. 1907.—Claus and Kalberlah, *Ibid.*, 12th Nov. 1906.—Strauss, *Ibid.*, 10th Dec. 1906.

Jecovol.—A proprietary preparation described as an egg emulsion of cod-liver oil, with glycerophosphates of calcium, sodium, and iron. According to the *British Medical Journal* analysis, the preparation contains practically 50 per cent. of oil (see *Brit. Med. Journ.*, i. for 1910, p. 209).

Jeddah Ulcer. — A synonym of "oriental sore" or "Aleppo boil"; it has recently been named "Leishmaniose cutanée" by the French writers.

Jenner's Stain.—A polychrome methylene-blue-eosin stain. *See* Blood (*Examination of Stained Films*).

Jensen's Tumour.—*See* Cancer.

"Joint-Mouse."—A foreign body in a joint, *e.g.* the knee; it may be a detached piece of bone or a loose cartilage.

Jolles's Ferrometer.—A colorimeter showing the amount of iron in the blood. *See* Webster, *Diagnostic Methods*, p. 425, 1909.

Jousset's Fluid.—*See* Inoscopy.

Justus Test.—The fact that the injection or inunction of mercurial preparation causes a reduction in the percentage of hæmoglobin (10 to 20 per cent.) in persons suffering from syphilis; this lasts for a few hours or days; it is not, however, an absolutely reliable test.

Juvis.—A proprietary food preparation described as being made solely from beef with vegetable properties added. For report and analysis, see *Lancet*, ii. for 1908, p. 803.

Kahler's Disease.—Myelopathic Albumosuria. *See* Multiple Myeloma.

Kala-Azar.—(*See Encyclopedia and Dictionary of Medicine*, Vol. X., p. 115).—ETIOLOGY.—The parasite which is now known to cause kala-azar was first demonstrated in 1903 by Leishman in *post-mortem* smear preparations from the spleen of a soldier who died in London from chronic fever contracted in Dum-Dum ("Dum-Dum fever"). Leishman regarded the new organism as a degenerated form of trypanosome. As soon as Leishman's paper reached India, Donovan realised that he had already observed the same organism in the spleens of patients dying from prolonged fever in Madras. He, however, denied that the parasite was a trypanosome, and Laveran, to whom specimens had been sent, formed the opinion that it was a piroplasma. In the same year, Wright discovered structures resembling these "Leishman-Donovan bodies" in the tissues of the Delhi boil, and it was at first thought that the two were identical. It is now believed, however, that the parasite found by Wright is not, in fact, the same as that of Leishman and Donovan. An important step was taken when Rogers, and subsequently James, showed that the Leishman-Donovan bodies were constantly present in the spleen in cases of kala-azar. The observation has been so thoroughly confirmed that it is now certain that they are the cause of the disease. (*See* PROTOZOA.)

As originally described by Leishman, the organism is a small, round or oval structure, from 2 to 3 μ in diameter, containing two masses of chromatin, one large and circular, the other smaller and rod-shaped—the macronucleus and micronucleus respectively. These stain deep red with Romanowsky, and are embedded in a faintly blue-staining cytoplasm. The organism is found either singly or in clumps of from 20 to 50. It is found in every organ of the body, but is most numerous in the spleen, bone marrow, and liver. In the circulating blood it is scanty, especially during the early stage of the disease; but in the later stages it is possible to demonstrate its presence in more than 75 per cent. of cases. The organism exists chiefly in the large endothelial cells of the spleen and marrow; it multiplies in these by division until the invaded cell bulges and ruptures into a vessel. In the blood the parasite is found in the polynuclear leucocytes, but not, apparently, in the red corpuscles—an important point in connection with its supposed relationship to the piroplasma. The further development of the parasite has been elucidated by Rogers. He found that by incubating blood containing the parasite at low temperatures (22° C.) rapid multiplication took place, the organism meanwhile developing a blue-staining cytoplasm, and then acquiring flagella and the power of active movement. At this stage the parasite was elongated instead of round or oval, and its flagella arose from the region of the micronucleus. Multiplication of the flagellar forms is effected by a process of division, beginning with the micronucleus and flagellum, and extending to the macronucleus and protoplasm. This process of division is repeated until a rosette-shaped mass of organisms is formed, the flagella being centrally, the bodies radially placed. Ultimately the actively mobile organisms break away from the rosette, undergo regressive changes, and are found (*in vitro*) in the polynuclear leucocytes as the original oval Leishman-Donovan bodies.

From the absence of any appearance of an undulating membrane, Rogers denies that the organism is a trypanosome, while the presence of a flagellum separates it from the piroplasma. He looks on it as allied to the hepatomonas. An essential factor for successful cultivation outside the body is that the temperature be low. The optimum is from 20° to 22° C.; above 25° C. there is no marked development. Bacterial contamination is fatal to its growth. Under anærobic conditions, though the organism does not die, its development does not occur. Rogers found that development was much favoured by rendering the blood slightly acid by citric acid, and from this hint he was led to suspect the bed bug (the tissue juices of which are also faintly acid) as a carrier of infection. In 1906 Dr. Patton detected the parasite in the stomachs of bugs which had fed on kala-azar patients, but not in mosquitoes; he subsequently traced their development in the bug up to the flagellar stage.

Leishman's discovery of the new pathogenic organism has not only placed the pathology of kala-azar on a sound basis, but has done a great deal towards clearing up the nature of the chronic fevers of Bengal. Since the Leishman-Donovan bodies have become known, cases of the disease have been reported in districts of India where kala-azar is not epidemic, as well as from Penang, Hankow, Tunis, the Egyptian Soudan, and Manila. The distribution of the disease is thus far wider than has hitherto been supposed.

The parasite can only be demonstrated in the blood after prolonged search, especially towards the commencement of the disease. It is much more readily found in smears of fluid withdrawn by splenic puncture, but this proceeding is not free from risk, and Rogers condemns it in patients who are markedly anæmic, or who have recently suffered from any kind of hæmorrhage. Apart from the detection of the parasite, however, the examination of the blood is of diagnostic importance, for in kala-azar leucopenia is a striking symptom. The leucocytes may fall to 1000 or even 500 per c.mm., and so low a count as this is almost diagnostic.

Unfortunately the treatment of the disease

has made no such strides as our knowledge of its pathology. The mortality comes within sight of 100 per cent. Rogers advises the persistent, patient use of large doses of quinine; he gives 60 grs. a day until the temperature falls, and then continues with smaller doses for many months. Under this treatment it is said that recovery takes place in a larger percentage of cases than by any other method.

LITERATURE.—Leishman, *Brit. Med. Journ.*, 30th May 1903; 26th Feb. 1904.—Donovan, *Ibid.*, 11th July 1903.—Ross, *Ibid.*, 14th Nov. 1903.—Manson and Low, *Ibid.*, 23rd Jan. 1904.—Roger, *Ibid.*, 28th May 1904.—Milroy Lectures, *ibid.*, 23rd Feb., 2nd March, and 9th March 1907.—Nicolle and Cassuto, *Presse méd.* (Paris), 8th Feb. 1908.—Bentley, *Indian Med. Gazette*, March 1904.

Kangri Cancer.—Kangri burn cancer is believed to be due to the irritation on the thighs and abdomen caused by the Kangri basket (a portable fire basket) carried under the clothes by the people in Kashmir; it is a typical squamous-celled epithelioma, with a malignancy which is slight in the early stages, with slow invasion of glands, and very amenable to operative treatment, but with, in the later stages, involvement of the deep glands and inoperability. E. E. Neve (*Brit. Med. Journ.*, ii. for 1910, pp. 589-591) regards its occurrence as a fact opposed to the parasitic theory of cancer. See also *Brit. Med. Journ.*, ii. for 1910, pp. 629, 912.

Karell "Milk-Cure."—A mode of treating obesity, consisting in the taking of a tumblerful of milk four or five times a day at intervals of 2½ hours, for from 5 to 8 days; the patient is in bed during the whole period, is generally massaged, and may take an apple or an orange during the last two or three days of the treatment; there is usually a great loss in weight (from 8 to 11 lbs. in the week); it may be followed by an "after-cure," or period in which the milk is diminished and the patient is allowed small quantities of sausage, bread, lean meat, and vegetables, prepared without fat. Strauss (*Med. Klin.*, vi. pp. 500-503, 1910) is of opinion that a modified form of this treatment (a miniature Karell cure), which can be repeated at intervals of some weeks or months, may give better results than the longer periods. *See also* L. Roemheld, *Monatschr. f. d. phys.-diätet. Heilmeth.*, i. p. 32, 1909; and *Lancet*, ii. for 1908, p. 979.

Karyolobism.—The conditions found in the nucleus of cells, *e.g.* leucocytes, in respect to the number and character of the lobes; Arneth, for instance, has used the number of the nuclear lobes as a means of classifying the polymorphonuclear neutrophiles of the blood into five groups.

Karyolysis.—The disappearance of the nucleus of the cell taking place in one of two ways: in one the nucleus swells up, becomes vesicular or œdematous, stains with nuclear dyes less and less markedly until it cannot be distinguished from the cytoplasm, *e.g.* in cloudy swelling; in the other (known as pathological chromidiation) minute bodies, which at first stain and later lose this power, pass out from the nucleus into the cytoplasm, and the nucleus itself in time becomes almost invisible, *e.g.* in the liver cells in phosphorus poisoning. *See* Adami, *Pathology*, i. p. 52, 1910.

Karyorrhexis.—An intracellular change consisting in disappearance of the nucleus through breaking down of the nuclear membrane, disintegration of the nucleus, and discharge of chromatin into the cell substance; it differs in nature from karyolysis, but produces the same result.

Kasauli Institute.—The Pasteur Institute in North India, near Simla, for the treatment of hydrophobia; there is another Institute at Coonoor in South India.

Katabiotic.—The property possessed by cells of dissipating stored up energy in the form of functions other than growth, *e.g.* producing heat or nervous action; it is opposed to *bioplastic*, but the energy in each is obtained from the assimilated food.

Kataplasia.—The term introduced by Beneke to signify reversionary degeneration or metamorphosis of cells in which these structures (highly organised cells) lose their specific characters and come to simulate those possessed by the developing cell; this is seen in striated muscular fibres, *e.g.* at the edge of an invading neoplasm; kataplasia differs from anaplasia, in that the power to return to the normal differentiation is preserved, whereas it is lost in anaplasia. *See* Adami, *Pathology*, i. p. 878, 1910.

Kathrein's Test.—A method of testing the urine for biliary pigments: to a few drops of urine rendered acid (if necessary) by acetic acid, a 1 per cent. alcoholic solution of iodine is added, so that the latter rests upon the former with a distinct line of contact; at this line an emerald-green colour is developed if bilirubin or any other bile pigment is present; a fallacy is to be guarded against if antipyrin and some other drugs are present; it is also known as Trousseau's test, and as Smith's test.

Kations.—*See* Cataphoresis; Ionic Medication; Ionisation.

Kawa.—A resin extracted from the root of *Piper methysticum*, and entering into the

composition of gonosan (a remedy for gonorrhœa).

Kelling's Test.—A test for lactic acid in the gastric contents; it depends upon the canary yellow colour developed when a 10 per cent. solution of ferric chloride has added to it a few drops of filtered gastric juice containing lactic acid. *See* Webster, *Diagnostic Methods*, p. 70, 1909.

Kellogg's System. — The use of a purin-free diet, as in Battle Creek Sanitorium; fruit, nuts, cereals, along with some eggs and dairy produce, are allowed, but no fish, flesh, fowl, tea, coffee, or cocoa.

Kephaldol. — An antipyretic of the phenacetin group, said to be a compound of citric and salicylic acids with phenetidin. *See* Fortescue-Brickdale, *Newer Remedies*, p. 217, 1910.

Kephalin.—A lipoid substance obtained from brain substance, described as a phosphorus and nitrogen-containing lipoid or phosphatid, or, more particularly, as a mono-amido-diphosphatid; it is closely related to lecithin, and contains two fatty acids, one being unsaturated (*kephalic acid*), and two bases, one being *cholin*.

Keratosic Cones.—Horny cones or domes developing on the skin of the hands, feet, and other parts; it is said to be very rare, and only met with in association with gonorrhœal arthritis. *See* A. W. Williams, *Lancet*, ii. for 1910, p. 1769.

Ketonuria.—*See* Acidosis.

Kharsin. — A proprietary preparation, described as sodium 3-methyl-4-aminophenylarsonate, containing 23·7 per cent. of the element arsenium (*Brit. Med. Journ.*, i. for 1909, p. 344; *Lancet*, ii. for 1908, p. 802).

Khoosh Bitters.—A proprietary preparation, described as a never-failing appetiser; an analysis in the *British Medical Journal* (ii. for 1909, p. 563) shows (in 100 parts) 14·4 parts by measure as alcohol and 0·14 as total solids, whilst the residue resembled that of tincture of quassia.

Kidneys, Surgery of.—In operations on the kidneys, as for example where nephrectomy is in prospect, it is obviously of the first importance to determine the adequacy of the organs separately. This can only be done by examining the urine from each kidney separately, and the instrument which is used for this purpose is the separator invented by Luys of Paris. The urine separator consists of a catheter composed of three parts—a central supporting piece and two lateral tubes. Over the central portion there is fitted a long slender glove finger of indiarubber. By a simple mechanism this rubber sheath can be stretched so as to form a diaphragm filling up the concavity of the terminal curved portion of the separator. In this condition the separator is roughly racket-shaped, with an outlet for urine on each side of the flattened part of the racket. The instrument is introduced into the bladder, previously washed out and containing 30-40 c.c. boric lotion, like an ordinary sound. When it is *in situ* the rubber sheath is stretched, and the resulting diaphragm being grasped by the muscular walls of the bladder forms a septum dividing the viscus into two halves, each communicating with the ureter on the one hand, and with one of the outer tubes of the separator on the other. "A safe index for the proper position of the instrument is given by the manner of the urinary flow from the tubes. Normally, in rhythmical intervals, series of drops are excreted corresponding with the contraction of the ureter and the alternating function of the kidneys. If the instrument is not properly placed, the urine can either flow in continuous drops, or the tubes excrete nothing, and between them and the separating rubber membrane the urine trickles out" (Lichtenstern).

Separation is much simpler than ureteral catheterisation, and does not cause infection of the ureters from the bladder. It can be used when ureteral catheterisation is impossible—*e.g.* if the ureteral openings are obscured by cystitis, if the rapid flow of pus or blood into the bladder clouds the bladder fluid, or if the ureteral openings cannot be found.

In addition to the examination of the urine by the ordinary physical and chemical tests, three main lines of additional research have been employed—(1) cryoscopy; (2) various colour tests; (3) phloridzin test. (1) Cryoscopy is referred to in the *Encyclopedia and Dictionary of Medicine*, ii. p. 255, but since 1906, when the article there was written, the method has to a great extent fallen into the background, as it has been found that the information obtainable may be gained by other simpler methods — especially by the estimation of the specific gravity. (2) Chromocystoscopy. Twenty cubic centimetres of a ·4 per cent. solution of indigo carmine are injected into the gluteal muscles. In fifteen to twenty minutes, if the kidneys are normal, the urine is discoloured. If the colour is pale, or its appearance delayed, the kidney is at fault. Indigo carmine is superior to methylene blue, which is employed in the same way. For this test a separator is not required; the jets of coloured urine from the ureters can be observed by the cystoscope. (3) Phloridzin test. A

subcutaneous injection of ·005 gr. phloridzin in 20-30 minims of water is given. Glucose should appear in the urine in half an hour. The average quantity eliminated during the first half-hour is ·5 per cent. If the kidneys are diseased this quantity is reduced by a half, and very little more is secreted in the first than during the second half-hour. If no sugar is present the kidneys are seriously affected, if its excretion is delayed there is renal insufficiency. The test is more delicate than the preceding.

Operative Treatment of Nephritis.—Decapsulation of the kidney. Edebohls has proposed partial or complete removal of the capsule of the kidney as a method of treating nephritis. It is claimed that after capsulectomy and the replacement of the denuded kidney in its fatty bed adhesions form and a new and additional blood supply is furnished to the organ. It is impossible to formulate definite indications for the operation, which has not, for the most part, been followed by very good results, or been received favourably by surgeons, although it has been the subject of a good deal of discussion in surgical journals (Edebohls, *N.Y. Med. Record*, lxviii., 1904, 21st May; *Philadelphia Med. Journ.*, 1904, 21st-28th May). Garré and Ehrhardt (*Mitth. a. d. Greuzgeb. d. Med. u. Chir.*, Hft. 2, 1904) regard operation as contra-indicated in the treatment of acute nephritis, unless in occasional cases of total anuria. They do not regard the results of Edebohls' operation as encouraging. The experimental evidence that, in fact, decapsulation does actually result in a fresh collateral circulation is conflicting. Thus Herxheimer and Walker Hall (*Brit. Med. Journ.*, 9th April 1904) found that in animals suffering from experimental nephritis, as well as in normal animals, the capsule was speedily renewed, and exceeded the old one in thickness; that, though decapsulation seemed harmless, there was no evidence of extensive collateral circulation being established; and that the course of the nephritis was uninfluenced by the operation. Liek (*Deut. Med. Woch.*, 1908, p. 4) did not find that by decapsulation he could re-establish a collateral circulation. Thelemann (*ibid.*, 1904, p. 15) comes to the same results. Martini's experiment (*Arch. f. klin. chir.*, 1905, lxxviii. p. 3) seemed to prove, however, that in the dog a certain degree of collateral circulation is established by decapsulation. Stern (*Deut. Med. Woch.*, 1905, p. 11) thinks that in certain cases surgery may do good in chronic nephritis; splitting of the kidney in cases of œdema and anuria; splitting of the capsule and puncture of the kidney for œdema and chronic diminution of the urine; decapsulation for albuminuria without œdema. Roosing is strongly against the operative treatment of true bilateral nephritis (Bright's disease), and equally in favour of operation in suitable cases of local, infective (*e.g.* tuberculous) nephritis. He very properly lays stress on the importance of correct diagnosis, and on the need for bacteriological and microscopical as well as chemical examination of the urine (*Centralbl. f. Chir.*, 1904, p. 17). Mohr is also against the operation (Volkmann's *Samml. kl. Vorträge, N.F.*, p. 383), and Israel, who operated on six cases of true nephritis, found that the operation was dangerous, was not followed by permanent cure, and was only in some cases of temporary benefit. Guitéras (*New York Med. Journ.*, 7th-14th Nov. 1903) is more favourable. He circularised 150 of the leading American surgeons on the subject, and about half were ranged on each side. One point which suggests itself is that the term chronic nephritis is not accurately defined. It is noteworthy that in many cases the coincidence of "Bright's disease" and movable kidney is spoken of; some, *e.g.* Fergusson (*Journ. Amer. Med. Assoc.*, 1904, 16th April), hold that every movable kidney is chronically inflamed and must therefore be operated on. The following are the statistics collected by Guitéras:—120 cases, with 16 per cent. cures, 40 per cent. improvement, 11 per cent. no improvement, 33 per cent. deaths. The best results were given by the decapsulation and fixation of movable kidney in which nephritis (albuminuria and casts) was present. This often disappeared after operation. In cases of interstitial nephritis the result was often striking—disappearance of albumin and casts. The mortality in chronic interstitial nephritis was 26 per cent.; in chronic parenchymatous nephritis 25 per cent.; in chronic diffuse nephritis 579.

It is not easy, out of all the conflicting literature, to glean any very definite information as to the true position of surgery in nephritis, but the following suggestions may be made:—(1) The majority of the papers on the subject appeared about the years 1903-5, and since then there has been less written on the subject. It would seem, then, that the ultimate results of the operation have not been what were hoped. (2) Apparently the cases operated on included a variety of different diseases—movable kidney, unilateral nephritis, hæmorrhage from the kidney, and true Bright's disease. (3) The operation is not justifiable in Bright's disease. (4) The frequency with which nephritis is present in cases of movable kidneys suggests the propriety of decapsulation as well as fixation (Fergusson). (5) In a miscellaneous class of cases of "unilateral nephritis," which includes obstinate pain in one kidney region, hæmaturia, etc., operation may be undertaken. Here, however, the question of diagnosis requires careful consideration. (6) In the last-mentioned group nephrotomy, with or without drainage,

or simple incision of the capsule, or puncture of the kidney, as well as, or along with, capsulectomy, have been performed.

Kienböck's Method.—A method of X-ray application for the cure of favus and ringworm of the scalp. *See* Adamson, *Lancet*, i. for 1905, p. 1715; i. for 1909, p. 1378.

Kinematography. — *See* Röntgen Rays and Radium (*Röntgen Kinematography*).

Klapp's Suction Cups.—*See* Bier's Method; Skin Diseases (*Bier's Treatment*).

"Klopfversuch."—Literally the tapping experiment, being the name given to Goltz's method of artificially producing syncope; if one taps a frog over the intestines, the effect is to cause an arrest of the circulation associated with accumulation of the blood of the body in the abdominal veins; there is evidence that the effect is due either to inhibition of the splanchnic vaso-constrictor centres (whereby the abdominal veins become dilated), or to stimulation of the cardiac inhibitory centre (whereby the heart's action is arrested). *See* Adami, *Pathology*, i. pp. 582-583, 1910.

Knop-Hufner Method.—A plan for determining the amount of urea in urine; it depends upon the decomposition of the urea by means of sodium hypobromite and the measurement of the nitrogen set free.

Kobelt's Tubes.—The outer vertical tubules of the parovarium (or organ of Rosenmüller) which do not reach the ovary, but end in flask-like dilatations (which may form cysts, *Kobelt's cysts*).

Koko.—A proprietary preparation, a hair-grower, whose analysis is given in the *British Medical Journal* (i. for 1910, p. 151); it contains borax, glycerine, formaldehyde solution, perfume, alcohol, and water.

Kolle's Serum.—*See* Cerebro-Spinal Meningitis, Epidemic (*Treatment, Curative*).

Kolynos Dental Cream.—A proprietary preparation recommended for the care of the teeth; according to the *Lancet* Report (*Lancet*, i. for 1910, p. 1007), the antiseptic agents it contains are benzoic acid, eucalyptus oil, peppermint oil, and thymol, whilst the vehicles are soap, precipitated chalk, alcohol, and glycerine; it is said to cleanse the teeth without injuring them, and to maintain mouth asepsis. Drs. Thresh and Beale report upon the action of liquid kolynos on the bacillus of influenza (*Lancet*, i. for 1910, p. 1406), finding that it apparently destroys that organism when used as a spray.

Kromayer Lamp.—A quartz lamp of mercury vapour, of **U**-shape, used for the sterilisation of water, and for local application of actinic rays in phototherapy in such diseases as lupus, vascular nævi, acne rosacea, alopecia areata, etc.; it is well to use it with a uviol (ultra-violet) glass screen. *See* Nogier, *Arch. d'electric. méd.*, xviii. pp. 174, 481, 1910.

Kuatsu.—*See* Abrams' Heart Reflex.

Kyrins.—Proteins or bodies of a "polypeptoid" nature, which are resistant to tryptic digestion, and which on treatment with acid yield amino-acids, some of which are present in the products of tryptic digestion and some not. *See* Adami, *Pathology*, i. p. 62, 1910.

Lab.—Chymosin or rennin; the gastric ferment which has the power of curdling milk by coagulating the casein; pepsin and lipase are the other two ferments.

Labour, Forceps in.—Little requires to be said regarding the position of the forceps-operation in obstetric practice during the past quinquennium. The revival of symphysiotomy and pubiotomy has tended to narrow the sphere of the forceps, whilst, on the other hand, the neglect of version has had the effect of slightly broadening it. There seems to be a growing feeling against the use of the instrument in high cases, especially in contracted pelves; and it is only too true that such an application of the forceps is sometimes simply a craniotomy in disguise, an embryulcia under a wrong name. On the other hand, it would seem, from some discussions which have taken place on the subject, that the use of forceps in cases of simple delay in labour, without marked pelvic contraction, is increasingly frequent. Thus in a discussion on the use and abuse of midwifery forceps (*Trans. Edin. Obstet. Soc.*, xxix. p. 231 *et seq.*, 1904) in 1904, Drs. Dewar, Macvie, Somerville, Hamilton, and Spence all spoke strongly in favour of having frequent recourse to the forceps, and bore witness to the safety of such a practice and to the good results arising from it. Even under these circumstances, however, the late Dr Horrocks and those who advocate his policy of non-interference in from 90 to 95 per cent. of all labours (*Brit. Med. Journ.*, i. for 1906, pp. 712, 713, 737, 773, etc., etc.) would forbid the employment of forceps; this may be described as an extreme opinion.

It is on the Continent, and especially in Germany and Austria, that the revolt against the routine use of forceps in contracted pelves has taken its orgin and made its influence felt. Leisewitz (*Arch. f. Gynaek.*, lxxxi. p. 686, 1907), for instance, publishes statistics which must be described as startling. He states that

between 1894 and 1907 there were 697 forceps extractions in the Dresden Lying-in Hospital; 63·13 per cent. were done to save the child, 14·2 per cent. to save the mother, and the rest for the sake of both mother and child; and that lesions due to the forceps were produced in 73·6 per cent. of the mothers and in 6·7 per cent. of the infants. He, therefore, thinks that the forceps in contracted pelves must be used with the greatest care and skill, that the high forceps operation is very dangerous, and that hebotomy or Cæsarean section ought to be performed in its place. He goes so far as to condemn absolutely the high forceps in the hands of the general practitioner, and recommends him to do hebotomy, or, when this cannot be done, perforation even of the living child (!). Leopold (*Arch. f. Gynaek.*, lxxxi. p. 731, 1907) holds somewhat similar views and uses the high forceps very seldom; in 81 per cent. of the patients with pelvic contraction spontaneous delivery occurred, and Weindler (*ibid.*, p. 718, 1907) also refers to this matter, stating that delivery without instrumental aid took place in pelves with a C.V. as small as 7 cm. It seems, therefore, as if the numerous cases of forceps delivery in this country (for pelvic contraction) were largely those which were left to deliver themselves in Dresden. It must be noted, however, that, while the forceps is being less used in Germany, its place is being taken by such cutting operations as pubiotomy and Cæsarean section and not as a rule by the plan of waiting for natural expulsion. If we may judge from current obstetric literature, the present time is the operative era in midwifery.

With regard to the type of forceps in use, no great change in opinion or practice has to be recorded. The axis-traction principle of forceps action is still that which is generally regarded as superior in theory; some obstetricians, however, would stop here, and argue that in practice it is unnecessary to use any other than forceps with a pelvic curve. The latter opinion is founded upon the fact that the chief advantage of axis-traction forceps is ease of extraction, and that it is only in exceptional cases that such a pair of forceps would succeed when the simple type has failed; but, surely, it is well to use by preference the instrument which gives the greatest amount of help in all cases. What may be called the spectre of the danger of the fixation-screw of axis-traction forceps was laid by Milne Murray in his letter to the *British Medical Journal* early in 1904, just before his lamented death. There still exists some difference of opinion as to the most suitable part of the forceps to which to attach the axis-traction rods. In Tarnier's forceps and in the British types (modelled upon Tarnier's) of Sir Alexander Simpson and the late Milne Murray, the rods are fixed just below the fenestræ of the blades; while in Neville's forceps and others their attachment is to the upper part of the handles near the lock. Theoretically the former is undoubtedly the more correct position; but possibly the greater ease of application and the simplification of the instrument found in the latter type may compensate for some loss of traction power and accuracy of direction, although Munro Kerr (*Operative Midwifery*, p. 336, 1908) does not think so.

Labour, Induction of Premature.

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THE induction of premature labour, more especially for a medium degree of pelvic deformity, is perhaps the obstetric operation which more than any other deserves to be known as "British." With Continental opinion always opposed to it, and with Transatlantic support never more than lukewarm, this operation seemed destined to pass out of use altogether save in Great Britain: the revival of symphysiotomy, the perfecting of forceps, the improvement in the technique and results of the Cæsarean section, these all seemed to be driving the induction of labour off the field, and even in this country there were not wanting signs that it was being less employed than formerly. During the past two or three years, however, there have been indications that this despised method was beginning again to attract attention.

It is only fair in judging by results that the operation of *induction of abortion* for medical reasons should be separated from the induction of premature labour: the former has been termed "therapeutic fœticide" (for, of course, it involves the death of the fœtus), whereas the latter is performed after the unborn infant is viable, and may save the child as well as the mother. The operations are quite distinct in their indications, and ought not to be compared in their results. It is doubtful even if it be fair to include the cases in which induction is performed at the end of the sixth or in the seventh month, when the viability of the fœtus is hardly established; and certainly the instances in which labour is induced because pregnancy has gone beyond the full term, although their results are often quite satisfactory, cannot be called *premature*, because they are indeed *post-mature* labours. If these cases were removed from our lists of operative successes and failures, a much fairer opinion could be formed of the merits of the induction of premature labour.

Among the *objections* which have been made to the performance of artificial interruption

of pregnancy, that which has perhaps had most weight has been the high mortality amongst the infants both at birth and within some days or weeks thereafter. In 1902 Ballantyne (*Brit. Med. Journ.*, i. for 1903, p. 1196) insisted that the problem of the premature infant was the root-difficulty standing in the way of a more general acceptance of the operation of induction of premature labour. So long as a third or a half of all infants brought prematurely into the world perished at or soon after birth, so long the operation which brought them there (however well performed and however safe it might be for the mother) would suffer obloquy. Obstetricians had to learn to keep premature infants in life if they were to continue prematurely to bring to a close their intra-uterine existence; the survival of the premature infant was the necessary complement of its early arrival in the world. Ballantyne, therefore, emphasised the value of researches bearing on the anatomy, physiology, and pathology of the premature infant; and he pointed out the self-evident, but little recognised, fact that it was really a fœtus placed before its time in an extra-uterine environment which severely tried all its tissues and organs. Camille Hahn's work (*Thèse* (Paris), 1901) on the characters, prognosis, and treatment of premature infants, marked a noteworthy advance in the right direction; and the improvement of the incubator, the scientific study and management of the feeding of such young infants, the aseptic treatment of the umbilical cord, and perhaps the addition of iron to the dietary (as suggested by Ballantyne, *loc. cit.*) may before long so improve the infant's chances of survival as to do away with this, the most serious, objection to the operation of induction of premature labour. At the same time it must not be forgotten that each advance in our successful treatment of the prematurely born infant will tend to push backwards a little the earliest date of viability, and so make possible the performance of induction at an earlier week of pregnancy; in this way there will be a temptation to induce labour earlier in higher degrees of pelvic deformity, and so, for a time, the advances that have been made and the difficulties overcome may be overshadowed by a further advance which brings with it new obstacles. Nevertheless it is in this direction that progress is to be looked for; indeed, it is essential for the very survival of the operation that the peculiarities of the prematurely born infant be studied, and that he be fitted as far as is possible to his environment.

From what has been stated, it will easily be understood that the *indications* for the performance of the operation of induction of premature labour are not, at the present time, well defined. With regard to the commonest indication, the existence of a degree of pelvic contraction which makes it unlikely that a full-time infant can be extracted alive and uninjured through the canals by forceps, version, or the unaided efforts of Nature, there is a tendency to limit its performance to those cases in which the conjugata vera measures from $3\frac{1}{4}$ to $3\frac{1}{2}$ inches (see Munro Kerr's *Operative Midwifery*, pp. 442-444, 1908; and Baisch's *Reformen in der Therapie des engen Beckens* (Leipzig), 1907). But the pelvic measurements are not enough in themselves to decide whether induction should or should not be performed; one must take into account the size and state of ossification of the fœtal head, for if these be above the average even a conjugate of $3\frac{1}{2}$ inches may no longer be large enough to warrant the operation. It is also necessary to remember that the age of the fœtus cannot always be ascertained with certainty, and that even when it can be fixed it does not follow that all fœtuses of the same age are of the same size. Whilst various plans of antenatal mensuration of the fœtus and of its head-diameters have been tried, there seems now to be a consensus of opinion that Müller's method or its modification by Hirst or Munro Kerr (*Journ. Obstet. and Gynæc. Brit. Emp.*, iii. p. 341; iv. p. 293, 1903), by which the fœtal head is pressed down into the pelvic brim, and made to act as the pelvimeter, is the most satisfactory (Cooke, *Amer. Journ. Obstet.*, lv. p. 753, 1907). By means of Müller's grasp applied every other day or so the obstetrician will be able to choose the most suitable time for induction, for, of course, so long as the fœtal head can be pressed easily through the pelvic brim there is no immediate necessity for the induction of labour. Apart from this, however, it may be stated generally that there is little hope of saving the infant if labour be induced before the thirty-fourth week (*i.e.* six weeks before the full term), and that the most hopeful date is the thirty-sixth week. The obstetrician who is considering induction of premature labour for pelvic contraction is ever on the horns of a dilemma; if he induces it before the thirty-fourth week in order to get a fœtus small enough to pass through the maternal canals, the infant will almost always fail to survive its birth, while if he waits till after the thirty-sixth week the child may be too large or have too well ossified a head to pass or be drawn alive through the pelvis. He must also act in accordance with an opinion founded upon three things, none of which can be accurately estimated, viz. the age of the pregnancy, the size of the internal pelvic diameters, and the size of the fœtal head (Morse, *Amer. Journ. Obstet.*, liv. p. 824, 1906). Yet, with all its difficulties and disadvantages, the induction of labour is a valuable method of dealing with pelvic contractions of moderate amount; it has a very low maternal mortality, it involves no such cutting as pubiotomy and

Cæsarean section necessitate, and if a lower fœtal and infantile mortality could be achieved it would soon become almost as popular as it is now neglected. Already there are signs of a lessened fœtal mortality (Scheffczyk, *Arch. f. Gynaek.*, lxxv. p. 633, 1905), a hopeful indication for the future.

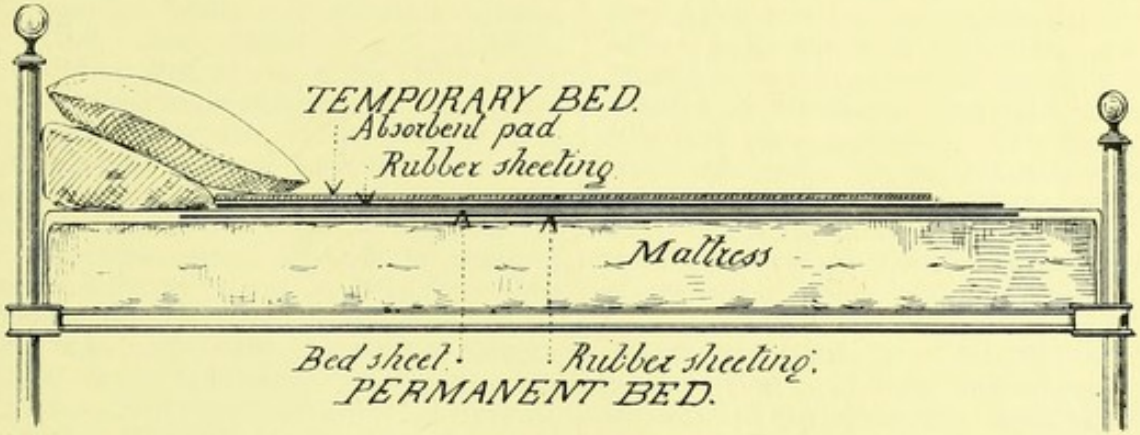
Many other indications for the induction of premature labour are commonly enumerated, such as nephritis, heart disease (valvular), blood diseases, chorea, hyperemesis, and hydramnios; but these stand on quite a different platform from that occupied by pelvic contractions. In most of the conditions named the primary question to be asked is whether the interruption of pregnancy is to be recommended in order to save the mother's life; if this be answered in the affirmative, then the age of the pregnancy will have to be taken into account, for it may be that the fœtus is not yet viable, and that consequently an induction of abortion, not of premature labour, will require to be practised. In a word, the life of the unborn infant is not relatively of such importance in this group of indications; we are operating not so much for the purpose of getting a woman a living child as for that of saving a woman's life without immediate reference to the existence of her fœtus. It is quite a different category of cases; and the question to be settled is, whether the disease from which the patient is suffering has so serious a prognosis, and depends to so large an extent upon the pregnancy itself, as to warrant the artificial terminating of the latter. The general trend of obstetric opinion and practice would seem to be greatly to limit the acceptance of these maladies of pregnancy as indications for the termination of gestation, and to encourage the treatment, by medical or surgical means, of the diseases themselves. Of course this conclusion presupposes the putting forth by the profession of a more determined and sustained effort to understand the etiology, pathogenesis, and nature of the maladies which are endangering the mother's life. The study of the pathology of pregnancy must be prosecuted if we are to prevent or cure the diseases peculiar to that state. At the present time, unhappily, the mother is too often allowed to come within sight of death, and then a consultation is asked for to determine whether induction of labour or abortion shall be practised or not; in many cases, especially, perhaps, in those of hyperemesis and chorea gravidarum, it is already too late to discuss the question, and the patient is doomed whether the operation be performed or not. Early recognition of the gravity of such maladies is necessary, and each case must be decided on its own merits. The ideal treatment, of course, will be the cure of the disease with continuance of the pregnancy, and the birth at a later date of a living infant. W. Bokelmann's article (*Samml. zw. Abh. aus d. Gebiet d. Frauenh. u. Geburtsh.*, vii., No. 6, 1907) indicates a strong tendency towards the limitation of the induction of labour or abortion as a means of treating the maladies which may complicate pregnancy; and Williamson (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 252, 1905; ix. p. 184, 1906), who has admirably summarised and digested recent literature, ends his contribution with the warning words that "in many of the conditions discussed it is only under exceptional circumstances that the premature termination of pregnancy is the necessary or proper treatment." It may be added that Schauta (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 318, 1909) regards the artificial induction of labour as an atypical method of treatment (both for contracted pelvis and for medical causes), and puts in its place Cæsarean section, hebosteotomy, or expectant treatment; he would restrict its use to cases "in which the mother is suffering from illness and Cæsarean section or hebosteotomy at the normal term would be too dangerous, or where it is positively known that the children are abnormally large, or the mother absolutely refuses an operation." This may be taken as the extreme German view.

We may now pass to the consideration of the methods of inducing premature labour. It may almost be stated that these resolve themselves into two alternatives—bougie or bag; and it may be added that most obstetricians precede the use of either by preparatory vaginal douching. But whilst this really summarises current opinion and practice fairly accurately, it is necessary to refer, in a few words, to two other plans. When Bossi's metallic dilator of the cervix was introduced into obstetrics, more especially for the rapid emptying of the uterus in eclampsia, it was not long before the suggestion was made that it might be equally well employed for the induction of premature labour in cases of narrow pelvis. Many obstetricians so employed it, and converted a labour lasting sometimes 3 or 4 days (when a bougie was used) into an operation of a few hours. This can hardly be called induction of labour, it is rather to be described as *accouchement forcé;* and it is generally conceded now that whatever may be the verdict upon the value of Bossi's dilator in other circumstances it is neither a suitable nor a safe means of inducing labour. It is well to bear in mind, as Hannes (*Münch. med. Wochensch.*, liv. p. 1974, 1907) pithily puts it, that while the labour should be artificially induced it ought not to be artificially completed. The other plan for the induction of labour to which reference must be made is tapping the membranes and drawing off the liquor amnii. This is an old method, and it has been carried out in two ways, either by puncturing the membranes with a sound passed through the cervical canal or by perforating them above the os

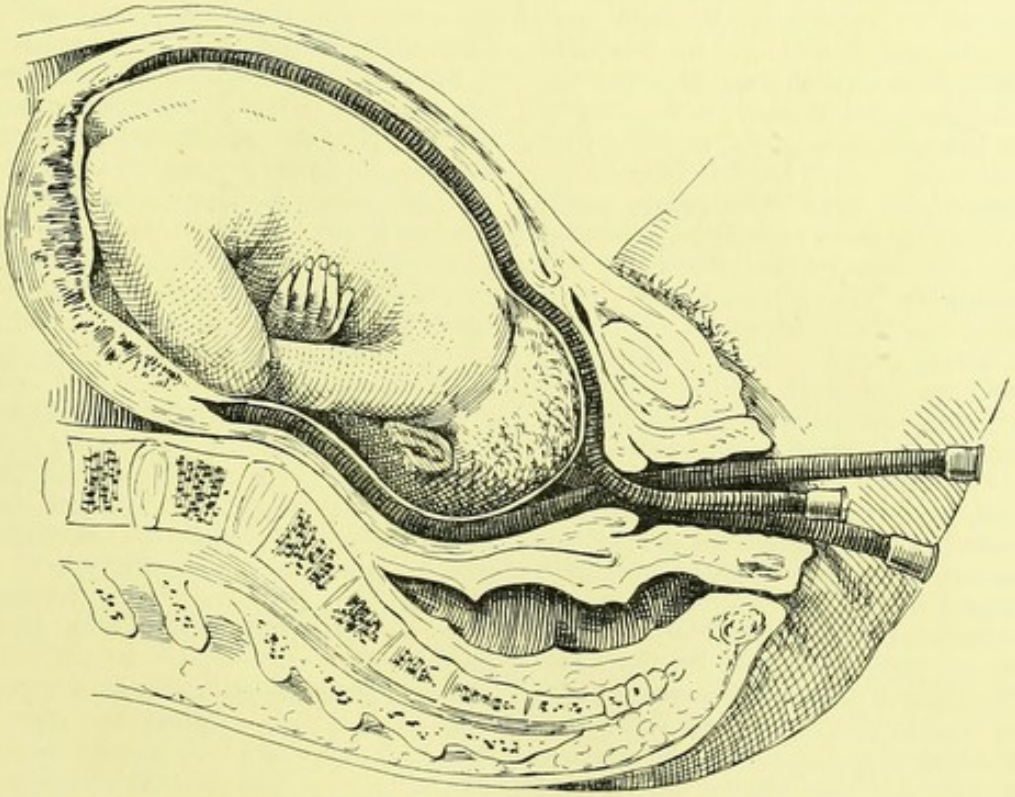
internum with a specially constructed instrument (never an easy procedure); but there was until lately a general consensus of opinion that its disadvantages were much greater than its advantages. The bag of waters, so important as a dilating agent, was lost; the labour was rendered "dry" by the escape of the waters (generally complete by reason of the inability of the presenting part to fit accurately into the brim of the pelvis); and the fœtal mortality was higher than with other methods. These disadvantages were held to do more than counterbalance the advantages that were alleged, viz. that the procedure was simple and easy (it was neither when the plan of perforating the membranes high up was tried), that it was certain to be followed by labour pains, that it was painless, and that no anæsthetic was needed. Most obstetricians, therefore, must have read with some surprise that Otto von Herff (*Münch. med. Wochensch.*, lv. p. 2595, 1908) employed rupture of the membranes and thought very highly of it, that Polano (*Münch. med. Wochensch.*, liii. p. 1852, 1906) thought it the most harmless and simplest method, although it might take some time to bring on pains, and that de Reynier (*Beitr. z. Geburtsh. u. Gynaek.*, ix. p. 97, 1904) strongly advocated it. Hannes (*Münch. med. Wochensch.*, liv. p. 1974, 1907), also, although he did not recommend it, did not apparently strongly disapprove of it; he thought it was unnecessary. Munro Kerr (*Operative Midwifery*, p. 446, 1908) took up a more orthodox position in simply ignoring puncture of the membranes; and we shall be surprised if Scheel's method (as it is sometimes called) is restored to favour once more.

In the meantime the method in common use in the maternity hospitals of this country would seem to be the insertion of a bougie between the membranes and the uterine wall. It has been termed Krause's method, but, as Moir (*Trans. Edin. Obstet. Soc.*, xxiii. pp. 15, 153, 1897-8) showed, it was being employed by Professor Hamilton at Edinburgh in the first quarter of the last century. Great care should be taken in sterilising the bougie (usually a large-sized rectal gum elastic one) by soaking it for twenty-four hours in a solution of perchloride of mercury (1 in 1000), and washing off the chemical in lysol solution just before use. Preliminary douching of the vagina should also be carried out for two or three days, and this itself is sometimes sufficient to bring on labour. The bougie is introduced either with or without an anæsthetic: in the former case it can be done with less risk of rupturing the membranes and with more hope of maintaining asepsis, but there is the risk that the sickness which may follow the chloroform will drive out the bougie or burst the membranes. If hæmorrhage come on during the introduction of the bougie (from separation of the placenta), it must be withdrawn and the cervix and vagina tightly packed with gauze. This accident twice happened to the writer and was rather alarming at the time; but packing stopped it, and in each case the labour followed promptly within twenty-four hours. The bougie, to be effectual, must be pushed well into the interior of the uterus; in fact, the outer end of it should be just within the vulva. It may be left *in situ* for forty-eight hours, and by that time labour pains are often in progress. It is here, however, that the disadvantage of the bougie method is often unhappily evident, for sometimes the uterus retracts very sluggishly to mechanical stimulation, and it becomes risky to leave the rod long inside the organ even when vaginal douches are being regularly given. For this reason, some obstetricians prefer the bag method, at any rate for multiparæ, as it is more certain to excite uterine contractions (*e.g.* Robecchi in Tibone's clinique, *Gior. d. r. Accad. di med. di Torino*, 4 s., ix. p. 806, 1903); but for primiparæ the bougie is still to be preferred. Perhaps the plan pursued by Munro Kerr (*Operative Midwifery*, p. 447, 1908) is the best; the bougie is introduced, and if, at the end of forty-eight hours, labour is not in progress, it is taken out and a dilating bag is put in. Even in a primipara this can usually be done, for the presence of the bougie has made the cervix dilatable.

The other favourite procedure for inducing premature labour is the hydrostatic dilating bag, such as Champetier de Ribes's or Barnes's or Müller's. Pomeroy's bag (*Trans. Amer. Gynec. Soc.*, xxxi. p. 127, 1906) is rather too complicated. The operation is then sometimes known as metreurysis or hystreurysis, the dilator being called a metreurynter. The bag is introduced in a collapsed state into the cervical canal. This may usually be done at once in a multipara; but in the case of a primipara preliminary dilatation is required, and hence many have abandoned the use of the hydrostatic dilator altogether in first labours. Champetier de Ribes's bag is generally allowed to be better than Barnes's, but it requires to be passed in by means of a special pair of forceps. When the bag is well in position in the cervix and lower uterine segment, its action may be assisted by making traction occasionally on it or by attaching to it by means of a string a weight which hangs over the end of the bed (Robecchi, *loc. cit.*). It is well to test beforehand how much fluid is needed to distend the bag, else it may burst *in utero*, always an awkward accident. Labour usually comes on in about fifteen or eighteen hours; and it is good practice to allow the natural efforts to expel the bag, thus thoroughly preparing the canals for the passage of the infant. The greatest inconvenience caused by the bag is its tendency



Arrangement of the temporary bed for labour and permanent bed after labour.



Induction of premature labour by Krause's method by the introduction of bougies.

to displace the presenting part. On the whole it would appear that the hydrostatic bag is more often used by Continental obstetricians (Burger, *Arch. f. Gynaek.*, lxxvii. p. 485, 1905-6; Plauchu, *Lyon méd.*, cviii. p. 144, 1907), and the bougie by British and American authorities (Hirst, *Amer. Med.*, ix. p. 723, 1905). Jardine (*Brit. Med. Journ.*, ii. for 1907, p. 427), however, seems to prefer the bag. Humphrey Davy (*Brit. Med. Journ.*, ii. for 1906, p. 302) would combine the two methods, introducing first the bougie, and, if this be insufficient, inserting some hours later a Barnes bag into the vagina. Some years ago the injection of glycerine into the uterus, or Pelzer's method of inducing labour, was given a somewhat extensive trial, both in this country and abroad; it is now very little heard of, but it is interesting to note that Scheffczyk (*Arch. f. Gynaek.*, lxxv. p. 633, 1905) uses a sheep's bladder filled with glycerine to set up labour pains, thus combining the oxytocic action of the latter with the mechanical effect of the former. It must, however, be somewhat difficult to be sure that Scheffczyk's "glycerine-bag" is aseptic. At any rate the glycerine method is contra-indicated in cases of nephritis.

Other methods of inducing labour, *e.g.* by plugging the vagina, by tents, by electricity, might be referred to; but they are little used, and an estimate of their value may be found in Williamson's summary (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. pp. 250, 271, 1905). Possibly, in time to come, a chemical excitant of labour, perhaps a placental extract or hormone, which shall be free from the dangerous effects of ergot, may be discovered; theoretically it would seem that uterine action thus set up would be both effective and safe; but no such tocophoric agent is at present known.

Labour, Management of.

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Since the beginning of the twentieth century there is hardly a detail in the management of an ordinary labour that has not been criticised, and, in some cases, altered. The midwifery bag, the midwifery bed, the mother's and the infant's binder, the obstetric douche, the cleansing of the obstetrician's hands, the support of the perineum, the vaginal examination, and the technique of the umbilical cord have all been called in question, with the result that, on the whole, labour is now conducted with greater safety because on more nearly aseptic principles than previously. Asepsis is now placed first in the management of a midwifery case, and it is only when, for some reason or other, asepsis is found to be impossible of attainment that the obstetrician falls back upon antisepsis. This means, *inter alia*, that routine vaginal douching with antiseptic lotions in labour and the puerperium has been abandoned, and that reliance is placed upon the thorough cleansing and keeping clean of the vulva and neighbouring parts during the confinement, upon the sterilisation of all instruments which are brought within the genital sphere, and upon the special care of the hands of the obstetrician and midwife (by prolonged scrubbing, washing in antiseptic lotions, wearing of indiarubber gloves, etc.).

With regard, in the first place, to the *obstetrical armamentarium*, various plans were soon suggested for improving the midwifery bag in order to prevent the risk of infection being carried from one case to another in its interstices or on its contents. Its lining was made washable and removable, the bag itself was made large enough to contain a metal steriliser, or a modified bag was constructed consisting in part of a sterilising chamber (see Higgins, *Boston Med. and Surg. Journ.*, cxlii. p. 88, 1900; Lipes, *Ann. Gynec. and Pediat.*, xiv. p. 912, 1900-1901). But none of these plans commended itself very readily to the profession, and it was not till the beginning of the twentieth century that the attempt was made to replace the bag by something that should be a steriliser first and a bag only in a secondary sense. Edgar, in his *Practice of Obstetrics*, p. 502, 1903, cut the Gordian knot of difficulty by making the obstetric bag consist of two metal trays with a leather cover of a portmanteau shape fitting over them both. The trays were of sheet-iron enamelled in white; one of them was shallower than the other but slightly longer and broader, and in it the deeper but shorter and narrower tray rested when ready for transportation; and while one of them contained the bottles and other glass-ware, the other held the obstetrician's operating-coat, douche, dressings, and instruments. The principle upon which Edgar proceeded was sound: the bag was simple and had no complicated fittings, it was sterilisable by boiling in all its parts (save the cover), it consisted of trays in which the various instruments might be sterilised, and it had a sufficient resemblance outwardly to the ordinary bag so as not to suggest a novelty. J. W. Ballantyne (*Brit. Med. Journ.*, i. for 1904, p. 1303) modified Edgar's bag, making it lighter, smaller, and cheaper, and giving it a washable canvas cover.

He proposed further that it should be called an *obstetric satchel*, and that name reserved for any form of metal steriliser contained within a washable or leather cover; the words "midwifery bag" might be given to an ordinary bag of leather closing with a lock or clasp. Ballantyne still further reduced the size of his satchel, and had it made of aluminium for the sake of lightness (*Trans. Edin. Obstet. Soc.*, xxix. p. 194, 1904; xxx. p. 173, 1905). He thought it was to be preferred to the appliances suggested by Veit (*Zentralb. f. Gynäk.*, xvi. p. 440, 1892), by von Herff (*ibid.*, xix. p. 1033, 1895), by Fehling (*ibid.*, xix. p. 1062, 1895), by Albers-Schönberg (*ibid.*, xix. p. 1361, 1895), and by de Seigneux (*ibid.*, xxvii. p. 1240, 1903). Certainly there seems to be a growing practice in the profession of sterilising instruments and the like before attending upon a confinement case, of taking the armamentarium wrapped up in clean towels to the patient's house in a steriliser of some sort, and of re-sterilising at the case such implements (*e.g.* forceps) as may be required. It is more than likely that modifications in the construction and mode of preparation ("guarding") of the *labour bed* in private as well as in hospital practice will be introduced. In the maternity hospital the labour bed is now practically an operating-table in the later stages of the confinement; but in ordinary practice the obstetrician delivers his patient on her own bed prepared in various ways (with mackintosh sheeting, wood-wool pads, draw sheet, etc.) for the event. The labour bed (Gebärbett), which has been introduced by Miklaschewsky (*Zentralb. f. Gynäk.*, xxxi. p. 504, 1907), can, it is true, be easily converted into an operating-table; it makes the thorough cleansing and irrigation of the genital organs much easier; it allows the patient to be quickly put into Walcher's position or into Trendelenburg's; and it lessens the number of assistants necessary in complicated and instrumental cases. Nevertheless, labour beds of this type can hardly be looked for in private practice, and the general practitioner will have to content himself with the ordinary bed, protected as far as possible by means of waterproof sheeting and kept clean with antiseptic pads and sterilised towels. Wooden blocks, with small depressions in their upper surfaces, may be used for raising the lower or upper end of the bed as circumstances may demand.

Another question in connection with the management of labour which has arisen during the past few years is the protection of the hands of the obstetrician with *rubber gloves* and of his face with *a mask*. Many articles dealing with this matter have appeared, among which may be named Schumacher's paper (*Arch. f. Gynaek.*, lxviii. p. 399, 1903) and Maguire's (*Detroit Med. Journ.*, iv. p. 198, 1904-5), as well as numerous short references in the *Zentralblatt für Gynäkologie* (*e.g.* xxxi. pp. 12, 251, 757, 872, 885, 1302, etc.). It may at once be stated that the *face mask* is not in use for ordinary confinements, and is not likely to be employed save for Cæsarean sections and the like. With regard to *rubber gloves*, there is a considerable difference of opinion, and, of course, circumstances alter cases. Certainly, if a medical practitioner be called to a midwifery case after dealing with any septic wound or any condition suspected to be septic, he will be well advised to wear rubber gloves which have been freshly sterilised; if, in addition, he find it necessary to pass a hand into the cavity of the uterus during the confinement, the putting on of the gloves will be clearly indicated (Wormser, *Deutsche med. Wochensch.*, xxx. p. 1645, 1904). At the same time, he will not be released from the necessity of cleansing his hands as thoroughly as he would have done if he had not been about to employ gloves. It must ever be borne in mind that rubber gloves do not replace handwashing and disinfection; they are an additional safeguard, not an alternative measure of precaution. It will probably be found from experience that if a medical man is careful to put on gloves in dealing with doubtful cases in his general practice, he may with safety use his bare hands in his midwifery work; he will find it easier to proceed in this way rather than attempt to work in gloves in all his confinement cases, many of them extending in time over some hours and necessitating frequent sterilising of the gloves. But, if he have on occasion to remove the placenta manually or to make any such intra-uterine manipulation, he may for additional security put on the rubber glove. There is one disadvantage in so doing, the difficulty which exists in grasping the leg of the child in version, and in removing pieces of retained or adherent membrane, and Munro Kerr (*Operative Midwifery*, p. 310, 1908) has had under such circumstances to remove the gloves before he could accomplish his purpose. There is, however, another standpoint from which this question may be looked at: if the medical man know or suspect that his parturient patient is suffering from sepsis, gonorrhœa, or syphilis, he will find it necessary to protect himself and his other patients by covering his hands during any manipulations which may become necessary. To sum up: the medical man ought to carry a pair of rubber gloves in his obstetric satchel for use in exceptional cases and under special circumstances.

The question of prophylactic *vaginal douching* in ordinary midwifery practice remains very much where it was when the fifth volume of the *Encycl. and Dict. of Med.* was published. See V., p. 191. *Routine* douching before, during, or after labour is probably not practised anywhere now; but vaginal douching with lysol or with

one of the mercuric salts, when there are indications that the mucous membrane of the canal is in an unhealthy state (free purulent discharge), when an operation of greater magnitude than forceps application at the outlet is to be employed, or has been employed, and when the placenta or membranes have had to be removed with the hand thrust deeply into the utero-vaginal canal, is regarded by many obstetricians as not only permissible but desirable. The abolition of routine preliminary douching is largely due to the result of such carefully conducted comparative methods of investigation as were instituted by K. Baisch (*Arch. f. Gynaek.*, lxxix. p. 325, 1906); from these observations it emerged that rises of temperature were more common in douched than in undouched patients, even when rubber gloves had been employed in giving the douches, and even after careful vulvar cleansing had been carried out. One is led to the conclusion that prophylactic douching in normal cases is harmful even when gloves are worn and the vulvar toilette is not omitted, and that, therefore, it is still more dangerous when these precautions are not taken. In the exceptional circumstances, above referred to, the douche, however, may, in the opinion of many, be wisely employed, not, of course, without the other precautions (careful handwashing and vulvar cleansing). The vaginal and intra-uterine hot douche (temperature 118° F.) is also of considerable value in the checking of post-partum hæmorrhage. Vulvar cleansing is now regarded as the important thing; but it is unnecessary to shave the hair, although it may be well to clip it short if it be very long (Herman, *Brit. Med. Journ.*, i. for 1906, p. 1516). The *cleansing of the obstetrician's hands*, all are agreed, must be carefully and repeatedly carried out during the progress of a confinement case. It is now admitted that it is impossible to *sterilise* the hands, but thorough cleansing of them gives a degree of security which is very nearly complete, and it is matter for congratulation that this thorough cleansing can be carried out without elaborate apparatus. With hot water, soap, and a clean nail-brush much can be accomplished, if the obstetrician will only give time enough to the scrubbing of the hands and nails, if he will rinse frequently and use running water, and if he will repeat these cleansing operations each time that he examines his patient. A midwifery case differs from even a prolonged surgical operation in the fact that there are times during its progress when, of necessity, the hands of the obstetrician must, by touching unsterilised things, become technically unclean again. It is also to be borne in mind that, as the labour lengthens, and as the amount of interference required increases, the attendant ought to increase the care he bestows on the disinfection of his hands; too often, unfortunately, the very opposite plan is pursued, and with continued delay, and more particularly with rapidly arising danger, precautionary cleansing is apt to be perfunctorily performed, or omitted altogether. Perhaps the most important modification in the actual technique of hand-washing which has been introduced of recent years, is the employment of alcohol for the removal of fatty matter as well as for its antiseptic and skin-hardening action (Tjaden, *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxviii. p. 351, 1898; von Herff, *Münch. med. Wochensch.*, lii. pp. 1132, 1203, 1905; etc.). Many now cleanse the hands by first washing thoroughly with hot water and soap, using the nail-brush persistently, and changing the water frequently; the hands are then rubbed with turpentine and washed in methylated spirit; finally they are soaked in, and washed with, a solution of perchloride of or biniodide of mercury. It is useful to dip the hands in a solution of lysol just before they are introduced into the patient's vagina, for the lysol, by its oily character, aids their passage and does away with the necessity for the use of such unguents as vaseline (which, in the past, were often a source of danger rather than a means of security).

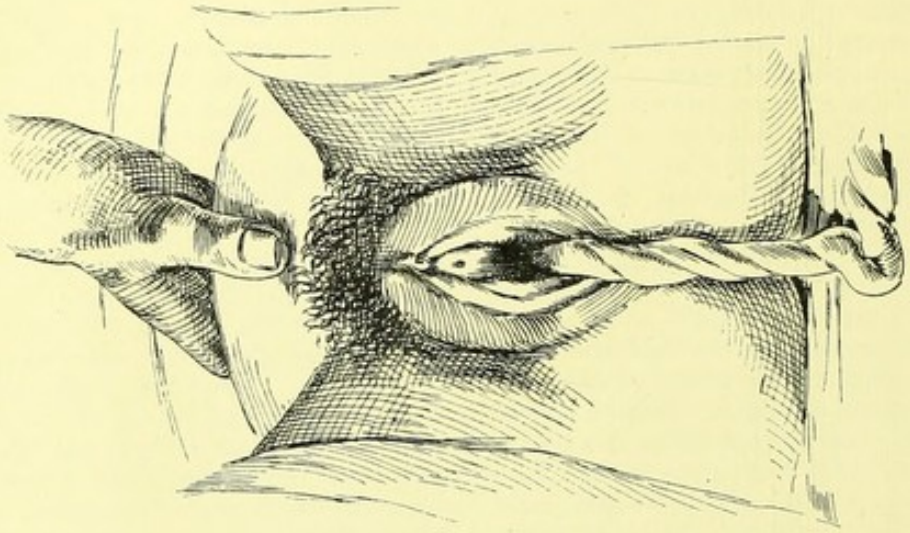
Since (in 1847) Sir James Young Simpson introduced *anæsthesia* into the management of labour, normal and abnormal, using, first, ether, and, later, chloroform, more than sixty-four years have passed away. After the first prolonged and stormy opposition to the use of anæsthetics in labour had been met, there followed a period of calm acquiescence in the practice on the part of the profession, and it is only within the past few years that the routine employment of chloroform has been challenged anew. A good deal of what has been written regarding the danger of this anæsthetic in midwifery practice has been founded on experience gained in surgical practice, but, as has been pointed out many times, surgical and obstetrical anæsthesia can hardly be fairly compared. Careful scrutiny of statistics and of the views of obstetricians shows that chloroform in midwifery practice is singularly free from risks, and while this immunity from danger has been variously explained as due to the elimination of emotion, the absence of the fear of operative consequences, the presence of acute pain, etc., the true explanation would seem to be the threefold one given by Alex. Ballantyne (*Trans. Edin. Obstet. Soc.*, xxii. p. 13, 1896-7). According to this obstetrician the increase of vascular tension in pregnancy, the increase in the total mass of blood in the system, and the eccentric hypertrophy of the heart, all tend to meet and overcome the dangers of chloroform anæsthesia, these dangers being chiefly paralysis of the vasomotor and respiratory centres and of the cardiac ganglia. Chloroform, in pregnancy, is acting upon a system specially prepared to resist its dangerous effects and to utilise its

pain-assuaging ones to the full. "During a pain the rapid action of chloroform is quickly recovered from by the forced expiration, and the nerve-centres, temporarily stimulated by the increased respiration, resist the effect of the depressing agent, while the general high blood-pressure furnishes a reserve power of resistance against any untoward effect or excessive amount of the anæsthetic." Perhaps, also, the dilatation of the vagina and external parts in labour acts as a constantly recurring stimulus to the respiratory centre. Chloroform, then, is remarkably suited to produce either the incomplete anæsthesia called for in natural labours to relieve the patient's sufferings, or the more complete anæsthesia required for the performance of such obstetric operations as version or symphysiotomy. For the first object it is given towards the close of the second stage and intermittently; the towel or mask is brought near to the face with the advent of each pain, and removed in the interval; but when the infant's head is actually distending the perineum and passing over it, the administration of the anæsthetic may be more nearly continuous. When it is given for the second purpose—the induction of full anæsthesia—the same precautions should be taken, and the same plans followed as in surgery, although even here the "obstetrical immunity" to danger can be observed. The good effects of chloroform in obstetric cases complicated by heart disease have been noted by many observers; but it ought to be remembered that the third stage of labour does not continue to enjoy the immunity from danger which is present in the first and second stages, and this remark applies not only to labours complicated with heart disease, but also to those which are natural. The chloroform towel or mask should be removed from the patient's face, and, indeed, from her vicinity altogether, after the birth of the child's head.

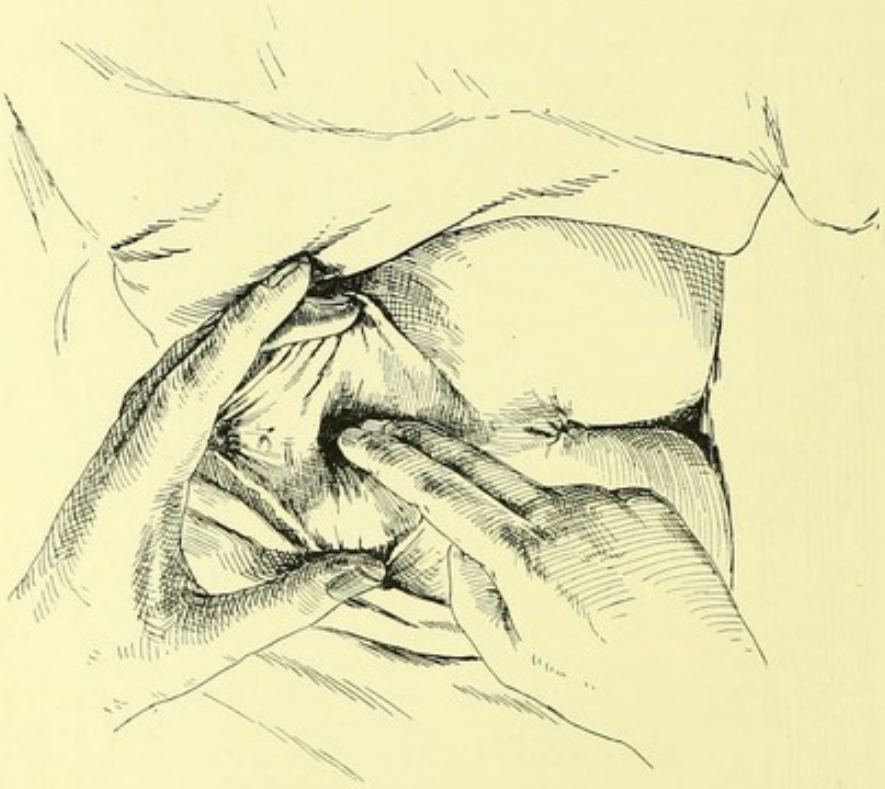
Whilst the foregoing are the views which are generally held regarding the use of chloroform in midwifery practice, no review of recent literature would be complete without a reference to the statements which have been made regarding the necessity for anæsthesia in labour. J. Veit (*Therap. Monatsh.*, xxii. p. 609, 1908) goes back to the arguments and standpoint of sixty years ago, and maintains that labour is a normal function and should be conducted without recourse to an anæsthetic, save in the case of neurasthenic women attended by a neurasthenic physician. This is obviously an extreme view, and it is one which Veit's fellow-countrymen apparently do not share in; Prof. von Krönig, for instance (*Brit. Med. Journ.*, ii. for 1908, p. 805), recognises the necessity of diminishing labour pains, especially in the case of sensitive and nervously-disposed women, and points out that, besides conferring a benefit upon the women in so doing, we remove factors which might have an injurious effect. Newell (*Surg., Gynec., and Obstet.*, iii. p. 126, 1906) goes further, and would allow the patient an anæsthetic even in the first stage of labour, believing that the sufferings of the lying-in woman deserve relief even before the cervix is fully dilated. It may, at any rate, be regarded as generally admitted that the pains even of a natural labour are so severe as to call for some assuagement.

But all obstetricians are not agreed that this alleviation of pain can be best or most safely obtained by the inhalation of chloroform. For a time it seemed as if *spinal anæsthesia* might succeed in establishing itself as a means of abrogating suffering in confinement cases. At first a sterilised 2 per cent. solution of cocaine was used, and from 1 to 2 grammes were injected into the spinal cavity by means of a needle introduced between the third and fourth lumbar vertebræ, about half an inch to one side of the middle line; then other drugs began to be employed, such as eucaine, novocaine, and stovaine; but the method, whatever agent be used, has its inconveniences (such as the throwing out of action of the secondary powers of labour), and its employment has been accompanied by dangerous and even by fatal results. (See Lea's review of the subject in the *Journ. Obstet. and Gynæc. Brit. Emp.*, i. p. 83, 1902; Martin's views are given in the *Münch. med. Wochensch.*, li. p. 1817, 1904; A. Falkner, in the *Zentralb. f. Gynäk.*, xxxi. p. 65, 1907, gives an account of evil after-effects; see also Krönig and Gauss in the *Münch. med. Wochensch.*, liv. pp. 1969, 2040, 1907.)

Ether continues to be used in midwifery practice in several parts of the world, notably in the United States of America. It was the agent which Sir James Simpson employed when, in January 1847, he introduced anæsthesia into obstetric practice; but later in the same year he abandoned ether for chloroform, finding that the latter was more portable, potent, and pleasant, and less irritating to the air-passages. On the other hand, chloroform is more dangerous than ether in *surgical* practice, and it has been argued that it will necessarily be so in midwifery likewise; and this consideration has, no doubt, influenced obstetric practice in the United States, in Ireland, and in England. Jewett (in Norris and Dickinson's *Obstetrics*, i. p. 413, 1902) thinks that the use of ether for partial anæsthesia is growing in America, and advises that it be always employed for complete anæsthesia. On the other hand, the writer of an editorial in *American Medicine* (June 1903) states that the safety of chloroform in midwifery is now conceded, and that most obstetricians prefer chloroform in obstetric operations. Whitridge Williams (*Obstetrics*, p. 321, 1908), also, favours chloroform as compared with ether, and regards "religious objections" on the part



Credi's method of placental expression.



Vaginal examination during labour.

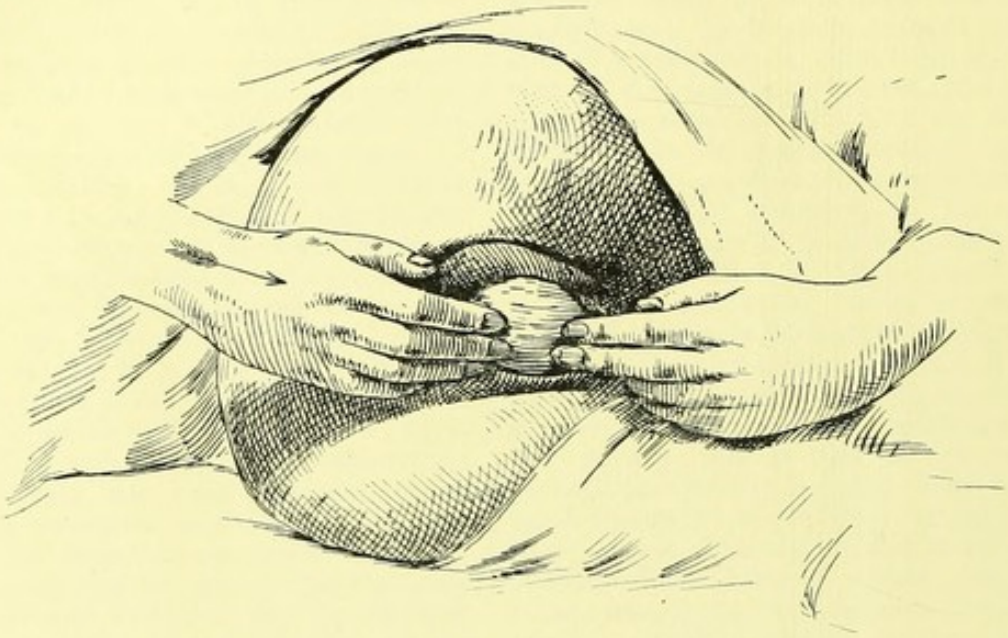
of the patient as almost its only contra-indication. It may be said, in passing, that Baldy (*Trans. Amer. Gynec. Soc.*, xxxiii. p. 6, 1908) paints rather a gloomy picture of the giving of anæsthetics in America (apparently referring to ether), and suggests that, in order to get over the difficulty of attracting skilled anæsthetists, women should be employed at smaller salaries. *Ethyl chloride* has been used as an anæsthetic during labour when deep anæsthesia by ether or chloroform was not called for. Lepage and Le Lorier (*Ann. de la Policlin. de Paris*, xiii. p. 160, 1903) have recommended it on account of the ease of administration, the rapidity with which anæsthesia is produced, the rapid recovery, and the freedom from unpleasant after-effects ; it is said to be specially useful for short manipulations, such as forceps, internal version, removal of placenta or membranes, and suturing the perineum. Anæsthesia may be begun with ethyl chloride and continued with chloroform, if necessary (Müller, *Deutsche med. Presse*, ix. p. 76, etc., 1905). But, again, ethyl chloride is not without inconveniences and dangers (*e.g.* spasm of the masseter muscles), and its administration has been the cause of death (*vide* Luke's article, *Internat. Clinics*, S. 15, vol. iii. p. 214, 1905).

Within the past few years, however, a still more formidable competitor has sprung up among the anæsthetics which may be used in midwifery practice. This is scopolamine (or hyoscine) given hypodermically in combination with morphine in order to produce semi-narcosis or drowsiness (Dämmerschlaf of the Germans) during labour. It was introduced by Steinbüchel into obstetrics. As practised by Gauss (*Arch. f. Gynaek.*, lxxviii. p. 579, 1906 ; *Münch. med. Wochensch.*, liv. p. 157, 1907 ; *Zentralb. f. Gynäk.*, xxxi. p. 33, 1907) the method consists in the injection of about $\frac{1}{130}$ gr. of hyoscine hydrobromate and $\frac{1}{6}$ gr. of muriate of morphine ; the anæsthetic effect is fully evident in an hour, or in three hours at the latest ; thereafter a second injection (with a smaller dose of morphine) may be given, and, if the labour be prolonged, still more medication with half doses may (according to Gauss) be carried out. The first dose is given when the pains begin to be distressing, and it is claimed that the method is safe for mother and fœtus, that it does not affect the strength of the uterine contractions, and that it sufficiently relieves the pain of labour and prevents unpleasant memories of suffering. These are the opinions, founded upon 1000 cases, advanced by Gauss, and they are supported by Preller from a smaller experience (*Münch. med. Wochensch.*, liv. p. 161, 1907), by Newell (*Surg., Gynec., and Obstet.*, v. p. 153, 1907), and by Lehmann (*Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 297, 1906), although the last-named author mentions the deleterious effect of the drug upon the fœtus. On the other hand, there is evidence that the scopolamine-morphine method is not without its disadvantages and risks. Steffen (*Arch. f. Gynaek.*, lxxxi. p. 451, 1907), Hocheisen (*Zeitsch. f. Geburtsh. u. Gynäk.*, lix. p. 131, 1907 ; *Münch. med. Wochensch.*, liv. p. 529, 1907), and Bertino (*Ginecologia*, 31st Oct. 1907) have all written strongly on this aspect of the subject. Steffen, for instance, found that the uterine contractions were weaker in 38·3 per cent. and stopped altogether in 5 per cent. ; Hocheisen noted weakening in 33 per cent. and arrest in 3 per cent ; the former observer stated further that the pain accompanying the contraction was unchanged in 18·6 per cent., and both he and Hocheisen found some inconvenience from the fact that the patients were unable voluntarily to control the contraction of the abdominal muscles at critical periods (*e.g.* when the head was crossing the perineum). Bertino, as well as Steffen and Hocheisen, noted that several of the infants at birth showed symptoms due to the hyoscine and morphine ; Bass, also, reported unfavourably in respect to the state of the fœtus (*Münch. med. Wochensch.*, liv. p. 519, 1907). Gauss himself allowed that 18·1 per cent. of the children were affected with what he termed oligopnœa, and Holzback (*Münch. med. Wochensch.*, liv. p. 1228, 1907) has proved that this condition, when it persisted after birth, might in part be due to hyoscine passing from the mother's system by the milk to the child. Then, again, it has been stated that the hyoscine causes excitement and even delirium, that atonic uterine hæmorrhage may follow, and that the circulation may be dangerously affected, although it must be added, in respect to the last-named inconvenience, that Gauss used the method with good results in twenty-three cases with marked heart disease. It may be stated here that the drugs require to be pure and invariable, that the solutions must be made with distilled water and sterilised, and that they should be kept in the dark. That the scopolamine-morphine method has not completely answered expectations is shown by the fact that Professor Krönig (whose assistant is Dr. Gauss) recommends the inhalation of ethyl chloride as the child's head is passing over the perineum, and the administration of a small dose of veronal to quiet the nervous system at the opening stage of labour (*Brit. Med. Journ.*, ii. for 1908, p. 807). Some of those who have used the scopolamine-morphine method emphasise the need for close watching of the patient while she is under the influence of the drugs, and would therefore restrict its use to hospitals ; others, such as R. C. Buist (*Brit. Med. Journ.*, ii. for 1908, pp. 809, 1044), find attractions, for private practice, "in method which relieves the patient's sufferings while it allows labour to progress regularly, and which does not require the con-

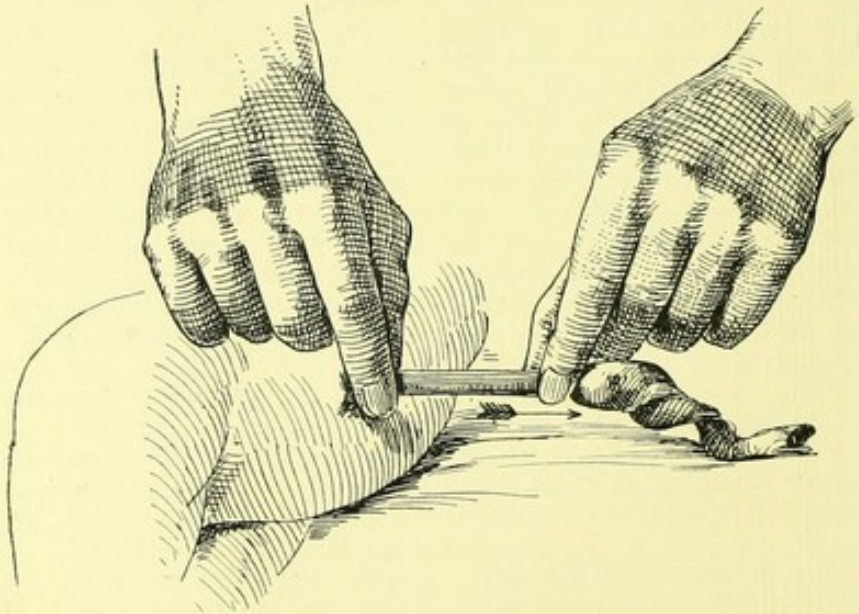
stant personal presence of the medical practitioner as the obstetric anæsthesia with chloroform does." Whilst it cannot be said that the scopolamine-morphine method has established itself with any degree of security in obstetric practice either in Germany, America, or in this country, neither has it, as yet, been shown to be so unsuitable or so dangerous for mother or fœtus as to forbid further experiment being made with it, both in hospital or private practice. One has a feeling that it will probably give way, as so many other new plans have done, to chloroform inhalation; but it is only fair that it should have a prolonged trial. It may be true that chloroform inhalation weakens the pains of labour and lengthens the intervals, although there is evidence against as well as for this statement (*vide* M'Kerron's summary in the *Edin. Med. Journ.*, N. S., ii. p. 581, 1909), and so delays the birth of the child; it may be, also, that there is an increased tendency to third-stage bleeding and post-partum hæmorrhage when chloroform has been employed (more especially if complete anæsthesia has been required); but these inconveniences can all be minimised by giving the chloroform with care and in accordance with the rules for obstetric anæsthesia, and the general practitioner will doubtless continue so to use it until some other drug or some other method has established a much stronger claim upon him than either spinal anæsthesia or the scopolamine-morphine plan has yet done.

When so many long-established methods of managing confinement cases are being attacked, it is little wonder that the *obstetric binder* (maternal and infantile) has come under censure. Of course, the wearing of a binder after labour is a national rather than a universal custom, being, for instance, common in Great Britain and America, and uncommon in Germany; but within the past few years it has been much discussed, even in the last-named country, and Bröse (*Berl. klin. Wochensch.*, xliii. p. 1339, 1906) now argues for its general adoption there, and Semmelink (*Zentralb. f. Gynäk.*, xxix. p. 1595, 1905) describes a new model. On the other hand, it has been criticised in America, and Whitridge Williams (*Obstetrics*, p. 341, 1908) has probably voiced the extreme view when he writes: "I am not in favour of its employment, and do not believe that it serves any of the purposes for which it is recommended. On the other hand, I am of the opinion that it occasionally gives rise to retroversion or retroflexion of the enlarged and soft uterus, especially if it be applied sufficiently snugly to exert compression. . . . Nor can I find any evidence of its value in restoring the figure, which will gradually return without its use, provided the tonicity of the abdominal muscles be retained." In conclusion, Williams thinks it can do no harm after the tenth day, and that "it is perhaps as well to permit its use by those patients who feel strongly that it will aid in restoring the figure, for if it be forbidden the physician will probably be blamed in case a shapeless figure follows." Edgar (*Obstetrics*, p. 730, 1903), however, names its advantages and urges its employment: "It tends to prevent atony and lack of contraction in the uterus, splanchnoptosis of the abdominal viscera, and obviates the danger of sudden filling of the abdominal veins due to the greatly lessened abdominal pressure after confinement; the binder, when properly applied, conduces to the patient's comfort, especially by permitting her to assume the lateral position." With regard to the material of which the binder is made, unbleached muslin is preferred by Edgar, and a sort of crape, very elastic, porous, and airy, by Bröse (*loc. cit.*). It cannot be admitted that a convincing case has been made out against the routine use of the binder, although, perhaps, the patient and nurse may expect too much benefit to accrue from its employment; there can be little doubt that it adds to the comfort of the lying-in woman, and, for this cause alone, it may well be continued, unless it can be definitely proven to do harm. In addition to its routine use immediately after labour and in the puerperium the obstetric binder may occasionally be employed during the course of labour; it has been found to be valuable in maintaining the fœtus in its corrected presentation and position after version has been performed, and in some cases of accidental hæmorrhage with or without vaginal plugging. The *infant's binder* has also been objected to as unnecessary, or dangerous, or both. Waring (*Brit. Med. Journ.*, i. for 1908, p. 1410), for instance, states that the only possible justification for its use is its protection of the ligatured cord, and he names the following evils which he thinks may be ascribed to its employment, viz. discomfort, vomiting, inguinal and umbilical hernia, prolapsus ani, thoracic deformities, and overlaying. It is possible, indeed probable, that when the infant's binder is tightly applied, some of these evil results may follow; but there seems to be a general consensus of opinion that, if properly applied and fixed by means of a few stitches down the back, it keeps the cord in position and free from injury, and so serves a useful purpose.

The ordinary *treatment of the umbilical cord* of the infant is another detail in the management of labour which has passed under criticism during the past few years. As long ago as 1899 Dickinson (*Trans. Amer. Gynec. Soc.* for 1899) asked the question, "Is the sloughing process at the child's navel consistent with asepsis in child-bed?" and of course there could be no possible answer save one in the negative.



Perineal protection. Retarding expulsion of head with left hand and directing it with right hand.



Stripping the umbilical cord so as to remove the excess of Wharton's jelly.

The question had only to be formulated in order to be answered. The ordinary method of treating the cord by tying it at two places and dividing it, and then allowing the stump of it which was left attached to the infant's umbilicus to slough off in five or six days, cannot be called a germ-free plan, even if antiseptic lotions and dressings be carefully employed as well. With such a mode of management there is the risk, when the cord-stump separates (or sooner), of microbic infection invading the child's body by the way of the umbilical vessels, more especially if these vessels are long in closing, as there is reason to believe is the case in premature infants (Audion, *Bull. et mém. Soc. anat. de Paris*, S. 6, ii. pp. 241, 291, 1900; J. W. Ballantyne, *Physician and Surgeon*, i. p. 988, 1900; Keller, *Zeitsch. f. Geburtsh. u. Gynäk.*, lviii. p. 454, 1906). Various plans have consequently been suggested in order to obviate the risks attendant upon funic separation by sloughing. Ligation of the cord closer to the abdomen than the point usually selected has been tried (Martin) with red-hot scissors as the cutting agent; Duke (*Brit. Med. Journ.*, i. for 1903, p. 615) clamped the stump and so reduced the portion of dead funic tissue adhering to the abdominal wall to a minimum; Gelli (*Boll. d. Soc. Toscana di ostet. e ginec.*, i. p. 13, 1902) used a simple clamp, shaped something like a safety-pin; Bacon (*Journ. Amer. Med. Assoc.*, xxxviii. p. 1071, 1902) cut the Whartonian jelly at the base of the cord and tied the vessels with fine silk or catgut; and even angiotripsy has been recommended. J. W. Ballantyne (*Brit. Med. Journ.*, i. for 1909, p. 944) tested six different methods in his hospital practice, *e.g.* tying the vessels separately, stripping back the sheath of the cord and ligaturing the rest of the cord *en masse* or the vessels in detail, stripping off the sheath and transfixing the contents and ligaturing them in two portions, etc.; but in the end he was led to prefer cutting off the cord flush with the skin of the umbilicus, tying the vessels individually, rawing the skin margins, and bringing them together. By the method last named he was able to get healed stumps with some signs of retraction at the fourth day. A somewhat similar procedure was found by Dickinson (*loc. cit.*) to give the best results also. No doubt the ideal plan is the complete removal at once of any funic tissue which is destined to die, and the closure of the wound by surgical methods; but, while such a plan may be carried out with advantage in Maternity Hospitals, it would be difficult to apply it in private practice. Under the latter circumstances the method of ligation with the subsequent application of moist or dry antiseptic dressings to the stump will still maintain its place; but it may be found to be good practice to compress the stump before tying it, so as to squeeze out as much of the Whartonian jelly as possible. It may be added that Ahlfeld (*Deutsche klin. Wochensch.*, xxxiv. p. 225, 1908) advises tying the cord for the first time about four inches from the umbilical ring, and then in about an hour and a half religaturing it as close as possible to the body of the child; the infant gets his bath between the two tyings.

It is not clear that any great change has been made during the past quinquennial period in the method of "*supporting*" or "*protecting*" *the perineum* during the passage of the child's head. It is now generally recognised, on the one hand, that meddlesome interference is not always the cause of perineal laceration; and, on the other hand, it is conceded that the most perfect method of support or protection will sometimes fail to preserve the structural integrity of the part. It would seem to be most desirable that the occipital end of the head as far as the nape of the neck should be born under the pubic arch before extension of the head be allowed to take place, for in this way the small sub-occipito-bregmatic diameter passes through the vulvar ring; it is also advisable that time be allowed (while the head "swings") for the dilatation of the perineum. The passage of the head over the perineum, like the third stage of labour, is a process rather than an act, and requires time for its due performance. Various plans may be adopted in order to prevent the premature undoing of flexion and to bring about the birth of the occiput before the forehead is allowed to swing over the perineum (see Apfelstedt, *Berl. klin. Wochensch.*, xliii. p. 1536, 1906; Toff, *Münch. med. Wochensch.*, liv. p. 525, 1907; Ahlfeld, *Deutsche med. Wochensch.*, xxxiii. p. 2121, 1907); but the principle is the same, and the method which involves as little handling of the parts as possible is no doubt the safest if not actually the best. Both the left lateral and the dorsal position of the patient have their advocates; there is a difference of opinion also as to the usefulness of an anæsthetic at this stage, and there are many ways in which manual or digital pressure is recommended to be applied to the advancing forehead; but perhaps Toff's method (*loc. cit.*) is as satisfactory as any. The patient lies on her left side; the obstetrician stands at the right side of the bed facing her; when the head appears at the vulva he lays his hand thereon, with the fingers directed towards the symphysis pubis; at each pain he tries to bring down more of the occiput, increasing the flexion; when the occiput has passed under the symphysis and the nape of the neck can be felt under the bone, then, and not till then, does he relax his pressure and allow extension to take place.

The controversy of ten or fifteen years ago regarding the *management of the third stage* of labour has now been almost forgotten, and a safe *via media* has been found between the method of rapid expulsion of the placenta which was fostered by the use of the Credé grasp and the plan of leaving the after-birth for hours in the hope of getting spontaneous expulsion (expectant method). Whether the placenta is separated from the uterine wall mainly during a pain or chiefly during the intervals of relaxation may be left uncertain; but the plan of treatment usually followed is to keep the hand on the fundus during the third stage, to gently knead the uterus if it become very soft and lose its rounded shape between the contractions, to wait until the organ becomes markedly smaller and harder (usually after five or six alternate hardenings and relaxations), and then to aid expulsion by compression, or if it do not undergo these changes in three-quarters of an hour or an hour, or if hæmorrhage occur, to expel it by grasping and squeezing the uterus. Berry Hart (*Edin. Med. Journ.*, N. S., ii. p. 532, 1909) is still of opinion that the placenta separates *after* the pain, and that the safe time to use hand-grasping of the uterus is after the placenta has separated. British obstetricians, who have widely accepted Matthew Duncan's view that the edge of the placenta is the first part to emerge from the cervical canal, will be surprised to learn from Von Winckel (*Deutsche med. Wochensch.*, xxxiv. p. 49, 1908) that in 76 per cent. of all cases the after-birth is expelled in inverted fashion by a more or less extensive hæmatoma situated retroplacentally, as was described by Schultze.

Whilst there has been (as we have seen) much discussion lately regarding the details of the management of an obstetric case, it remains to be added that the whole question of interference *versus* non-interference in natural confinements has been the subject of a prolonged and somewhat angry controversy in British medical literature during the past three or four years. In March 1906 the late Dr. Horrocks's address on "The Midwifery of the Present Day" was published (*Brit. Med. Journ.*, i. for 1906, p. 541). In this paper and in the letters and articles which followed it (vide *Brit. Med. Journ.*, i. for 1906, pp. 712, 713, 737, 773, 831, 949, 1012, 1073, 1132, 1199, 1259, 1383, 1448, 1509, 1572; ii. for 1906, pp. 114, 225, 330, 399, 452, 600, etc.) we find marshalled once more in order the arguments for and against interference in labour: on the one side it is stated that 90 or more, probably 95, per cent. of all labours are normal, that "a woman can in most cases deliver herself successfully, without help, without instruction, and without knowledge beyond her own instincts," that parturition is a well-nigh perfect physiological act, that what is needed in its management is patience and ever more patience to give Nature time to act, and the banner which flies over this army of opinion is "meddlesome midwifery is bad"; on the other side, are the reasons for expediting labour, the pain suffered by the parturient woman (severe even in the most normal of confinements), the enervating and debilitating effects of modern conditions of life, the effects of civilisation in increasing the difficulty and consequent delay met with in labour, the frequency of minor troubles following prolonged parturition, and the ease and safety with which manual and instrumental means may be employed, and the watchword of this body of opinion is that "delays are dangerous." It is simply the renewal of the old controversy of sixty or seventy years ago under modern conditions. With anæsthesia we can lessen or remove the pains of childbirth, and with aseptic and antiseptic methods and the use of well-contrived instruments we can expedite labour with almost complete safety to mother and child; it is little matter for wonder that busy general practitioners apply forceps more often than of old, and believe that by so doing they are conferring a benefit upon suffering women. Against them who act thus Dr. Horrocks spoke strongly, saying "that in these days it is little short of criminal to terminate normal labours as quickly as possible by the use of forceps or manual interference." In the fact that such interference could be rendered safe by modern asepsis Horrocks saw no reason for departing from his strongly expressed opinion; but it is quite evident that this circumstance has an important bearing upon the question, and does go far to justify more frequent resort being made to instrumental aid. It is easy to see also that the very ease and safety with which interference can be carried through is a temptation to treat every case (not actually precipitate) as one requiring artificial assistance. Perhaps the safe modern position in midwifery practice may be said to be founded on the following general principles:—(*a*) to adopt the policy of watchful, alert waiting, not interfering so long as the natural forces are acting naturally, but doing so immediately when Nature's forces are inefficient or wrongly directed; (*b*) to strive after cleanliness, surgical cleanliness, in patient, in doctor, and in nurse, making asepsis the first line of defence and antisepsis the second, touching the patient's genital organs only with clean hands or boiled implements, and not allowing her natural defences (germicidal vaginal mucus, etc.) to be removed or her strength to be depreciated; and (*c*) to repair at once all injuries, such as perineal, vulvar, vaginal, and cervical lacerations (Ballantyne, *Essentials of Obstetrics*, p. 58, 1904).

Labour: Post-partum Hæmorrhage.

CAUSATION 235
TREATMENT 235

REFERENCE has already been made to recent advances in the treatment of placenta prævia and accidental hæmorrhage (see ACCOUCHEMENT FORCÉ and CÆSAREAN SECTION); but there is another condition associated with labour in which bleeding is the prominent symptom, viz. post-partum hæmorrhage, and to that dangerous complication of childbirth it is necessary to direct attention.

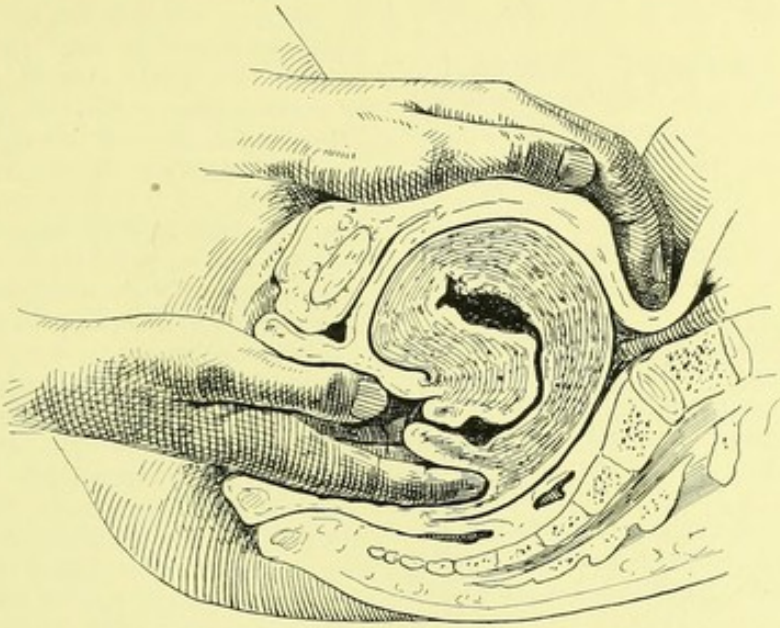
CAUSATION.—It is generally admitted that the commonest cause of post-partum hæmorrhage (including under that term not only the bleeding which occurs after the completion of the parturient process (true post-partum hæmorrhage), but also that which takes place before the expulsion or removal of the placenta (third-stage hæmorrhage)), is a relaxed condition of the uterus. At the same time it is necessary to remember that other causes may be at work. The bleeding, for instance, may be due to lacerations or tears of various structures in the genital tract from the cervix to the vulva. In such a case the bleeding begins soon after the birth of the child and continues, unaffected by the state of contraction, retraction, or relaxation of the uterus; indeed, one should always look for a laceration when there is post-partum bleeding with a firmly contracted uterus. Cervical and perineal tears are common causes, and the former may be associated with considerable danger if they extend into the vaginal roof; but there are also the less frequent vaginal and vulvar lacerations to be taken into account. Vaginal tears of considerable gravity may be met with in labours following upon such operations as colporrhaphy (anterior and posterior) and colpo-perineorrhaphy; for gynecologists are prone to constrict the vaginal canal to a high degree in order thoroughly to prevent the descent or backward displacement of the uterus, forgetting in their zeal to obtain a good gynecological result that a subsequent pregnancy and labour may take place, and that an infant with head diameters of four inches or thereby may have to pass through the constricted canal. Vulvar lacerations also may be the cause of considerable bleeding, those in the neighbourhood of the clitoris being specially troublesome; occasionally such cases have had a fatal ending, as in that reported by Kossow-Gerronay (*Wien. klin. Wochensch.*, xviii. p. 1334, 1905).

TREATMENT.—The treatment of post-partum hæmorrhage due to lacerations at any level in the cervico-vulvar tract should be immediate repair of the tear. In slight cases hot vaginal douches or the temporary application of pressure-forceps or of plugs may suffice, but immediate suturing gives the best results, preventing, as it generally does, both sepsis and subsequent cicatrisation. Difficulty, however, may arise in connection with cervical lacerations which invade the vaginal roof and open into the parametrium, producing a deep cavity; under these circumstances the pulling down of the cervix and the closure of the cervico-vaginal wound may leave the bleeding in the parametrium unchecked, and even plugging of the large parametric cavity may be insufficient. In such an emergency Fritsch (*Deutsche med. Wochensch.*, xxx. p. 19, 1904) recommends the application of double pressure: he first expresses the placenta; then, with the right hand, he presses the anteflexed uterus deeply down into the pelvis; at the same time, with his left hand, he pushes the labia majora upwards towards the sacral promontory; in this way pressure is applied on both aspects of the pelvic floor, and the bleeding in the parametrium is checked. The pressure may have to be kept up for half an hour or longer.

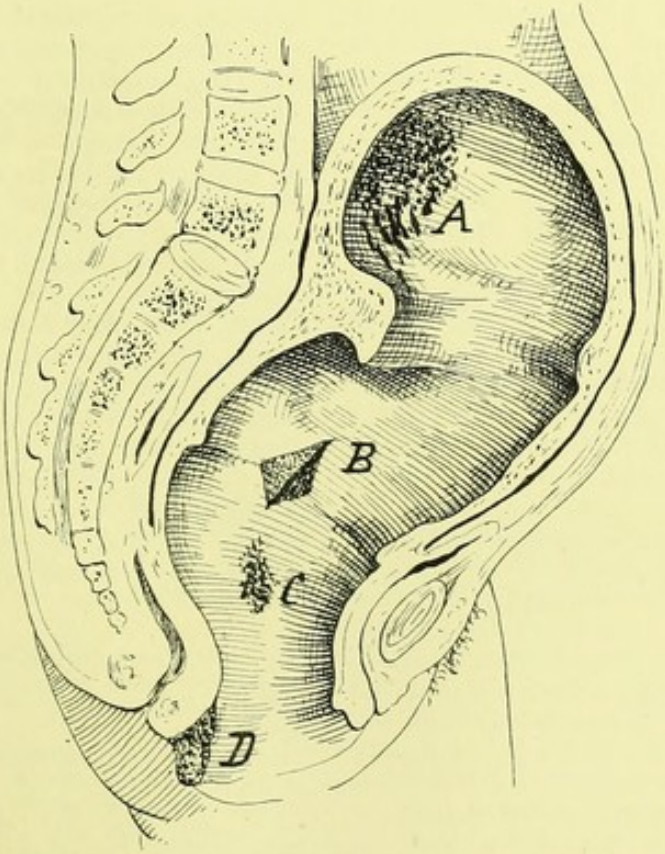
The proper treatment of the common form of post-partum hæmorrhage, that due to relaxation of the uterus, has generally been regarded as fairly well established and fixed. Teachers and practitioners of obstetrics, as well as most text-books of midwifery, have emphasised the importance of applying pressure to the uterus by the hands, and of thus checking bleeding by causing uterine contraction, and by favouring the supervention of uterine retraction. It is true that some writers of text-books, in their desire to name all the means of treatment which may prove beneficial in the various degrees and varieties of post-partum bleeding, have enumerated so many plans of procedure (hot douches, hypodermic injections of ergotin, bandaging the limbs, injection of saline *per rectum* or under the breasts, plugging the uterus, administration of stimulants, etc., etc.) that no single doctor, even when aided by a reliable nurse, could possibly hope to put them all into operation and continue to grasp the uterus with both hands; but it is doubtful whether anyone was misled by these statements in text-books into trying to perform impossibilities. It may be regarded as probable that the medical practitioner, in the presence of post-partum hæmorrhage, grasped the uterus through the abdominal walls, and by exercising pressure and massage succeeded in producing, first contraction and later retraction, of the organ; after some minutes he was able to give directions to the nurse to prepare other means of treatment, and he was himself able in a little while to apply some of them, or, at least, immediately to superintend their application; but he relied chiefly upon the hold which he had of the uterus, and the general experience of the profession was that he did not rely in vain. Within the past few years,

however, the practice outlined above has been attacked, and the measures referred to have been characterised as "unscientific and delusive."

Dr. John F. Le Page (*Brit. Med. Journ.*, i. for 1907, p. 185) criticises the routine treatment of post-partum hæmorrhage described in most text-books of midwifery, and adduces the fact that in 1905 there were 619 deaths registered in England and Wales from "flooding," admitting, however, that deaths from placenta prævia were included among the 619 cases. His practice is to compress the abdominal aorta according to the following plan:—"I raise the pelvis to cause blood to gravitate towards the heart and brain, and to prevent bleeding from the uterine and ovarian veins. The aorta is compressed to immediately arrest arterial hæmorrhage. The spinal column beneath and below the umbilicus is very prominent and broad, and for the length of 3 or 4 ins. forms an admirable *point de résistance*, for the aorta lies immediately over it. Compression is best made by the outer, the ulnar, portion of the left clenched hand, than which nothing could be more convenient and effective. Pressure should at short intervals be made to slide from one part to another of the available 3 or 4 ins., that no injury be done to the sympathetic system of nerves which forms a network around the vessel, and should be continued until uterine contraction is secured, even if this be delayed for one or two hours. Its release must always be very gradual; the greatest care in this particular is essential. An important fact is that, although no blood is allowed to pass the compressing hand, there is still a sufficient, but very limited, flow through the ovarian arteries to maintain uterine vitality. I raise the legs and arms to transmit their blood into the trunk, and then bandage them firmly to prevent the return of blood when they are lowered. The effect of this manœuvre is that in many cases a tension of whole blood approaching the normal is attained in one or two minutes. Ergot and other remedial means are at once available. The hand, rendered aseptic, is then very carefully passed into the uterus—first, to detect any possible laceration of the body or cervix or any remaining portion of placenta; and, secondly, to afford a *point d'appui* for grasping and compressing the uterus from outside." This treatment, Dr. Le Page says, is "rational, always practicable, and so far as his experience goes, unfailing," and Dr. Bishop (*Practitioner*, lxxviii. pp. 201, 791, 1907) agrees with him regarding the efficacy of compression of the aorta; but their view has not commended itself to all their professional brethren, as a study of the recent literature of the subject shows (*vide* papers by Fitzgerald, Duke, M'Kerron, and others). Le Page attempts to strengthen his argument for compression of the aorta by using the following illustration:—"What should we say of a water-department engineer who, when a water main burst, immediately sent for every servant in his employ to attempt to plug the broken pipe? I think a child would say: 'Turn off the main.' I have said 'Turn it off at the main' for the last quarter of a century. And I say now that this is the one thing which should be immediately done, the one rational initial treatment in all cases of post-partum hæmorrhage. Shut off the current along the uterine arteries by compressing the abdominal aorta. Everything is in favour of this procedure. It is done in a moment; it is done without the smallest difficulty; it is absolutely and instantly effective. Effective in what? In causing the uterus to contract? Certainly not; that is impossible. Effective in immediately restraining the pouring out of blood, which is the one primary indication." The illustration here employed may, however, be turned round and used effectively in support of the argument for uterine compression, for if a pipe bursts in a private house, the quickest plan to stop the loss is to hammer in the pipe at the break; to turn it off at the main would be to throw every tap in the house out of action. But it is doubtful if the illustration be an apt one in either case. It is more important to remember that bleeding from the interior of the uterus in and after the third stage is naturally checked by the contraction of that organ, which has the effect of applying, so to say, a thousand muscular ligatures to the vessels in the mesometrium; and the effect is maintained between the contractions (which are intermittent) by retraction (which is permanent). It is claimed, therefore, that the right plan to be adopted is to cause contraction of the uterus to check the bleeding and to allow time for retraction to develop; and, unless complete atony, a very rare condition, exist, this result follows the compression, kneading, or massage of the womb. At the same time it may be admitted that some of the many plans of treating post-partum hæmorrhage named in obstetric text-books (*e.g.* the use of ice and of perchloride of iron) are of little or no use, and that compression of the aorta is occasionally of considerable value. Perhaps, however, the most important consideration is the early detection of the commencement of post-partum hæmorrhage by watching the woman in labour carefully during, not only the third stage, but also the half-hour which follows the expulsion of the placenta. The dangerous cases are those in which the first indications of commencing intra-uterine bleeding have been unobserved, overlooked, or neglected; and if the obstetrician will note the state of his patient's pulse and the condition of her uterus with persistent care, he will not often find himself face to face with serious post-partum bleeding. M'Kerron (*Scot. Med. and Surg. Journ.*, xxi. p. 439, 1907)



Bimanual compression of the uterus for the control of post-partum hæmorrhage.



Four different varieties of post-partum hæmorrhage.

A. Placental site.
B. Rupture of cervix.
C. Vagina.
D. Rupture of perineum.

summarises very fairly the whole discussion which has arisen regarding the method of treatment which has been so enthusiastically advocated by Le Page, when he writes: "Although inferior to direct compression of the uterus, pressure on the abdominal aorta is a method which is of undeniable value in post-partum hæmorrhage. In exceptional cases it may be the most readily employed and the quickest means of effecting arrest, but that can scarcely be regarded as a sufficient reason, merely for the sake of uniformity, for attempting to substitute it in all cases for methods which have not only proved their utility and efficiency, but are at the same time in accordance with the natural method and more scientific. The method has, undoubtedly, its value, and it is unfortunate that those who advocate it have taken up the position that it is the only means of arresting post-partum hæmorrhage. They have done good service in emphasising its value, but have gone far towards defeating the object they had in view by their intemperate denunciation of methods which are not only theoretically superior, but which are the outcome of, and have stood the test of, long experience."

If uterine compression be regarded as the method of checking post-partum hæmorrhage which is generally to be preferred, it is essential that it be applied in the best way; and it must be confessed that it is sometimes rendered ineffective by wrongly-directed manipulations. Fritsch (*Deutsche med. Wochensch.*, xxx. p. 19, 1904) has suggested a thorough method of exercising uterine compression in the rare cases in which the excitation of contraction of the womb is almost impossible: the uterus is brought forward in the abdomen by pressing both hands behind it; it is thus forced into an anteflexed position over the symphysis pubis; into the depression behind it towels or pledgets of wool are packed; a binder is then passed round the abdomen and firmly fixed so as to compress the uterus against the symphysis and keep the pads *in situ;* and the binder is allowed to remain on for some hours till the vessels have thrombosed, and the danger has passed away.

LITERATURE.—In addition to the articles referred to above, the following may also be named:—Gossett, *Amer. Pract. and News*, xli. p. 407, 1907.—Boeck, *Zeitsch. f. d. ärztl. Prax.*, xx. p. 179, 1907.—Calderini, *Lucina*, xii. p. 33, 1907.—Chester, *Mass. Med. Journ.*, xxvii. p. 385, 1907.—De Lee, *Internat. Clinics*, 17 S., ii. p. 147, 1907.—Elliott, *Bristol Med.-Chir. Journ.*, xxv. p. 121, 1907.—Henry, *Brit. Med. Journ.*, i. for 1907, p. 1362.—Herman, *Practitioner*, lxxviii. p. 445, 1907.—Stowe, *Surg., Gynec., and Obstet.*, iv. p. 751, 1907.—Tweedy, *Practitioner*, lxxviii. p. 361, 1907.—Bell, *Amer. Journ. Obstet.*, lvii. p. 385, 1908.—Brock, *Practitioner*, lxxx. p. 87, 1908.—Elliott, *Bristol Med.-Chir. Journ.*, xxv. pp. 121, 310, 1907.—Walker, *New York Med. Journ.*, lxxxvii. p. 164, 1908.—Von Winckel, *Deutsche med. Wochensch.*, xxxiv. p. 49, 1908.—Griffith, *Med. Press and Circ.*, N. S., lxxxv. pp. 257, 448, 1908.—Paggi, *Clin. ostet.*, x. p. 337, 1908.

Lacteol Tablets. — Tablets which produce lactic acid when added to fresh milk; they are recommended in the antiseptic treatment of autointoxication and catarrhal conditions of the intestine.

Lacticaciduria. — *See* Eclampsia (*Theories of Origin*).

Lactimase.—A proprietary preparation designed to prevent putrefactive processes in the intestine; it is stated to act by the production of lactic acid. See *Lancet*, i. for 1910, p. 307.

Lactitia. — A proprietary infant food preparation made from buttermilk. *See* Report in *Lancet*, i. for 1909, p. 1465.

Lacto-bacilline. — Metchnikoff's preparation for producing soured milk and nascent lactic acid which is recommended in various intestinal ailments; Cantlie (*Brit. Med. Journ.*, ii. for 1910, p. 875) is of opinion that it is of little value in such tropical intestinal diseases as sprue and post-dysenteric states. For a detailed discussion of lactic acid therapy see Grünbaum, Tanner, Hewlett, Bryce, Harley, Sahli, and others in the *British Medical Journal*, ii. for 1910, pp. 1583-1593. *See also* the *Lancet*, ii. for 1908, pp. 1600, 1678.

Lacto Food. — A proprietary food preparation, described as "a malted food, containing in suitable proportions the nutritive constituents of milk." See Report in *Lancet*, ii. for 1908, p. 1374.

Lactone Tablets. — A proprietary preparation which is described as a pure culture of lactic acid bacilli, and is active in producing buttermilk. See *Lancet*, ii. for 1908, p. 284.

Lactoserum.—A serum of cow's milk prepared by Dr. Raoul Blondel, by coagulating milk with hydrochloric acid or rennet, and filtering off the whey through muslin and an Arsonval candle (under pressure of carbonic acid gas); it is thus sterilised at the same time; the whey contains milk sugar and salts and the ferments of the milk (especially the oxydases); and when it is injected under the skin it causes an increase in leucocytosis, a fall of temperature (in fever), a discharge of uric acid, and a fall in blood pressure. Dr. Blondel has found it of service in pneumonia, and specially in the arterial hypertension of arterio-sclerosis. See *Lancet*, i. for 1909, pp. 1038-1040.

Laiose.—A substance closely resembling

levulose, but differing from it in being unfermentable with yeast.

Lak Cit.—A proprietary preparation of milk for infant feeding; it is a dry preparation, and when mixed with hot water gives a fluid resembling milk; the addition of an acid yields a finely divided not a clotted curd. For reports see *Brit. Med. Journ.*, ii. for 1910, p. 1349; *Lancet*, ii. for 1910, p. 35.

Lana Kerol.—A proprietary preparation described as an oxidised di-phenyl compound made miscible with water by means of a special soap; it has bactericidal properties. G. M. Lowe reports favourably on its use in eczema exudans (*Lancet*, ii. for 1910, p. 1343).

Law, Galton's.—*See* HEREDITY.

Law, Mendel's.—*See* HEREDITY.

Laxans.—One of the many trade names for phenolphthalein; others are purgen, phenolax, laxatin, laxatol, laxiconfect, purgylum, etc.

Laxatin.—A trade name for phenolphthalein.

Laxatol.—A trade name for phenolphthalein.

Laxiconfect. — A trade name for phenolphthalein.

Laxophen.—A trade name for phenolphthalein.

"Lebenswecker" Treatment.—The "Lebenswecker" is an instrument carrying a number of sharp needles which can be driven into the skin; it is employed in "Baunscheidtism," or the treatment of rheumatism and chronic neuralgias and sciatica by counter-irritation; after the punctures are made, an irritant such as croton oil is rubbed into them. See *Brit. Med. Journ.*, i. for 1910, p. 732.

Lecithalbumin. — A compound of lecithin with protein.

Lecithin-Agfa.—A proprietary preparation consisting of a sterilised solution of lecithin (prepared from pure yolk of egg) in olive oil; it is intended for intramuscular injection. See *Lancet*, ii. for 1908, p. 99.

Lecithoproteins.—A group of conjugated proteins in which the protein molecule is believed to be compounded with lecithins (*phosphatides*, *lecithans*). On the question of the existence of these as true compounds, *see* Adami, *Pathology*, i. p. 57, 1910.

Legal's Test.—A means of determining the presence of acetone (dimethyl ketone); it depends on the development of a ruby-red colour, changing to yellow, when to the suspected urine a few drops of concentrated solution of sodium nitro-prussid are added, followed by sodium or potassium hydrate till the mixture is markedly alkaline; it is also called Le Noble's Test. *See* Webster, *Diagnostic Methods*, p. 305, 1909.

Legumine Biscuits.—A proprietary food preparation which is made with legumine or vegetable albumin; the starch is partially converted into dextrin by means of diastase. See *Lancet*, ii. for 1908, p. 1824.

Leiner's Test.—A test for casein in the fæces; the fæcal matter is dried on a slide, fixed by heat, and stained with a mixture of acid fuchsin and methyl green in alcohol; casein and paracasein stain pale blue or violet. For details, *see* Webster's *Diagnostic Methods*, p. 108, 1909.

Leiomyosarcoma.—A spindle-celled sarcoma (*e.g.* of the uterus) arising from unstriped muscle elements.

Leishman's Method.—In bacteriology this term is used to describe a method of observing phagocytosis by leucocytes outside the body and under the microscope. A few drops of blood are taken from the finger, treated so as to get the leucocytes, which are then suspended in serum; to this suspension one of some pathogenic microbe is added, the mixture is put for a short time in the incubator, and then the number of microbes within the leucocytes is observed.

Leishman's Stain.—*See* BLOOD (*Examination of Films*).

"Lemco" Wine.—A proprietary meat wine of which an analysis is given in the *Brit. Med. Journ.* (i. for 1909, p. 795). *See also* the Lancet Special Commission on Extract of Meat (*Lancet*, ii. for 1908, p. 1240).

Lenitol.—A proprietary preparation, described as a "specially prepared petroleum, combined with suitable flavouring agents"; it is recommended as a rational cure for constipation, acting mechanically as an emollient and not as an aperient.

Lepidomas.—Lepidic or "rind" tumours, or neoplasms arising from the "lining membrane" tissues, *i.e.* "tissues in which the blood-vessels do not penetrate the groups of specific cells, and in which there is an absence of definite stroma between the individual cells, although such

stroma, of mesenchymatous origin, may be present between the groups of cells" (Adami). The lepidomas have been divided into two orders: in the first are (1) those of epiblastic origin, such as papillomas, epidermal adenomas, squamous epitheliomata, and carcinomata of glands of epiblastic origin, and (2) those of hypoblastic origin, such as adenomata and papillomas of the digestive and respiratory tract, of the thyroid, bladder, liver, etc., and carcinomata developing in these regions and organs; in the second are the transitional lepidomas, of which some are (1) of mesothelial origin, *e.g.* adenomata of the kidney, testicle, ovary, uterus, and prostate, and cancers of these organs, along with squamous endotheliomas of serous surfaces, hypernephromas, etc., whilst others (2) are of endothelial origin, such as lymphangio-endotheliomas, hæmangio-endotheliomas, psammomas, some cylindromas, peritheliomas, etc. *See* Adami, *Pathology*, i. pp. 703, 705, 775, 806, 1910.

Leprosy.—In the treatment of leprosy Professor Deycke claims to have obtained remarkable results by the use of injections of nastin, which is a neutral fat obtained from streptothrix leproides, which was cultivated in pure culture from leprous tissue. By these injections a distinct general and local reaction may be produced. Benzoyl-nastin is said to be superior to pure nastin, and when injected to remove the fat from the leprosy bacillus, which then becomes easily destroyed by the tissues. Until more work is done on the subject a definite opinion cannot be formed of its value, but the results are promising.

REFERENCES.—Deycke, *Lepra-Bibliotheka Internationalis*, vii. p. 3; *The Therapist*, 1908, pp. 28, 37; *Brit. Med. Journ.*, 4th April 1908.

Leube's Test.—A means of testing gastric motility, consisting in giving a Riegel Test Meal, and washing out the stomach with a litre of water six hours later; the presence of only slight traces of food indicates normal motility of the stomach.

Leucofermantin.—A Merck preparation, described as a normal animal serum whose antiferment property has been so far increased as to correspond at least to the anti-tryptic index of normal blood serum; it is recommended in inflammatory processes accompanied by suppuration and fermentation where it is wished to prevent great destruction of tissue; in the case of open suppurative foci it is simply poured on to the cavity, whilst in other cases a small incision is made to evacuate the pus and receive the leucofermantin. For Report see *Lancet*, i. for 1910, p. 653.

Leukæmia.—The cause of leukæmia is still as great a mystery as ever. Löwit's theory of its parasitic origin has never received any confirmation, and is now universally abandoned. From the pathological side all observers are agreed that, whatever form the disease assumes, the primary lesion is in the bone marrow. A very great deal has been written about the malady during the past five or six years, and the principal new facts which have been brought out may be considered under the heads of—1. Atypical Forms of Leukæmia; 2. Leukanæmia; 3. X-ray Treatment.

1. Atypical Forms of Leukæmia.—It would be wrong to say that the classical distinction between lymphatic and splenomedullary leukæmia has been given up, for the two main types of the disease are so well marked, and in most cases present such characteristic features, that as a matter of convenience they must be retained. There is, nevertheless, a growing body of evidence that they are more closely related than used to be supposed. A number of cases have now been described which do not conform strictly to the classical type, and while it would encroach unduly on the available space to refer to these in any detail, some of the main facts about them may be discussed under the following heads:—

(1) *Leukæmia without Leucocytosis.*—Leukæmia may exist with little or no increase in the total number of leucocytes; it may even be associated with leucopenia. Cases which show this peculiarity are generally of the lymphocytic variety, and in them the differential count will show 90 per cent. of lymphocytes or more. The diagnosis rests on the high percentage of these cells, not on the total number present. An exception to this rule must be made in the case of young children, in whom slight leucocytosis with a high lymphocyte count is normal. In some cases of anæmia in children one finds a great diminution of the red corpuscles and of the granular leucocytes, without affection of the lymphocytes. When this occurs there may be a blood count of (say) 8000 to 10,000 leucocytes with 90 per cent. of lymphocytes. Yet under iron these cases often make a complete recovery. The explanation of the peculiar blood change is to be found in some interference with the function of the marrow, the normal activity of the lymphatic tissues remaining unimpaired. In the adult, however, a lymphocyte count of 90 per cent. or over justifies the diagnosis of leukæmia, irrespective of the total leucocytosis. Low leucocyte counts with a large percentage of myelocytes mostly occur in acute myelocytic leukæmia (*vide infra*) and in cases treated by X-rays.

Cases of lymphatic leukæmia with a low white count have been described as "aleukæmic leukæmia," and as "aplastic leukæmia." Wollf [1] recorded one such in which there was aplasia of the marrow, and states that the

diagnosis can be made during life by the association of (*a*) leucopenia, (*b*) high percentage of large lymphocytes, and (*c*) progressive severe anæmia without signs of regeneration.

In all doubtful or atypical cases of leukæmia it is essential to calculate the total number of each variety of cell present, as by this means a much clearer conception of the functional activity of the hæmopoietic organs is gained than from the percentages alone (cf. BLOOD, *Clinical Examination*).

(2) *Acute Myelocytic Leukæmia.*—It was formerly held that all acute cases of leukæmia belonged to the lymphocytic group, but this is now known not to be the case. Though lymphocytic forms predominate, acute myelocytic leukæmia does occur. The course and general clinical features of the malady are practically identical with those of the more common lymphocytic form. The degree of the anæmia is considerable; the leucocyte count is usually low, but sometimes rises to a figure comparable to what occurs in chronic cases. The essential change in the blood is the presence of a considerable percentage of neutrophile myelocytes —10 per cent. at least. Eosinophiles may be absent or few; the same applies to an even greater extent to mast cells. Hirschfeld[2] regards absence of eosinophiles and mast cells as characteristic of acute as opposed to chronic myelocytic leukæmia. As in other forms of atypical leukæmia the classification of the leucocytes found is very difficult on account of the presence of aberrant forms; the difficulty is enhanced by the fact that many of them stain badly. It is usually possible to trace a complete series, beginning at the one end with large lymphocytes and ending at the other in neutrophile myelocytes. Normoblasts may be plentiful or absent. In a paper on the subject Billings and Capps[3] give the following as the more important sources of error in diagnosis:—(1) Chronic myelocythæmia with an acute exacerbation. Here the history is of long standing, and the spleen is large, whereas in acute cases it is scarcely palpable in the early stages. (2) Lymphatic leukæmia complicated by leucocytosis. Myelocytes are absent. (3) Acute lymphatic leukæmia with predominance of large mononuclears. Myelocytes are absent. (4) Acute infections causing rapid anæmia with myelocytes and nucleated reds. The leucocyte count is low, and the myelocytes few. (5) Acute exacerbation of pernicious anæmia in which a leucocytosis with myelocytes may occur. (6) Neoplasms invading the marrow.

(3) *Leukæmia Intermediate in Type between the Myelocytic and Lymphocytic Varieties.*—Difficulty in deciding from the blood examination whether a leukæmia should be reckoned as lymphocytic or myelocytic arises under two conditions—(*a*) A considerable number of cases are now on record in which the blood shows *both* excess of lymphocytes (usually large lymphocytes) and numerous myelocytes. (*b*) Yet other cases are described in which the blood during one period of the disease was myelocytic, and subsequently became lymphocytic, or *vice versâ*.

These intermediate forms, which may, for convenience, be termed "mixed-cell leukæmia," require some further description. (*a*) A typical instance of mixed-cell leukæmia of the first group, in a child aged 5, recorded by Fowler,[4] showed the following blood picture:—Red corpuscles, 2,610,000; leucocytes, 240,800, with small lymphocytes, 10·2 per cent., large lymphocytes, 34·4 per cent., non-granular mononuclears ("lymphoid cells"), 15·9 per cent., polynuclears, 16·3 per cent., neutrophile myelocytes, 17 per cent., eosinophiles, ·8 per cent., eosinophile myelocytes, 1·1 per cent., mast cells, 4·3 per cent., nucleated reds, 4000 per c.mm. That is to say, here is a case which cannot be reckoned among the lymphocythæmias on account of the myelocytes present, nor to the myelæmias, on account of the large lymphocytes. The total lymphocytes (including small, large, and uninuclears) amounted to 62·5 per cent. In an almost exactly similar case, Findlay[5] found marked leucoblastic hyperplasia of the marrow as in myelocytic leukæmia, and hyperplasia of the lymphatic tissues, as in lymphocythæmia. The most satisfactory explanation of these mixed cases is afforded by assuming (as there is good ground for doing) that the lymphocytes and myelocytes are not genetically distinct, but both arise from a common ancestor. A characteristic feature of mixed-cell leukæmias is the large number of leucocytes which are intermediate morphologically between myelocytes and large lymphocytes; an almost unbroken series of forms links the two, and this renders differential counting far from easy. Wollf and Michaelis,[6] who were among the first to describe such cases, call them "lymphoid-cell leukæmia"; they look on the undifferentiated lymphoid cell (the non-granular uninuclear) as the primitive leucocyte, and interpret the condition as being due to a proliferation of these elements. The term lymphoid cell, however, has been applied to large lymphocytes, and is, therefore, likely to lead to confusion; for this reason, and because it implies no theory, the term "mixed cell" is preferable. Emerson[7] sets out the common-ancestor theory in these words: "It may be that they [*i.e.* myeloblasts or undifferentiated lymphoid cells] are only an early generation of cell which later changes to one of the various granular cells, or perhaps to a red cell. It may be that in myelocytic cases the descendants of these cells which have changed to granular cells are increased; perhaps the disease attacks a different generation of bone marrow cell. . . .

It is possible that the relative involvement of these cells is an index of the profundity of the marrow involvement, the myeloblasts preponderating when the marrow lesion strikes at the root of cell genesis, the myelocytes preponderating when the involvement is less fundamental." Muir[10] explains these cases differently. The presence of the myelocytes is "the result of the disturbance of the marrow by the invasion of lymphocytes in a manner analogous to what has been noticed in some cases of tumours implicating the bone marrow. The question whether there is a real mixed-cell leucocythæmia—that is, one where the proliferative process involves the cells both of the granular and non-granular series . . . must be still considered an open one. If such a type occurs it may be due to an involvement of the primitive cell from which both series spring, or to a concomitant affection of the two series." He has not observed a case which requires such an explanation.

(*b*) *Leukæmia with Change in the Type of Cell Present in the Blood.*—Wilkinson[8] has reported a good example of this. After the patient had been ill for nearly a year the blood was absolutely pathognomonic of advanced splenomedullary leukæmia, the most striking feature being the enormous number of large myelocytes. The lymphocytes were also numerous, there being every gradation between them and the myelocytes. Coincidently with an acute fatal exacerbation the blood took on the picture of typical large-celled lymphatic leukæmia. Browning[9] has also placed on record a similar case. Ehrlich has suggested in explanation of the change that the "lymphocytes" which appear in the blood in the later stages of the case are merely myelocytes, the granules of which have ceased to take on the stain, on account of inanition. The explanation, however, is not generally regarded as adequate. Cases of the reverse transformation —lymphocytic into myelocytic—have been reported—*e.g.* by Hirschlaff,[11] but the authenticity of most is questionable. Some are in all probability merely instances of terminal leucocytosis; in others the explanation given by Muir may be correct.

In connection with the diagnosis of leukæmia, and as showing some of the further difficulties in adhering strictly to the older division into lymphatic and splenomedullary, the following points may be noted. Leukæmia may occur without enlargement of the liver, glands, or spleen; the diagnosis always rests on the examination of the blood alone. An apparently unique case of a leukæmic blood picture in a patient suffering from fracture of the ankle is reported by Simon[12] The fracture was compound, and amputation was required a month after the accident. At this time there was a leucocyte count of 50,000, with 16·2 per cent. of myelocytes, and many normoblasts and megaloblasts. The abnormal appearance soon disappeared, and the patient remained permanently well. One can only account for such a condition by the supposition of temporary hyperactivity of hæmopoiesis resulting from the injury plus septic infection. In whooping-cough the leucocytosis is often very great, especially when the disease is complicated by pneumonia or capillary bronchitis. Leucocyte counts of over 100,000 have been reported by Crombie,[13] and the blood has a superficial resemblance to that of leukæmia. No abnormal cells, however, occur; the phenomenon is of diagnostic importance, particularly in young infants, for in them the characteristic whoop is often absent, especially if a pulmonary complication is present.

2. Leukanæmia.—The hybrid term "leukanæmia" was coined by Leube in 1902 to describe the case of a child aged 10, who died of profound anæmia lasting only three weeks. The blood changes and post-mortem findings were a combination of those usually observed in leukæmia and pernicious anæmia. The condition is an ill-defined one, but similar cases have now been described by Hurter,[14] Weber,[15] Drysdale,[16] and others. In Leube's patient the liver and spleen were enlarged; the red cells were reduced to 256,000, the whites numbered 10,600, the colour-index was 2·0. There were megaloblasts and normoblasts, and 13 per cent. of myelocytes. Post-mortem there was myeloid transformation of marrow and spleen, and no siderosis of the liver. Drysdale, whose case was very similar, has collected reports of 11 other cases, and points out that in all save one siderosis of the liver has been absent. This suggests a primary megaloblastic degeneration, not hæmolysis, as the cause of the anæmia. The leucocyte count is not low in all cases; the pathological appearances are not inconsistent with the diagnosis of leukæmia. Drysdale is of the opinion that the majority of the cases described as leukanæmia properly belong to the group of atypical myelocytic leukæmias, and certainly the balance of evidence seems to point in this direction rather than in favour of a combination of two such definite pathological entities as pernicious anæmia and leukæmia.

3. X-Ray Treatment of Leukæmia.—The earliest cases of leukæmia treated by the Röntgen rays were reported in America, and the credit of priority in the introduction of a remedy which, though not curative, is yet more likely than any other known to us to prolong life and mitigate suffering, belongs to Pusey and Senn, who in 1903 and 1904 first brought the subject under the notice of the medical world. Since that time the treatment has been very extensively tested, and its value can now be estimated with fair accuracy.

Röntgen rays do not cure leukæmia perma-

nently; in many cases, nevertheless, splenic and glandular enlargements subside, the blood becomes practically normal, and the patient enjoys a period of respite from symptoms which may be of very considerable duration. The following tables, compiled by Pancoast,[17] give the results of 123 cases treated between 1901 and 1906:—

	Spleno-medullary.	Lymphatic.	Unclassified.
Symptomatic cure .	33	11	3
Improved . .	22	8	1
Improved; still under treatment . .	14	1	0
Unimproved . .	13	0	3
Unknown . .	1	0	2
The final results in 63 cases are:—			
Still living and well .	2	2	0
Symptomatic cure, fatal relapse . .	11	5	0
Symptomatic cure, serious relapse .	5	0	0
Improvement, fatal relapse . . .	14	3	1
Unimproved, died .	5	8	3
Relapsed and under treatment . .	4	0	0

The duration of symptomatic cure varies. Though it often lasts but a few months, four patients, at least, are reported as alive and well three, four, and six years after treatment. Myelocytic leukæmia appears to respond more readily than the lymphocytic type, and patients suffering from the acute form of the disease are more likely to derive harm than good from the treatment.

Technique.—A hard tube should be used, as being more penetrating in its effect, and less likely than a soft tube to cause dermatitis. The sittings should be brief, from three to ten minutes thrice a week or oftener. Exposures should be made over the spleen, enlarged glands, and bones, particularly the ribs and sternum. Neighbouring parts may be protected by lead shields.

Effect of the Rays on the Hæmopoietic Organs and Blood.—As a rule the spleen becomes softer and diminishes in size after a few exposures. In many cases it speedily returns to normal dimensions; in a few instances, however, even repeated applications have produced no effect. Enlarged glands become smaller, though the change in them is less marked than in the spleen. Tenderness of the bones disappears. The general effect on the blood is to produce a steady diminution in the leucocytes. There is, it is true, a temporary rise of short duration, due, in all probability, to the profound changes in the lymphoid tissues causing a flooding of the blood with white cells; but this is followed by a speedy fall, which may amount to nearly 200,000 per c.mm. after a single exposure. Generally, however, the diminution is more gradual—perhaps 20 or 30 exposures spread over 5 or 6 weeks being required to bring the leucocytes down to an approximately normal number. The leucocytes, moreover, are altered qualitatively as well as quantitatively, the abnormal elements practically disappearing. Arneth and others have worked out the changes which occur. The lymphocytes, particularly the larger forms, steadily diminish; the neutrophile myelocytes dwindle and may vanish altogether, while the polynuclears correspondingly increase. Mast-cells fall, while the eosinophile group becomes normal. There is, at the same time, a rise in the red corpuscles, and a disappearance of abnormal forms. Broadly, then, the effect of the rays is to produce an aleukæmic phase. Myelocytes are more susceptible than lymphocytes, and in lymphocythæmia, though the count may become normal, the percentage of lymphocytes usually remains high.

With the symptomatic cure the general health improves correspondingly; relapse, sooner or later, inevitably occurs, and the treatment must be repeated with, on the whole, less prospect of success than before. Satisfactory on the whole, considering the nature of the malady, as Röntgen rays are, the treatment is not devoid of risk. The rapid destruction of large numbers of leucocytes must be associated with the liberation of products of their disintegration, and it is not surprising that some cases of fatal toxæmia have been reported. Sudden death has occurred from this cause in not a few instances, and in some of these nephritis has been found. Treatment, therefore, should not be instituted unless the kidneys are sound, nor if there is any evidence of toxæmia. A moderate degree of pyrexia does not contra-indicate raying, but if the temperature is inclined to rise after exposure, it is probably safer to desist. The patient should be kept in bed during the early days of the course of treatment, until it is certain that the rays are doing no harm. At first the exposure should not exceed 3 minutes, and it should not be repeated for 3 or 4 days, until it is seen whether any reaction is going to occur. The action of the rays continues after the rays themselves have been stopped; it may sometimes be observed that glands which have begun to soften progressively diminish in size for several weeks later. The immediate effect of the rays on enlarged glands is sometimes to produce a temporary swelling and hardness, accompanied by a feeling of local discomfort or even pain. These symptoms, however, are of short duration. Cases of acute leukæmia should not be treated with X-rays. Among minor incon-

veniences, dermatitis, palpitation, vomiting, and diarrhœa have been reported.

Nature of the Action of X-rays.—Theoretically, the fall in the leucocytes produced by the rays might be due either to lessened production or stimulation of leucolysis. In animals subjected to the action of the rays, Heinecke,[18] whose work has been confirmed and is generally accepted, found marked evidence of destruction of the lymphocytes throughout the body—in the splenic pulp, marrow, glands, and follicles of the intestine. The process begins within 3 hours of exposure, and is complete in from 36 to 48 hours. Probably the circulating leucocytes are also destroyed. The red corpuscles, on the contrary, resist the action of the rays. The destruction of the lymphoid tissue is always more marked in the spleen than in the glands or marrow. Young forms of cell—myelocytes and lymphocytes—are most affected. Regeneration is slow after prolonged or repeated exposure (Warthin [19]). The diminution of leucocytes is accompanied by an excessive output of urinary phosphorus and nitrogen.

Warthin's final conclusions are, that improvement is more marked in cases seen early; that lymphatic cases require more energetic treatment than myelocytic; that the prolonged action of X-rays is due to a leukolytic toxin formed in the serum; that X-ray treatment should be combined with arsenic; that no permanent cure has ever been effected.

X-ray treatment has also been employed in *pseudoleukæmia*, with results which are said to be better than in leukæmia, for about a quarter of the patients remain alive and in good health for three or four years; in polycythæmia without benefit; and in pernicious anæmia. In the last-named disease the liability to the occurrence of toxæmia, and the frequency with which the kidneys are diseased, contra-indicate this line of treatment.

LITERATURE.—The literature is extensive. Many of the references in the text give bibliographies on special subjects. General literature is regularly abstracted in *Folia hæmatologica*, which is an invaluable source of reference in all blood diseases. 1. *Berl. klin. Wochensch.*, p. 35, 1905. 2. *Ibid.*, 24th June 1907. 3. *Amer. Journ. Med. Sci.*, Sept. 1903. 4. *Internat. Clinics*, ser. 13, vol. iii., 1903. 5. *Glas. Med. Journ.*, 1907. 6. *Zeitsch. f. klin. Med.*, lxv. pp. 87, 411, 1902. 7. *Johns Hopkins Hosp. Bull.*, March 1907. 8. *Lancet*, 20th July 1903. 9. *Ibid.*, 19th Aug. 1905. 10. *Glas. Med. Journ.*, Sept. 1905. 11. *Centralb. f. inner. Med.*, p. 836, 1898. 12. *Amer. Journ. Med. Sci.*, Sept. 1907. 13. *Edin. Med. Journ.*, Sept. 1908. 14. *Liverpool Med. Journ.*, Jan. 1907. 15. *Trans. Path. Soc., London*, lx., 1904. 16. *Quarterly Journ. Med.*, Oct. 1907. 17. *Univ. Penn. Med. Bull.*, 1906. 18. *Münch. med. Wochensch.*, No. 48, 1903. 19. *The Physician and Surgeon*, Jan., Feb., March, 1907 (full references to X-rays).

Leukolysis or Leucolysis.—Destruction and dissolution of leucocytes in the blood, resulting in reduction in the number of white cells (*leucopenia* or *leukopenia*).

Leukopenia or Leucopenia.—Diminution in the number of leucocytes in blood. *See* LEUKOLYSIS.

Levulosuria.—A rare condition in which levulose is found in the urine, levulose ($C_6H_{12}O_6$) being specially the sugar of fruits and honey; it may occur either as a pure levulosuria or in association with glycosuria (an association which is common in diabetes); it may be detected by Seliwanoff's Test.

Lieben's Test.—A test for acetone in the urine, consisting in the addition to a few c.c. of urine of a few drops of concentrated potassium hydrate and a few drops of a solution of iodine in iodide of potassium; then, on warming, yellow crystals of iodoform will separate, recognisable by their odour and by their microscopical characters (hexagonal shape). *See* Webster, *Diagnostic Methods*, p. 306, 1909.

Light-touch Palpation.—A method by which the outlines of underlying organs, such as the heart, liver, and spleen, and even of affected parts of the lungs, can be determined by lightly feeling the skin with the tip of the finger; it is probably a skin reflex; a slight degree of rigidity of the muscles overlying the organs, or inflammatory changes may also give diagnostic information. *See* F. M. Pottenger, *Trans. Amer. Climat. Assoc.*, xxv. p. 82, 1909; *South. Med. Journ.*, iii. p. 149, 1910; and A. Wolff-Eisner, *Deutsche med. Wochnschr.*, xxxvi. p. 755, 1910.

Lin Aulagne.—A proprietary preparation of Parisian origin, constituting a linseed-meal poultice; it consists of linseed meal (rendered antiseptic by boric acid), finely powdered over several layers of gauze, which are compressed, sewn together, and made up in rolls; a piece of the shape and size can be cut out, dipped in boiling water, and applied to the skin. *See* Report in *Lancet* (ii. for 1910, p. 1143).

Linin.—Part of the nuclear matter; more particularly the achromatic network in which the chromatin (the part which can be stained) lies.

Lipochromes.—*See* LIPOIDS.

Lipoidæmia.—The presence of lipoids in the blood.

Lipoids.—Intracellular fatty compounds which are believed to be of great importance not only in cellular metabolism but also in connection with immunity. Overton, who introduced the term, defined them as bodies which dissolved narcotics; but Bang has re-

garded them as bodies which (like ordinary fats) are dissolved in ether, alcohol, benzene, chloroform, and carbon bisulphide. Bang further classifies them into (1) substances containing neither phosphorus nor nitrogen, *e.g.* fatty acids, neutral fats, soaps, and cholesterines and phytosterines; (2) nitrogen- and phosphorus-containing lipoids or phosphatides, *e.g.* lecithin, kephalin, and sphingomyelin; (3) nitrogen-containing phosphorus-free bodies, *e.g.* the cerebrosides (phrenosin and kerasin) and the lipoproteins; and (4) bodies of fatty nature not as yet analysed, *e.g.* lipochromes and certain antigens. *See* Adami, *Pathology*, i. pp. 92, 304, 1910.

Lipoproteins.—*See* LIPOIDS.

Liposarcoma.—A lipoma in which areas of sarcomatous change appear, the whole tumour growing much more rapidly.

Liposis.—A synonym of obesity.

Lip-Reflex.—*See* REFLEXES; SPASMOPHILE DIATHESIS.

Liver, Cirrhosis of the—Surgical Treatment.—Seeing that attempts to relieve the ascites of hepatic cirrhosis by medical means so often fail to produce more than temporary amelioration, several operative procedures have been introduced. The underlying principle of most of these is to avert the extravasation of serum into the peritoneal cavity by sending the venous blood through the veins of the belly wall instead of through the portal system. Fixation of the omentum to the abdominal parietes (omentopexy), or fixation of the spleen to the same structure, has been found in a fair number of cases to remove the ascites by establishing a collateral circulation. Greenough in 1902 collected statistics of 104 cases of cirrhosis in which one or both of these procedures had been employed. In 57 per cent. there was no real improvement; in 42 per cent. there was improvement. Omentopexy is the less serious and therefore preferable operation; it will probably do good in one case out of every three. According to O'Malley (*Amer. Jour. Med. Sci.*, May 1906), Schiassi's method of operating is the most effective. A right-angled incision down to the peritoneum is made in the left hypochondrium and epigastrium. A triangular flap is dissected up from the peritoneum. The peritoneum is then divided horizontally along the upper edge of the wound, and the omentum is brought through the opening and sutured to the peritoneum along the lips of the opening, the projecting part of the omentum being attached by a few stitches to the outer surface of the peritoneum towards the lower part of exposed area. If splenopexy is to be performed the peritoneum is incised vertically, and the spleen is stitched by deep sutures through its substance to the wound. The flap of skin and muscle is replaced.

Paterson (*Lancet*, 29th October 1910) suggests treating ascites by draining the fluid from the abdomen into the subcutaneous tissue of the parietes. To create a channel he employs a flanged glass cylinder, one flange of which lies in the abdomen, the other in the subcutaneous tissue. He removes the omentum in order to prevent its blocking the orifice of the bobbin. The operation has been performed in the ascites of cirrhosis and malignant disease.

In *hypertrophic cirrhosis with icterus* (*biliary cirrhosis*, *Hanot's cirrhosis*) Cumston (*Amer. Jour. Med. Sci.*, July 1906) advocates drainage of the biliary tract by cholecystenterostomy or cholecystostomy. The underlying idea being to get rid of the (probable) infective element in the bile, the latter is preferable.

These surgical procedures, though in some cases very successful, have so often failed altogether, or proved merely palliative in their effects, that they have to some extent fallen into disuse. They have, at all events, scarcely fulfilled the hopes which their inventors raised, and during the last year or two comparatively little has been said about them.

"Lodal."—This preparation is described as an oxidation product of laudanosine (one of the minor alkaloids of opium), and resembles in its action cotarnine and hydrastine; it has been shown experimentally to cause a persistent rise in blood pressure when injected intravenously (in animals) and to slow the heart's action; it also produces tonic contraction of both the pregnant and the non-pregnant uterus; it has been recommended in uterine hæmorrhage and pain. See also *Lancet*, i. for 1910, p. 1210; *Brit. Med. Journ.*, ii. for 1910, p. 84.

Lohnstein's Saccharometer.—An apparatus for estimating quantitatively the sugar in urine; it depends upon fermentation.

Longinymph Condition. — The enlargement of the labia minora (nymphæ), which is apt to occur in association with steatopygy (lipomatosis of gluteal region) in Bushwomen and Hottentots; "Hottentot apron."

Long's Coefficient. — *See also* HAESER'S COEFFICIENT. The total solids in urine may roughly be estimated by multiplying the last two figures of the specific gravity by 2·6, the result being the number of grams in every 1000 c.c. of urine. The 2·6 is called Long's coefficient.

Lumbar Puncture.—(*See also Encycl. and Dict. of Med.*, IX., 306.)—Lumbar puncture is now fully recognised as a legitimate and valuable diagnostic procedure. It is simple, practically devoid of danger, and often gives information of the greatest possible worth.

Technique.—In the adult the spinal cord terminates at the lower part of the first lumbar vertebra. Lumbar puncture is performed between this point and the upper sacral vertebræ, the site usually selected being between the third and fourth or fourth and fifth vertebræ. The position is easily determined by drawing a transverse line at the level of the highest point of the iliac crest, and puncturing below the spinous process which this line intersects—the fourth lumbar. The needle used should be about three inches long; it may be one of platinum and iridium specially made for the purpose, but an ordinary exploring needle answers perfectly well. It must be provided with a wire stylet to clear it if it becomes blocked. It is convenient to have the needle mounted on a syringe, which serves as a handle. The needle should be boiled before use, and the skin of the patient should be thoroughly purified with lysol and ether. In performing lumbar puncture it is important to have the patient's spine flexed; in cases of meningitis this may necessitate the use of a general anæsthetic; otherwise anæsthesia is not required. In children, lumbar puncture may be performed as the patient lies in bed, the body being held in the flexed position by the hands of an assistant, one of which controls the head, the other the pelvis. In adults the operation may be performed with the patient either in the recumbent or stooping posture. The needle should be introduced in an interspace rather to one side of the middle line, and pushed steadily forwards with a slight inclination upwards and inwards. The most common error is to direct the point too much up and in. The tissues through which the needle has to pass are somewhat dense, and it is generally easy to feel when the point has entered the subarachnoid pond. In place of introducing the needle laterally the middle line may be selected and the puncture made directly forwards and slightly upwards. When the needle is felt to have entered the subarachnoid space the syringe is removed to allow the fluid to escape. If none flows out the stylet should be passed to clear the needle, and if this manœuvre fails, the needle may be pushed in a little farther, lest it should not actually have entered the spinal canal, or *very gentle* suction may be made with the syringe. As a rule the fluid drops out freely, and may be collected in a sterile tube. The first few drops should be rejected, lest they be accidentally contaminated with blood.

Exceptions.—1. "*Dry Taps.*" It is sometimes impossible to withdraw fluid by lumbar puncture. The reason for this is not always apparent. In some cases it is due to occlusion of the channels between brain and spinal canal. In commencing hydrocephalus from meningitis a "dry tap" is a bad sign for this reason. 2. *Hæmorrhage.* If the fluid is blood-stained, cytological examination is useless. The fluid may be hæmorrhagic either because of a cerebral hæmorrhage, or, much more commonly, from wound of one of the subarachnoid veins. This is most likely to occur if the needle is thrust in too far, and impinges against the venous plexes on the bodies of the vertebræ. Dangerous hæmorrhage into the spinal canal may occur in this way. 3. *Injury to Cauda Equina.* If a trunk of the cauda equina be touched, the patient may complain of pain shooting down the legs. Headache may follow the operation. Lumbar puncture, however, is a very safe proceeding; hæmorrhage is the only real danger, and this can to a large extent be prevented by not making the puncture too deep.

Quantity of Fluid Withdrawn.—In most cases it is sufficient to withdraw 5 or 10 c.c. of cerebro-spinal fluid. When the fluid is under great pressure it may be allowed to escape until the pressure falls. In infants the effect which is being produced may be judged of by noting the fall in the tension of the anterior fontanelle. It is undesirable to withdraw more fluid than is necessary, as temporary collapse may occur.

Cerebro-Spinal Fluid.—The cerebro-spinal fluid is a secretion, probably from the choroid plexus, not an exudation (Mott). Normally, it is a perfectly limpid fluid containing no true albumin or fibrinogen; it yields traces of a Fehling-reducing body, not sugar. It has a specific gravity of 1006-1008, is sterile, and is practically free from cells. From a diagnostic point of view the physical characters, chemical characters, bacteriology, and cytology of the fluid have to be considered; the last is the most important.

1. *Physical Characters.*—(1) *Pressure.* Normal fluid emerges from the needle in drops at the rate of 2 to 3 per second; in pathological conditions it may drop out more rapidly, flow out in a continuous stream, or even spurt out in a jet of some length. It is not difficult to judge from observing the rate of flow whether or not the fluid is under pressure, and the knowledge so gained is sufficiently accurate for practical purposes. The pressure can, however, be measured easily enough. A glass tube about 18 ins. long, with a bore of about $\frac{1}{10}$ in., is connected by an inch of rubber tube to the needle, and the height to which the fluid rises when the tube is held upright, is measured. The normal pressure is about 125 mm. H_2O; in disease (*e.g.* tuberculous meningitis) it may rise to 700 mm. or more. The chief information obtained from

estimations of the pressure is in cases of hydrocephalus following meningitis. If the pressure is high, the foramen of Magendie must be patent; if it is low, there is probably an occlusion between the base of the brain and the spinal canal. (2) *Colour.* The fluid is usually perfectly limpid, and deposits no coagulum on standing. In acute cerebro-spinal or pneumococcal meningitis it is turbid or even purulent; in chronic cerebro-spinal, post-basic, and tuberculous meningitis, especially the last, it may be almost clear, though as a rule a faint opalescence can be made out. Even the perfectly clear fluid of tuberculous meningitis often deposits a fine coagulum on standing. The fluid is blood-stained in many cases of hæmorrhage into the central nervous system. Estimations of the specific gravity, freezing-point, and electrical resistance are useless.

Thus mere physical examination yields much definite information. Turbidity is proof of meningitis, and even the slightest haziness is highly suspicious. Perfectly clear fluid negatives all forms of meningitis except tuberculous, and if the fluid is both clear and under no increase of pressure, there is probably no meningitis.

2. *Chemical Examination.*—Albumin may be estimated in a small-sized Esbach's tube. A quantity exceeding ·5 gram. to the litre is pathological; it has much the same significance as excess of cells. In general paralysis of the insane, Guillan and Paraut describe the following reaction:—"When normal cerebro-spinal fluid is boiled, the albumin coagulates, and the fluid becomes slightly opalescent. If the globulin be precipitated by adding a saturated solution of magnesium sulphate, the fluid filtered, and the filtrate again boiled, it should remain clear. In general paralysis, however, the second boiling yielded a characteristic precipitate in every case out of a series of 16 general paralytics examined by these observers" (Purves Stewart). In 1899 Mott and Halliburton described cholin in the cerebro-spinal fluid in cases of degenerative diseases of the nervous system, and suggested that its presence might serve to differentiate between organic and functional disorders. The cholin is crystallised out as a cholin-platinum chloride. The test is too complicated for clinical use, and, moreover, there is considerable doubt as to the nature and reliability of the reaction. Donath (*Rev. Neurologique*, 16th Feb. 1906) has introduced a modification of the test, and states a positive result is given in epilepsy as well as in degenerative diseases. Kaufmann (*Neur. Zentralb.*, 16th March 1908) thinks that the reaction has no clinical significance. The Fehling-reducing body is said to be absent in cases of tuberculous meningitis. At least 10 c.c. of fluid are required to test for its presence.

3. *Bacteriology.*—Among the organisms which, when present, are easily detected in ordinary smears, meningococci, pneumococci, and strepto- and staphy-lococci are the most common. It is difficult to detect tubercle bacilli; they should be sought for in the small coagulum which forms in the fluid from tuberculous meningitis. Much patience is required to discover them; some diligent workers state that they can be found in nearly 100 per cent. of cases; others have been less fortunate. Stuart M'Donald has recently demonstrated a leptothrix in some cases of meningitis.

The Wasserman test and other immunity tests may be applied to cerebro-spinal fluid (*see* IMMUNITY DIAGNOSIS). The cerebro-spinal fluid of the great majority of cases of general paralysis gives a positive Wasserman reaction.

In cases of sleeping sickness the trypanosoma gambiense is found in the cerebro-spinal fluid.

4. *Cytology.*—Normal fluid contains few or no cells. The cellular contents of the fluid may be estimated in several ways:—(1) Centrifuge about 5 c.c. of fluid for 10 minutes, pour off the fluid and remove the tiny clot at the foot of the tube with a platinum loop. Spread this on a clean slide over an area of 5 mm.^{2}, fix, and stain. By always adopting the same routine the number of cells per field gives an index of the cellular content. Normally, there should not be more than one or two per field of an oil-immersion lens. (2) Count the cells in an ordinary Thoma-Zeiss blood-chamber. The fluid over the whole ruled area ($\frac{1}{10}$ mm.^{3}) in 5 successive preparations must be counted. From 1 to 5 cells per cubic millimetre is normal, 5 to 9 doubtful, 10 and over, pathological. This is the easiest and most accurate method. It is unnecessary to stain or dilute the fluid; all that has to be done is to place a drop on a well-cleaned slide, to cover, and to examine. In tuberculous meningitis one commonly finds from 10 to 30 cells in each preparation, *i.e.* 100 to 300 per cubic millimetre. When they are numerous it is not necessary to examine more than one drop of fluid. (3) A third method, specially adapted for careful study of the cells, is unnecessarily elaborate for clinical work. Some fixing agent, *e.g.* alcohol, is added to the cerebro-spinal fluid, which is then thoroughly centrifuged. The deposit is embedded in celloidin, and sectioned. Cotton and Ayres have worked out the details of this method. The standard taken for comparison is the number of cells per 100 oil-immersion fields. They describe the following varieties of cells:—(1) Lymphocytes, including forms transitional between these and plasma cells. (2) Endothelial cells, large, oval, with horse-shoe nuclei. (3) Phagocytes. (4) Plasma cells—pathognomonic of general paralysis. (5) "Körnchen" cells, containing droplets of fat. (6) Polynuclear leucocytes.

The chief directions on which diagnostic information can be derived from a study of the

cytology of the cerebro-spinal fluid are as follows:—

1. *Tuberculous Meningitis.*—Cells are fairly abundant; in round numbers from 40 to 700 per c.mm. The average in Rous's cases was 213. Both mononuclear and polynuclear forms occur; there is a tendency to lymphocytosis, but the ratio between the two forms is not of importance.

2. *Acute Meningitis, Pneumococcal, Meningococcal, etc.*—Marked polynuclear leucocytosis.

3. *Other Nervous Diseases, excluding Syphilitic and Parasyphilitic Lesions.*—In serous meningitis (Quincke) the fluid is sterile, the pressure is slightly raised, and there may be a few lymphocytes. In hæmorrhagic meningitis, cerebral hæmorrhage, etc., blood may be present. In poliomyelitis, cerebral tumour, meningism, and the majority of other diseases, cytological examination is negative. The pressure may be raised.

4. *Lymphocytosis* occurs in practically all syphilitic affections, in tabes, and in general paralysis. In the last named, Cotton and Ayres describe lymphocytes, plasma cells, and sometimes phagocytes as pathognomonic of the disease.

5. In *non-nervous diseases* the findings are negative.

6. Generally speaking, *lymphocytosis* points to an organic affection of the meninges, especially tuberculous or syphilitic; it may therefore occur now and again in cases of cerebral tumour. In any old-standing disease of the nervous system "Kornchen" cells may be found (Cotton and Ayres).

7. In *mental diseases*, other than syphilitic, the fluid contains no cells.

THERAPEUTIC USE OF LUMBAR PUNCTURE.—Lumbar puncture is often effective in relieving headache due to intra-cranial pressure, *e.g.* from cerebral tumour. Care must be taken to drain the fluid off slowly, lest a sudden lowering of the pressure produce hæmorrhage into the tumour. Lumbar puncture may also be tried in cases of obstinate tinnitus, in coma from fracture of the base of the skull, in uræmia, and in convulsions. Tetanus has been treated by the injection of antitoxin into the spinal or cranial cavity, and strychnine poisoning by the intra-spinal injection of eucaine (*see also* CEREBRO-SPINAL MENINGITIS, p. 98, and ANÆSTHESIA, SPINAL, p. 32).

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Lungs and Thorax, Surgery of the.

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A GENERAL review of this subject was published in the *Gazette des Hôpitaux*, 29th Sept. 1906. Willems, the reporter, deals with empyema, costopleural tumours, tumours of the sternum, wounds of the lung and diaphragm, diaphragmatic hernia, intrapulmonary suppuration, tumour of the lung, and operations on the thoracic portion of the gullet. The use of Sauerbruch's negative pressure cabinet, and Brauer's positive pressure apparatus is also considered. Loison (*ibid.*) gives three principal routes for gaining access to the cavity of the chest—through the trachea and bronchi; the mediastinum; and the pleura. Both these papers will be found to give useful reviews of the subject up to the date of publication. The principal advances made have been in the direction of the avoidance of pneumothorax, especially by the use of differential pressure apparatus, and in the application of arterial suture to the large vessels. It should also be said, however, that the occurrence of pneumothorax is now less dreaded than formerly (*vide infra*). A considerable amount of experimental surgery on animals has been used as a basis for human surgery, especially in connection with the resection of portions of the lung. A very general note running through all the papers on thoracic surgery, whether the writers believe in the use of differential pressure apparatus, or whether they are disposed to minimise the value of appliances which, like these, are not generally available, is the insistence of the paramount importance of avoiding wound infection in this region of the body. Elsberg (*Med. Record*, 23rd May 1908) insists on the importance of placing the patient in the prone position in operations on the chest. He found that in dogs a much larger opening could be made in the chest without causing distress, if the animal was lying on its belly than when it was lying on its back. He operates on patients in this position with decided advantage.

Technique of Lung Resection—Experimental Work.—This subject is discussed by Sauerbruch (the inventor of the pneumatic cabinet which bears his name) and Robinson in the *Annals of*

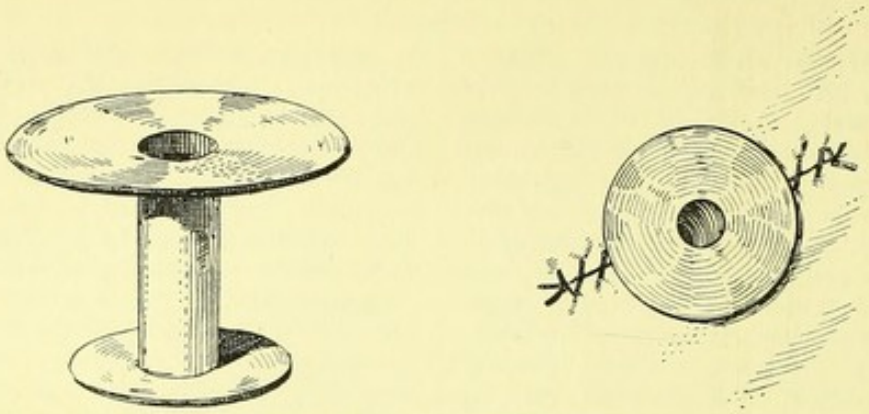
Surgery, li. 1910, p. 230. In the execution of a lung resection two difficulties arise—the treatment of the operative wound of the lung, and the prevention of pneumothorax. The use of differential pressure obviates with certainty the dangers of lung collapse. More or less extensive removal of lung tissue has been practised for the relief of tumours of the chest wall involving the lung, and for bronchiectasis; in some cases a whole lobe, and in one two lobes, have been removed. The extirpation of a complete lobe has been attended with poor results, the patients having succumbed within at most a few days after the operation.

In experimental work on animals, using the differential pressure chamber, an entire lobe can be ablated without causing death, and even after removal of a whole lung the mortality is not very high. The animals rarely die as an immediate result of ligature of the vessels or air-passages at the hilus. When death occurs it is due to reflex vagus stimulation. Some animals die from infection, others from so-called "tension pneumothorax" and mediastinal emphysema from the escape of air from an improperly treated bronchus. These two dangers, therefore, can be avoided by (*a*) careful asepsis, and (*b*) proper treatment of the bronchial stump. Probably the best method of closing the bronchus is that adopted by Willy Meyer—crushing the cartilage at two points, and folding in and suturing. After the removal of one lung, considerable empty space remains in the pleural cavity, but this fills up by a compensatory displacement of organs, which begins immediately after operation, and in young animals, may be complete in eight days. In older animals, or where for any reason the mediastinum cannot change its position, the obliteration of the cavity may be impossible, and it becomes filled with a transudate. The success of lung extirpation depends on the prevention of such a transudate.

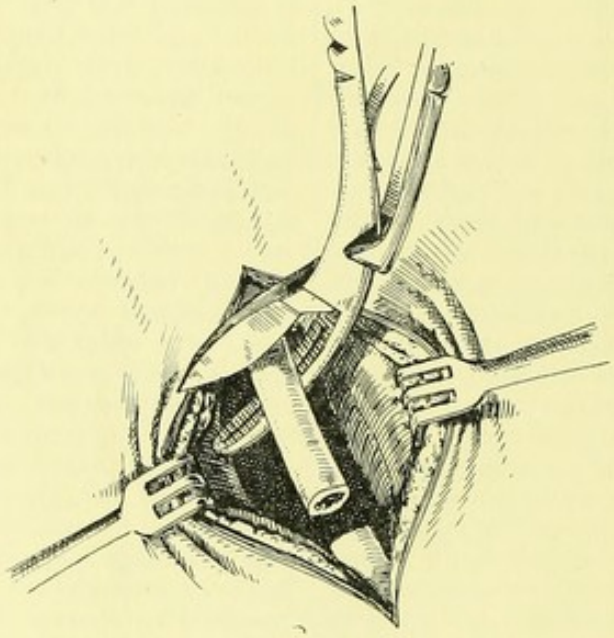
In Sauerbruch's pneumatic cabinet, the head of the patient remains outside when the anæsthetic is being administered, and the rest of the body remains inside the cabinet, which is large enough to accommodate the operator and assistants. When the cabinet is closed, the pressure in it can be lowered by about 10 mm. of mercury, equivalent to a difference in level of 1000-1200 feet. The patient, breathing air at the external pressure, does not suffer from collapse of the lungs, as would otherwise occur. After the operation the dressings are applied and hermetically sealed before the pressure is equalised. Subsequent dressings can be made in the same way. Brauer has introduced a positive pressure apparatus, in which the patient breathes air under pressure. It consists of a glass chamber fitted to the patient's face, with means for giving the anæsthetic and collecting the expired air in a pressure box guarded by a valve. Dreyer finds that in animals there is no difference between the two methods as regards effect on blood pressure and respiration, while Küttner (*Zentralblatt f. Chirurgie*, 29th Aug., 1908) states that both are equally convenient.

Sauerbruch and Robinson performed total extirpation of the left lung in a series of twenty-eight dogs by three different methods—simple excision through an intercostal incision with primary suture; secondly, extirpation with primary thoracoplasty; thirdly, a two-stage operation. In the first series, performed with a positive pressure apparatus, the mortality was very high as compared with the earlier results of these and other experimenters using a negative pressure apparatus. These contradictory results are ascribed solely to the differences in the apparatus used. In employing the pneumatic negative pressure cabinet, the negative pressure which has been produced in the thorax during the operation persists after the wound is sealed by the dressings, and continues to facilitate the compensatory displacement of organs, producing a state of matters unfavourable to the occurrence of a transudate. With the positive pressure apparatus, on the other hand, the pressure in the pleural cavity after the operation is that of the surrounding air, and as a negative pressure exists in the unopened pleural cavity the mediastinum tends to draw away from, rather than towards, the side operated on. We have, in fact, a simple closed pneumothorax, minus the normal air-absorbing surface of the lung. During the period which elapses before the air is absorbed transudation is liable to occur. With negative pressure the conditions after lung extirpation are favourable to a prompt diminution in the resulting cavity—with positive pressure the reverse. While removal of an entire lung will probably never become practicable in human surgery, the same conditions apply to partial excisions, hence the distinction which has been found in these experiments to exist between the two forms of differential pressure apparatus is of much importance.

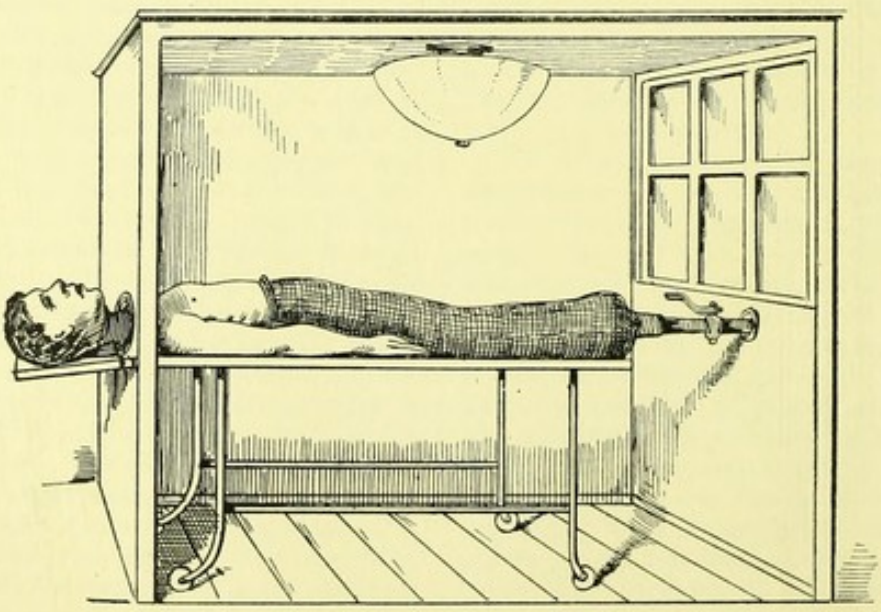
The object of combining thoracoplasty with extirpation is to provide for immobility of the mediastinum by diminishing the size of the cavity through the removal of ribs. When two ribs only were resected the animals died; one of two dogs which had four ribs resected survived; two of four animals which had six or seven ribs resected survived. In all cases of extensive resection there was marked dyspnœa. The mechanical displacement of the mediastinal septum after the removal of the chest wall has a serious effect on the great vessels, and in interfering with the action of the heart. The object of the two-sitting operation was to discover the practicability of avoiding primary suture of the bronchus, *e.g.* as might be



Wilson's empyema drainage tube.
The same in position.



Resection of rib for empyema.



Sauerbruch's cabinet for operation on lungs.

dangerous in cases of infection of the pleural cavity. One or two ribs are resected above and below the incision, so as to allow the lung to be drawn through the wound and fixed to the chest wall by sutures. Six dogs were dealt with thus, but only one lived long enough (to the third day) to allow of removal of the transplanted lung.

These experiments have a practical bearing on human surgery. Removal of a large part of a lung can only succeed when the cavity resulting diminishes in size as soon as possible to avoid a transudate. Negative pressure apparatus is to be preferred to positive pressure. Reduction in the size of the cavity by thoracoplasty should be limited to the removal of a few ribs, unless the mediastinum is immobile, when it may be more extensive. Suturing the bronchus to the chest wall must be done in such a way that tearing of the mediastinum is avoided.

The Surgery of the Thorax was discussed at the German Surgical Congress in 1908 (*Zentralbl. f. Chir.*, 29th Aug. 1908). Küttner recorded 18 operations, all under differential atmospheric pressure. These included tumours of the thoracic wall, bullet wounds of the lung, and primary malignant disease of the lung. The differential pressure prevents collapse of the lung, and facilitates the detection and suture of wounds of the organ. Sauerbruch reported the disappearance of generalised surgical emphysema in his cabinet after an incision had been made in the skin. In cases of cancer of the lung the prospect of surgical relief is very small. Surgical intervention has been attempted in a number of different pulmonary diseases, but so far it cannot be said to have justified itself as a routine practice, and at present remains largely in the experimental stage.

Pulmonary Embolism.—Trendelenburg has operated on several cases (*Zentralbl. f. Chirurgie*, 29th Aug. 1908; *Deuts. med. Woch.*, 2nd July 1908) of pulmonary embolism, and cases have also been reported by Sievers (*Zeitsch. f. Chirurgie*, May 1908) and Riedel (*Zentralbl. f. Chir.*, 22nd May 1909). None of the patients have recovered, and Trendelenburg urges that it is only to be undertaken as a *dernier ressort*. The method he advises is an incision over the second left costal cartilage, and another at right angles to this, allowing two flaps to be lifted. The second costal cartilage is removed, the pericardium opened, and the great vessels surrounded by an elastic ligature. The pulmonary artery is then opened and the clot aspirated; the opening is temporarily closed with forceps (the constricting band being removed meanwhile) and then sutured. Trendelenburg's first patient died during the operation of hæmorrhage, caused by laceration of the vessel wall by the ligature. His second patient, from whom a clot several inches long was removed, survived for 37 hours. Sievers' patient died 15 hours after the operation of heart failure. Riedel's case was the most promising as regards future possibilities. The patient was a woman, aged 32, who, after an operation for hernia, developed symptoms of pulmonary embolus. Operation was begun about 25 minutes after the onset. The second, third, and fourth costal cartilages were divided and the border of the left lung clamped to the edge of the wound with forceps. The pericardium was opened and a rubber tube was passed round it on a curved director, and then tied. The artery was then opened between forceps, and a clot about the size of the finger removed. The operation was interrupted twice by the heart ceasing to beat, which necessitated the temporary closure of the arterial wound with forceps, the slackening of the constricting rubber band, and massage of the heart to restore the circulation. Some difficulty was experienced in suturing the pulmonary artery. The operation lasted an hour. The patient did well until the fourth day, when the respiration became embarrassed, and some dulness was detected at the left base. Next day about 15 oz. of dark blood-stained fluid were removed from the left pleura, and again on the sixth day. The patient died the same evening. On post-mortem, the thoracic wound was found to be infected, and there was a quantity of pus and blood in the pleura. The incision in the artery was intact. Death was due to wound infection, attributed to the haste with which the preparations for the operation were made.

Pulmonary Tuberculosis.—Bonney (*Pulmonary Tuberculosis*, 2nd edition, London, 1910) devotes a chapter to surgical procedures in this disease. Drainage of pulmonary cavities has not been productive of good results, nor has the injection of various substances directly into the lung been particularly gratifying either to surgeon or patient. Notwithstanding the interest which attaches to the work of Murphy, Brauer, and others on the production of artificial pneumothorax so as to exert any desired degree of compression of the lung, the application of this principle (though method is based on one of the rarer of Nature's methods of favouring the cure of tuberculosis) has been found in practice more or less unsatisfactory. The objections are (1) the frequent existence of adhesions; (2) the fact that suitable cases belong to a class in which the prospect of cure by non-surgical means is good; (3) the impossibility of gauging the amount of compression which ought to be employed; and (4) the inevitable risk of operation. Bonney thinks that recourse may be had to operation in a few carefully selected cases. The measures which deserve consideration are (1) rib-resection and compression over the site of large pulmonary cavities and gangrenous areas; (2) chondrotomy of the first rib in

beginning apical tuberculosis; (3) resection of several costal cartilages in emphysema with fixed thorax; (4) the production of artificial pneumothorax in selected cases with extensive cavity formation or in patients suffering from uncontrollable hæmorrhage; and (5) total mobilisation of the chest wall by removal of the ribs from the second to the tenth inclusive.

Rib-Resection over large Cavities.—When a large cavity has formed, the natural process of cure depends on fibrous tissue formation in and round its walls, and shrinkage. If septic infection of the cavity has occurred this process is checked, and, on the other hand, where there is much development of fibrous tissue shrinkage may be prevented by the existence of firm pleural adhesions and the unyielding chest wall. In some cases, therefore, it may be advisable to resect several ribs without opening the pleura, and to apply a large pad to favour shrinkage. Freeman (*Annals of Surgery*, July 1909) also advocates a limited resection, under local anæsthesia if desirable, of two or three ribs near the apex, as perfectly safe, and of much service, especially when supplemented by the external pressure of a truss, the pads of which rest on the front and back of the chest, and are connected by a spring passing over the shoulder. The procedure should be reserved for refractory cases with marked, limited, apical lesions, especially those with a tendency to excavation. Two to three inches of each rib (second, third, and perhaps fourth) are removed below the clavicle. Recovery is protracted. He has performed the operation twice, with encouraging results.

Chondrotomy of First Rib in beginning Apical Tuberculosis.—The rationale of this operation is based on the belief that in certain cases the apex of the lung is damaged, and infection with tuberculosis predisposed to, by ossification of the first rib and contraction of the bony wall of the thorax. Hart reports (from post-mortem findings) that arrest of apical foci is more common when a pseudo-arthrosis is established in the cartilage of the first rib. Seidel describes a method of producing an artificial joint. A skin flap is raised from the clavicle to the second rib, its base being lateral, and its apex towards the sternum. The cartilage is exposed and freed from muscle fibres, and the perichondrium freed. A narrow segment of cartilage, about $\frac{1}{5}$ inch thick, is excised, the line of its long axis running from the axilla towards the throat. A false joint is assured by placing a few fibres of the pectoral muscle in the channel made by the removed segment. The operation can be of little use when the tuberculosis process extends materially beyond the apex of the lung.

Resection of Ribs for Emphysema.—Patients suffering from emphysema with fixation of the thorax may be benefited by the resection of several ribs. The operation consists in the excision of $1\frac{1}{2}$ to $2\frac{1}{2}$ ins. of rib, with the periosteum, at the junction of bone and costal cartilage from the second to the sixth ribs inclusive. In emphysema, with the loss of the normal flexibility of the ribs and cartilages, the chest is permanently fixed in a position of more or less full inspiration, and the breathing is largely abdominal. Upon removal of the rigid cartilages and ribs the normal range of movement returns. The operation is said to give good results, and to be comparatively free from danger. Goodmann and Wachsmann (*Medical Record*, 16th May 1908) report favourably on four cases operated on, and conclude as follows:—"Freund's operation is of great benefit in emphysema with a rigid dilated thorax. A most convincing feature is observed during operation; when the costal cartilage is resected the rib recedes immediately, at times below the level of the sternum. The ribs move so freely that the finger tip is distinctly squeezed when inserted between the sternum and rib. The lung visibly contracts; relief may be afforded by operating on one side. The operation is not dangerous and is not followed by shock. Cardiac insufficiency, asthma, chronic bronchitis, and albuminuria are not necessarily contra-indications. The best results are likely to follow when operation is undertaken before complications have arisen. A removal of, or plastic operation on, the perichondrium of the resected cartilages seems imperative to obtain lasting improvement." Passler and Seidel (*Centralbl. f. Chir.*, 1907, 2nd Nov.) also report successful cases.

Artificial Pneumothorax is only justifiable in exceptional cases. It has been employed with most success in cases of uncontrollable hæmorrhage, but it is futile to resort to it when there are extensive pleuritic adhesions. The originator of the idea of employing artificial pneumothorax in the cure of pulmonary tuberculosis was Fortanini (*Deuts. med. Woch.*, 1906, xxxv., and other papers). On account of its slow absorption he employed nitrogen, injecting a little each day, so as gradually to increase the size of the pneumothorax. Murphy next took up the question (*Jour. Amer. Med. Assoc.*, 1898), using larger quantities of nitrogen (1-$3\frac{1}{2}$ litres) and repeating every month or so, as Röntgen ray examinations showed it was being absorbed. Murphy regarded extensive bilateral pulmonary mischief, adhesions, and cardiac weakness as contra-indications; as the chief dangers—infection, subcutaneous emphysema, air embolus and dyspnœa from two large injections. Schell applied pneumothorax in the treatment of intractable hæmophysis with considerable success. Brauer independently (*Deut. med. Woch.*, 1906, xvii.) introduced the method into Germany, following in the main, Murphy's technique. Fortanini prefers gradual

production of pneumothorax, and lays down the following rules for its performance:—(1) It must be large enough to immobilise the lung and abolish the breath sounds. (2) It must be brought about gradually lest (*a*) the mediastinum be suddenly displaced, and (*b*) large quantities of suddenly dislodged sputum cause an aspiration pneumonia; (3) during the whole period of treatment the pneumothorax must be maintained at the same level by repeated small additions of nitrogen as needed. For a general review of the subject see Bunzl, *Centralbl. f. d. Grenzgebeite d. Medizin u. Chirurgie*, 1908, No. 3. The consensus of opinion is that the operation is only permissible in carefully selected cases; it is very rarely performed nowadays.

Total Mobilisation of the Chest Wall by Multiple Rib-Resection (Friedreich's Pneumolysis).—This is a heroic operation, by no means free from danger. Friedreich resects all the ribs from the second to the tenth inclusive, and from the anterior cartilages to the spine. The pleura must not be punctured. The work must be done rapidly owing to the weakened condition, and the defective circulation and respiration—Friedreich is said to be able to perform the operation in less than half an hour. After operation the diminution in the size of the lung is considerable, the volume being reduced by one half or two-thirds. The operation has only been performed in a small number of cases; it would seem only to be indicated in patients in whom the disease is unilateral and progressive, whose nutrition is fair, and where all ordinary treatment has failed to check the disease. As minor forms of mobilisation, we may mention Landner's method—the removal of portions of ribs and periosteum along the axillary line, and local removal of ribs and periosteum over diseased areas.

Empyema.—A number of papers dealing with the operative treatment of empyema have appeared. In most of these the use of various mechanical methods of favouring drainage and promoting expansion of the lung by means of suction is discussed. The idea of employing suction is by no means new, and the number of modifications of comparatively old forms of apparatus seems to prove that, simple as the method is in theory, its practical application involves considerable difficulty. Williams (*Lancet*, 29th Sept. 1906) fits a rubber valve on the aspirator tube which passes through the stopper of the bottle. The object of this valve is to prevent air from passing back into the pleura during thoracocentesis. This accident, however, can scarcely occur if ordinary care is exercised, and if one of the stopcocks only is allowed to remain open at a time—the proximal after the bottle is exhausted, and the distal when the pump is being used. Williams also describes an empyema tube consisting of a metal shield, rubber tube, and valve. The valve is of the ordinary form used in enema syringes. The principle of this mechanism is that when once properly applied (a simple matter) the patient pumps his own chest out, the diaphragm being the piston, and the respiratory movements the power. The valve allows of the egress of gas, and prevents the reflux of air or fluid. The tube is liable to be blocked, but can easily be changed. The end of the tube to which the valve is attached is kept immersed in water. Bryant's apparatus (*Surgery, Gynæcology, and Obstetrics*, Aug. 1906) consists of a suction elastic bag, resembling a Politzer's bag, connected by a stopcock to a drainage tube. It is not easy to seal the tube efficiently to the chest wall, and on this point, of course, the successful application of suction drainage depends. Adhesive plaster, rubber tissue applied with chloroform round the margins, wet absorbent cotton, oxide of zinc ointment, have been used. A preparation made by Johnson & Johnson, known as adhesive rubber dam, is said to fulfil all requirements. In using this apparatus the amount of suction can be varied by altering the size of the bag and by regulating the stopcock. Schley (*Amer. Journ. Med. Sci.*, 1908, Jan.) advises a similar apparatus. Tennant (*Journ. Amer. Med. Assoc.*, 16th Nov. 1907) recommends a special form of two-way drainage tube, which can be manufactured in a few minutes from an ordinary drain. The method is simple, but can scarcely be rendered intelligible without diagrams, for which, therefore, the original should be referred to. Bencker advises Henry's rubber drainage spool for empyema. The spool consists of a rubber drain 1½ to 2 ins. long, with a lumen of ½ in., at each end there is a flange about 2 ins. in diameter. One is compressed with a pair of forceps and thrust through the incision, and lies against the pleura. The advantages of the spool are that the discharge from the empyema flows directly into the dressing without coming in contact with the wound; the tube cannot slip; the tissues cannot block the tube.

The general question of empyema from a surgical point of view is discussed by A. E. Morison in the *Edinburgh Medical Journal*, March 1908. In an editorial note in the *Practical Medicine Series*, ii., 1908, p. 222, edited by John B. Murphy, the practice of aspiration followed by the injection of a few drachms to 2 oz. of 2 % formalin in glycerin is recommended in all empyemas which do not communicate with the bronchi or hollow abdominal viscera. The aspiration may be repeated in two or three days, but a second injection should not be performed before a week has elapsed In post-pneumonic empyemas, particularly in children, one injection usually suffices for a cure. "Absorption of the purulent

sero-sanguinolent, or serous material, may require months or even years. . . . This fluid . . . does the patient no harm, as it is aseptic. The irritation produced by the formalin, first, sterilises the pus and abscess wall; second, stimulates cicatrisation and contraction of the granulation tissue; and third, it stimulates the production of the polymorpho-nuclear cells, which supply trypsin, the proteolytic action of which converts the albuminoid bodies in the fluid into peptones and prepares them for absorption."

In chronic empyema discission of the pleura is advocated by Ransohoff (*Annals of Surgery*, April 1906). As much of the pleura as possible is dissected off through the **V**-shaped schede incision with multiple rib-resections. If the cavity is large repeated operations may be necessary.

Pneumothorax.—Murphy (*General Medicine Series*, ii., 1909) states that in pneumothorax, where the pressure is increasing and giving rise to alarming dyspnœa, the danger can be averted by introducing a large exploring needle into the pleural cavity. This is retained as long as necessary, and should be plugged with wool to prevent infection. Pneumothorax resulting from an opening in the chest wall does not possess the dangers that are usually attributed to it. The chest wall may be opened and air permitted to enter and escape freely without giving the patient any particular trouble. A small opening, which admits more air than escapes, is always dangerous; its evil effect, however, can be overcome by placing the hand over the opening, thereby stopping the ingress and egress of air. If the respiratory exchange is not sufficient when the chest is extensively opened, a towel may be slipped into the chest and pressed against the mediastinum, so as to fix its tissues and prevent vibration, thus restoring respiratory exchange. The Sauerbruch chamber and other mechanisms are rarely needed when only one-half of the chest is opened.

Lupus Erythematosus.—Although we are still in the dark as to the etiology of lupus erythematosus, some advance has recently been made in its treatment.

Finsen Light.—In chronic cases, after soothing local treatment has been tried unsuccessfully, exposures to the Finsen light are found to be beneficial. As suggested by Norman Walker, the exposures are given at a distance of about a foot from the lens of the lamp on every alternate day for half an hour. In this way a comparatively large area may be treated at one time, and the difficulty of applying the compressor, which is used in treating lupus vulgaris, done away with. At the same time as the light treatment is being given, the patient should also use some soothing lotion night and morning.

X-Rays.—X-rays have been tried in lupus erythematosus with varying results. The seborrhœic form of the disease is the one which is most benefited by rays, but as considerable exposures have to be given there is a risk of producing a local reaction with a subsequent atrophy and telangiectasis. Recurrence of the disease after its removal by X-rays is also not uncommon. Taking into account the risks of the treatment, the uncertainty of the result, and the tendency to relapse, X-rays cannot be said to be better than other methods of treatment, and therefore other less dangerous methods have to be preferred.

Freezing.—Another method which has given good results is that of freezing the skin. This was first introduced by Arning, who sprayed a mixture of ethyl and methyl chloride on the skin till it was frozen. Later Juliusberg attained the same object, but got a deeper and more rapid effect, by allowing liquid CO_2 from a cylinder to jet on the skin. The difficulty of controlling the escape of the CO_2 was overcome by Pusey, who allows the carbon dioxide to escape with a rush from the cylinder into a piece of chamois leather. It deposits on the leather in the form of a snow which can be compressed into solid masses, which are cut into shape with a knife, grasped by forceps, and applied to the skin. The snow may also be stamped out into pencils of convenient shape and size by means of an ear speculum or cylindrical rubber tube of different widths. The snow is pressed into the lesion for a half to one minute. The longer the contact and the firmer the pressure, the deeper the freezing. The skin is thus frozen to a depth of about half an inch. The freezing is absolutely painless, and the subsequent thawing causes only a slight stinging sensation, which soon passes off. A few moments later a wheal begins to develop, and later the affected part shows a circumscribed inflammatory reaction with vesiculation. Later this crusts over, and when the crust falls off the lesion has disappeared without any visible scar formation.

REFERENCES. — Pusey, "The Use of Carbon Dioxide in Treatment of Nævi and other Lesions of the Skin," *Jour. Amer. Med. Assoc.*, Oct. 1907.—Tremble, *Journ. Cutan. Diseases*, Sept. 1907.—Zeisler, *Journ. Cutan. Diseases*, p. 32, 1909.—Arning, *Deutsche med. Wochensch.*, No. 32, 1903; *Congress der Deutsche Derm. Gesellsch*, Sept. 1903.—Hansen, *Deutsche med. Wochensch.*, No. 40, 1903.—Dreuw, *Monatssh. f. prakt. Derm.*, Bd. 37, p. 193, 1903.—*Münch. med. Wochensch.*, No. 15, p. 683, 1904.—Juliusberg, *Berlin. klin. Wochensch.*, No. 10, 1905.

Lupus Vulgaris.—Finsen Light.—The Finsen light treatment of lupus vulgaris is undoubtedly the method of choice where a good cosmetic result is desired, but the expense and time necessary for the treatment are beyond the means of many patients. After the light treat-

ment, cases must be kept for some time under observation, as recurrences are not uncommon, because the deeper nodules are not readily accessible to the rays, and the disease heals on the surface but reappears, starting from some deep nodule which has been overlooked. In the Edinburgh Royal Infirmary the Finsen light treatment has been almost entirely replaced by the X-rays.

X-RAYS.—The rays should be given regularly for a period and then stopped, as the disease continues to heal for weeks and sometimes months after X-ray treatment has been discontinued. A combined method of treatment gives the best results. X-rays alone are not advisable. Locally a very good application is an ointment consisting of Ichthyolici ♏xv., Ac. salicyl. gr. x., and Ung. hydrarg. oleat. (5 per cent.), ℥i. This ointment should be rubbed very well into all the nodules for at least half an hour, night and morning. The advantage of this ointment is that the patient can use it himself at home for an indefinite time without supervision. Combined with simultaneous X-ray exposures very rapid results may be obtained.

DREUW'S METHOD.—For those who cannot obtain X-ray treatment, a useful method is that introduced by Dreuw. This method consists in first freezing the diseased area by ethyl chloride or carbon dioxide snow, and then rubbing crude hydrochloric acid well in. Pieces of wood with cotton-wool wound round the end are dipped in the hydrochloric acid, which is very thoroughly rubbed in. The acid has a selective action on the lupus tissue, causing it to slough off. After the acid is applied, the area is dressed with a bland powder. A crusted slough forms, and when that falls off the resulting scar is a good one. For large areas it is recommended to give the patient chloroform, as the treatment can thus be much more thoroughly carried out. This method is suitable for lupus of the mucous membranes as well as of the skin. Dreuw claims that the preliminary freezing makes the operation practically painless, but that is not the case, the pain, although of short duration, often being very considerable. The cauterisation has to be repeated as often as necessary. After the greater part of the disease has been cured, any isolated nodules, which are left, are spiked with the crude acid, which is introduced by a small sharp-pointed glass tube. The advantages of the method are its cheapness, rapidity of action, and good cosmetic result.

TUBERCULIN.—Tuberculin (T. R.) has now been used fairly extensively in the treatment of all tuberculoses of the skin, but the results recorded are very various. Some claim to have cured the disease with tuberculin alone, but the majority report improvement only in certain cases, the dry scaly forms without ulceration being least affected by tuberculin.

Tuberculin (T. R.) may safely be given in doses of $\frac{1}{2000}$–$\frac{1}{1000}$ mgm. every three weeks, and the counting of the opsonic index is not essential. The effect on the disease and on the general condition should be watched, and if these improve the injections continued. The injections should not cause any rise of temperature or local reaction in the diseased area. Tuberculin treatment should be combined with local treatment, such as X-rays, etc.

The use of old tuberculin (A. T.) is now entirely reserved for diagnostic purposes in doubtful cases. It is given subcutaneously in an initial dose of $\frac{1}{10}$ mgm. This usually causes a rise of temperature and a marked local redness and swelling of the lesions. The local reaction is the only reliable one, as the general reaction may be due to tubercle of the internal organs. It should also be remembered that a rash not infrequently follows the injection of old tuberculin. The rash is usually a small papular one, and often indistinguishable from lichen scrofulosorum. It has no significance, and fades as a rule in a few days, but may persist as a chronic eruption like lichen scrofulosorum.

CALMETTE'S AND PIRQUET'S REACTIONS.—The ophthalmic tuberculin reaction and Pirquet's cutaneous tuberculin reaction are of no value in the diagnosis of skin diseases. If a positive result be obtained, it is simply an indication that the patient has either active or latent tuberculosis in his body somewhere, and does not imply that any skin lesion present is tuberculous in nature.

RADIUM.—Radium is also useful in the treatment of lupus. The duration and frequency of the applications depend on the quantity of radium used, and can only be learned by experimenting with a given specimen of radium. Its action is very much like X-rays, but it has the further advantage that it can be applied to the mucous membrane of cavities, such as the nose and mouth, where it is difficult or impossible to apply X-ray treatment. It can also be readily applied to lesions which are in close proximity to the eye. The disadvantages are the high price and its applicability to only limited areas at a time.

REFERENCES.—MORRIS and DORE, *Light and X-Ray Treatment of Skin Diseases*, 1907.—DREUW, *Berl. klin. Wochensch.*, No. 17, 1904.—REYN and PETERSEN, *Lancet*, p. 1004, 1908.—RAW, *Lancet*, p. 481, 1908.—LOW, *Scott. Med. and Surg. Journ.*, May and Sept. 1905.

Lymphæmia.—Lymphatic leukæmia; it differs from splenomyelogenous leukæmia in that the increase is marked in the mononuclear non-granular cells rather than in the granular ones.

Lymphangioplasty.—An operation for the relief of lymphatic œdema, a number of

silk threads being buried in the subcutaneous tissue to form an artificial lymphatic system for draining the part. *See* Sampson Handley, *Lancet*, i. for 1908, pp. 783, 1207; ii. for 1908, p. 1671; i. for 1909, p. 543; i. for 1910, pp. 977-979.

Lymphopenia.—The condition of the blood in which there is a reduction in the number of lymphocytes; it is the opposite to lymphocytosis.

Lysæmia.—*See* Blackwater Fever (*Experimental Hæmolysis*).

Lytic Action.—Destructive action, as seen in hæmolysis when certain sera cause breaking up of the red cells, etc.

M'Gavin Operation.—The wire filigree operation recommended in cases of ventral and inguinal hernia of large size and with wide separation and atrophy of the muscular and fascial structures.

Macrocytase.—In Metchnikoff's theory of immunity the complement (cytase) developed by the macrophages (hyaline leucocytes, endothelial cells, fixed phagocytes) is called the macrocytase (Gr. μακρός, long; κύτος, the body).

Macronucleus.—The larger of the two nuclei of the infusorian cell, and the one which disappears during conjugation and fertilisation.

Macrophages.—The large phagocytes of Metchnikoff's theory of immunity, including hyaline leucocytes, endothelial cells, and fixed phagocytes (Gr. μακρός, long; φαγεῖν, to eat).

Madelung's Disease.—*Radius curvus.*—This condition was originally described by Madelung as a spontaneous luxation of the wrist joint, which is produced slowly, and little by little becomes worse without the occurrence of trauma or inflammation. Recent observations, particularly X-ray examinations, have, however, shown that there is no true luxation but a curving forward of the lower epiphyses, or lower end of the diaphyses, of the radius, which results in a displacement forwards of the carpus and hand, subluxation of the inferior radio-ulnar articulation, and masked dorsal projection of lower end of the ulna above the anteriorly displaced carpus. There is impairment of muscular power, but not much interference with movement. The disease usually appears between the twelfth and eighteenth years; it is more common in females than in males, and may be unilateral or bilateral. From its commencement about two years are required for its full development, and during this stage it is painful. Thereafter there is no pain, only permanent deformity. The etiology is uncertain; heredity is said to be a factor. Among the theories which may be mentioned are congenital laxity of the inferior radio-ulnar articulation, rickets, trauma, and tuberculosis. The treatment during the active stage is rest; when the disease is fully developed, osteotomy (Marsan, *Arch. généralis de chirurgie*, 1908, ii. p. 472; Estor, *Rev. de chirurgie*, 1907).

Magnesium Sulphate, Intraspinal Injection.—*See* Tetanus.

Magolan.—This is calcium anhydro-oxydiamine-phosphate, an organic phosphorus compound, which has been used in diabetes mellitus. *See* Nachmann, *Med. Bl.*, xxix. p. 579, 1906; *Ærtzl. Rundschau*, xvi. p. 221, 1906.

Malakin.—A body of the phenacetin group, being a compound of salicylaldehyde and phenetidin; it is in the form of yellow crystalline needles, almost insoluble in water; the dose is from 10 to 30 grains; and the effect produced is analgesic rather than antipyretic. *See* Fortescue-Brickdale, *Newer Remedies*, p. 217, 1910.

Mallein Test.—*See* Immunity.

Maltase.—An enzyme which splits up maltose ($C_{12}H_{22}O_{11}$) into two molecules of glucose ($C_6H_{12}O_6$), and which has also the power (in a certain measure) of synthetising glucose into maltose. *See* Digestion (*Intestinal Juice*).

Malted Foods.—The composition of various malted foods, *i.e.* foods consisting of a farinaceous material (*e.g.* wheat flour) mixed with malt flour (*i.e.* flour obtained by milling malted barley), is given in the *British Medical Journal*, i. for 1910, p. 86; the list includes Allenbury's Malted Food, Fry's Malted Cocoa, Horlick's Malted Milk, Paget's Malted Farina, and others.

Malt Extracts.—Analyses of various proprietary extracts of malt are given in the *British Medical Journal* (ii. for 1909, pp. 1477-1478); they include the Kepler Extract of Malt, Trommer's Extract of Malt, Allen and Hanbury's Malt Extract, D.C.L. Malt Extract, Oppenheimer's Cream of Malt, Maltine, Diamalt, Standard Malt Extract, Bynin, Standard Liquid Malt Extract, and Hoff's Malt Extract or Homax; the making of malt extract is thus described: "It is prepared by 'mashing' crushed malt, as in the first stage of the brewing of beer; the malt is infused in warm water for some time, and the liquor is then drained off and concentrated *in vacuo* to about the consistence of treacle; during the mashing process

the starch of the grain is attacked by two enzymes —cytase and diastase—and converted principally into a mixture of dextrin and maltose" . . . and "a small proportion of the maltose is further hydrolysed to glucose;" some malt extracts, further, have glucose added to them, some have dextrin (usually made from potato starch), and others have various preservatives (*e.g.* salicylic acid, benzoic acid, formaldehyde, glycerine).

Maltico.—A proprietary food preparation, which is described as "a perfect infant food"; its analysis is given in the *Brit. Med. Journ.*, i. for 1910, p. 30.

Mango Juice.—The fruit of the mango may be used as a mild laxative and for its antiscorbutic properties; it has been recommended in cases of gout and diabetes (on account of the almost entire absence of sugar); there is a proprietary preparation called "preserved mango juice" which is analysed in the *Lancet* (ii. for 1910, p. 1142); another preparation called *mango pulp* is reported on in the *Brit. Med. Journ.* (ii. for 1910, p. 1349).

Mania Contionabunda.—A semi-humorous term (Lat. *contionabundus*, haranguing in a public assembly) for the amazing amount of public speaking common at the present time; the "haranguing disease"; a "determination of words to the mouth" with "relaxation of the mental sphincter." *See* editorial in *Lancet*, ii. for 1910, p. 1775.

Mania Errabunda.—A semi-humorous term (Lat. *errabundus*, wandering) for the restlessness of modern life, the "running-to-and-fro disease"; the desire wherever one is to go somewhere else immediately. *See* editorial in *Lancet*, ii. for 1910, p. 1775.

Marechalt's Test.—A test for bile pigment in urine; a 1 per cent. alcoholic solution of iodine is run into a tube containing a few drops of suspected urine in such a way that it forms a layer on the top of the latter; if bile pigments are present an emerald green colour develops at the point of contact; it is known also as Smith's, Rosin's, or Trousseau's test.

Margination.—A stage in inflammation artificially produced when the leucocytes lag behind in the blood current, and finally become adherent to the walls of the blood-vessel.

Mariani's Tonic Coca Wine.—A proprietary tonic wine; for analysis see *Brit. Med. Journ.*, i. for 1909, p. 1307.

Marrow Exhaustion.—A depleted state of the bone marrow, with widened blood spaces and a decrease in the number of cells; clinical evidence may be afforded by leucopenia. *See* Andrewes, *Lancet*, ii. for 1910, pp. 86-88.

Marx's Fluid.—A staining reagent which contains hydrochlorate of quinine, potassium hydrate solution, and eosin.

Marza Wine.—A proprietary tonic wine, described as "containing iron, phosphorus, coca, and pepsine"; analysis in *Brit. Med. Journ.*, i. for 1909, p. 1307.

Massolette.—A medicated sweetmeat containing the bacillus of Massol, which, when added to milk, develops lactic acid. See *Lancet*, ii. for 1909, p. 1678; *Brit. Med. Journ.*, i. for 1910, p. 452.

Mast Cells.—Polymorphonuclear basophilic leucocytes; these cells are increased in the so-called mast-cell leucocytosis of myelogenous leukæmia. *See also* BLOOD (*Pathological Appearances*).

Matas's Operation.—See ANEURISM (*Surgical Treatment*).

Maydl's Operation.—*See* BLADDER, FEMALE (*Ectopia*).

Mayo's Operation.—An operation for Hallux Valgus, in which part of the head of the metatarsal bone is removed, and the adventitious bursa used to form the new joint.

Meat-Packing Houses.—*See* ABATTOIRS.

Mechanotherapy.—OSTEOPATHY (*q.v.*).

Medinal.—Sodium veronal, having an advantage over veronal itself only in being easily soluble in water, and in being capable therefore of being injected intramuscularly, or as an enema; but it has an objectionable taste, and being more rapidly absorbed may set up toxic symptoms in specially susceptible individuals. *See* Fortescue-Brickdale, *Newer Remedies*, p. 165, 1910; T. Forrest, *Prescriber* (Edinburgh), iii. p. 12, 1909; Ebstein, *München. med. Wochnschr.*, lvi. p. 136, 1909.

Mediterranean Fever—Malta Fever (*see also* MUHINYO).—The work of the Mediterranean Fever Commission, appointed in 1904, has thrown a great deal of light on the nature of this disease, which is due to the *micrococcus melitensis* described by Bruce in 1886. In 1897 Wright showed that

the blood of Malta fever patients contained specific agglutinins. The chief results of the commission's work are as follows:—

1. *M. melitensis* is a vigorous organism which may resist desiccation for a period of several weeks.

2. Malta fever is a septicæmia; the specific organism can be recovered from the peripheral blood of the patient, from the urine, and from the fæces.

3. An ambulatory type of the disease exists among the inhabitants of the island. Infected persons give the agglutination reaction, have the micrococci in their blood, and excrete them by the urine.

4. Infection is not conveyed by the sputum, sweat, breath, or scrapings of the skin of patients. It does not take place "if contact is limited to skin surfaces only, and if contamination with infected excretion is carefully eliminated" (Eyre). Infection is probably occasionally conveyed by sexual intercourse.

5. The disease can seldom be induced in monkeys by exposing them to infected dust.

6. About 50 per cent. of the Maltese goats give a positive agglutination reaction, and about 10 per cent. excrete milk which contains the *micrococcus*. By feeding goats on infected material it is, in many cases, possible to produce the disease in them. Monkeys fed on infected milk contract the disease.

7. A steamer conveying infected milch goats to Antwerp became the seat of an epidemic. Of 10 individuals who drank freely of the milk on board 8 fell sick of Malta fever. Attempts to inspect the milch goats on the island led to a strike among the dairymen, which necessitated the replacement of the goats' milk in the dietary of the troops by condensed milk: Malta fever at once diminished. In 1905 there were 750 cases; in the first half of 1906, 144 cases; second half of 1906 (after alteration of milk supply), 32 cases; 1907, 7 cases. In the navy during 1905 there were 498 cases; during 1906, 248 cases, January to September 1907, no cases. These observations in the epidemiology of the disease have been confirmed by investigations showing that, in the majority of cases of the disease, a direct relationship with fresh milk can be traced. The goat is probably the primary source of the disease in most, if not all, cases.

REFERENCES.—*Mediterranean Fever Reports* (London), V.Y.; also Critical Review by Eyre, *Quarterly Journ. Med.*, Jan. 1908.

Meiosis.—The true reduction process in the chromosomes in the spermatozoon and ovum during maturation (Moore); it is derived from the Gr. μεῖον, less.

Meiostagmin Reaction. — *See* Cancer (*Cancer Reactions*).

Meligrin. — A proprietary preparation, being a mixture of 86 parts of antipyrin and 14 of exalgin (*Brit. Med. Journ.*, ii. for 1909, p. 1264).

Membroids.—The trade name given to an administrative form of drug which passes unaltered through the stomach to be dissolved in the intestine, the drug being enclosed in two layers of membrane which resist gastric juice, but not the pancreatic. See *Lancet*, ii. for 1908, p. 99.

Meningism.—This term, or that of *Syndrome of Dupré*, is given to the morbid state, nearly always due to toxæmia, which is accompanied by the clinical features of true meningitis, but not by the pathological changes in the meninges which are characteristic of that disease; this form of meningeal irritation can usually be distinguished from meningitis by lumbar puncture, the fluid being clear, flowing with no increased pressure, showing no organisms, giving rise to no bacterial growths in media, developing no "spider-web" coagulum on standing, containing albumen only in very small amount, and having a normal reducing power with Fehling's solution; blood counts show no increase in the polymorph leucocytes in meningism. When the toxæmia is relieved, rapid and complete recovery usually follows; and treatment includes the use of salt solution subcutaneously (Langley Porter, *Arch. of Pediat.*, xxvii. p. 9, 1910).

Menstruation.

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Since the appearance of Green's *Encyclopædia Medica* the most imporant advance in our knowledge of *menstruation* has been in the direction of the elucidation of its comparative physiology. W. Heape's article (*Quarterly Journ. Microsc. Sc.*, xliv. p. 1, 1900) may fairly be said to have inaugurated a new series of investigations which have been of the greatest value in breaking down the artificial wall of separation which had been built up between menstruation in the human female and that process in other mammals. Heape began with a revision of the current terminology of the subject. He defined the "reproductive period" as the whole period of the life of a mammal (male or female) during

which its generative organs were capable of the reproductive function; the "breeding season" was the whole of the consecutive period during which any male or female mammal was concerned in the production of young, and it did not include (in the case of the female) the nursing period, although it did include the "sexual season" and gestation; and the "sexual season" was for both male and female mammals the particular time, or times, in the year during which their sexual organs exhibited special activity, and it might consist of one or more periods, long or short, interrupted or not by gestation (in the female). It was desirable to restrict the terms "rutting season" and "rut" to the phenomena of reproduction in male mammals; but "rutting season" might be regarded as synonymous with the "sexual season in the male." In some mammals, such as the stag, the rutting season was a limited and defined period of the year, during which alone the male had power of inseminating the female; in others, such as the dog, there was sexual capability all the year round. Having in this way simplified and defined the terminology of the subject, Heape proceeded to deal with the female sexual season and its phenomena, especially as they were manifested in the absence of the male, for his presence, and more particularly the occurrence of gestation, introduced complications. He found that the sexual season consisted of four consecutive periods. In the case of mammals (*e.g.* the bitch and wolf) which are named "*monœstrous*," the four periods were as follow:—(1) There was the pro-œstrum, or "coming in season," during which the internal and external genital organs showed congestive and hypertrophic changes and exhibited a discharge, generally mucous in character, but sometimes containing blood also; (2) this was followed by the "œstrus," the climax of the whole cycle, and the time during which the female had desire for the male and was capable of being fertilised by him; as a rule œstrus succeeded the pro-œstrum, and during its occurrence the wave of vascular disturbance which had affected, in turn, the external and the internal generative organs passed back again to the external parts; (3) a period ("met-œstrum") during which the functional activity of the organs was subsiding, followed upon œstrus; and (4) "an-œstrum" or the anœstrous period, a resting time during which the reproductive organs lay fallow, so to speak, brought the whole cycle to a close. A "monœstrous" mammal might have one, two, or three such *anœstrous* cycles in a year, thus (representing the periods by their initials) there might be P : Œ : M : A (of ten or eleven months); or P : Œ : M : A (of two or three months): P : Œ : M : A (of two or three months).

But there was also another type of sexual season, such as was met with in the mare. In that type there occurred the pro-œstrum, œstrus, and the metœstrum as in monœstrous mammals; but then followed, not *anœstrum* but a short resting time called "*di-œstrum*," and then the cycle recommenced (pro-œstrum, œstrus, metœstrum), to end this time in anœstrum, or, perhaps, once more to have diœstrum and a third cycle. The sexual season consisted of a series of such cycles, which might be termed *diœstrous*, and the mammal which had this type of sexual season was called "*polyœstrous*." The human subject had this diœstrous type in so exaggerated a degree that, during her whole reproductive life, she never had anœstrum at all; there was a continuous series of diœstrous cycles, and she had a sexual season which (in the absence of gestation) was coterminous with her reproductive period. There were ethnical traces, however, of a time in the development of the human race when the series of cycles had been broken by anœstrous periods, and at the present day there was some evidence that Esquimaux women had such occasional resting periods. It was possible, therefore, to regard the polyœstrous type as a concentration of several monœstrous sexual seasons; on the other hand, it could be argued that the monœstrous type was a decentralised polyœstrum. Of course, the occurrence of conception, of gestation, and of the suckling period interfered with the symmetry of these cyclical processions; the mammal which became impregnated then had a pro-œstrum and œstrus, followed by gestation and parturition, and, after that, passed through what was left of an anœstrous period, or entered at once into another œstrus and another gestation. The cause or origin of the sexual season was difficult of determination, but there was some evidence that a nutritional stimulus had something to do with it; at any rate the special feeding (the so-called "flushing") of ewes hastened the appearance of the sexual season in them.

Having cleared up the comparative physiology of the sexual season for mammals, Heape proceeded to fix the position of menstruation in the human female and the primates with regard thereto. He identified menstruation with the pro-œstrum; and he pointed out that in both there was congestion and growth followed by destruction of tissue, in both there was recurrence, and that the phylogeny of the subject indicated this identification. The difficulty which was presented by the absence of the discharge of blood in most mammals, and by its presence in the primates, was capable of explanation. There were gradations between the mammals in which the discharge consisted of mucus with a few epithelial cells and those in which it was made up of blood and some of the uterine stroma. Again, the absence of an

external discharge of blood was not necessarily indicative of the lack of intra-uterine hæmorrhage, for in certain cases blood was undoubtedly extravasated into the uterine cavity, to be re-absorbed or expelled as a clot. Heape, therefore, not only showed the analogies between the sexual season in mammals and the reproductive processes in the human female, but also brought menstruation, as it occurs in the primates, into line with analogous phenomena in other mammals, identifying it with the pro-œstrum or period of "coming in season," or "in heat."

It was not long before other observers followed the path of investigation and research which Heape had entered upon; and Francis Marshall (*Proc. Roy. Soc. Lond.*, lxxi. p. 354, 1903; *Phil. Tr.* (Lond.), cxcvi. p. 47, 1904; *Quart. Journ. Microsc. Sc.* (Lond.), xlviii. p. 323, 1904-5; *Internat. Clin.* (Phila.), 17 s., ii. p. 190, 1907), Marshall and Jolly (*Proc. Roy. Soc. Lond.*, s. B., lxxvi. p. 395, 1905; *Proc. Physiol. Soc. Lond.*, p. xxvi., 1906), and Emrys-Roberts (*Proc. Roy. Soc. Lond.*, s. B., lxxvi. p. 164, 1905) all made important contributions to our knowledge of the comparative physiology of the sexual season by their inquiries into the œstrous cycle in the sheep, the ferret, the bitch, and other mammals. The œstrous cycle of the lower mammals was to be regarded as homologous with the menstrual cycle of monkeys and the human female, for similar histological changes occurred in the uterus and external genital organs during these cycles. While, however, the changes were essentially similar, there were differences in detail: thus the destruction of uterine tissue was greater in menstruation than in the pro-œstrum, and the monthly phenomena in the human female showed, at first sight, little resemblance to the sexual season of the sheep or bitch. The identification of menstruation with a part and not with the whole of the œstrous cycle helped to bring out the homology of the two processes, and the following schematic representation may be usefully kept in mind:—

Histological Changes.	Periods of the Œstrous Cycle.	
Period of growth	Pro-œstrum	Period of "Heat"
Period of destruction	(Menstruation)	
Period of recuperation	Œstrus	
	Metœstrum	Not in "Heat"
Period of rest	Anœstrum	

Menstruation corresponded simply with the period of pro-œstrum in the lower mammals; it differed from it, in detail, by reason of the greater destruction of uterine tissue which took place in it, but the difference was insufficient to obscure the homology. Menstruation, therefore, did not correspond with the period of "heat" in the lower mammals, but only with the early part of that period, known as "coming into heat" or "season." If there was a definite period of desire in the human female, it would be the time immediately following menstruation, the period of "œstrus" (commencing recuperation of tissue) in the lower mammals.

Questions next arose as to the light these discoveries and identifications might throw upon the vexed question of the relation of ovulation to menstruation. There was evidence that in the rabbit, the ferret, and sometimes in the sheep, ovulation did not take place without the stimulus of coitus, and not, therefore, till the period of œstrus; in the bitch, also, ovulation occurred either during œstrus or in the later stage of the pro-œstrum. It was evident, therefore, that in these mammals the destruction-period of the pro-œstrum could not be regarded as the undoing of a preparation for a fertilised ovum (the preceding growth-stage), for the pro-œstrum was over or nearly over before ovulation (and fertilisation) occurred. Neither could menstruation, the homologue of the pro-œstrum, be so regarded, and therefore Sigismund's view (which looked upon the period of growth as a preparation for a fertilised ovum, and the period of destruction as the undoing thereof) could no longer be maintained. Further, the destruction-period of the pro-œstrum (and therefore also of menstruation) could not be regarded as of the nature of an abortion (as Beard had suggested in 1897), for in the case of the bitch, at any rate, it occurred before ovulation, and it could hardly be associated with the ovulation which had taken place at the preceding period of "heat" or œstrus six months before. Recent researches in the comparative physiology of the sexual season went to support the theory that menstruation in the human female and the periods of pro-œstrum and œstrus in other mammals were of the nature of preparation for an embryo—a sort of "surgical freshening" of the uterine mucosa for the reception and attachment of an impregnated ovum; there was also some evidence that the ovum was that discharged at the ovulation period immediately following the pro-œstrum (menstruation). It was probable that in the human subject the whole sexual season had lost its original characters, and had been changed, by evolution, into what it now was; there had, no doubt, once been a chronological arrangement of events similar to that now obtaining in the lower mammals; in other words, the usual period for ovulation in women had occurred after pro-œstrum (menstruation) during a period of œstrus. Even now there was some evidence to show that the most likely time for fertilisation to take place was during the week following menstruation.

We must turn next to the light which recent researches have thrown upon the influence of the ovaries upon menstruation. On the whole, these investigations went to support the view

that the changes in the uterus were dependent on those in the ovaries, for both in the human subject and in the lower mammals the removal of the latter organs caused the cessation of menstruation (in woman) and of the pro-œstrum and œstrus (in other mammals). The small number of exceptional cases were probably to be explained by failure to remove the whole of the ovarian tissue (see Bondi, *Wien. klin. Wochensch.*, xvii. p. 104, 1904; French, *Journ. Comp. Med. and Vet. Arch.*, xxii. p. 284, 1901; Taylor, *Vet. Journ.*, N. S., viii. p. 282, 1903; F. D. Thompson, *Texas Med. Gaz.*, iii. No. 12, 1903; and Wackerhagen, *Brooklyn Med. Journ.*, xvi. p. 424, 1902). At any rate, instances of pregnancy occurring after double ovariotomy or oophorectomy, such as the case reported by Doran (*Journ. Obstet. and Gynæc. Brit. Emp.*, ii. p. 1, 1902), could hardly be accounted for in any other way; and if pregnancy might occasionally follow, why should not menstruation sometimes persist? There have been several theories as to the nature and mode of transmission of the ovarian influence. It could hardly be of a nervous character, cerebral or spinal, for experimental section of the spinal cord in animals did not prevent them coming into "heat"; ovarian grafting, also, was effectual in causing a reappearance of heat, although, of course, all the nervous connections of the transplanted glands had been severed (see Halban, J., *Monatssch. f. Geburtsh. u. Gynäk.*, xii. p. 496, 1900; Marshall and Jolly, *Proc. Physiol. Soc. Lond.*, p. xxvi., 1906). The weight of evidence was in favour of the view that the influence was chemical, and most probably of the nature of an internal secretion (a hormone or "activator"). The statement of L. Fraenkel's theory in 1903 (*Arch. f. Gynaek.*, lxviii. pp. 438-545, 1903) did much to focus attention upon the corpus luteum as the centre of ovarian activity. Born had already suggested that the corpus luteum of pregnancy was a gland with an internal secretion, which had to do with the embedding and development of the impregnated ovum in the uterus, but he was unable to carry out the experimental investigation necessary to establish his views, and this was done for him by Fraenkel. The results were striking, and carried Fraenkel further than Born had foreseen. He soon came to the conclusion that the corpus luteum was a gland; the character of the lutein cells and their mode of arrangement; its size, which was out of proportion to that of the unruptured Graafian follicle; and the signs of functional activity in the corpus luteum when all the rest of the ovary was quiescent and anæmic; these all pointed to its glandular character. Experiments showed that destruction or removal of corpora lutea brought an existing pregnancy to an end, or in the non-pregnant state prevented the onset of the next menstrual period. Andrews, in his summary (*Journ. Obstet. and Gynæc. Brit. Emp.*, v. p. 459, 1904), says that Fraenkel's deductions were as follow:—The corpus luteum was a gland which was renewed every four weeks in women during reproductive life, and at varying intervals in animals. It controlled the nutrition of the uterus in a cyclic fashion, prevented it from relapsing into its infantile or passing into its senile condition, and prepared the endometrium for the reception of the ovum (or rather, in the light of Peters's work on ovum implantation, stimulated the activity of the trophoblast, and so fixed the ovum to the uterine wall). If the ovum were not fertilised, the corpus luteum produced the hyperæmia of menstruation and then degenerated. Menstruation was caused by the secretory activity of the corpus luteum, and not by the pressure of the growing follicle on the ovarian nerves; and this activity produced the four-weekly hyperæmia which led on either to pregnancy or to menstruation. Anomalous uterine bleeding and some cases of sterility might depend on pathological conditions of the corpus luteum. Amenorrhœa and uterine atrophy might result from the same cause. Lactation-atrophy was a good example, for ovulation ceased, as a rule, during lactation, and therefore no fresh corpora lutea were formed. Fraenkel believed lutein to be the active principle, and recommended its use in troubles occurring at the menopause, and when ovariotomy had to be performed during pregnancy.

Whilst it may be said that in the main Fraenkel's theory of the importance of the corpus luteum in menstruation holds the field, it must be admitted that later researches have tended to undermine parts of it. The somewhat inert character of lutein, as determined by the physiological chemists, does not strengthen the view that it has such far-reaching effects upon the female economy. Again, the researches of J. Jankowski (*Arch. f. mikr. Anat.*, lxiv. p. 361, 1904) on the cells of the corpus luteum, showing that they arise from the tissue of the theca interna, and are therefore mesodermic in origin, weaken the claim that has been made for them that they perform secretory functions in connection with ovarian activity In appearance they resemble epithelial cells, but appearances are deceitful in such matters, as may be shown by the puerperal changes of the stroma cells of the uterine mucous membrane. Further, the destruction or excision of a corpus luteum does not invariably prevent the occurrence of menstruation at the following period (Ries, *Amer. Journ. Obstet.*, xlix. p. 165, 1904; Kleinhaus and Schenk, *Zeitsch. f. Geburtsh. u. Gynäk.*, lxi. p. 283, 1907), as Fraenkel expected it would do.

If, however, it cannot be stated that Fraenkel's

views regarding the importance of the corpus luteum and of lutein have been fully upheld by recent research, nevertheless the evidence in support of the dominant influence of the ovary is still very strong. It has been strengthened, for instance, by the results of transplantation experiments in animals and in the human subject: ovaries have been removed from one situation to another in the same animal (homoplastic transplantation), and they have been taken from one animal to another of the same species (heteroplastic transplantation); and in a few cases, both homotransplantation and heterotransplantation have been performed on the human subject. In all these varieties of grafting it has been claimed that conception has followed; even in heterotransplantation in the human female, Morris (*Med. Rec.*, lxix. p. 697, 1906) has reported a pregnancy and the birth of a living child. But, apart from this latter somewhat extraordinary result (in which the success can hardly be regarded as other than embarrassing), the grafting of ovaries has apparently counteracted the symptoms of the menopause and prevented the atrophy of the genitals which usually follows castration. There is a considerable literature on this subject of ovarian grafting (summaries of which, for English readers, are provided by the articles of Scott Carmichael, *Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 215, 1907, and of Franklin H. Martin, *Trans. Amer. Gynec. Soc.*, xxxiii. p. 489, 1908), and the general result of a perusal of what has been written is to support the view that the ovary will live and functionate in other localities than the normal one, and will prevent the troublesome sequelæ which usually occur at a premature menopause; but whether it does so on account of persistence of ovulation or by reason of continued production of its internal secretion (apart from ovulation) is not clear.

The introduction into practice of the operation of hysterectomy and its performance in a large group of cases has raised the cognate question of the influence of the uterus upon the general metabolism of the body and upon the ovaries. Now the experiments of C. J. Bond and Sir Victor Horsley upon the two-horned uterus of rabbits (*Brit. Med. Journ.*, ii. for 1906, p. 121) seem to show that removal of the whole organ does not prevent the continuance of the functions of the ovary (ovulation going on as usual), and the taking away of one horn does not interfere with ovulation in the ovary of the same side. In the rabbit it was also found that there was a saline secretion taking place into the interior of the uterus, and it was thought that this antagonised in some way the ovarian internal secretion, that it prevented lutein formation in the ovary in pregnancy, and had a prejudicial effect on the general nutrition of the individual. Bond's experiments seemed, further, to prove that in the rabbit compensatory hypertrophy of one ovary takes place after removal of the other, and does so independently of the presence of the uterus so long as coition be continued. It cannot, however, be said that Bond's experiments or those of Carmichael and Marshall (*Proc. Roy. Soc.*, B. lxxix. p. 387, 1907) have done much to weaken the dominant rôle of the ovaries in menstruation; but the work done by Blair Bell and Pantland Hick (*Brit. Med. Journ.*, i. for 1909, pp. 517, 592, 655, and 716), while it does not show that removal of the uterus (in rabbits) produces marked changes in the ovaries, is none the less damaging to the theory of the importance of the ovaries. Blair Bell and Pantland Hick have been led by their investigations to the belief that the calcium content of the blood plays a leading part in the occurrence of menstruation, that the periodicity of the latter is due to the periodicity of the calcium metabolism, that rupture of Graafian follicles is in no way responsible for menstruation, and that, indeed, the ovary is no more predominant in respect to the menstrual function than the other ductless glands (*e.g.* the thyroid gland and pituitary body). These authors go so far as to say "that menstruation *per se* is not a necessary adjuvant, nor concomitant to fertility and reproduction"; they, therefore, arrive at results widely different from those of Fraenkel and his followers. The results, then, of the work on menstruation carried out during the first eight or nine years of the twentieth century cannot be said to contain the solution of the vexed question of the ovarian influence; but they indicate the lines of advance by which that matter may in time be settled. Meanwhile it would seem to be a matter of some practical importance for the patient who has her uterus removed to be spared one or both of her ovaries, so long at least as she is not beyond the menopause.

What have been called the *forensic aspects of menstruation* have been exercising the minds of some recent writers, and the matter is one which may be expected to assume greater importance if the franchise be given to women, and if women be elected to posts of responsibility involving nervous strain. It is well known that menstruation bears a relationship (of cause or only of effect is not yet certain) to insanity, and the frequency of the association of menstrual irregularities (precocious menarché, retarded puberty, amenorrhœa, etc.) with mental disorders has often been pointed out (recently, for instance, by Salerni, *Policlin.*, xiii., sez. med., p. 221, 1906, and by Sheila M. Ross, *Journ. Ment. Sci.*, lv. p. 270. April 1909); it is also admitted that hysteria, epilepsy, and other nervous maladies are aggravated during the menstrual period; but it is not so generally

accepted that in women otherwise normal the occurrence of menstruation may be the sole, or at least the only obvious cause of abnormal acts. Marx (*Berl. klin. Wochensch.*, xlv. p. 1776, 1908) has thrown some light upon this last-named question. He has pointed out that shop-thefts are nearly always perpetrated by women, a fact which is generally known, but he has further stated that the thief is nearly always found to be menstruating at the time when she is caught stealing. This fact, he adds, is specially noticeable in those apparently purposeless thefts, when the criminal is a woman in comfortable circumstances and even wealthy. Marx further is of opinion that menstruation may affect the reliability of the evidence of female witnesses in law cases, by altering their capability of observation and their soundness of judgment, although he admits that Wollenburg had found little difference in this respect between women in the intra-menstrual and in the extra-menstrual period. It is also pointed out that female suicides in most cases take away their lives during menstruation. Marx therefore comes to the conclusion that even women apparently healthy may pass into a condition of "transitory mental inferiority during the time of ovulation." But to settle this and other cognate questions is hardly possible on the evidence that has been collected; what is needed is a work containing full statistics of large numbers of cases in which the relationship of menstruation to the physical and mental health of the woman has been carefully ascertained and recorded, an expansion, in fact, of Mary Putnam Jacobi's Essay on *The Question of Rest for Women during Menstruation* which was published more than thirty years ago. Tobler's contribution (*Monatssch. f. Geburtsh. u. Gynäk.*, xxii. p. 1, 1905) to the subject, although small, is important; she finds that in most women at the present day menstruation is associated with distinct deterioration of the general health and diminution of functional energy, but in a small number of cases (3·3 per cent.) there is greater strength in the mental and other functions during the period.

Menstruation, Morbid.

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MENORRHAGIA AND METRORRHAGIA . 264

1. AMENORRHŒA.—In addition to the causes of amenorrhœa usually enumerated (vide *Encyclopedia and Dictionary of Medicine*, Vol. VI. pp. 341-343), it may be found necessary to mention eye diseases, such as hæmorrhages into the vitreous. J. E. Gemmell (*Journ. Obstet. and Gynæc. Brit. Emp.*, v. p. 445, 1904) has, at any rate, recorded a case in which a girl of 16 years of age ceased to menstruate, and at the same time lost the sight of the right eye, and developed a faint floating vitreous cloud in the left. There was no anæmia, and the blood and urine were found to be normal. The only other possible causes of the amenorrhœa were that the girl had left home for the first time to go to school, and had been subject to some mental strain in connection with her lessons. Under the administration of iron and aloes and thyroid tabloids, along with local treatment of the eyes, menstruation returned, and the sight of the left eye was fully recovered, but very little improvement took place in the right. The author was of opinion that the hæmorrhages into the vitreous might be regarded as due to vicarious menstruation. Blondel and Sendral (*Gynécologie*, ix. p. 5, 1904) have also reported a case in which amenorrhœa was associated with eye disease. The patient, at the age of 29, lost her husband, and began to suffer from irregular menstruation, followed in a year by amenorrhœa. At the same time the sight of the left eye began to depreciate, and, notwithstanding sympathectomy and iridectomy, was lost by the age of 32 years; an ulcer developed on the cornea of the right eye. Under emmenagogue treatment (ovarine capsules, apiol tabloids, and iron and aloes), menstruation was restored, and the sight of the right eye recovered, through healing of the corneal ulcer; the useless left eyeball was removed. These two cases strengthen the belief, that has often been expressed, in the possibility of vicarious menstruation (*xenomenia*), although they cannot be regarded as affording absolute proof; they, at any rate, indicate close sympathy between menstrual phenomena in the uterus and the functions of other bodily organs. Other alleged instances of vicarious menstruation have been reported by Delaney (*Virginia Med. Semi-Month.*, ix. p. 536, 1904-5), Gillmore (*Amer. Journ. Obstet.*, liii. p. 520, 1906), Scherer (*Beitr. z. klin. d. Tuberk.*, vi. p. 287, 1906), Shambaugh (*Laryngoscope*, xvi. p. 53, 1906), and Larrabee (*Boston Med. and Surg. Journ.*, clvii. p. 217, 1907).

Recent researches have shown that the so-called physiological amenorrhœa of lactation is by no means so constant as has been supposed. Thus, Elis Essen-Möller (*Zentralb. f. Gynäk.*, xxx. p. 175, 1906) has found that in 59·3 per cent of 428 nursing women, menstruation went on normally; no discharge occurred in 32·3 per cent.; whilst 8·5 per cent. showed irregularities. Karl Heil (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 340, 1906) studied the histories of 200 women, with, in all, 540 deliveries, and found that 125 of these women experienced the return of menstruation while they were suckling their babies. In 234 of 499 lactations the periods were re-established before weaning, the

time distribution being as follows:—first six weeks, 37; second six weeks, 62; three to twelve months, 100; later, 4; and 31 were indefinite. Heil's general conclusion was, about half only of all women who are nursing their infants have absolute amenorrhœa; he thought that the appearance of the menses during lactation was not a reason for weaning; and he was of opinion that menstruation, and not amenorrhœa, was the original normal condition with women during lactation. These observations must be taken into account in connection with the common practice of weaning on the appearance of menstruation. Apparently ablactation is not so necessary in that case as has been supposed; and probably the supervention of another pregnancy is a far more pressing indication for weaning, as Church has pointed out in an article on the risks of allowing lactation and pregnancy to overlap (*Trans. Edin. Obstet. Soc.*, xxviii. p. 204, 1903).

2. Dysmenorrhœa. — It was towards the close of 1896 that Fliess (*Zentralb. f. Gynäk.*, xxi. p. 111, 1897) made a communication to the Berlin Obstetrical and Gynecological Society in which he claimed that there existed a close connection between the nasal mucous membrane and menstruation. The forms of dysmenorrhœa in which the pain continued after the appearance of the bleeding had in a great number of cases their origin in the nose. This was not to be wondered at, for during menstruation regular changes occurred in the nose, and these consisted of swelling, increased sensitiveness to touch, a tendency to bleed, and cyanotic discoloration. These changes were most marked on the inferior turbinated bones and on the tubercula septi, and to these spots in particular the name of the "genital areas" of the nose might be given. Temporary relief of the pain of dysmenorrhœa was obtained by applying cocaine to these "genital spots," and in some cases the relief was made permanent by cauterising the same regions. Since the publication of Fliess's article the subject has been investigated by many observers, who have to a certain extent corroborated Fliess's statements, and found benefit to accrue from the nasal treatment recommended. It has been found to be difficult to eliminate entirely the possibility of cure by suggestion. A. Schiff (*Wien. klin. Wochensch.*, xiv. pp. 57-65, etc., 1901) found that cocainisation of the tubercula septi relieved the sacralgia, whilst the abdominal pain was also benefited when the "nasal spots" on the inferior turbinateds were similarly treated. A few drops of a 20 per cent. solution of cocaine were applied on cotton-wool. In a smaller number of cases permanent relief followed cauterisation. A. Ephraim (*Allg. med. Centr.-Ztg.*, lxxi. pp. 229, 241, 1902) obtained good results in three-fourths of the patients whom he treated by cocainisation of the "genital spots." During the past six or seven years a considerable number of communications on this subject, and on the nearly allied one of the relationship between the nasal mucous membrane and the genital organs in the male, have appeared in current medical literature, and among these may be named papers by Hall (*Westminster Hosp. Rep.*, xii. p. 65, 1901), Heymann (*Verhandl. d. Gesellsch. f. Geburtsh. zu Leipz.*, p. 41, 1902), Jaworski and Iwanicki (*Gaz. lek.*, 2 S., xxii. pp. 429, 456, 1902), Krönig (*Verhandl. d. Gesellsch. f. Geburtsh. zu Leipz.*, pp. 41-48, 1902), Pitous (*Thèse* (Bordeaux). 1902), Haug (*Monatssch. f. Ohrenh.*, xxxvii. p. 96, 1903), Heiman (*Rev. hebd. de laryngol.*, ii. p. 209, 1903), H. Löwy (*Verhandl. d. Gesellsch. deutsche Naturf. u. Aerzte*, 1902 (Leipz.), ii. pp. 2, 206, 1903), A. Malherbe (*Ann. d'electrobiol.*, vi. p. 561, 1903), F. La Torre (*Clin. ostet.* (Roma), v. p. 345, 1903), Trautmann (*Monatssch. f. Ohrenh.*, xxxvii. p. 129, 1903), Kolischer (*Amer. Journ. Obstet.*, xlix. p. 804, 1904), A. Martin (*Rev. frenopat. españ.*, ii. p. 133, 1904), Opitz (*Verhandl. d. deutsche Gesellsch. f. Gynäk.*, x. p. 683, 1904), Vacher (*Ann. méd.-chir. du Centre* (Tours), iv. p. 25, 1904), Delie (*Rev. hebd. de laryngol.*, ii. p. 641, 1905), M. Falta (*Monatssch. f. Ohrenh.*, xxxix. p. 506, 1905), B. Reko (*Allg Wien. med. Ztg.*, i. pp. 270, 280, 1905), L. Chierici (*Riv. veneta di sc. med.*, xliv. p. 416, 1906), Latis (*Arch. ital. di ginec.*, i. p. 263, 1906), C. Jacobs (*Progres méd. belge*, viii. p. 145, 1906), Royet (*Arch. internat. de laryngol.*, xxiii. p. 715, 1907), Küttner (*Deutsche med. Wochensch.*, xxxiv. p. 1050, 1908), and F. E. Walker (*Journ. Amer. Med. Assoc.*, li. p. 1077, 1908). Although the question cannot yet be regarded as definitely settled, it may be said that there is a considerable body of evidence in support of the belief in the existence of what may be called nasal dysmenorrhœa, and a certain amount of proof that local nasal treatment (by the application of cocaine to the "genital spots" on the septum nasi and inferior turbinateds) is beneficial in a large proportion of these cases. Of course it is well known that certain odours and perfumes stimulate the genital sense (see A. Hagen, *Die sexuelle Osphresiologie* (Charlottenburg), 1901, and others), and cases of priapism as a nasal reflex are not unknown (Hobbs, *Gaillard's South. Med.*, lxxxiv. p. 187, 1906); and these facts increase the likelihood of the existence of *nasal dysmenorrhœa*. Further, it has been shown by H. W. Freund (*Monatssch. f. Geburtsh. u. Gynäk.*, xx. pp. 210, 383, 1904) and others that nasal and pharyngeal changes are associated with the processes of pregnancy, labour, and the puerperium, as well as with the phenomenon of menstruation. Freund found that 66 per cent. of pregnant women had hyperæmia of the pharyngeal mucous membrane and hypertrophy of the turbinated bones

(especially the inferior ones), and that the nasal changes were not periodic but persisted throughout the gestation, causing epistaxis in 25 per cent. of the cases. They sometimes continued during the puerperium, and were not influenced by lactation. The swelling of the turbinated bones increased during the pains of labour. In certain patients swelling of the septum of the nose and of the turbinated bones seemed to cause hyperemesis gravidarum, for the vomiting ceased after the application of the galvano-cautery to the swollen parts. Hyperæmia of the pharynx and hypertrophy of the tonsils were less frequently met with in pregnancy than were the nasal changes.

A *statistical investigation* of primary and secondary *dysmenorrhœa* in girls has been made by Marie Tobler (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvi. p. 801, 1907). Seven hundred cases were reviewed; in 234 of these the symptom was primary (*i.e.* began at the menarché), and in 466 it was secondary. She found that the dysmenorrhœa of young girls was markedly premenstrual, and had its climax during the first hours of the show of blood; it was very often secondary, a fact which was not in favour of its mechanical origin (uterine displacements and stenoses); neither was there evidence to show that its origin lay in the nervous system. The conclusion drawn was that disturbances of the pelvic circulation constituted the common causes. Herman and Andrews (*Journ. Obstet. and Gynæc. Brit. Emp.*, iii. pp. 1, 83, 1903), on the other hand, from a review of cases at the London Hospital, have ascribed the pain to uterine contractions, and have seen marked benefit following cervical dilatation. Routh (*Brit. Med. Journ.*, ii. for 1906, p. 234) gives an able summary of the modern aspects of dysmenorrhœa, both as regards causation and treatment.

Among the new methods of treatment which have been introduced for the alleviation of metrorrhagia and dysmenorrhœa is *radiotherapy*. Fraenkel (*Zentralb. f. Gynäk.*, xxxii. p. 142, 1908) employed the Röntgen rays in such cases with good effect; but he warns others who may use this agent to make the applications in such a way as to avoid the sterilising effect of the rays upon the ovaries. The effect of *styptol* in cases of idiopathic dysmenorrhœa is highly spoken of by Jacoby (*Therap. d. Gegenw.*, xlvii. p. 253, 1906); the improvement which follows is ascribed to the double sedative and hæmostatic properties of the drug. For stubborn cases of dysmenorrhœa, Polano (*Münch. med. Wochensch.*, liv. p. 1731, 1907) recommends the application of *Klapp's suction apparatus to each breast* for a quarter to half an hour at a time for some days before the onset of the menstrual flow.

3. Intermenstrual Pain (*Mittelschmerz*). —Closely associated with dysmenorrhœa is mid-pain (*Mittelschmerz*), a little-understood phenomenon, apt to recur, and difficult to cure. It has recently been discussed at a meeting of the Royal Academy of Medicine in Ireland (*Brit. Med. Journ.*, i. for 1909, p. 91), in connection with contributions by Purefoy and Shiell, when it was suggested that it was due to some form of toxæmia arising from an excess of internal secretion of the ovary. Purefoy did not regard it as due to hydrosalpinx. Rosner (*Gynécologie*, x. p. 230, 1905) agreed with Richelot in ascribing intermenstrual pain to diffuse hyperæmia and hypertrophy of the uterus of a non-inflammatory nature; he did not regard it as set up by contractions of the Fallopian tubes. He thought that varicosity of the pelvic veins was a causal factor, and recommended systematic firm packing of the vagina (to support the veins) as a means of treatment. It must be confessed that no thoroughly satisfactory mode of treatment has been discovered; curettage, dilatation, and drugs have all failed, and hysterectomy and oophorectomy are hardly justifiable. Associated, perhaps, with Mittelschmerz is *intermenstrual fever*, of which Van Voornweld (*Zeitsch. f. Tuberk. u. Heilstättenw.*, vii. p. 543, 1905) has recorded an instance in a girl of 18 suffering from phthisis; the observer did not regard the phenomenon as due to tubercular salpingitis, but that morbid state could not be absolutely excluded; he was inclined to look upon the fever as a token of a periodical intermenstrual hyperæsthesia of the heat centre. H. Kraus (*Wien. med. Wochensch.*, lv. p. 610, 1905) has found premenstrual fever in two-thirds of the tubercular patients under his care; in some of these cases the rise in temperature was intermenstrual; it bore no relation to the gravity of the general tubercular infection. It must be admitted that the Mittelschmerz is still a mystery.

4. Menstruatio Præcox.—A certain degree of mystery surrounds also early menstruation (*menstruatio præcox*). According to Wischmann (*Norsk. Mag. f. Laegevidensk.*, 5 R. i. p. 306, 1903) there are two groups, that in which the phenomenon is associated with rickets or hydrocephalus, and that in which it is accompanied by other signs of puberty (enlargement of mammæ, appearance of hair on the mons and elsewhere). Wischmann himself records a case of the latter type, in which menstruation began at the age of 18 months; there were twelve periods. In Näcke's patient (*Zentralb. f. Gynäk.*, xxxii. p. 1116, 1908) there were signs of rickets during the first two years of life, and at the age of 3 menstruation began, and soon afterwards other signs of puberty began to appear. At the age of 5 years the child had the build of 8 years, and the vagina and left ovary had the development of a child of 11. Her mother had been pregnant eleven times, and Näcke

remarked that unusual fertility of the parent of a child with early menstruation had been observed in connection with other cases. Stoeltzner (*Med. Klin.*, iv. p. 5, 1908) has recorded another instance of menstruatio præcox, and Hendrix (*Policlin.* (Bruxelles), xv. p. 1, 1906) noted a case in which periodical discharges began at the age of 8 months and had continued till the third year.

5. MENORRHAGIA AND METRORRHAGIA.—It is admitted by everyone that menorrhagia and metrorrhagia are symptoms due to many different diseases; but there is still considerable difficulty in discovering the causal disease in every case, and specially in some forms of bleeding at the menopause. There is a tendency to ascribe to hæmophilia these cases of climacteric hæmorrhage in which there is neither a tumour (*e.g.* cancer of the cervix or body or fibroid tumour) nor a diseased state of the uterine mucous membrane (*e.g.* fungous endometritis); but Dickinson (*Brooklyn Med. Journ.*, xx. p. 45, 1906) is not of this opinion, and believes that in such cases the cause is arterio-sclerosis (of the uterine vessels), obstruction to the return circulation, diseased structure and function of the ovary, or increase in the connective tissue in the uterine wall. The arterio-sclerosis may affect the uterus alone, and not the general vascular system, although a clear case has not yet been described. Palmer Findley (*Trans. Amer. Gynec. Soc.*, xxx. p. 399, 1905) has written at length on the subject of arterio-sclerosis of the uterus, and Elizabeth H. B. Macdonald (*Trans. Edin. Obstet. Soc.*, xxxii. p. 83, 1907) has made a valuable addition to our knowledge of its morbid anatomy (with a bibliography); but there is still some obscurity surrounding the causation of metrorrhagia myopathica and chronic metritis. (*See also* Barbour, *Trans. Edin. Obstet. Soc.*, xxx. p. 71, 1905; Anspach, *Amer. Journ. Obstet.*, liii. p. 1, 1906; and Solowij, *Monatssch. f. Geburtsh. u. Gynäk.*, xxv. p. 291, 1907.)

Mercurettes.—A proprietary preparation for administering mercury by inunction; in them the finely divided mercury is incorporated with cocoa butter. See *Lancet*, ii. for 1909, p. 302.

Mercury Atoxylate.—A white powder, almost insoluble in water, being a compound of atoxyl or soamin (the sodium salt of *p*-amidophenyl arsenic acid) and mercury, and recommended by intramuscular injection in syphilis. *See* Fortescue-Brickdale, *Newer Remedies*, p. 49, 1910.

Mercury, Oleo-brassidate of.—A preparation formed when erucic acid (from rape oil) and oleic acid react with mercuric oxide; it forms a jelly which is useful for applying to the skin in the cases in which mercurial ointment would be used, *i.e.* as an antisyphilitic, antiparasitic, and antiseptic inunction (R. Dupuy, *Rev. de thérap. méd.-chir.*, lxxvi. p. 253, 1909; *Bull. gén. de thérap.*, clvii. p. 424, 1909).

Mesin.—A urinary antiseptic, being a double salt of hexamethylene-tetramine citrate and lithium citrate.

Meso-sigmoiditis.—Inflammation of the mesentery of the sigmoid flexure of the colon; it has been pointed out that sigmoiditis and meso-sigmoiditis produce a clinical picture which resembles and has been mistaken for that of malignant disease of the lower colon (Rowlands, *Lancet*, i. for 1910, pp. 1194-1197); surgical measures for its relief include colostomy (which should only be a temporary operation in these cases), ileosigmoidostomy or anastomosis between the lower part of the ileum and the sigmoid flexure (which is rarely possible on account of the sigmoid itself being the affected part), and resection of the affected portion of the bowel (which gives the best promise of permanent cure).

Mesothelioma.—A tumour arising in mesothelial tissue, *e.g.* adenoma of the kidney, ovary, uterus, or serous membrane (pleura, peritoneum), hypernephroma, and rhabdomyoma.

Metaphase.—A stage (the second) in mitosis (indirect cell division), during which the splitting of the chromosomes takes place. *See* ANAPHASE.

Metaplasia.—The post-natal production of specialised tissues from cells which normally produce tissues of other orders; it occurs physiologically (*e.g.* when connective tissue corpuscles are converted into fat cells) as well as pathologically. *See* Adami, *Pathology*, i. p. 639, 1910.

Metaproteins.—Derived proteins, such as acid albumin, etc.

Metchnikoff's Theory.—*See* IMMUNITY; *also* F. W. Andrewes's Croonian Lecture in the *Lancet* (i. for 1910, pp. 1737-1743).

Methyl Aspirin. — Acetyl-salicylic methyl ester; methyl rhodin; recommended in rheumatism.

Methylatropine Bromide.—Atropine to which one atom of bromine and one methyl (CH_3) group have been added to the nitrogen with resulting changes in the physiological action of the drug and a lessen-

ing of its toxicity; it is recommended in whooping cough and as a substitute for morphine. *See* Fortescue-Brickdale, *Newer Remedies*, p. 255, 1910.

Methylxanthin.—One of the purin bases.

Metramine.—Another name for urotropin.

Mette's Test.—A quantitative test for pepsin in the gastric contents, in which tubes of coagulated albumin are used to determine the quantity of pepsin by the amount of digestion which takes place in a given time. *See* Webster, *Diagnostic Methods*, p. 75, 1909.

Microcytase.—In Metchnikoff's theory of immunity the complement (cytase) developed by the microphages (polymorphonuclear leucocytes, etc.) is called the microcytase.

Micronucleus.—The smaller of the two nuclei of the infusorian cell which becomes active during conjugation and fertilisation; it has been thought by some that the centrosome of the ordinary cell is the homologue of this micronucleus of infusorian cell activity.

Microphages.—The small phagocytes of Metchnikoff's theory of immunity, including the polymorphonuclear leucocytes, the eosinophiles, etc.

Microsphygmia.—A morbid condition of the pulse, having as its chief character its difficulty of being felt with the finger (Gr. *μικρός*, small; *σφυγμός*, the pulse); it was noted as a permanent condition associated with idiocy and ichthyosis by Variot (in 1898), but later observers (*e.g.* Richet and Saint-Girons, *Progrès méd.*, 3 s., xxiv. p. 529, 1908; *Rev. de méd.*, xxviii. p. 987, 1908) found that ichthyosis was not constantly present, and that it was only one of several dystrophic states (dwarfism, malformations of the genital organs, hare-lip, etc.) any one or several of which might be combined with the mental state and the peculiarity of the pulse to form the clinical picture; the state of the pulse (which varied in degree from feebleness with perceptibility up to imperceptibility under all circumstances) was ascribed to permanent spasm of the muscular coats of the artery.

Mintz's Test.—A quantitative test for free hydrochloric acid in the gastric contents. *See* Webster, *Diagnostic Methods*, p. 63, 1909.

Miol.—A proprietary food preparation described as "a preparation of the richest diastatic malt, the finest product of the olive, free phosphorus, the active principle of certain seaweeds, and other nutritious substances, also the necessary properties for forming bone and muscle." Its analysis is given in the *Brit. Med. Journ.*, i. for 1910, p. 29.

Mitochondria.—Minute globules which pass out of the nucleus of the cell into the cytoplasm in metabolism; chromidia or plasmosomes (Gr. *χόνδρος*, a grain; *μίτος*, a thread).

Mnemism.—The name of a theory introduced by Richard Semon which attempts to connect somatic variations due to outside influences with the sexual glands so as to make them (the sexual glands) causal to their progeny *quâ* this somatic variation; it has to do with the mechanism of the transmission of acquired peculiarities; it is quite hypothetical (Dr. B. Hart, *Evolution and Heredity*, pp. 75-78, 1910).

Molluscum Contagiosum.—Although for some time it has been known that molluscum contagiosum can be artificially produced by inoculation of the central core of the lesion, containing the so-called molluscum bodies, from one person to another, the causal organism has not yet been discovered. The incubation period of the disease is a long one, usually from two to four months. Juliusberg has advanced our knowledge a step further by showing that, if the molluscum bodies are pounded up with sand and bouillon in a mortar and then filtered through a Chamberland filter, the disease can still be reproduced by inoculation of the skin with the filtrate. This would lead to the supposition that the causal organism must be very much smaller than the ordinary pathogenic organisms which we know in other diseases.

REFERENCE.—Juliusberg, *Deutsche med. Wochensch.*, p. 1598, 1905.

Momburg's Method of Arresting Hæmorrhage.—In 1908 Momburg described (*Zentralbl. f. Chir.*, xxxv. pp. 697, 1193, 1908) a method of preventing or of stopping bleeding in the lower half of the body by constricting the waist with a rubber tube. At first it was thought that the plan carried no danger with it, and it was adopted for a number of morbid states in surgery (in operations on lower limbs and pelvis), in gynecology (*e.g.* in hysterectomy for fibroids), and in obstetrics (*e.g.* in post-partum hæmorrhage). The pelvis is raised so as to allow the intestines to gravitate towards the diaphragm, an Esmarch's bandage is applied to each leg, then the india-rubber tube is wound so tightly round the waist that pulsation in the femoral arteries ceases. It is not, however, entirely free from risk. In cases of post-partum hæmorrhage a

death followed its use from the formation of a hæmatoma; there have been instances of paralysis of the bladder and rectum, of hæmoptysis, of bleeding from the nose or bowel, and of persistent irregularity and weakness of the heart's action. The cardiac danger is perhaps the most serious, for the constriction by the tube always causes marked frequency of the pulse, the rate rising as high as 150 and even as 180 per minute. Gross and Binet (*Lancet*, i. for 1910, p. 1771) have recorded a fatal case in connection with amputation at the hip for tuberculosis of the knee; the heart ceased to act when the tubing was taken off. Another fatal case was reported by Amberger (*Beitr. z. klin. Chir.*, lxvi. p. 463, 1910). Further references are found in articles by Mayer (*Journ. de chir.*, iv. p. 121, 1910), Auvray (*Bull. et mém. Soc. de chir. de Paris*, N. S., xxxvi. p. 262, 1910), Morestin (*ibid.*, p. 299), Popow (*Therap. Rundschau*, iv. p. 179, 1910), Gerster (*Ann. Surg.*, li. p. 878, 1910), Abadie (*Bull. et mém. Soc. de chir. de Paris*, N. S., xxxvi. p. 498, 1910), Burk (*Beitr. z. klin. Chir.*, lxviii. p. 379, 1910), Hardouin (*Bull. méd.*, xxiv. p. 659, 1910), and Gelyi (*Med. Klin.*, vi. p. 1376, 1910).

Monochromatophilia.—The property which a cell may possess of taking up only one colour from a mixture of dyes; it contrasts with polychromatophilia on the one hand and with achromatophilia on the other.

Morax-Axenfeld Bacillus.—A micro-organism (usually a diplo-bacillus) regarded as the bacillus which most commonly causes chronic conjunctivitis.

Mörner's Test.—A test for tyrosin in urine; the suspected urine is evaporated to small bulk, the fluid removed, and the residue dissolved in water; then 1 c.c. of a reagent containing 1 c.c. of formalin, 55 c.c. of concentrated sulphuric acid, and 45 c.c. of water is added, and the mixture brought to the boiling-point; in the presence of tyrosin a beautiful green colour appears. *See* Webster, *Diagnostic Methods*, p. 330, 1909.

Moro's Tuberculin Ointment (*see also* IMMUNITY (*Pirquet's Reaction*).—This ointment may be used as a means of diagnosis instead of the ophthalmo-reaction, and is to be preferred as less dangerous and no less reliable; it contains Koch's tuberculin incorporated with wool-fat; if tuberculosis be present the application of the ointment to the skin is followed in from twelve to thirty-six hours by a papular or pustular exanthem which disappears in a few days (*Lancet*, ii. for 1909, p. 1443; i. for 1910, p. 73).

Mosaic Inheritance.—A term given to a form of inheritance in which certain cell groups show the paternal and others the maternal influence to be dominant, *e.g.*, when the internal sexual organs on one side are male and on the other female, when the two eyes are of a different colour, etc. *See* Adami, *Pathology*, i. p. 175, 1910.

Mossman Fever.—A fever occurring in North Queensland, especially in the Mossman district, lasting for ten to fourteen days, accompanied by enlargement and tenderness of the posterior axillary and sometimes of the inguinal glands, affecting persons engaged in cutting the sugar cane, uninfluenced by quinine and the salicylates, apparently non-infectious, and not transmitted by the mosquito. *See* Smithson, *Journ. Trop. Med. and Hyg.*, Dec. 1910.

Mothers, School for (*see* GOUTTES DE LAIT CONGRESSES).—The Mothers' Guild and School for Mothers is an institution on the lines of the *Gouttes de Lait* of France, "to check the high rate of infantile mortality by providing meals at low charge to expectant nursing mothers, by giving instruction in the care and feeding of infants, in general hygiene, and by other means;" such "schools" are in existence in London (St. Pancras), Manchester, Newport, and other places, and they promise to become general.

Mouse Cancer.—*See* CANCER; see also *Lancet*, i. for 1910, pp. 782, 787, 990, 991, 1011; ii. for 1910, p. 1550.

Moynihan's Operation.—*See* BLADDER, FEMALE (*Ectopia*).

Much Reaction.—The Much or Much-Holzmann reaction (also called the psycho-reaction) is the alleged property that the blood serum of patients affected with dementia præcox or manic depressive insanity has of inhibiting the hæmolysis caused by cobra-venom; it has not been corroborated by all observers (*Internat. Clinics*, 20 s., i. p. 250, 1910; Hübner and Selter, *Deutsche med. Wochnschr.*, xxxv. p. 1183, 1909; A. T. Rosanoff, *Arch. Int. Med.*, iv. p. 405, 1909).

Muhinyo.—The native name for Malta fever as it exists in Uganda, as shown by Sir David Bruce and the Sleeping Sickness Commission. See *Brit. Med. Journ.*, ii. for 1910, p. 549.

Multiple Myeloma.—The general features of this disease, according to Parkes Weber, on whose exhaustive study the following note is based, are those of a diffuse new

growth involving the marrow of the vertebræ, sternum, and ribs. Males are as, or more, often affected than females; the disease is one of later middle life. The new growth nearly always remains limited to the skeleton; deformities and fractures may occur; the cord may be compressed; anæmia results from the disturbance of the function of the marrow. In one group of cases a peculiar proteid (Bence-Jones's albumose) appears in the urine—myelopathic albumosuria (Kahler's disease).

The term multiple myeloma has been applied to a variety of new growths arising in the marrow, and not giving rise to metastases to other tissues — myelogenic sarcoma, endothelioma, plasmoma, etc.

Nothing definite is known as to the cause of myeloma. Rose Bradford draws attention to the possibility of its relationship with antecedent syphilis. The leading symptoms may be inferred from the nature of the lesion. Pain in the back or trunk, progressive deformity of the spine, bending of the sternum, fractures of ribs, and more rarely of other bones, tenderness over the bones, are among the most common. Nervous symptoms—increase of the knee-jerks, etc.—may be caused by compression of the cord. Anæmia and cachexia supervene. The anæmia seems usually to resemble a simple secondary anæmia, and abnormal cells are not, at least, prominent in the blood. Myelomatosis is always fatal, though not necessarily rapidly so. Bradford mentions cases in which the patients survived for 8 years after the characteristic albumosuria was discovered.

According to Weber, the disease may simulate osteomalacia, lumbago and rheumatism, spondylosis, spinal caries, secondary malignant disease of the skeleton, pernicious anæmia, and nephritis.

Osteomalacia tends to attack women during the reproductive period of life; the pelvis and legs are chiefly affected, and fractures are rare. In spondylosis (see SPONDYLOSIS) the rigidity is most marked in the cervical region, and there is no cachexia. In caries the curvature is more angular, and the bone disease does not involve ribs and sternum. There may be other signs of tuberculosis. Secondary new growths are more local, and a primary focus can be discovered. In pernicious anæmia there may be tenderness of the bones, but no deformity. Nephritis is only simulated where albumosuria exists. Bence-Jones's proteid, with the ordinary cold nitric acid, and Esbach's tests, give reactions like albumin.

ALBUMOSURIA.—Bence-Jones's proteid is precipitated by heating to about 58° C., and on boiling the precipitate diminishes. It also gives a precipitate with cold nitric acid (Heller's test), with hydrochloric acid, and with picric acid, which is also partially redissolved by heat. It may separate spontaneously, and give the urine a milky colour. Full details of its reactions are given by Drs. Hutchison and MacLeod in their report on Parkes Weber's case. This peculiar proteid may be present in very large amount (15 grams daily). It is believed to arise in the new growth in the marrow. Weber believes that it results from abnormal metabolism or degeneration of cells derived from the myelocyte series, but not from non-myelogenic tumour cells, hence metastatic tumours of the marrow do not give rise to Bence-Jones's albumosuria.

HISTOLOGY.—In Weber's case the marrow of all the bones was affected by a diffuse sarcoma, like growths of peculiar cells bearing a certain resemblance to the ordinary neutrophile myelocytes, but with smaller nuclei, and larger, more oxyphile, granules. In Professor Muir's opinion the tumour was formed of a special and characteristic type of cell, probably derived either from the neutrophile myelocyte or its predecessor. Christian has more recently studied the histology of 11 cases, and states that the tumour cells bear more resemblance to the bone marrow plasma cells than to the myelocytes. He regards myeloma as a true tumour, not, as Pappenheim claims, merely the marrow manifestation of a systemic disease. Sternberg divides myelomata into those with cells resembling plasma cells, and those with cells resembling myelocytes, and Weber appears to take a somewhat similar view — "(1) a growth . . . in which the bone marrow only is involved; (2) a growth in which nearly all the cells resemble small or large lymphocytes, and are probably derived from the non-granular predecessors of the myelocytes; in the second type of 'multiple myeloma' lymphatic glands, as well as bone marrow, may probably be affected." Weber proposes the following scheme for the classification of the whole group of leukæmias and allied diseases:—

(*a*) A new growth of lymphocyte-like cells originating in the bone marrow and not overflowing into the blood-stream — myelogenic pseudo-leukæmia, myelogenic lymphosarcoma, multiple myeloma of the lymphatic type.

(*b*) Similar to (*a*), but the cells enter the blood-stream — myelogenic lymphocythæmia, acute lymphocythæmia.

(*c*) New growth of lymphocyte-like cells originating in lymph glands or lymphadenoid tissue elsewhere, not overflowing into the blood-stream—lymphatic or splenic pseudo-leukæmia. Hodgkin's disease.

(*d*) Similar to (*c*), but cells enter blood-stream —ordinary lymphocythæmia.

(*e*) New growth derived from myelocytes, originating in the marrow; cells not entering the blood-stream. Sometimes associated with Bence-Jones's albumosuria—multiple myeloma (myelomatosis).

(*f*) Similar to (*e*), but with myelocytes

entering blood-stream; no Bence-Jones's albumosuria—myelogenous leukæmia, myelocythæmia.

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Musicotherapy.—The employment of music as a means of treating disease. The subject is exhaustively dealt with in Professor La Torre's *La Musica al Tribunale d'Igea* (Torino, 1910), which is a well-illustrated book of over 250 pages.

Muskoka Sanatoriums.—Sanatoriums for tuberculosis in the Muskoka Lake District, about 100 miles from Toronto, Canada. For description see *Lancet*, ii. for 1910, p. 1041.

Mutation.—A term (introduced by De Vries) for the sudden formation of a species, in contrast with variation (De Vries, *Die Mutations-theorie*, 1901).

Myatonia Congenita.—This name was applied by Oppenheim in 1900 to a congenital condition of localised or general atony of the muscles, especially of the legs. He conjectured that the disease was due to an arrested development of the muscles. Myatonia congenita is a rare affection, and not very many cases have been recorded. The disease is apparently always congenital, though the paresis and atony of the muscles may escape notice for a few months—until such time as a normal infant ought to be trying to hold up the head and use its muscles more freely. The chief symptom is a marked hypotonicity, with loss of the power of voluntary movement, of the muscles generally, including those of the trunk. The diaphragm, and the muscles innervated by the cranial nerves, escape. The patients can neither stand, sit upright, nor hold up the head. The palsy is not necessarily complete, and slight movement of the limbs or hands may be possible. Though they feel soft and flabby, the muscles are not really atrophied; the electrical reactions are quantitatively diminished or absent in bad cases; normal in slight ones. The tendon-jerks are abolished. The sphincters appear to act normally; swallowing is unimpaired. In Oppenheim's original description, the mental function was said to be unaffected, but in Baudouin's case there appeared to be some mental dulness, and in Spiller's case the vision was apparently very defective. Myatonia congenita is not a family disease, and it is not related to rickets, congenital syphilis, or malnutrition. Post-mortem examinations have been made on at least two cases. Baudouin found that the anterior horns of the grey matter of the spinal cord and the anterior roots were abnormally small, and that the medullation of the sciatic and other nerves was defective. The muscles showed marked changes of a retrogressive character—sclerosis, inequality of the muscle fibres, increase of the nuclei, and disappearance of the transverse striation. Spiller describes the nervous system of his case as healthy; the muscles had a hyaloid appearance, and contained much fatty tissue; the fibres were small, and the striation was indistinct. In a later communication dealing with the findings in the same case, Smith described fibrosis of the thymus and enlargement of Hassal's corpuscles, and endothelial proliferation in the thymus and in the spleen. There was also proliferation of the lymphoid elements of the mesenteric glands. Smith looks on the muscular lesion as definitely a part of the pathology of the malady, and suggests that the fibrosis of the thymus may, in some way or other, have so altered the function of that organ as to have brought about the muscular change.

Diagnosis and Prognosis.—In connection with the differential diagnosis of the disease, the following maladies have to be excluded—post-rachitic pseudo-paralysis, myopathies, progressive muscular atrophy, amaurotic idiocy, and mental defect generally, associated with extreme hypotonicity and flaccidity of the muscles. Collier and S. A. K. Wilson state that while the post-mortem findings are compatible with a condition of myopathy, the following clinical facts tend to show that myatonia (or, as they would call the disease, amyotonia) is distinct from that malady:—Myatonia is not a family disease, and has not been reported in a myopathic family. In the large majority of cases it is congenital, whereas myopathy is not. There is marked flaccidity, but not local muscular wasting—in myopathy it is the reverse. Myopathies pursue a downward course; myatonia undergoes progressive amelioration, with return of the deep reflexes. The chief points to be borne in mind are that the disease is congenital, or noticed for the first time during the earlier months, and that it is not progressive. The prognosis is not necessarily bad, for some cases recover. The chief danger to life arises from the presence of bronchitis.

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Myelæmia.—A synonym of splenomyelogenous leukæmia.

Myeloblastoma.—*See* Chloroma (*Classification*).

Myelocytoma.—*See* CHLOROMA (*Classification*).

Myelocytosis.—An increase in the number of myelocytes in the blood, *e.g.* in leukæmia.

Nævi.—The same freezing method with carbon dioxide as is described under LUPUS ERYTHEMATOSUS has also been found very useful in the treatment of pigmented nævi. The lesions, of course, require to have a longer application of the CO_2 snow, so as to be frozen to a greater depth. The result is at first the formation of a bulla, which bursts and crusts over, and when the crust falls off a fine scar is left. Should one application not have completely removed the nævus, the same treatment is repeated. Besides being of use in pigmented nævi, good results have been obtained in vascular nævi. The advantages of the method are its easy application, its painlessness, and the beauty of the scar which it leaves behind.

Warts may also be readily treated by the same freezing method, the application being of such short duration, and made with such slight pressure, that no scar results.

Nakayama's Test.—A very delicate test for bile pigments in the urine: the urine is treated with barium chloride solution, and centrifuged, when a reagent consisting of alcohol, concentrated hydrochloric acid, and ferric chloride is added to the precipitate and the mixture heated to boiling-point, a bluish-green or green solution is got, which becomes violet or red on the addition of nitric acid. *See* Webster, *Diagnostic Methods*, p. 316, 1909.

Naphthamine.—A synonym of urotropin.

Nastin (*see* LEPROSY).—Further reports on the Nastin treatment are to be found in articles by Kupffer (*Lepra*, viii. p. 144, 1909; *Therapist*, xix. p. 25, 1909), Lenz (*Arch. f. Schiffs- u. Tropen-Hyg.*, xiii. p. 365, 1909; *Lepra*, ix. p. 19, 1909), Rodrigues (*Therapist*, xix. p. 73, 1909), Much (*München. med. Wochnschr.*, lvi. p. 1825, 1909), Deycke (*Monatsh. f. prakt. Dermat.*, xlix. p. 475, 1909), Raschid (*Brit. Med. Journ.*, ii. for 1909, p. 1343), Chatterjee (*Indian Med. Gaz.*, xliv., Suppl. 15, 1909), J. Davidson (*ibid.*), Pascha (*ibid.* p. 1), T. S. B. Williams (*ibid.* p. 5), Peiper (*Arch. f. Schiffs- u. Tropen-Hyg.*, xiv. pp. 46, 286, 1910), J. A. Thompson (*Brit. Med. Journ.*, i. for 1910, p. 565), Kiwull (*Lepra*, xi. p. 226, 1910), Brinckerhoff (*Lepra*, xi. p. 291, 1910), MacLeod (*ibid.* p. 270, 1910), and Messum (*Transvaal Med. Journ.*, v. p. 214, 1910; and *Lancet*, ii. for 1910, p. 325).

Natality and Depopulation.

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UNTIL the close of the nineteenth century the question of natality or the birth-rate in its relation to population had scarcely come to be pressing for any country save France; but with the beginning of the twentieth century has come the knowledge that a falling birth-rate is no longer a Gallic prerogative, but has become a common attribute of the civilised nations of the world. The tendency to limit families, and so to prepare the way for what has been called "race-suicide," has spread from the Latin to the Teutonic and Anglo-Saxon peoples, and from Europe to America and Australia. The birth-rate of a country, formerly a matter of mild interest to the statistician and of self-congratulation to the politician, has suddenly come to be a question of national importance, and possibly of grave anxiety, to the rulers of the land. When, from the standpoint of international relationships and of high politics, it became evident that a decline in the birth-rate of one country, with no such decline in a neighbouring state, might fairly be translated into the terms of a condition of less readiness for defence on the part of the former and of greater preparedness and capacity for attack on that of the latter nation, natality had at once secured for itself the position of a world-problem. As soon as it was realised that a fall of 1 or 2 per thousand in the birth-rate meant, for a large nation like France, the lack in the next generation of citizens capable of military service equal in number to an army corps, the gravity of the question of natality could no longer be ignored.

No sooner were the decennial census returns for Great Britain published than it became evident that there had taken place a serious fall in the birth-rate of this country. To this marked decline Dean Freemantle drew attention in the *Times* (vide *Brit. Med. Journ.*, i. for 1901, p. 1630), and on it Stead commented in the *Review of Reviews* (xxiv. p. 14, 1901); the matter had clearly passed out of the sphere of medicine, and had become one of general interest. The Dean of Ripon pointed out that in a quarter of a century (viz. between the years 1875 and 1900) the birth-rate of the United Kingdom had fallen from 35 per thousand to 29 per thousand. For the population of 41½ millions inhabiting these islands there was, therefore, now an annual deficiency (at the present rate) of 249,000 babies. This was a more rapid decline than had taken place in France where the process had been slower

and longer in action. In the census returns the effect of this lowered natality was masked to some extent by the fall in the death-rate; but, of course, this could only be a temporary hindrance to the coming about of the ultimate result of a falling natality, viz. depopulation, for death was inevitable although it might be postponed for a decade or so, while births might be reduced to zero at the will of the people. Immigration, also, might mask the effect of a falling birth-rate, but it could hardly be regarded as diminishing the seriousness of the decline from a national or racial point of view. Since 1901 evidence of a declining natality has been accumulating, not only in Great Britain, but also in Australia and in the United States of America; and within the past few years the birth-rate of Germany, not excluding Prussia, has shown the same downward trend, for in 1876 it stood at 41 per thousand, and it fell to 33·1 in 1906. In Berlin, in 1876, natality was 45·4 per thousand, and in 1905 it was 24·6! Within the past year (1908) there has been evidence of an upward tendency in the birth-rate of France; the hope may be expressed that as the fall began in this country some years ago, with the other nations following suit, so, now, the rising again of the rate may extend to other countries than France. The somewhat extensive literature which has grown up round this interesting, but also alarming, tendency in modern life will be found at the end of the present article (*vide* p. 272).

The *causes* of the falling birth-rate are not far to seek, however difficult it may be found to check them. It may be that one of these causes is the greater frequency of sterility due to syphilis and gonorrhœa in the male as well as in the female parent; it is possible that alcoholism and drug-taking have acted in a prejudicial fashion upon pregnancy; it is generally admitted that the crime of producing abortion is becoming distressingly common; and there are other influences, such as over-eating, and especially the use of an exclusively meat diet, which may be at work (B. P. Watson, *Brit. Med. Journ.*, i. for 1907, p. 193); but the great causes of a lowered natality are not to be found among these things. Ballantyne, in his Presidential Address to the Edinburgh Obstetrical Society in 1906 (*Trans. Edin. Obstet. Soc.*, xxxii. p. 21, 1907), put the matter thus: "The falling of the birth-rate was not due to less knowledge or less skill in the obstetricians of the day, or to want of training of the midwives and monthly nurses, or to the neglect of chloroform or the forceps, or to the excessive use of these means of relieving pain and hastening the second stage of labour, or, indeed, to any other thing which lay in the power of the medical man to do or to leave undone. The causes lay deep among the roots of the somewhat artificial conditions of the sexual relationships in modern society. Renan had said: 'The spread of an enlightened selfishness is, in the moral world, a fact of the same nature as the exhaustion of coal-fields is in the physical world; in each case the existing generation is living upon and not replacing the economies of the past,' and his words applied very exactly to the enlightened selfishness which was the root-cause of the falling birth-rate. The era of personal comfort first, and at any cost; the age of marriages made late in life, because the entrants upon the matrimonial state wished to begin, not where their parents began, but where they were prepared to leave off; the period of frequent holidays and expensive amusement—that epoch could hardly be described as other than 'selfish,' although it might be doubted whether it deserved the honour of being entitled 'enlightened.' In any case, such an age was not one in which frequent child-bearing was likely to be thought of with favour, or carried through with enthusiasm. If there was ergophobia in the one sex there was maieusophobia in the other." There can be no doubt that voluntary sterility by the artificial prevention of conception is the great factor in the causation of the falling birth-rate to be observed in civilised lands; the means of checking pregnancy are now better known, and their use is apparently much more frequent now than formerly, and so families are limited to two or three children, or marriage is rendered absolutely sterile from the very beginning (*Brit. Med. Journ.*, i. for 1906, p. 269). It may be, and has been, argued that such practices indicate an increased sense of "the responsibilities of parenthood, and an awakening of the conscience of the individual to a sense of the wickedness of bringing into the world children whom their parents are not able either to feed or educate properly"; but a ready answer to this argument is found in the fact that it is in the well-to-do classes, and not among the poor and thriftless, that the fall in the birth-rate is most evident. The fall is all the more serious on this account, for, as Mr. Stead puts it (*Review of Reviews*, xxiv. p. 14, 1901), perhaps somewhat strongly, "if the moral and intelligent classes reduce their families to ones and twos, they hand over the future to the litters who are spawned every year by the thousand by parents who have as little sense of the responsibilities of fatherhood and motherhood as the fishes in the sea." It is surely a curious modern development of Malthusianism by which the educated, intelligent, and successful classes of the community are abrogating their privileges of reproducing their like, and are leaving the replenishing of the earth to others; there is little evidence that the world contains too many of the "fit," but there is more than one sign that it is inhabited by masses of the "unfit," and it is the propagation of the former, and not the increase of the latter,

that is to be desired. Eugenics is a very interesting branch of science, and it has high aims, which are the propagation of the fit and the elimination of the unfit in reproduction; but it comes upon the stage of the world's progress at an unpropitious hour, and will have a hard battle to fight. It is no doubt true that if "the babies are to be few, they ought to be fine," in other words, if the birth-rate must fall, then the progeny of the best parents ought to be preserved at all costs; but, unfortunately, it is precisely in what may be called the best stock that the restriction of the family is most evident. Further, there is no certain evidence that the declining birth-rate coincides with improvement of social conditions and is part of the economy of Nature (*Brit. Med. Journ.*, i. for 1906, p. 279).

The great cause, then, of the falling birth-rate is the voluntary restriction of the size of the family, the seeking for a sort of "voluptuous sterility"; but there is a subsidiary cause which is of some importance, the elevation of the age when marriage is entered into. Obviously, if a man and woman marry at the ages of forty and thirty-five their chance of having a large family is much less than if they married at twenty-five and twenty. Dumont (*Bull. et mém. Soc. d'anthrop. de Paris*, 5 S. iii. p. 248, 1902) has worked out the effect of opsigamy or late marriage upon the birth-rate of France. Of the whole male population of that country between the ages of 18 and 45, 45·8 per cent. were unmarried, while of the whole female population between the ages of 15 and 40, there were 44·9 per cent. unmarried. "What mysterious obstacle was it that prevented the 44 per cent. falling figuratively into the arms of the 45 per cent.?" (Edit., *Brit. Med. Journ.*, i. for 1903, p. 267). Dumont believed that the answer was to be found in the state of society which kept a son so long dependent upon his parents. "Businesses and professions were tardily lucrative, and the parasitic stage of life was lengthened"; further, there was the "dotal" or dowry difficulty, for French parents with their sons on their hands were unable to provide dowries for their daughters; third, there was the military service which France demanded of her young men; and, fourth, there was the example and influence of the Roman Catholic Church with its celibate clergy and its unmarried nuns. Some of these reasons are inoperative in this country, but others are in action; and there is doubtless another cause, which is touched upon by Snyder (*Journ. Amer. Med. Assoc.*, xlix. p. 363, 1907) as delaying marriage, viz. the dread of maternity fostered in the minds of unmarried girls by the tales of matrimonial disease and disaster, and the irksomeness of caring for infants, told them by their married sisters.

The fall in the birth-rate is in itself a serious phenomenon, but it is made still more grave by certain other occurrences which have been called its "aggravations" (*Trans. Edin. Obstet. Soc.*, xxxii. p. 17, 1906-7). The first of these is the almost stationary character of the infantile death-rate. Hygiene has greatly increased the chances of survival among individuals between the ages of 5 years and 25 years, and it has added a little to the length of the life of the aged, but it has been disappointingly ineffectual in checking the high death-rate among newborn infants. To quote from the *Report of the National Conference on Infantile Mortality* (p. 99) held in London in 1906: "In the twenty years ended 1874, we find that out of every 1000 children born alive in England and Wales, 153 never completed their first year, while in the twenty years ended 1904, the ratio was 148 per 1000." Here, then, is the first aggravation of the decline in natality: fewer babies are being born, and they are dying off almost as rapidly during the first year of life as they did in the past. The second aggravation is our ignorance, in this country at least, of the still-birth-rate and of the abortion-rate; national statistics are silent on these matters; but there is an uneasy feeling in the medical mind, resting upon the figures obtained in some localities by trained midwives and others, that these rates are increasing and not diminishing. In other words, out of the already fewer pregnancies more are ending in abortions and in still-births than formerly. A third aggravation is found in the increasing number of premature labours and in the infantile mortality following them, so that alongside the falling birth-rate is a depreciation in the death-resisting powers of the offspring due to an early termination of antenatal life and a premature entrance into the more exacting environment of the neonatal state.

Much has been written regarding the *checking of the falling birth-rate*, but, so far, little has been effected. Perhaps the first and most obvious step has already been taken in giving publicity to the facts of the case. The constantly recurring head-line in the newspapers—"the falling birth-rate" or "further decline in the birth-rate"—will in time impress the public mind and perchance awaken the national conscience. It would be well if such notices were accompanied by comparisons with the figures of past years and by a calculation of the annual deficiency (so to speak) in babies which the lowered rate brings with it. On the other hand, there is possibly the risk that such notices in the papers may make known to married people the hitherto unsuspected existence of means of preventing large families and so lead to the still more extensive employment of "checks." This danger, however, must be faced and the truth told. Perhaps, after all, the risk is not very great; for there are other agencies (with less worthy motives) at work

disseminating information; and it is well that the facts should reach the people, without accompanying incitements to initiate the parents who have abandoned the responsibilities, not to speak of the happiness, of parenthood. Then, again, it would be well if the medical profession defined carefully the morbid consequences (if there are such) attaching to marriages voluntarily made sterile, and let these results be known to their patients. Information of the same kind might be given to the public by midwives and monthly nurses.

There are ways in which an upward tendency in the birth-rate might be excited and fostered. There are, for instance, the legislative and fixed devices of giving abatement of income-tax to all fathers having families of more than 3 or 4 children or of offering grants to the individual children in large families. In some way or other there might be an "endowment of motherhood" (*Brit. Med. Journ.*, ii. for 1906, p. 1051). The evolution of a healthy public opinion on the subject could not fail to do good. Then, if it became clear that the birth-rate was rising, the preaching of eugenics would doubtless help to "improve the breed" by encouraging procreation by the fit and preventing it among the unfit. But it is to be feared that we are yet far from the days of a birth-rate going up by leaps and bounds, for it is doubtful whether any of the means suggested will prove efficacious in stopping the downward trend for some years to come.

But there are other ways in which the evil effects of a falling birth-rate may be lessened: we can attack the aggravations of diminished natality. We can try, for instance, to conserve the lives *in utero* which, under present circumstances, run so many risks of never coming to the birth; in other words, we can endeavour to check abortions and still-births. The laws of antenatal life and health are beginning to be better understood, and it is known that parental alcoholism, that improper feeding of the pregnant woman, and that certain trades with their toxicological risks are specially dangerous to the unborn infant. The registration of abortions and still-births, and perhaps of pregnancy (*Brit. Med. Journ.*, ii. for 1907, p. 425), the prohibition of women working at certain trades during their pregnancies, the provision of pre-maternity hospitals for women suffering from the diseases of pregnancy, and possibly, as Havelock Ellis suggests, the establishment of a "State Department for the Unborn" might achieve much in preventing the present appalling wastage of antenatal life. Then, again, the prevention of eclampsia, of hyperemesis gravidarum, of chorea of the pregnant, and of other grave complications of gestation, founded upon a right understanding of the causation of these states, would save many fœtal lives. The keeping alive of the prematurely-born infant by the perfecting of incubators and the devising of suitable methods of feeding would, of course, tend to lessen the high neonatal death-rate, and so for a time counteract the falling birth-rate. Further, and of the greatest importance, the spreading of knowledge as to the proper care and feeding of all new-born infants among all classes of the community could not fail to be most beneficial; the Huddersfield experiment might well be carried out on a large scale with advantage. The early notification of births now being widely adopted cannot do aught but good in enabling health visitors and others to get in touch with infant life before the ignorance or culpable carelessness of parents of a certain class convert it into early death. So, while it may not be possible yet to check the tendency to limit families, it may be quite practicable to save much life that is at present lost and so prevent the relative depopulation of our land and its fall to a secondary place among other nations.

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Nativelle's Digitalin.—A preparation consisting chiefly of digitoxin. *See* DIGITALIS in *Encycloped. and Dict. Med.* (ii. p. 384).

N'gana.—The tsetse-fly disease, due to the *Trypanosoma brucei*.

"Nebenkern." — *See* PARANUCLEAR BODY.

"Nebulique" Spray.—An apparatus which produces a fine cloud spray with aqueous, spirituous, or oily solutions ; it is recommended for laryngeal, pharyngeal, and nasal affections. Report in *Lancet*, i. for 1910, p. 1279.

Negri Bodies.—The possible causal agent of rabies.

Neo-Malthusianism. — *See* ABORTION (*Frequency*).

Nephritis, Treatment of.—In the dietetic management of nephritis the modern tendency is to favour reducing by every possible means the nitrogenous constituents of the food in acute cases, but to allow a more liberal diet than was formerly approved of in chronic parenchymatous and interstitial nephritis. Dr. J. M. Finny, in a recent paper on the subject, adopts the view of those who hold that it is a mistake to order milk *ad libitum* in acute nephritis ; milk contains too much albumen and too much water—it is, therefore, a doubtful practice, as well as unscientific, to endeavour, on the one hand, to save the kidney, whose function of secreting water by the glomeruli is in abeyance, and, on the other, to order four or five pints of milk in the twenty-four hours, to add to the already overfull circulation.

In very acute cases von Noorden believes it is best to give no nitrogen—nothing but sugar and water and fruit juice for from three to eight days at a stretch (often 200 to 300 grams of sugar daily). For less acute cases, milk combined with some such farinaceous food as arrowroot, cornflour, Benger's food, etc., should be given, and in every instance cream and sugar should be added. Von Noorden gives a sample of a daily menu containing a minimum of protein, yet possessing high nutritive value, as follows : — Milk, 150 grams ; cream, 375 grams ; rice, 50 grams ; rusk, 50 grams ; butter, 50 grams ; sugar, 20 grams ; it contains 2900 calories. Such a diet is suitable for acute nephritis. In convalescence the milk is to be increased to 2½ litres, and white bread, cereals, cream cheese, and a little egg and meal are added. Free libations of fluid, given with the idea of flushing out the kidneys, do more harm than good until the excretion of urine is fully re-established. In chronic nephritis, whether interstitial or parenchymatous, von Noorden allows a daily ration of 6 to 7 ozs. of meat, either red or white, in addition to the above. Any considerable deficiency of protein affects the general strength and nutrition of patients suffering from Bright's disease, even though the excretion of albumin may be temporarily diminished. He advises, however, that there should be an occasional interpolation of a period (7 to 14 days) of strict non-proteid diet.

CHLORIDE-FREE DIET.—Cases of acute and chronic parenchymatous nephritis, especially the latter, accompanied by dropsy, often improve rapidly on a diet free from chloride of sodium. The excretion of urine rises, the œdema disappears, and, coincidently therewith, the albumin in the urine diminishes. The introduction of this method of treatment—"dechlorination"—is due chiefly to the work of Widal and Javal, who have thrown much light on the salt-interchange of the body and the nature of œdema.

Contrary to popular belief, there is no evidence that the almost universal practice of adding salt to food is necessary to health. Among uncivilised races there are many exceptions to the rule, and alleged instances of ill-health following privation from salt break down on scrutiny. The actual bodily require-

ment of salt, as estimated by the quantity excreted by subjects who are fasting, is about ·6 gram daily, and this loss is more than replaced by the amount—1·5 to 2 grams—naturally present in an average mixed diet. In health, the body remains in a state of chloride equilibrium, the amount eliminated daily corresponding with what is ingested. All the tissues of the body are bathed in saline fluid, and it is imperative that the osmotic pressure, or concentration, of this should remain constant. The negative action of physiological salt-solution on the tissue cells as compared with the deleterious effects of stronger or weaker solutions is an illustration of this. Variations in the quantity of salt in the body must therefore be compensated for, and this is done, partly by the retention of enough water to keep it in solution of normal strength, and partly by the eliminatory action of the kidneys. If a healthy man be given a diet free from added salt he continues for several days to eliminate a quantity exceeding that ingested, losing weight the while; at the end of that time chloride equilibrium — *i.e.* output equals intake—is restored and the weight remains stationary. The addition of a fixed ration of salt causes the weight to rise again, and there is a corresponding retention of chloride before equilibrium is re-established. From such experiments it has been shown that about 12 grams of sodium chloride and 1·5 to 2 kilos of water represent the floating quantity lost by a normal adult in the process of dechlorination. Owing to the ability of the kidneys to excrete chlorides freely, large doses are tolerated in health, yet the power of even the normal organ has its limits, and the habitual consumption of quantities of salt in excess of the renal capacity may, *per se*, lead to retention of salt, and œdema from the excess of water required to keep it in isotonic solution.

In many forms of nephritis the kidneys become impermeable to sodium chloride, salt is retained in the tissues, and dropsy ensues. Patients with Bright's disease, swollen with dropsy, often lose weight steadily and recover from their dropsy when put on a diet containing no added salt. On adding salt the weight rises, and the œdema disappears. In such a case it will be found that on each addition or subtraction of salt with its rise or fall in the weight curve, there is a definite level at which visible œdema makes its appearance. Widal calls the period during which the weight is rising towards this point the *pre-œdematous period;* it represents the accumulation of fluid in the viscera. The kidneys, like the other viscera, suffer from the effects of interstitial œdema, and there is reason to believe that in curing this renal œdema we break a link in the chain of a vicious circle, in which the renal inadequacy produces a lesion of the kidney which still further impairs the efficiency of the organ. Thus, in removing œdema by dechlorination we are doing more than merely treating a symptom. Whatever be the precise explanation, it is certain that a dropsical patient, whose kidneys are impervious to very small quantities of chloride, may, after dechlorination has abolished the dropsy, regain part, at least, of his power of eliminating salt, and along with this there may be a marked diminution in the albuminuria. Dechlorination is said to be occasionally attended by nervous symptoms resembling those of uræmia; they are, however, rare and temporary. The practice of dechlorination is simple, and, contrary to what might be anticipated, patients do not rebel against being deprived of salt. Milk contains about 1·6 grams of salt per litre, which is equivalent to about 5·6 grams in an ordinary daily ration. Although this considerably exceeds the proportion naturally present in a mixed diet, it is much inferior to the quantity habitually consumed as added salt (15 to 20 grams), and probably some of the efficacy of milk in the treatment of nephritis is as much due to its comparative poverty in chloride as to any special attribute of its chlorine content. In strict dechlorination recourse must be had to a mixed diet, which may be selected from among the following, cooked without the addition of salt:—Fresh meat of all kinds, fresh-water fish, eggs, fresh butter, cream, potatoes, farinaceæ generally, sweets, vegetables, and fruit. The only article which requires special fabrication is bread; as ordinarily baked it contains from ·8 to 1 per cent. of salt; this, therefore, must be omitted. Home-made scones, free from salt, may be used instead. Soups, sea-water fish, all forms of salted or preserved foods, cheese, and milk, are proscribed. In practice, Widal allows from 3½ to 7 ozs. of meat daily, with cereals, eggs, etc., as the appetite demands.

Patients subjected to dechlorination should be kept in bed until the weight ceases falling and becomes stationary. Should dehydration be slow, it may be assisted by diuretics, particularly theobromine. To gauge the amount of fluid (and chlorides) lost, daily weighing is essential, and replaces chloride estimations.

Biancardi (*Ann. di ostet. e ginec.*, ii. for 1905, p. 641) and Cramer (*Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 437, 1906) reported cases of parenchymatous nephritis in pregnancy which improved markedly on chloride-free diet.

Dechlorination has been successfully employed in all forms of dropsy, cardiac and hepatic as well as renal, in œdema of the legs from exertion, phlegmasia, etc. The rationale of its action is the same in all such cases.

Decapsulation of the Kidneys (Edebohl's operation) has been employed in the treatment of nephritis, but the operation is now generally

discarded (see PUERPERAL ECLAMPSIA, p. 128; KIDNEYS, SURGERY OF, p. 221).

URÆMIA.—The pathology of uræmia still remains to be elucidated. The general impression at the present time is that it cannot be explained simply on the assumption that it is due to retention in the blood of substances which should be eliminated by the kidney, but that it is rather due to some abnormal metabolic process. Some recent work by Golla suggests that its phenomena may be due to the presence of trimethylamine, which is present in excess in the blood of nephritic patients. The precursor of trimethylamine is probably lecithin. Widal ascribes some of the symptoms of uræmia—particularly those affecting the nervous system—to retention of chlorides. His view is that both the chlorides and urea may be retained in some cases; in others, the chlorides only; in others, the urea. The percentage of urea in the blood is invoked to distinguish these; if it is below 1 gram per litre the toxæmia is due to chlorides, if 3 to 4 grams per litre, it is probably due to the urea. The chief signs of azotæmia are gastro-intestinal disturbance, anorexia, prostration, and torpor.

To Widal and his school œdema is explained solely as due to salt retention. This, however, is too one-sided a view. Chloride retention undoubtedly does lead to œdema, but, as von Noorden says, "we should be greatly wanting in critical acumen were we to suppose that this is the only, or even the most important, factor in the production of the condition, and, in consequence, to regulate the entire diet of renal patients on 'osmotic principles.'"

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Nephrotoxin.—The cytotoxin or cytolysin of the renal cells.

Nerves, Surgery of.—*Regeneration of Nerves.*—There are two theories as to the manner in which regeneration takes place in a divided nerve. We have first the older, neuron theory, according to which new axis cylinders grow down from the central segment into the peripheral degenerated part of the nerve; and second, the peripheral theory, according to which axis cylinders arise independently in the periphery from chains of cells which ultimately represent the sheath of Schwann, and become united secondarily with the central cells. Murphy (*Surgery, Gynæcology, and Obstetrics*, April 1907) summarises the main arguments on either side thus:—In support of the neuron theory—(1) His and others have found that an axon is an embryologic outgrowth of a nerve cell. (2) The neurons are anatomically independent. (3) An axis cylinder separated from its trophic cell degenerates, but the degeneration does not involve neighbouring neurons. Against the neuron theory — (1) Some of the appearances on which the theory is based are artefacts. (2) Clinical observations force us to conclude that peripheral regeneration is possible. (3) According to the neuron theory, degeneration precedes regeneration. Histological examination shows that repair and degeneration go on simultaneously. In a discussion which took place at the Liverpool Medico-Chirurgical Society (*Liverpool Medico-Chirurgical Journal*, Jan. 1906), both views were promulgated. Harrison held the central theory, stating that observation made by Gotch and himself on rabbits showed that after division and suture sensation reflexes appeared first near the point of suture, and at later periods at more distant parts. Kennedy, who held the peripheral view, relied on the rapid return of sensation after secondary suture in support of his theory. Mott (*British Med. Journ.*, 29th Sept. 1906) holds that the axis cylinder has an exclusively central origin. The neurilemmal activity which takes place in the peripheral part of the divided nerve provides a preparatory scaffolding for the development of new nerve fibres, but in no case has any evidence been forthcoming of auto-regeneration. On the whole, the leading authorities on the subject incline to older, central, neuron theory, in spite of the attempts which have been made to establish the fact of peripheral regeneration.

Clinical reports as to the sequence of events in the return of function after division and suture of a nerve are very conflicting. Part of the conflict, so far as sensation is concerned, no doubt arise from failure to appreciate the various forms of sensibility, so brilliantly demonstrated by Dr. Henry Head (*vide* SENSATION). According to Murphy, the order in which restoration takes place is (*a*) restoration of the trophic energy of the tissues; (*b*) sensation; (*c*) motion; (*d*) material increase of the wasted muscles. According to Head and Sherren, there follow upon union of a divided nerve (1) restoration of protopathic sensibility, which begins in from six to sixteen weeks; (2) return of sensibility to light, touch, and minor degrees of temperature. This stage may begin as early as the sixth week, more likely as late as the fortieth, and may not be complete until the seventy-fifth week. Complete recovery may not occur until one and a-half or two years. Motor power is generally considerably later than the first stage of sensation in returning, and often requires one or two years. The time required in cases of secondary suture is nearly double that required in primary suture. A limit of two years after

the primary lesion renders the final complete recovery almost impossible (Clifford Allbutt, *A System of Medicine*, 2nd edition, vii. p. 381, Lond., 1910).

Treatment of Cerebral, Spinal, and Peripheral Nerve Palsies and Athetosis by Nerve Transplantation.—Spiller, Frazier, and van Kaathoven have made an important contribution to this subject (*Amer. Journal Medical Sciences*, Mar. 1906). In 1902 Spiller suggested that in anterior poliomyelitis it might be possible to bring diseased peripheral nerve fibres into union with healthy nerves, and thereby to restore function, and in accordance with this suggestion a patient was treated in this way with distinct benefit. The chief dangers in operating on anterior poliomyelitis are delayed union and overgrowth of connective tissue in the nerve at the site of operation. Where a whole nerve is diseased and is so large as the peroneal, it is probably necessary to cut a portion of the sound nerve used for grafting, either transversely or transversely and longitudinally, and when the latter is done, to insert the split portion into the diseased nerve, but where the fibres are small, as are those supplying the anterior tibial muscle, probably enough fibres are cut in the healthy nerve by the longitudinal splitting and the insertion of the diseased fibres within the slit. The new axis cylinders which develop after an injury of nerve fibres are more numerous than those existing before the operation, and probably by growing into the diseased nerve suffice for its innervation. Even at the date of Spiller's paper, grafting for limited paralysis due to anterior poliomyelitis had passed the experimental stage, Hackenbruch (*Deuts. med. Woch.*, 22nd June 1905) had treated such cases with a measure of success; Kilvington (*Brit. Med. Journal*, 29th April 1905) had discussed the subject, and Harris and Low had grafted the fifth cervical into the sixth for deltoid paralysis.

In athetosis it seemed to Spiller that it might be possible by nerve grafting to divert some of the excessive innervation of the flexors into the extensors and thus check or diminish the movements. In a case in which this was tried, the athetosis was relieved at the expense of causing a partial paralysis of the flexors, but as the athetosis had previously been very severe and incapacitating, the patient's life was rendered much more comfortable by the operation. It is obvious that in treating athetosis thus the source of irritation is not removed, and it might have the impulses sent over the motor tracts from the diseased cortex, having been arrested, would overflow into other tracts and cause discomfort. Nothing of the kind, however, took place. The operation performed in this case showed that when the peripheral end of a healthy nerve is inserted into another healthy nerve by longitudinal and not transverse incision in the latter, return of function will occur in the inserted nerve. The musculo-spiral nerve was not cut transversely, yet partial return of function occurred in the distributions of the median and ulnar nerves. This justifies end-to-side anastomosis—the peripheral end of the affected nerve inserted into the unaffected nerve—in anterior poliomyelitis if the paralysis is confined to one or two muscles. If an entire nerve domain, such as that of the peroneal, were affected, end-to-side anastomosis might not be enough, and it would be advisable to insert some healthy fibres into the diseased nerve.

Frazier enunciates the principles of anastomosis from a surgeon's point of view. We have (1) lateral anastomosis (Fig. 1). Theoretically end-to-end anastomosis should give the best results; but one must bear in mind that failures will occur, and if we split off from an unaffected nerve some of its fibres, we are robbing a healthy group of muscles of part of their nerve supply. Hence lateral anastomosis causes less interference with the healthy nerves, and is to be preferred when the paralysis is not extensive. (2) End-to-end anastomosis (Fig. 2). This would become the operation of choice if it be shown that the healthy muscles are not permanently damaged. It would probably be necessary to operate thus where the paralysis is extensive. (3) Lateral anastomosis of the central end of a segment split from the unaffected nerve into the affected nerve (Fig. 3). This is Hagenbruch's method, and, as a believer in the central theory of regeneration, he argues that it will ensure the young axis cylinders from the central stump sprouting into the diseased nerve, instead of leaving it more or less to chance as in ordinary lateral anastomosis. (4) End-to-end anastomosis of both central and peripheral ends of the affected nerve into the split segments of the unaffected nerve (Fig. 4). The object is to preserve the function of any unaffected fibres which may happen to persist in the diseased nerve. *Technique.*—The nerves must be injured as little as possible. They should never be handled with forceps. To avoid the need for steadying the nerves during suture, the sutures should be inserted before the nerve is divided; the sutures should only include the sheath. A knife should be used to divide the nerves in preference to scissors, which cause bruising. Dissection should be as delicate as possible, with a minimum of trauma, so as to avoid the formation of scar tissue. Wound infection is fatal to success. After operation a plaster splint should be employed to ensure rest; the limb should be kept perfectly quiet for four to six weeks.

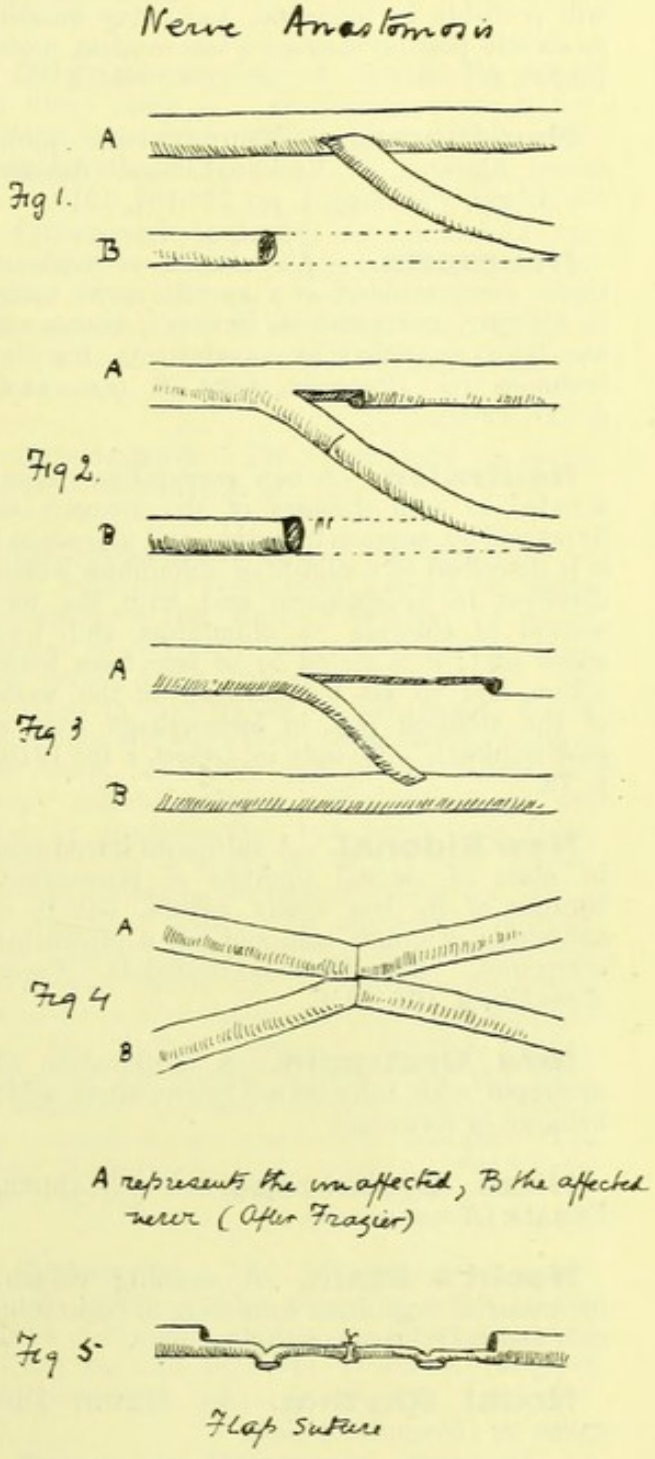
The operative technique of nerve suture is also discussed by Murphy (*op. cit.*). First, remove all connective tissue from the nerve endings, even though this involves considerable

shortening. Suture needles should be round without cutting edges, and the stitches should be of linen, silk, kangaroo tendon, or slowly absorbable catgut, and must not pass through the substance of the nerve. If the ends cannot be approximated by slight traction, a flap suture may be used (Fig. 5). Other devices to compensate for gaps between the ends of nerves are the insertion of grafts—nerves and spinal cords from animals, or from neighbouring healthy nerves, foreign bodies to act as conductors—rabbits' aorta, strands of catgut. Another plan is to resect bone, so as to shorten the limb, and allow the nerve ends to come together. To prevent the invasion of connective tissue various forms of protectors have been used—decalcified bone tubes, magnesium tubes, formalin hardened gelatine tubes, thin sheets of a mixture of paraffin and sesame oil, layers of fascia, etc., from adjacent tissues, the membrane lining the inner surface of an eggshell.

Badenheuer (*Deuts. Zeitschrift f. Chirurgie*, 1908, xcv. 24) advises that the sutures should pierce the nerve itself. It is well to combine suture with transplantation of tendons, shortening of the paralysed muscles by suture, and division of sound muscles and tendons.

Nerve Anastomosis for the Cure of Facial Paralysis.—The spinal accessory has mostly been used; less frequently the hypoglossal or glossopharyngeal. The hypoglossal is preferred on account of its larger trunk; because if union is perfect, associated movements are not noticed if the mouth is kept closed; because of the vicinity of the cortical centres for the facial and hypoglossal; and because the fibres of the facial which close the mouth may originate in the hypoglossal nucleus. The reason for using the spinal accessory is that it is a less important nerve; for using the glossopharyngeal, that its motor nucleus is near that of the facial. Anastomosis may be end-to-end (in the case of the spinal accessory) or longitudinal.

Nerve Anastomosis in the Cure of Peripheral Birth Paralysis.—It is doubtful whether the treatment of the ordinary brachial plexus paralysis (Erb's paralysis) by operation is justifiable, as the great majority of cases recover completely in the course of a few months or more. In cases in which there is no improvement at the end of a year the question of operation may be considered, but here we are met with the difficulty that in some of these severe cases the nerve roots are torn through in the intervertebral foramina, which will render it impossible to unite the divided ends. Murphy points out that in order to make a diagnosis of the point at which the nerves are injured, the movements of the diaphragm, as shown on the X-ray screen, should be considered. If it acts on the side of the paralysis, then the cords of the plexus must be divided beyond the point at which the phrenic nerve is given off—*i.e.* outside the foramina. So far as the ordinary obstetrical paralysis (Erb's form) is concerned, however, this would not prove of much value, for here the lesion is of the fifth and sixth roots, whereas the phrenic is given off by the third and fourth. The test would only be useful in total brachial plexus palsy. Nerve anastomosis



is likely to prove more useful in brachial plexus paralysis following injury during life than in the group of obstetrical palsies.

Brilliant as some of the results of nerve anastomosis have been, the operation has not proved uniformly successful. Failures have been reported by Warrington and Murray

(*Lancet*, 2nd April 1910). With a more exact knowledge of the minute anatomy of the peripheral nerves—*i.e.* the topography of the bundles of fibres in their trunks going to different muscles and groups of muscles, the study of which has been undertaken by Stoffel (*Deuts. Zeitschrift f. Orthopæd. Chir.*, Bd. xxv.), the possibilities of good results being obtained will probably be increased, and nerve anastomosis will possibly become a less random, more precise, procedure.

Neurinoma. — Neuro-fibroma, molluscum fibrosum, or Recklinghausen's disease. *See* Adami, *Pathology*, i. pp. 758-761, 1910.

Neuroprin. — An extract of nervous tissue, recommended as a specific nerve tonic in epilepsy, neurasthenia, Graves's disease ; it has been suggested as a substitute for the bromides (G. Roasenda, *Gazz. d. osp.*, xxx. p. 217, 1909).

Neutralon.—A new preparation recommended in such diseases of the stomach as hyperacidity, nervous irritation, and ulceration ; it is described as a silicate of aluminium which dissolves in hydrochloric acid with the formation of chloride of aluminium and free silicic acid ; it is stated to be free from toxic action, and to act by adhering to the walls of the stomach (*e.g.* in hæmorrhage from a gastric ulcer). *See* note in *Lancet*, i. for 1910, p. 73.

New Sidonal.—A substance introduced in place of sidonal (quinate of piperazine), because of its less costly nature, but it is anhydride of quinic acid and not a piperazine compound. *See* Fortescue-Brickdale, *Newer Remedies*, p. 102, 1910.

New Urotropin.—A combination of urotropin with anhydro-methylene citric acid ; helmitol or formamol.

Nitze Cystoscope.—*See* BLADDER, FEMALE (*Examination*).

Nocht's Stain.—A staining reagent for malarial organisms consisting of eosin solution and polychrome methylene blue.

Nodal Rhythm.—*See* HEART, DISEASES OF (*Irregular Action*).

Normocyte. — The normal red blood corpuscle of human blood.

Nourry's Iodinated Wine. — A proprietary tonic wine described as rich in iodine, this being "chemically combined with tannin in an almost tasteless compound" ; an analysis is given in the *Brit. Med. Journ.*, i. for 1909, p. 1308.

Nuclease.—A ferment or enzyme which causes disintegration of nucleo-proteids and the liberation of purin bases.

Nucleinic or Nucleic Acid.—One of the intermediate stages in the conversion of nucleo-proteid by digestion into phosphoric acid, purin bases, and pyrimidin bases ; nucleo-proteid yields (on digestion with HCl and pepsin) nuclein and protein, and the former (on tryptic digestion) yields nucleic acid and protein ; its chief pharmacological effect is to produce leucocytosis like yeast. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 56-57, 1910.

Nucleol.—A preparation of nuclein got from yeast.

Nucleo-proteins.—Compounds of one or more protein molecules with nucleic acid, which enter largely into the composition of the nucleus.

Nucleotin Phosphoric Acid.—A reputed uric acid solvent known also as *solurol*.

Nut Bromose.—A proprietary food preparation described as a pre-digested food, and an analysis of it is given in the *Brit. Med. Journ.*, i. for 1910, p. 1241.

Nycturia.—That morbid condition of the urine when the amount passed at night exceeds that of the day ; it is present in dropsical conditions of renal, cardiac, or hepatic origin.

Oatmeal Cure.—*See* ACIDOSIS (*Therapeutics*) ; DIET (*von Noorden's Oatmeal Cure*).

Ochronosis. — This extremely rare disease was first described by Virchow in 1866, but comparatively little had been added to our knowledge of it until 1906. Ochronosis is a condition of widely diffused melanotic pigmentation, the cartilaginous and fibrous structures throughout the body being chiefly affected. It does not seem to occur in persons under middle age, and is not in itself a fatal malady. According to Osler the patients usually seek medical aid on account of pigmentation, of passing discoloured urine, or of arthritis, hence the disorder may be described under these three heads. 1. *Pigmentation.* During life the pigmentation is usually most evident in the sclerotics and ears ; sometimes it also affects the hands, especially about the knuckles, and the skin of the face. Apparently there is less tendency for covered parts of the skin to suffer. The pigmentation differs from that of Addison's disease and argyria ; it

varies from a brown to a pure black, while in some cases the ears and fingers have a steely iridescence. Pick describes the aspect of a patient with ochronosis as grotesque: her face was coffee-brown, with deep brown spots round the eyes; the ears were iridescent steel-blue; and the hands, a dull slate The pigmentation of the eyes is almost pathognomonic (Osler). There are symmetrically disposed brown or black triangular areas on each eye, bounded by a narrow border of normal sclera. On post-mortem examination the cartilages, tendons, ligaments, inner coats of arteries, valves of the heart, fascia, and even the kidneys and other viscera are yellow, brown, smoky, or inky black. 2. *Urine.* In a number of cases melanuria has been observed. Sometimes the urine is dark when passed; in other instances it turns black on exposure to the air. 3. Chronic arthritis affecting various joints has been described in several of the reported cases.

PATHOLOGY.—The nature of ochronosis is obscure. In several cases there is definite proof that the patient suffered from alkaptonuria (*Encyclopedia and Dictionary*, Vol. X. p. 294), a congenital condition in which the urine contains a copper-reducing substance and turns black on exposure to the air. In another group of cases there is presumptive evidence of chronic carbolic acid poisoning. Such, for example, have been reported by Pick and Reid, in which the existence of chronic ulcer of the leg had led to the continued application of carbolic acid dressings over long periods of time. Here the urinary discoloration is probably due to carboluria. In yet a third series of cases the black urine was due to neither of the above causes; these may have been examples of true melanuria. Melanotic pigments in general are derived from tyrosin by the action of a ferment named tyrosinase, and Pick suggests that this ferment may also be able to convert into melanin the hydroxyl aromatic substances which exist in the circulation of alkaptonuric patients (endogenous ochronosis) as well as the phenol absorbed in chronic carbolic poisoning (exogenous ochronosis). Garrod states that while alkaptonuria and chronic carboluria may cause ochronosis they cannot be the only conditions producing this curious pigmentary anomaly.

LITERATURE.—POPE, *Lancet*, 6th Jan. 1906.—PICK, *Berl. klin. Wochensch.*, 16th, 23rd, 30th April, 7th May 1906.—GARROD, *Lancet*, 6th Jan. 1906.—REID, OSLER, and GARROD, *Quarterly Journ. Med.*, 1908, vol. i. p. 199. Excellent coloured plates illustrating the appearances are contained in Pope's and Reid's papers.

Occupational Diseases. — *See* TRADES, DANGEROUS, in *Encyclopedia and Dictionary*, Vol. X. pp. 84-100. A second International Congress of Occupational Diseases met in Brussels in 1910. See *Lancet*, ii. for 1910, p. 514.

Oculo-reaction. — *See* IMMUNITY (*Calmette's Test*).

Odynphagia.—Pain during swallowing (Gr. ὀδύνη, pain; and φαγειν, I eat).

Offset Theory. — *See* "ERSATZ" THEORY.

Oligoplasmia.—A state of the blood in which there is a diminution in its liquid constituents; anhydræmia; it contrasts with polyplasmia.

Olivenol Iodate.—A substitute for the alkaline iodides, being a combination of iodine with olive oil; it may be given subcutaneously; and it is stated that iodism is not produced. *See* Fortescue-Brickdale, *Newer Remedies*, p. 20, 1910.

Omnopon.—The name used in Great Britain for pantopon (*q.v.*).

Onchocerciasis. — The infection of meat with the *Onchocerca gibsoni*, a worm belonging to the family Filariidæ. In an ox carcase so infected nodular swellings or cysts are found under the skin (but not in the muscles) in the regions of the flanks, knees, shoulders, and elsewhere; these nodules contain the worm or worms, and in the female are many minute embryos. The worms are not directly transmissible but require an intermediary, *e.g.* a biting insect for their spread, so that, of course, no danger follows the eating of flesh thus infected by the human subject. The condition is not peculiar to Australia and Australian meat, for the parasite has been reported from the Malay States, Java, India, and also the United States of America. Corresponding but distinct species affect the horse (*Onchocerca reticulata*) and the human subject in tropical Africa (*Onchocerca volvulus*). See *Brit. Med. Journ.*, ii. for 1910, p. 1796; i. for 1911, p. 385.

Oökinet. — The vermiculus or motile spindle which results from the union of the nuclei of the macrogamete and the microgamete of the malarial organism within the body of the mosquito.

Open-air Recovery School.—A plan introduced in Berlin (Charlottenburg), and extended to other places, of giving anæmic and poorly nourished children the open-air treatment with systematic feeding and a certain amount of intellectual work; most of the time at the school is occupied with gardening, nature study, personal hygiene, etc. *See*

Editorial in *Lancet*, i. for 1910, pp. 583, 1231, etc.; ii. for 1910, p. 1246.

Ophthalmo-fundoscope. — An instrument, invented by Dr. Fritz Baum (Rome) for inspecting the fundus oculi under magnification; it can be used in broad daylight. See *Brit. Med. Journ.*, i. for 1910, p. 817.

Opsonic Index. — *See* IMMUNITY (*Opsonic Index*).

Optic Thalamus Syndrome.—The symptomatology of lesions of the thalamic region was described by Déjérine in 1903, and more recently Hartenberg has given a *résumé* of the condition, of which what follows is a brief epitome. The essential symptoms of the "thalamic syndrome" are:—Hemianæsthesia, pain on the anæsthetic side, slight hemiplegia, hemiataxia, and athetosis. Certain accidental symptoms, of which hemianopsia is the most important, may also occur; these, however, are due to the involvement of structures adjacent to the thalamus, and are not part of the symptom-complex. The thalamic syndrome is produced by a lesion which destroys the postero-external division of the external nucleus, together with part of the middle and internal nuclei and the corresponding fragment of the internal capsule. Hemianopsia is caused when Gratiolet's fibres are also implicated by a lesion of the posterior and inferior part of the thalamus. The onset is usually insidious.

The *hemianæsthesia* involves superficial sensibility, deep sensibility, the muscular sense, and the stereognostic sense. There is much less disturbance of superficial sensibility, whether to touch, pain, or temperature, than of the others. The *pain* on the anæsthetic side is intense; it is superficial rather than deep, and is continuous, with occasional paroxysmal exacerbations. It is due to irritation of the fibres of the internal capsule. The *hemiplegia* is very slight; there is neither atrophy nor contraction of the muscles. The reflexes are exaggerated or normal; Babinski's sign is inconstant (absent—Déjérine). *Hemiataxia* and *athetoid movement* usually occur; they do not seriously affect voluntary motion.

The thalamic symptom-complex, therefore, is due to a lesion of the sensory path, which at the same time just implicates the pyramidal tract. The diagnosis is not easy, because a very similar train of symptoms may be brought about by a lesion of the same tracts lower down in the brain and pons. When this is the case, however, some of the cranial nerves will also be affected—the ocular or facial especially. In the thalamic syndrome these are spared.

REFERENCES. — DÉJÉRINE and ROUSSY, *Rev. Neurol.*, 30th June 1906.—HARTENBERG, *Presse méd.* (Paris), 15th Jan. 1908.—ROQUE, *Lyon méd.*, 10th May 1908.

Orcein Stain.—A staining reagent for elastic tissue; it consists according to Unna and Tänzer of 1 gram of orcein dissolved in a mixture of 80 c.c. of 95 per cent. alcohol, and 35 c.c. of distilled water, 40 drops of strong hydrochloric acid being added after solution is complete; the elastic fibres stain a brownish-violet; and care must be taken after adding a few drops of the stain to warm for five minutes and then decolorise with acid alcohol. *See* Webster, *Diagnostic Methods*, p. 13, 1909.

Orchiococcus.—The orchiococcus of Eraud and Hugounenq is an organism found in the vaginal secretion which is apt to be confused with the gonococcus, but it grows easily upon ordinary media, and does not require the special ones which the gonococcus needs.

Orphol.—A compound of bismuth containing a phenol derivative (β-naphthol bismuth), having an antiseptic action in the small intestine as well as possessing the other properties of the bismuth preparations; the dose is from 4 to 8 grains several times daily. *See* Fortescue-Brickdale, *Newer Remedies*, p. 62, 1910.

"Orsudan."—An organic compound of arsenium, of which it is said to contain 25·4 per cent.; chemically it is sodium 3-methyl-4-acetylamino-phenylarsonate; and it is recommended in syphilis, malaria, trypanosomiasis, and other protozoal diseases; it is soluble in water. See also *Lancet*, ii. for 1908, p. 802.

Orthin. — A modification of phenylhydrazine.

Orthograde Posture.—The erect, walking, or standing posture (Gr. ὀρθός, straight or erect), as constrasted with the pronograde posture. *See* Scanes-Spicer, *Brit. Med. Journ.*, ii. for 1910, p. 1912.

Orthostatic.—*See* ORTHOTIC.

Orthotic.—Erect (Gr. ὀρθός, straight), as in orthotic albuminuria, that form of functional albuminuria which disappears when the patient is lying in bed; it is the converse of hypostatic albuminuria.

Osteopathy.—A system of medical treatment which consists very largely in the "correction of anatomical abnormalities (subluxations of bones, contractured muscles) which produce physiological discord" by manipulation. For a guarded and yet appreciative estimate of

manipulative therapeutics see A. Bryce (*Brit. Med. Journ.*, ii. for 1910, pp. 581-584; Leading Article, p. 638; and Letters, pp. 1004, 1564, 1824; also in i. for 1910, pp. 400, 656.

Ovaltine. — A proprietary food preparation described as "composed of malt extract, fresh Swiss cow's milk, fresh eggs, and converted cocoa, and containing active lecithin"; its analysis is given in the *Brit. Med. Journ.*, i. for 1910, p. 30.

Oxidases. — Oxidising ferments (substances setting free active oxygen), which are found in many of the tissues and secretions of the body, and which include laccase (ferments oxidising guaiacum and other organic substances directly by means of atmospheric or dissolved oxygen), tyrosinase (ferments acting on tyrosin), aldehydase (ferments oxidising aromatic aldehydes, etc.), indophenol oxidase, the purin oxidases, and glycolytic ferments (causing the disappearance of sugar from animal tissues); related to the oxidases are the peroxidases (bodies oxidising only in the presence of a peroxide), the catalases (ferments decomposing hydrogen peroxide, but incapable of effecting the oxidation of oxidase reagents by means of the peroxide), and oxygen carriers (*e.g.* the iron-containing pigments of the blood); the oxidases and true peroxidases are bodies which have great instability; they are believed to play a part in the defence of the organism against pathogenic microbes, and even to destroy toxins (*e.g.* diphtheria and tetanus). *See* summary of J. H. Kastle's work in *Lancet*, i. for 1910, p. 1561.

Oxo.—A proprietary extract of meat with dry beef-powder added; an analysis and details are given in the *Lancet*, ii. for 1908, pp. 1242-1243.

Oxygenia Water. — A proprietary water containing oxygen as well as carbonic acid gas. *See* Report, *Lancet*, i. for 1910, p. 36.

Pabst Extract.—A proprietary tonic described as "a liquid preparation of malt and hops, combined with calcium hypophosphite and iron pyrophosphate-alcohol 5 per cent."; an analysis is given in the *Brit. Med. Journ.* (ii. for 1909, p. 563), showing 6·2 parts of alcohol by measure, 4·1 parts of dextrin by weight, etc.

"Paco" Diastase Malt Extract.—A proprietary malt extract reported on in the *Lancet*, ii. for 1909, p. 1678; *Brit. Med. Journ.*, ii. for 1909, p. 1805.

Palæogenetic.—This term is applied to conditions which are, it is believed, explained by the presence in the early embryo of a germ, which normally disappears, but which may in certain circumstances remain and develop. On this theory of *palæogenesis*, Sir Jonathan Hutchinson explains the pattern of various skin anomalies (leucoderma, etc.). See *Brit. Med. Journ.*, i. for 1910, pp. 980, 1146, 1152, 1479; ii. for 1910, pp. 258, 340, 405, 658, 856, 914.

Palmine.—A proprietary vegetable fat recommended for cooking purposes for those who object to the use of animal fat (lard, dripping, etc.) See *Brit. Med. Journ.*, i. for 1909, p. 475.

Palmoform.—Methylene guaiacol, one of the insoluble compounds of guaiacol.

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SINCE Mr. Mayo Robson contributed the article on diseases of the pancreas to the *Encyclopædia Medica* (Vol. IX. p. 70) he has, in collaboration with Dr. Cammidge, published a compendious treatise on the same subject, which has added enormously to our knowledge of the affections of this organ, and has to some extent revolutionised our methods of treatment. In the department of diagnosis, particularly, we owe to Mr. Robson and Dr. Cammidge the introduction of several new methods.

DIAGNOSIS OF PANCREATIC DISEASE.—Very great assistance in diagnosis may be obtained by a careful pathological examination of the urine and of the fæces.

(1) *Fæces.*—In many instances the condition of the stools is almost characteristic of pancreatic mischief. The motions are bulky, pale, greasy, and offensive; though soft and frequent, they are not liquid. Patients, however, often complain of "diarrhœa," but inquiry will elicit the fact that the stools are not really liquid. The motions contain undigested fat and much fibre. This condition of affairs is more common in pancreatitis than in malignant disease of the organ, probably because in cancer the appetite is usually impaired, whereas in inflammatory affections it is more or less undisturbed, at any rate during the early stages. Fatty stools have long been recognised as symptomatic of pancreatic affection; the steatorrhœa occurs independently of jaundice, and is directly due to the pancreatic lesion. When fat is very abundant it may be recognised by the naked eye as an oily exudate, but if full advantage is to be taken of the occurrence of steatorrhœa as a symptom of disease of the pancreas a quantitative analysis of the fæces is required.

Method.—Mayo Robson and Cammidge recommend the following method:—"Two clean,

dry, Schmidt-Stokes milk tubes, labelled A and B, and provided with a 10 c.c. mark, are taken, and into the lower bulb of each is introduced an accurately weighed quantity (about half a gram) of the finely powdered fæces, that have been dried to a constant weight in a water-bath. The residue on the watch-glass used for weighing, and on the sides of the short-necked funnel with which the powder is introduced into the tube, is washed down with a fine jet from a wash-bottle, which for the A-tube contains hydrochloric acid (1 : 3), and for the B-tube plain water. The sides of the tube are also washed until the whole of the sample is collected in the lower bulb and the 10 c.c. mark is reached. The A-tube is then heated in boiling water for twenty minutes, occasionally rotating it so as to well mix the contents. After cooling, both of the tubes are filled to the 50 c.c. mark with ether, securely corked, and inverted forty times, taking care that the whole of the solid material runs through at each turn. Each tube is then rotated between the hands, and allowed to stand for half an hour or more, in order that the solid residue may be collected into the lower bulb. Considerable care is necessary in carrying out this part of the process in some instances, or a perfectly clear supernatant layer of ether, free from solid particles, is not secured. With a pipette, exactly 20 c.c. of the clear ethereal extract are drawn off from each tube and delivered into two CO_2 flasks of known weight, the amount of ether left in the tubes being noted. The ether in the flasks is then evaporated, the residue dried on the water-bath, and the flasks again weighed. From the amount of extract yielded by 20 c.c. of ether, and the quantity of ether left in the tubes, the total amount yielded by the weight of dried fæces used may be calculated, and from this the percentage in the stool determined. The result from the A-tube gives the total fat in the fæces, including the neutral fats, free fatty acids, and combined fatty acids, or soaps, since the latter will have been decomposed by being boiled with the hydrochloric acid and thus rendered soluble ; that from the B-tube represents the neutral fats and fatty acids only, as the soaps will remain undissolved by the ether : the difference between the two will therefore give the proportion of saponified fat present. Other substances in the fæces soluble in ether, such as cholesterin, lecithin, cholic acid, and pigments, are included in the estimates, but as the quantity is small it does not appreciably affect the results. For convenience of reference we shall speak of the yield from the A-tube as 'total fat,' that from the B-tube as 'neutral fat,' and the difference between the two as 'fatty acid.'"

When the functions of the pancreas are seriously interfered with, the amount of "total fat" in the stools is usually excessive. There is also a disturbance of the normal ratio between "neutral fat" and "fatty acids," the former, instead of the latter, being in excess. Robson and Cammidge give the following average figures :—

	Total Fats.	Neutral Fats.	Fatty Acids.
Normal, per cent. . .	21	11	10
Malignant disease, per cent.	77	50	27
Chronic pancreatitis, per cent.	50	32	18

In some cases of undoubted pancreatic disease there is no excess of fat in the stools. This may be due to (1) the food containing an unusually small proportion of fat ; (2) the fat in the food being of a readily digestible kind—*e.g.* milk ; (3) the action of the fat-splitting ferment in the stomach. An excess of fat may sometimes be detected microscopically, but this method of examination is far inferior as a diagnostic aid to chemical analysis.

In estimating the significance of steatorrhœa, the following facts should be taken into consideration :—(1) An excess of fat in the stools may be due to ingestion of food containing abnormal quantities of fat. (2) It may also be due to disease of the intestine, etc., interfering with the absorption of fat—*e.g.* tuberculosis. (3) Even if jaundice be present, an excess of neutral fat over fatty acids points to some interference with the fat-splitting action of the pancreas. (4) Disappearance of the steatorrhœa on the administration of a preparation of pancreas confirms the diagnosis of pancreatic mischief.

Other signs of pancreatic disease afforded by the examination of the stools are—(1) The presence of large numbers of undigested muscle fibres (see DIGESTION, p. 119, examination of the gastric functions, Schmidt's diet). (2) The application of the test for stercobilin may differentiate between jaundice due to cancer of the head of the pancreas and jaundice due to chronic pancreatitis or gall-stones. In the former stercobilin is absent, or present only in faint traces ; in the latter, though less than normal, it is distinctly present.

The test for stercobilin advised by Cammidge is the following :—"The solid residue from the B-tube [*supra*] can be used. . . . For this purpose it is filtered off, extracted with acid alcohol, the extract neutralised with ammonia, and mixed with an equal quantity of 10 per cent. zinc acetate in alcohol. The precipitate that forms is removed by filtration, and the clear filtrate examined with a lens, against a black background, for the green fluorescence that indicates the presence of stercobilin. The intensity of the colour varies with the amount of pigment, so that by always using approximately the same proportion of fæces and of the reagents any marked variation from the normal can be detected."

(2) *Urine.—Cammidge's "Pancreatic Reaction."*—The original method of performing the test, as described by Cammidge in 1904, has undergone more than one modification, and has been superseded by the improved or "C-reaction," the technique of which is described by Robson and Cammidge in these words :—

"A specimen of the twenty-four hours' urine, or of the mixed evening and morning secretions, is filtered several times through the same filter-paper. If it is found to be free from sugar and albumin, and is acid in reaction, 2 c.c. of strong hydrochloric acid (sp. gr. 1·16) are mixed with 40 c.c. of the clear filtrate, and the mixture gently boiled on a sand-bath, in a small flask, fitted with a funnel condenser. After ten minutes' boiling the flask is well cooled in a stream of water, and the contents made up to 40 c.c. with cold distilled water. The excess of acid is then neutralised by slowly adding 8 grams of lead carbonate. After standing for a few minutes to allow of the completion of the reaction, the flask is again cooled in running water, and the contents filtered through a well-moistened, close-grained filter-paper until a perfectly clear filtrate is obtained. The acid filtrate is then well shaken with 8 grams of powdered tribasic lead acetate, and the resulting precipitate removed by filtration, as clear a filtrate as possible being secured by repeating the filtration several times if necessary. Since the large amount of lead now in solution would interfere with the subsequent steps of the experiment, it is removed, either by a stream of sulphuretted hydrogen, or, what we have found to be equally satisfactory and less disagreeable, by precipitating the lead as a sulphate. For this purpose the filtrate is well shaken with 4 grams of powdered sodium sulphate, the mixture heated to the boiling-point, then cooled to as low a temperature as possible in a stream of cold water, and the whole precipitate removed by careful filtration. Ten cubic centimetres of the perfectly clear, transparent filtrate are taken and made up to 17 c.c. with distilled water ; it is then added to ·8 gram phenylhydrazin hydrochlorate, 2 grams of sodium acetate, and 1 c.c. of 50 per cent. acetic acid, contained in a small flask fitted with a funnel condenser. The mixture is boiled on a sand-bath for ten minutes and filtered hot through a small filter-paper, moistened with hot water, into a test-tube provided with a 15 c.c. mark. Should the filtrate fall short of 15 c.c., it is made up to that amount with hot distilled water, the added water being well mixed with the fluid by stirring with a glass rod, but in our own work we find that any addition is rarely necessary, as, with a little practice, it is possible to so regulate the boiling that the final result almost always comes out at between 15 and 16 c.c.

"In well-marked cases of pancreatic inflammation a light yellow, flocculent precipitate should appear in a few hours, but in less characteristic cases it may be necessary to leave the preparation overnight before a deposit occurs. Under the microscope the precipitate is seen to consist of long, light yellow, flexible, hair-like crystals arranged in delicate sheaves, which, when irrigated with 33 per cent. sulphuric acid, melt away and disappear in ten to fifteen seconds after the acid first touches them. The preparation must always be examined microscopically, as a small deposit may be easily overlooked with the naked eye, and it is also difficult to determine the exact nature of a slight precipitate by microscopical examination alone.

"To exclude traces of sugar, undetected by the preliminary reduction tests, a control experiment is carried out by treating 40 c.c. of the filtered urine in the same way as that in the test just described, except that it is not boiled with hydrochloric acid. Any albumin that may be present in the urine is removed, previous to commencing the test, by faintly acidulating, boiling, filtering off the albuminous precipitate, cooling, and making the specimen up to its original bulk with distilled water. The urine employed for the experiment should be fresh, and not have undergone fermentative changes. If alkaline in reaction, it should be made distinctly acid with hydrochloric acid before the test is commenced. Any dextrose that may be present can be removed by fermentation *after* the urine has been boiled with the acid and the excess neutralised."

This "C-reaction" is slightly more complicated than the earlier tests advised by Cammidge. It is said, however, to be more reliable, in that the result is more absolute, and less dependent on the personal equation of the observer. It may be added that the manipulations sound more troublesome than they actually are, and that with a little practice the test can be readily enough performed by anyone with the aid of a little simple apparatus. A positive reaction may be expected in all cases in which active inflammatory changes are going on in the pancreas. Acute pancreatitis can thus be distinguished from intestinal obstruction, and other conditions, while chronic pancreatitis associated with obstruction of the common duct can be distinguished by this means from obstruction of the duct due to gall-stones, etc.

In the diagnosis of chronic pancreatitis from cancer of the organ the test is also of value. In about three-fourths of all cases of malignant disease the reaction is negative, while in the remaining fourth it is positive. The positive reaction in these cases shows that there is an

associated inflammatory change in the organ. In interpreting the result of the test in this group of cases, therefore, the results of an examination of the fæces must be considered along with it. Oxaluria is a common symptom in pancreatic disease (63 per cent. of cases), and may therefore be of confirmatory value.

TREATMENT OF PANCREATITIS.—*In acute pancreatitis* the abdomen should be opened and drained. Mayo Robson reports two recoveries out of four cases so dealt with. Otherwise the disease is invariably fatal.

Chronic Pancreatitis.—Mayo Robson emphasises the importance of preventive treatment directed to the cure of conditions which tend to favour the development of chronic pancreatitis, *e.g.* gall-stones, duodenal catarrh, duodenal ulcer, alcoholism, or syphilis. If after a fair trial of general treatment, care in diet, wet packs to the epigastrium, rest, and mild mercurial purges, the symptoms persist, and the signs of failure in pancreatic digestion are manifesting themselves, the question of surgical treatment should be seriously considered, especially when jaundice is present, because if unrelieved the condition will certainly lead to serious degeneration of the liver and pancreas, and endanger life.

In operating for chronic pancreatitis, the surgeon must be prepared to expose the whole length of the common bile-duct, as well as the head of the pancreas. He will then be able to remove the cause, should it be a gall-stone, or a pancreatic calculus, or any other removable condition. In the absence of some obvious removable cause, it is advisable to secure efficient drainage of the infected bile and pancreatic ducts, either by cholecystotomy or cholecystenterostomy, preferably the latter. When the pancreatic disease is dependent on duodenal catarrh, associated with ulcer of the duodenum, it may be advisable, at the same time that the bile-passages are drained, to perform also a gastro-enterostomy in order to cure the original cause of the disease. Experience has taught that if the cause can be removed at an early stage an absolute cure is possible, and though complete restoration of the damaged gland in more advanced cases cannot always be promised, yet an arrest of the morbid process may be looked for, and the remaining portion of the pancreas will be able to carry on the metabolic, even if it can only incompletely carry on the digestive, functions of the gland.

Results.—Mayo Robson gives the following after-results of the surgical treatment of the class of case under consideration :—

"Of 102 operations undertaken in patients where chronic pancreatic trouble constituted the chief disease, or where it formed a serious complication of other diseases, 96·1 per cent. of cases were followed by recovery, giving a mortality of 3·9 per cent. Of the four cases that died, one was a cholecystotomy undertaken in a patient very deeply jaundiced, and reduced to the last stage of exhaustion before a surgical opinion was sought, and where at autopsy a cirrhotic condition of the head of the pancreas was found. The second was a cholecystenterostomy undertaken in a deeply jaundiced patient in the presence of extensive adhesions, which, on account of the feeble condition of the subject, seemed too formidable to deal with. In this case a necropsy revealed a calculus in the pancreatic portion of the common bile-duct, occluding the opening of the pancreatic duct, which would have been discovered had the patient's condition permitted a thorough exploration. A third, in a very feeble patient operated on away from home, extremely jaundiced, and suffering from repeated rigors. Drainage was imperfectly carried out, and she died of cholæmia two weeks later. And a fourth was a choledochotomy in an aged feeble man, who died of heart failure, accelerated by intestinal hæmorrhage, in the third week after operation, when the wound had healed.

"In the 55 cases of catarrhal interstitial pancreatitis, where gall-stones were found obstructing the pancreatic portion of the common duct, choledochotomy was performed in 42, cholecystotomy in 9, and cholecystenterostomy in 4.

"Of the 52 patients that recovered, 48 were living and well when last heard of; 1 is apparently well nine and a half years subsequent to operation, though sugar has recently been found in his urine; 1 died from cirrhosis of liver and ascites a year after, it being present and far advanced at the time of operation. Another has since died of acute bronchitis, and another from some non-specified ailment.

"In one case where the cause was pancreatic lithiasis, where calculi were removed both from Wirsung's and Santorini's ducts, the patient is now in very good health.

"In 46 cases of interstitial pancreatitis without gall-stones or other removable cause, the bile-ducts, and thus indirectly the pancreatic ducts, were drained in 19 cases by simple cholecystotomy, in 17 by cholecystenterostomy, and in 5 by separation of adhesions and thoroughly freeing the ducts. Of the 45 patients that recovered, no reply to letters was received from 6, who were well some time after operation. The rest were in good health when last heard of, with the exception of one (not drained) who has developed glycosuria some years after operation, but is otherwise well; one who shows signs of permanent damage to the pancreas by the ordinary test; and one who has anæmia, suggestive of the pernicious type.

"Besides the 19 cholecystotomies were 5 where the pancreatitis was associated with

duodenal ulcer, and in these cases a posterior gastro-enterostomy was performed at the same time, with good results in every case.

"It will thus be seen that in a very large percentage of cases the removal of the cause, together with drainage of the bile-ducts, or, in the absence of a removable cause, the simple drainage of the bile-ducts alone, is an operation that may be safely recommended in suitable cases that have failed to yield to general treatment."

LITERATURE. — *The Pancreas, its Surgery and Pathology*, by A. W. Mayo Robson and P. J. Cammidge (London), 1907, should be referred to. It is a complete treatise on the subject, and contains, besides a large number of illustrative cases, full details of diagnostic methods, and a bibliography.

Pancreatic Reaction.—*See* GALL BLADDER AND BILE-DUCTS.

Pankreon.—A proprietary preparation acting as a digestive agent when it reaches the duodenum; this is accomplished by combining the ferment with a tannin albumin compound which resists the gastric juice; it is recommended in a number of digestive disorders, in arteriosclerosis, angina pectoris, gastric migraine, etc. See *Lancet*, i. for 1910, p. 653; also Fischer and Hoppe, *München. med. Wochnschr.*, liv. p. 2640, 1907.

Panopeptone.—A proprietary food preparation, described as containing "the nutritive constituents of beef and wheat in a soluble and freely absorbable form"; an analysis (*Brit. Med. Journ.*, ii. for 1909, p. 562) gives 20·0 parts by measure of alcohol, and 26·9 parts by weight of total solids.

Pantopon.—A proprietary preparation of opium which is said to represent all the alkaloids of that drug in the form of chlorides; it is claimed for it that it does not cause vomiting, constipation, or excitement, and that it does have a sedative action when morphine fails; the average dose is from $\frac{1}{5}$ to $\frac{1}{3}$ grain thrice daily; in Great Britain it is known (on account of legal reasons) as *omnopon*. *See* Sahli, *Therap. Monatsh.*, xxiii. p. 1, 1909; *München. med. Wochnschr.*, lvii. p. 1326, 1910; Ewald, *Berl. klin. Wochnschr.*, xlvii. p. 1609, 1910; Pertik, *Deutsche med. Wochnschr.*, xxxvi. p. 1661, 1910; and *Brit. Med. Journ.*, ii. for 1910, pp. 1179, 1295, and 1572.

Papillœdema.—Œdema of the intra-ocular end of the optic nerve.

Parabismuth.—A yellowish powder consisting chiefly of paranucleinate of bismuth. *See* Fortescue-Brickdale, *Newer Remedies*, p. 59, 1910.

Paradox Reaction.—*See* IMMUNITY (*Supersensitisation*).

Paraform.—A disinfecting agent, described as a polymer of formic aldehyde; also known as *triformal*.

Paragonimus Westermanii.—One of the trematodes (the lung fluke or distoma pulmonale) sometimes found (generally in the form of its ova) in sputum.

Paranephrin.—One of the many names for the active principle of the adrenal body.

Paranuclear Body.—A body consisting of granules lying outside the nucleus; "Nebenkern."

Paranuclein.—One of the first products of the peptic digestion of casein, obtained by synthesis. *See* Adami, *Pathology*, i. p. 82, 1910.

Paraphthalein.—One of the many trade names given to phenolphthalein (*q.v.*).

Paraplasm.—That portion of the cell-substance which is neither cytoplasm proper nor the cell fluid of the meshes, but either granules taken up by phagocytic action, or produced by cell metabolism, or the fluid contents of secretory vacuoles, or inactive substances laid down as a framework. *See* Adami, *Pathology*, i. p. 33, 1910.

Pararegulin.—A mechanically-acting purgative, composed of paraffin and cascara. *See also* REGULIN.

Parathyroidectomy.—*See* PARATHYROID GLANDS.

Parathyroid Glands.—Opinions on the nature and functions of the parathyroid glands are divided between two camps. On the one hand there is a school of physiologists who look on them merely as potential or actual thyroid tissue, and on the other hand a large number of experimenters regard them as totally distinct and equally important to the animal economy. According to those who hold this view thyroidectomy produces "post-operative" myxœdema, parathyroidectomy, tetany.

Among the leading representatives of the negative school are Jolly, Swale Vincent, and Forsyth. The objections which have been directed against the results of the experimenters who assert that tetany can be caused by extirpation of the parathyroids are based on (1) the admitted technical difficulties of total parathyroidectomy, and (2) the impossi-

bility of making certain that in the operation *all* parathyroid tissue has been removed and no aberrant parathyroid left behind, and at the same time of performing complete excision without in any way injuring the thyroid gland. (3) The contradictory nature of the alleged symptoms. Jolly and Vincent found that removal of all four parathyroids was not necessarily fatal; a few experiments which they made in the way of injuring adjacent structures in the neck without removing the parathyroids suggest that tetany might be due to accidental injury to nerves, etc., during parathyroidectomy. Forsyth reasons on evolutionary grounds, that it is impossible that the parathyroid possesses a special, vitally important function. "If it be granted that these glands are essential to life they cannot be regarded as of recent [phylogenetic] development, yet, if their origin is to be set back to a remote evolutionary period, the difficulty has to be met that few, if any, of the organs in the body show such wide variations." Forsyth worked out the comparative histology of the glands on mammals and birds, and found that all stages between parathyroid and typical thyroid structure were traceable. According to Forsyth, Swale Vincent, and Jolly the parathyroids and thyroids are parts of one whole; the parathyroids are "essentially thyroidal in nature, possessing no peculiar function, but engaged in the active secretion of the same substance as the thyroid gland" (Forsyth).

As opposed to this theory, we have the opinions of the large number of workers who believe they have established the existence of a definite function independent of (or even antagonistic to) that of the thyroid. In 1896 Vassale and Generali carried out an exhaustive series of experiments on the effects of extirpating some or all of the parathyroids, with or without partial or total thyroidectomy, and it is really on their results, which seemed very clearly to prove that total parathyroidectomy caused tetany, that all subsequent research has been founded. A great many other observers have obtained more or less confirmatory results; the principal experimenters have been Gley, Pineles, Welsh, Erdheim, MacCallum, and Halsted. Halsted has quite recently published a long series of experiments on dogs on transplantation of parathyroid tissue, the object of his research being to settle what course a surgeon should pursue when he accidentally injures the structures in operating for goitre. He found that grafts only "took" when an animal's own parathyroid was used (auto-transplantation), and that, only when a deficiency of parathyroid tissue had been created by the removal of at least half the parathyroids. Parathyroid tissue in excess of what the organism needs does not survive. Total thyroid-parathyroidectomy causes death from tetany; total thyroid-parathyroidectomy with auto-transplantation of a parathyroid causes myxœdema. If, in the latter case, the grafted parathyroid be removed subsequently, tetany occurs.

In addition to suffering from acute or chronic tetany, parathyroidectomised animals become emaciated, lose their hair, and become affected with dermatitis. Erdheim found that in rats the enamel of the teeth showed characteristic lesions, and became defective, the process ending in loss of the upper incisors. The lower incisors grew abnormally. Albuminuria is fairly constant after the operation. In young animals there is some evidence that the growth of the bones is interfered with.

In the face of these two conflictory sets of experiments it is very difficult to form any conclusion as to the functions of the parathyroids. It may be remarked, however, that those workers who believe that extirpation of the organs cause tetany greatly outnumber those who deny a connection between the two. There is, moreover, a certain amount of evidence along other lines which lends support to the idea that ablation of the parathyroids, or disturbance of their function, causes tetany.

Tetany is a disease which occurs under a variety of different conditions, and it is now generally accepted that, whether it is associated with pregnancy, with rickets, or with occupation, it is fundamentally the same. It is not unreasonable to suppose, therefore, that insufficiency of some internal secretion predisposes to it, while some other cause precipitates an attack. Tetany has a peculiar geographical distribution; it is endemic in certain localities, unknown, or almost unknown, in others—in this respect it is comparable to goitre. Persons going to reside in a goitrous district often develop goitre; the same is observed with regard to tetany. In Vienna, where tetany used to be endemic, Chvostek states that the majority of the cases occurred among Slav immigrants. There appears to be some antagonism between goitre and tetany, for in goitrous districts tetany is rare, and *vice versâ*. In Vienna, where tetany is now declining, goitre is becoming more common. These analogies are at least interesting as suggesting that the two diseases have the same kind of origin. Another point of some interest is, that in some cases animals which have had several parathyroids removed, and have remained apparently healthy, have subsequently become pregnant and developed tetany.

In the tetany of childreen (see SPASMOPHILE DIATHESIS) there is some reason to suppose that calcium metabolism is at fault. MacCallum and Voigtlein have shown that in parathyroidectomised animals the calcium content of the

blood during an attack of tetany is lowered. The brain is poor in calcium, and the excretion of calcium by the bowel and kidneys is increased. Leopold and Reuss found that in young animals removal of the parathyroid was followed by deficiency of lime in the skeleton. MacCallum and Halsted proved that animals which appeared to be on the point of death from operative tetany could be rescued by oral, intravenous, or subcutaneous administration of calcium acetate or lactate. Some of Halsted's animals were kept alive in this way during the period which intervened between total parathyroidectomy and the grafted parathyroid beginning to function.

There is some pathological evidence of an association between lesion of the parathyroid and tetany. Facial irritability (Chvostek's sign) is one of the most constant features of the disease—it is an expression of that increased mechanical and electrical irritability of the nerves which underlies tetany ("latent tetany"). Now facial irritability according to Chvostek is not very uncommon in apical phthisis, and in one case of this kind he found tuberculous infiltration of the parathyroid. In children dying with manifest or latent tetany evidences of hæmorrhage into the glands have been demonstrated by Yanase (in Escherich's clinic) and others.

Post-operative tetany in animals, and a few cases of human tetany, have been cured by the use of parathyroid extract, either by the mouth, or subcutaneously.

THEORIES AS TO THE FUNCTION OF THE PARATHYROIDS.—As none of these has passed from the region of hypothesis to proof, it will be enough to enumerate the chief.

1. The parathyroids are simply a part of the thyroidal system, and have the same function as the thyroid.

2. The parathyroids have a "detoxicating" action; they neutralise a poison produced by the thyroid. On this theory there is an antagonism between the thyroids and parathyroids. The grounds on which this has been supposed are—(1) parathyroid extract has a beneficial action in exophthalmic goitre; (2) when the thyroid is ablated as well as the parathyroids, the resulting tetany is milder than when the thyroid is left behind; (3) when the thyroid is ablated the parathyroids undergo hypertrophy. (It would seem, however, equally plausible to believe that the hypertrophy is compensatory.)

3. The parathyroids regulate calcium metabolism. This theory may be given in the words of MacCallum and Voigtlein. "The rôle of the calcium salts in connection with tetany may be conceived as follows:—The parathyroid secretion in some way controls the calcium exchange in the body. It may possibly be that in the absence of the parathyroid secretion, substances arise which can combine with calcium, abstract it from the tissues, and cause its excretion, and that the parathyroid secretion prevents the appearance of such bodies. The mechanism of the parathyroid action is not determined, but the result—the impoverishment of the tissues with respect to calcium, and the consequent hyper-excitability of the nerve-cells, and tenany—is proven."

LITERATURE.—The literature is rather extensive; a full bibliography will be found in the references marked*. *SWALE VINCENT and JOLLY, *Journ. Phys.*, xxxii., 1904; xxxiv., 1906.—FORSYTH, *Journ. Anat. and Phys.*, lxii., 1908; *Quarterly Journ. Med.*, Jan., April, 1908.—*MACCALLUM and VOIGTLEIN, *Journ. Exper. Med.*, 9th Jan. 1909.—HALSTED, *Ibid.*—CHVOSTEK, *Wien. klin. Wochensch.*, 25th April and 3rd May 1907; 9th Jan. 1908, and other issues of the same journal.—YANASE. *Wien. klin. Wochensch.*, 26th Sept. 1907.—LEOPOLD and REUSS, *Wien. klin. Wochensch.*, 28th Aug. 1908.—ERDHEIM, *Mittheil a. d. Grenzgebiete Med. u. Chir.*, No. 16, 1906.—VASSALE and GENERALI, *Arch. ital di Biol.*, 1895, 1896.—*RUDINGER, *Ergeb. d. inner. Med. u. Kinderheilk.*, Bd. ii. (Berlin), 1908 (critical review).

Paravaginal Section.—*See* UTERUS, MALIGNANT TUMOURS (*Schauta's Operation*).

Paravertebral Triangle.—*See* GROCCO'S SIGN.

Paraxanthin.—One of the purin bodies, having the chemical formula, $C_7H_8N_4O_2$.

Pelvis, Hæmatocele and Hæmatoma of.—There is little to be added to the account given of pelvic hæmatocele and hæmatoma in the *Encyclopedia and Dictionary of Medicine*, Vol. VII. p. 391. There have indeed been marked advances in our knowledge of hæmorrhage into the pelvic tissues, but these have been made in connection with ectopic pregnancy and are considered under that heading (*vide* p. 133). There is an increasingly strong tendency to suspect extra-uterine pregnancy in nearly all cases of hæmatocele, a tendency which has been greatly favoured by the discovery of cases of primary ovarian gestation and of early abdominal pregnancy (primary or secondary), and by the knowledge that the Fallopian tubes after tubal abortion, and even after tubal rupture, return very quickly to a normal state. Unless the tissues involved in a hæmatocele be carefully examined under the microscope and found free from fœtal elements, it must be very difficult entirely to exclude an ectopic gestation. At the same time it cannot yet be confidently affirmed that pelvic hæmatoceles are always the result of tubal or ovarian pregnancies. Otto Engström (*Arch. f. Gynaek.*, lxxxii. p. 60, 1907), for instance, has described a case of intra-peritoneal hæmatocele due to hæmorrhage into a corpus luteum; the tubes were normal, and a microscopic examination showed no fœtal elements; and in de Rouville's case (*Ann. de*

gynéc. et d'obstét., 2 S. v. p. 222, 1908) the hæmorrhage seems to have been caused by the rupture of follicular cysts in the ovary, but the writer gives no details regarding the menstrual history of the patient, and it can hardly be affirmed that ovarian pregnancy was excluded. But, apart from tubal and ovarian conditions, there is the possibility of hæmorrhage into the pelvic peritoneum or cellular tissue from other causes; in Perrier's observation (*Thèse de Lyon*, 1904), for instance, there were uterine fibromyomata, and hæmorrhage was traced to subserous uterine varicose veins of the uterus, and in Walter's case (*Journ. Obstet. and Gynæc. Brit. Emp.*, xiii. p. 145, 1908), there was bleeding into both broad ligaments after the performance of a supra-vaginal hysterectomy. But these are exceptional occurrences. So commonly is hæmatocele the result of ectopic gestation that unless there is very strong evidence to the contrary it should, when diagnosed, be regarded as so originating, and it should be treated in the same way as an extra-uterine pregnancy, viz. by opening the abdomen, securing the bleeding points, and clearing out the blood and clot.

Pemphigus and Dermatitis Herpetiformis.—Whilst many still hold that pemphigus and dermatitis herpetiformis are diseases of nervous origin, there has been a good deal of evidence recently brought forward that they are due to toxæmias, which are probably of intestinal origin. Johnstone and Engmann are strong upholders of this opinion. In support of this view is the fact, which is undoubted, that nearly all of such cases show a marked indicanuria. Treatment based on an attempt to wash out any toxic substance from the system has given favourable results. Johnstone recommends giving large quantities of water to drink, at least three quarts daily in addition to the liquid which is taken at meals. He also gives diuretics, and helps elimination through the skin by hot-air baths and pilocarpine, gr. $\frac{1}{40}$–$\frac{1}{20}$ by mouth four times daily. Iron should also be given if there is any anæmia.

REFERENCES.—Engmann, *Journ. Cutan. Diseases*, May 1906.—Johnstone, *Brit. Med. Journ.*, 6th Oct. 1906.

Peptobromeigon.—A substitute for the alkaline bromides, being a combination of bromine with protein; it differs from bromeigon itself in being soluble.

Peptoiodeigon.—An iodoform substitute, an albumin compound of iodine; it differs from iodeigon itself in being soluble in water, and contains 15 per cent. iodine. *See* Fortescue-Brickdale, *Newer Remedies*, p. 12, 1910.

Perhydrol.—A proprietary preparation, being Merck's "Chemically Pure and Acid-Free Hydrogen Peroxide"; it is described as a colourless limpid liquid, and, being a highly concentrated preparation, it is said to produce therapeutic effects which cannot be obtained from ordinary solutions of hydrogen peroxide; 1 part of perhydrol to 9 parts of distilled water gives a 3 per cent. solution; it acts as a deodorant and as a styptic, and produces a mechanical cleansing effect on the tissues (catalytic action followed by effervescence taking place on contact); and it is recommended in the various morbid states (surgical, gynecological, dermatological, etc.), in which hydrogen peroxide itself does good. There is also a perhydrol mouth-wash and a perhydrol tooth powder.

Periappendicitis Decidualis.—*See* Ectopic Pregnancy (*Tubal, Pathology*).

Peridiverticulitis.—Inflammation of the tissues surrounding a diverticulum (*e.g.* of the intestinal canal); it is one of the causes of sigmoiditis and meso-sigmoiditis when the diverticulum is situated in the sigmoid flexure.

Perineosynthesis. — A somewhat grandiloquent term for perineal repair.

Perpetuale.—A proprietary preparation, being an aerated beverage containing lactic acid. See *Lancet*, ii. for 1910, p. 467.

Perseveration.—This term, entered as obsolete in the *New English Dictionary*, has been re-introduced to express a particular form of perseverance experimentally determined, viz. the persistence of mental impressions, or the rapidity with which one impression could follow another as tested by two-coloured rotating discs (Wiersma's); perseveration, as thus understood, indicated the quality rather than the amount of the intelligence. *See* J. G. Gray, *Brit. Med. Journ.*, ii. for 1910, p. 791.

"Pessary" Cells. — Erythrocytes which have lost so much of their hæmoglobin that only their periphery is visible, and so they come to look like ring pessaries.

Petrosulphol.—An artificial ichthyol produced from crude petroleum, obtained in the Tyrol, and containing 16·27 per cent. of sulphur. *See* Fortescue-Brickdale, *Newer Remedies*, p. 27, 1910.

Pfannenstiel Incision.—*See* Cæsarean Section (*Sectio Cæsarea Abdominalis Inferior*).

Pfeiffer's Experiment.—*See* IMMUNITY (*Antibacterial Action*).

Phagolysis. — *See* IMMUNITY (*Metchnikoff's Theory*).

Pharyngomycosis Leptothrica.—The presence of a coating or membrane (with micro-organisms in it) upon the tonsils and other parts of the mouth and pharynx; the membrane shows numerous lymphocytes, epithelial cells, and the *leptothrices buccalis*; it is to be observed in normal subjects sometimes over the tonsils, but is specially associated with thrush and diphtheria, and is common in those who are liable to tonsillitis.

Phenolax.—A trade name of phenolphthalein (*q.v.*).

Phenolphthalein.—A chemical substance, a phenol derivative, represented by the formula $C_6H_4CO.O.C(C_6H_4.OH)_2$; its purgative properties were accidentally discovered as the result of its being used as an "indicator" for certain Hungarian wines; it is a tasteless, odourless powder, insoluble in water, and does not, save in large doses, have any irritant action on the kidneys; its dose is from 1 to 5 grains, and it may be given in one dose at bedtime, or in smaller amounts after each meal; its purgative action has been ascribed to the production "of a solution with high osmotic pressure in the alkaline contents of the small intestine; it is recommended as a mild purgative, specially suitable for children, although some have reported that its use aggravated hæmorrhoids, and others have noted some uncertainty in its action," and if given in tablet form it must not be swallowed whole but sucked or broken down into powder. There is already a large literature dealing with phenolphthalein, either under that or another of its many trade names; but *see* Fortescue-Brickdale, *Newer Remedies*, pp. 76-77, 1910; Benedict, *Therap. Gaz.*, 3 S. xxv. p. 622, 1909; Quintard, *Arch. méd. d'Angers*, xii. p. 400, 1908; Rowntree, *Bull. Johns Hopkins Hosp.*, xx. p. 293, 1909; Turlais, *Arch. méd. d'Angers*, xii. p. 406, 1908; Wood, *Phila. Hosp. Rep.*, vii. p. 183, 1909; *Lancet*, ii. for 1909, p. 1443.

Phenosal.—An antipyretic of the phenacetin group, being a compound of salicylacetic acid with phenetidin; it forms a bitter powder, insoluble in water; its dose is 8 grains; it has been stated to have only slight physiological action. *See* Fortescue-Brickdale, *Newer Remedies*, p. 217, 1910.

Phenyl-alanin.—One of the polypeptids which have been produced synthetically, alanin being amino-propionic acid.

Phesin.—A drug of the phenacetin group, being a sodium salt of phenacetin sulphonic acid, much more soluble than phenacetin; the dose is from 15 to 30 grains; it is said, however, to be a feeble antipyretic and analgesic, and to be liable to produce much sweating. *See* Fortescue-Brickdale, *Newer Remedies*, p. 225, 1910.

Phlebotomus Fever. — A disease occurring in Malta, Egypt, and other countries bordering on the Mediterranean, called also "sandfly" or "three-days' fever," or "Pym's fever" (after Surgeon Pym, who described cases in 1804); it is said to be due to an organism transmitted by the owl-midge or sandfly (*Phlebotomus papatasii*); and it shows resemblances to dengue and influenza. *See* Lieut.-Col. Birt's article (with *Literature*) in the *Brit. Med. Journ.*, ii. for 1910, pp. 875-878.

Phonoscope.—An instrument devised by Otto Weiss for photographing heart sounds, in which the vibrations are collected on a circular soap film (to which is attached a silvered glass thread) and thrown on a photographic plate; Weiss has thus been able to get curves of great delicacy and accuracy, and has even been able to photograph the heart sounds of the unborn infant. See his work, *Phono-Kardiogramme*, Jena, 1909.

Phosphatides. — Lecitho-proteins or compounds of the protein molecule with lecithins, or, according to another view, nitrogen and phosphorus-containing lipoids; they enter into the composition of nervous tissue, of the red blood corpuscle, of egg yolk, etc.; chemically they are compounds of amino-acids with fatty acids and one or more nitrogenous bases; and physically they are colloidal and can dissolve other colloids, acting as fat- and cholesterin-carriers. *See* Adami, *Pathology*, i. p. 96, 1910.

Phrenosin.—A cerebroside (a nitrogen-containing phosphorus-free body), a constituent of brain protagon, containing galactose.

Phtysoremid.—Koch's bacillary emulsion in capsule form as introduced by Krause for the internal treatment of tuberculosis; Köhler's results were not altogether encouraging (*Ztschr. f. Tuberk.*, xiv. p. 89, 1909).

Phytotoxin.—A vegetable toxin.

Pincus's Kettle.—*See* ATMOCAUSIS.

Pine-Apple Test.—A test for the presence of butyric acid in the stomach contents; a few drops of concentrated sulphuric acid and a little alcohol are added to the dried ethereal extract of the gastric juice when, if butyric acid be present, the odour of ethyl butyrate (pine-apple odour) is given off.

Piroplasmosis. — A disease due to

infection with one of the piroplasmata (*Piroplasma canis, bigeminum, mutans*); such diseases are bovine hæmoglobinuria, Texas Fever, Tick Fever, South African Red Water, Heart Water, and probably Dum-dum Fever.

Pirquet's Reaction. — A cutaneous tuberculin reaction, of which Moro's salve reaction is a modification. *See* IMMUNITY (*Specific Tuberculin Tests*); LUPUS VULGARIS (*Pirquet's Reaction*).

Pistoia Gout Powder.—A powder containing colchicum corm, bryony root, betony root, gentian root, and camomile. See *Brit. Med. Journ.*, i. for 1909, p. 852.

Pitchblende.—*See* RÖNTGEN RAYS AND RADIUM.

Pituitary Fluid.—A proprietary preparation, stated to be a 20 per cent. extract of the separated infundibular portion (posterior lobe) of the fresh pituitary gland, with the protein matter carefully eliminated.

Pituitary Gland, Surgery of.

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UNDER the heading of ACROMEGALY (*see* p. 24) some references have been made to the surgical treatment thereof by removal of the tumour of the hypophysis cerebri, which is often found associated with that disease; but the subject of the pituitary body calls for some further consideration.

There is still much that is mysterious about the pituitary gland. It is a very small, almost a minute structure, and yet it would seem to be as essential to life as the suprarenal capsule; at any rate its removal in dogs is invariably followed by death, as the experiments of Paulesco, Reford, Cushing, Crowe, and Homans show. Further, great care was taken in its experimental removal to avoid any fallacies, for so elaborate an operative technique was adopted that absolute asepsis was generally achieved; in a word, the dogs were treated as carefully as if they had been human beings undergoing operation in hospital. The removal of the whole pituitary gland (total hypophysectomy) always led to the death of the animal, although puppies lived for several days longer than adult dogs. In a day or two after removal the dog showed some dulness and lassitude, then its temperature began to fall and continued to do so till it almost reached that of the room in which it was being kept; the blood pressure also fell, and along with this fall there was a slowing of the pulse, which also became feeble and irregular; the respirations likewise slowed down remarkably; some stiffness of the muscles began to show itself and affected specially the hind legs; sugar sometimes appeared in the urine, and the amount of urine fell or disappeared entirely; then twitchings (rhythmic, easily set up, and spasmodic) of the muscles were noticed; and, finally, the animal passed into a coma, which deepened into death. Partial hypophysectomy produced results which differed according to the part excised. If the posterior lobe was taken away, no characteristic symptoms followed; if the anterior part was removed, the same symptoms occurred as were noted after complete hypophysectomy; but if only a part of the anterior lobe was excised certain changes occurred to which the name of hypopituitarism has been given. The animal tended to put on fat, and if it were an adult dog its genital organs diminished in size, whilst if it were a puppy, it remained sexually nonpotent. Resistance to infection was lessened, the temperature had a tendency to fall below the normal, sugar appeared in the urine along with an increase in the amount of urine secreted, and there were psychical disturbances of various kinds in some instances. That these phenomena were really due to removal of the pituitary gland or of its internal secretion was confirmed by the fact that transplantation of the gland, or even the injection of an emulsion made from the anterior lobe was capable of delaying death, and even, in instances of partial hypophysectomy, of permanently keeping the animal in life.

These experiments have also opened the way to hypophysary medication or treatment by means of such preparations as pituitary extract and pituitrin (extract of the infundibular or posterior part of the gland). Several morbid states have been found to be benefited thereby, *e.g.* shock, intestinal paresis, uterine atony, as well as in pituitary insufficiency and hyperactivity, and in what are called somewhat fancifully the polyglandular syndromes (exophthalmic goitre, acromegaly). Delille, Blair Bell, Rowell, and many others have written upon the therapeutic uses of the drug, but in this article we are concerned rather with the surgical relations of the gland than the beneficial activity of its extract.

The great problem in the *surgery* of the pituitary gland is to find an easy and at the same time a safe route of approach and mode of access. Two routes have been used, the intracranial and the extracranial (or transsphenoidal); but each has its disadvantages, the

former carrying with it the danger of damaging the brain, and the latter (through its length and intricacy) the risk of infection. But let us look at the different surgical procedures more in detail.

The Intracranial Route.—Through the *anterior* fossa attempts have been made to deal with the pituitary gland. Krause, for instance, working on the dead body, obtained access by an osteoplastic resection of the frontal bone, followed by an approach outside the dura to the small wing of the sphenoid, the opening of the dura there, and the removal of the pituitary tumour by means of a specially curved knife; and Borchardt (*Ann. Surg.*, xlviii. p. 783, 1908) applied Krause's method to the living subject, but was compelled to stop by reason of the hæmorrhage. To avoid this danger Kiliani opened the dura immediately, tied the longitudinal sinus, and lifted up the temporal lobe; but, on the whole, access through the anterior fossa is difficult and dangerous, and Horsley and Dahlgren have, it is stated, tried the *middle* fossa. The temporal bone is trephined, the dura is opened, the temporo-sphenoidal lobe of the brain is raised, and the pituitary body reached from the side. Cushing states (*Ann. Surg.*, l. p. 1014, 1909) that he employed this method in one case, but although he easily got a view of the infundibular region, the tumour did not project above the dural margin of the clinoid processes, and he brought the operation to an end there and then. It would seem, therefore, that for the success of this method the tumour must be well above the sella turcica so as to be visible from the side. Cushing, in his experimental work on dogs, however, has successfully used this intracranial method, but has combined it with the making of a generous opening over the opposite hemisphere to allow for cerebral dislocation; by this means the temporo-sphenoidal lobe on the approach side can be freely raised without risk of compression or cortical injury, for plenty of room is got by the protrusion of the opposite hemisphere; and the pituitary gland can then be easily lifted out of the shallow fossa in which it lies. But, as has been said, the anatomical conditions in the human subject are different, and the hypophyseal tumour must project considerably into the infundibular region before it can be dealt with thus.

The Extracranial Route.—These considerations and experiences have led operators to the extracranial route of approach or the transphenoidal mode of doing hypophysectomy. The study of vertical sections of the head prove the anatomical possibility of reaching the pituitary gland by this route; the facts that the operation of hypophysectomy is usually performed for the removal of tumours of the gland, and that such growths usually extend downwards away from the cranial cavity, and towards that of the nose support the transphenoidal route, and the occasional occurrence of ectopia of the gland is an additional argument in its favour. In connection with the last statement it is interesting to note the case reported by A. R. Tweedie and A. Keith (*Proc. Roy. Soc. Med.*, iv. p. 47, 1911), in which an infant with various facial defects exhibited also a cleft palate in the depths of which a body was detected which turned out to be the displaced pituitary gland.

As long ago as 1900, König proposed the extracranial operation, and recommended splitting the superior maxilla. The stages were as follow:—The palatal process of the superior maxilla was chiselled away after its mucoperiosteal covering had been separated; then the superior maxilla was split and the two lateral halves were retracted; then the nasal septum, the vomer, and the other structures of the nose which prevented the obtaining of a good view were removed; the sphenoidal cells were opened; and, finally, the posterior sphenoidal wall was chiselled away in order to reach the gland in the sella turcica. This method, however, is very difficult of performance, and is apt to produce great disfigurement. Other methods of reaching the hypophysis have been devised, and may be arranged in two groups, according as they are supranasal or infranasal.

The Supranasal Extracranial Operation.—This operation, as practised by Giordano, Löwe, Schloffer, von Eiselsberg, and others, consists (stated shortly) in turning the nose to one side or downwards, in removing the ethmoid cells and turbinates, and in thus reaching the sphenoid. Giordani turned down an osteoplastic flap of the anterior wall of the frontal sinuses and the nose, went through the ethmoidal and sphenoidal cells, opened the anterior wall of the sella turcica, and so reached the pituitary body. Schloffer follows a slightly different plan. He turns the nose downwards and to the right; excises the turbinates, the ethmoidal cells, and the septum; he removes the inner wall of the left orbit down to the optic foramen, and the inner wall of the antrum of Highmore, with part of the nasal projection of the left superior maxilla; and, finally, he breaks down the walls of the ethmoidal cells and so gets to the sphenoidal cells and the sella turcica with the tumour in it. In this operation the skin incision runs down the middle of the brow and along the lateral aspect of the nose. Von Eiselsberg, who has had considerable experience in hypophysectomy, opens the frontal sinus to get more room. He makes an incision along the junction of the left side of the nose with the cheek, which meets a transverse one at the root of the nose; he then turns the nose downwards and to the right, divides the septum, and removes the turbinates; next, he divides

the vomer as far back as he can; and so, finally, he gets to the sphenoidal cells. As stated above, he does temporary resection of the frontal sinus to gain space. On reaching the sella turcica he opens it in the middle line, but not too far forward for fear of injuring the carotid arteries and the optic chiasma; he removes the tumour, drains the cavity, and packs the nasal cavity; and last of all closes the skin incisions. Hochenegg's plan is similar, but certain devices are added to lessen the subsequent deformity, including the performance of the excision of the gland through a very small opening (*Ann. Surg.*, xlviii. p. 781, 1908). Indeed, the resulting deformity is a serious consideration; and Church, in his estimate of the different methods of doing hypophysectomy, warns operators about it; at the same time he regards the nasal route as the best; for, after all, a tumour of the pituitary body is practically extracranial.

The Infranasal Extracranial Operation.—Partly to lessen deformity, and partly to prevent the risk of infection of the cerebral membranes through the cribriform plate of the ethmoid, Kanavel was led to turn the nose upward. An entrance is made into the inferior part of the nasal cavity, the septum is cut along its inferior part and its attachment to the perpendicular plate of the ethmoid, the middle turbinates are removed and the septum deflected to one side; in this way he gets a good view; then he locates the sphenoidal foramina, he bites away the intervening attachment of the perpendicular plate of the ethmoid and the vomer, and then he breaks into the anterior wall of the sphenoidal cells. Kanavel has practised this method upon nine cadavers, and is satisfied with its practicability and advantages. Mixter has successfully used Kanavel's method for a case of infantilism associated with tumour of the hypophysis (as revealed by the X-rays). The posterior nares were packed, and a **U**-shaped incision was made beneath the nose, the nasal processes were divided with a chisel and the nose turned upwards and held by a stitch through the septum and forehead, the mucous membrane was separated from the bony septum, which was cut away; with the use of retractors a good view was now got of the upper part of the vomer where it was attached to the sphenoid, and this was avulsed, opening the sphenoidal cells; the hæmorrhage was controlled by adrenalin gauze and pressure; a blunt instrument was thrust through the posterior wall of the sphenoidal cells, and this was followed by the escape of fluid from the cyst of the hypophysis; the opening was enlarged, the cyst cavity was swabbed out and packed with a cigarette wick brought out through the nostril, and the wound was closed, a plug being put in the other nostril to keep the septum straight. Kanavel's operation certainly has the advantage of the greater width of the lower part of the nasal opening, and the fact that access to the spenoidal cells is got by removal of the vomer alone is also important.

Oskar Hirsch removes the pituitary tumour by an endonasal method based upon Hajek's radical operation. There are several stages. Under cocaine he removes the middle turbinated bone at the first sitting; in a few days the anterior and posterior ethmoidal cells are taken away, exposing the sphenoidal cavity; a few days later the anterior wall of the sphenoid is removed *in toto*, and this is followed at once (or in a few days) by opening the hypophyseal prominence and partially removing the hypophysis. Hirsch occupied five weeks in carrying out these operative procedures (all under cocaine anæsthesia), but he thinks they might be done in two or three weeks.

Halstead's method is named *oro-nasal;* and two cases have been reported (one of which was a success, whilst death followed in the other). The details as summarised by Lochhead were as follow:—Under ether anæsthesia a high tracheotomy was performed, and a Trendelenburg balloon cannula inserted; the nasal cavities and pharynx were plugged with adrenalin gauze; then chloroform was given; the upper lip was raised, and the mucous membrane incised parallel to the alveolar process, and five-sixths of an inch from the muco-cutaneous junction; the soft tissues were freed and the nose gradually drawn up with retractors, the septum being divided with bone forceps, and displaced upwards and to the side; the inferior turbinates, vomer, and vertical plate of the ethmoid were removed (the middle turbinates having been previously taken away); the anterior wall of the sphenoidal sinus was opened and the tumour removed with a blunt curette; the cavity was flushed out and then packed with iodoform gauze; and, finally, the septum was sutured in position, the mucous membrane of the mouth replaced and stitched, and the tracheotomy tube removed.

From what has been said, it is obvious that none of the surgical plans for reaching the hypophysis cerebri is easy; the operation, further, carries grave risks with it; and whilst subsequent advances may reduce these risks, it is clear that hypophysectomy ought not to be undertaken except to save life or to preserve the most important functions.

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Pituitrin. — A proprietary extract of the pituitary gland, said to contain the active principles of the infundibular part of that body; it is described as acting on the circulation similarly to adrenalin, as increasing nitrogenous metabolism, as affecting the heart similarly to digitalis and strophanthus, and as causing diuresis.

Piutinol. — A proprietary preparation forming a reddish-brown fluid containing pine oils and sulphur dissolved in alcohol and glycerine; it is recommended for application as a sulphur bath in rheumatism, gout, and certain skin diseases. *See* Reports in *Lancet*, i. for 1910, p. 307; *Brit. Med. Journ.*, i. for 1910, p. 1298.

Plague.—In a paper entitled "Recent Researches into the Etiology of Plague in India," Col. Bannerman, the Director of the Bombay Bacteriological Laboratory, summarises the conclusions to which these lead in the following words:—1. Pneumonic plague is highly contagious, but being rare (less than 3 per cent. of all cases) plays a very small part in the spread of the disease. 2. Bubonic plague in man is not infectious, and is entirely dependent on the disease in the rat. 3. The infection is conveyed from rat to rat, and from rat to man, solely by means of the rat-flea. 4. Plague is usually conveyed from place to place by rat-fleas brought by people in their baggage or on their persons.

The present epidemic of plague in India dates from the autumn of 1896; in China it had broken out two years previously. One of the features of the Indian epidemic which soon became apparent, was that in each locality it had a particular seasonal prevalence of its own: thus in Bombay, the epidemic occurs in the early months of the year; in Poona, only 80 miles away, the disease does not appear till the autumn. As epidemic succeeded epidemic facts came to light which pointed to the existence of infected houses—such houses were most infective by night; they might become infective even where standing empty; houses in close proximity became infective, although caste prejudices ensured that the inhabitants had no inter-communication. These and other facts suggest the idea of spread by animals, and the only animal that fills the rôle is the house rat of India. Notwithstanding the adverse criticism passed by the first Plague Commission on Simond's suggestion that the flea might communicate the disease from rat to rat and from rat to man, Liston reinvestigated the subject, and placed the theory on an assured basis.

Two species of rats are common in Bombay —*mus rattus*, the black rat, and *mus decumanus*, the brown Norway rat. The former is the house rat proper; the latter lives apart from the people in gullies and sewers. They meet in the basements of houses. *Mus decumanus* develops plague before *mus rattus*, but man is more likely to become infected by *mus rattus*, with which he is brought into more intimate contact. The fleas of rats (*pulex cheopis*) are of a different species from those of man, but in the absence of rats this flea will take to other animals and even to man. In the stomachs of these fleas, taken from plague-infected houses, living plague germs are found. When rats die of plague the infected fleas leave them and begin to attack other animals—*e.g.* guinea-pigs—and transmit the disease to them; they also bite man, and infect him.

Bannerman considers that there is no evidence that rats spread plague by infecting food with their excreta, nor by contaminating the soil, suppositions which have both been entertained to account for the spread of the disease.

Major Lamb, of the Second Plague Commission, writes, concerning the experimental transmissions of plague from rats to rats, monkeys, etc.:—"(*a*) Close and continuous contact of plague-infected animals with healthy animals, if fleas be excluded, does not give rise to an epizootic among the healthy animals. As the godowns [experimental huts] were never cleaned out, close contact includes contact with fæces and urine of infected animals. Close contact, even the suckling of young by plague-infected mothers, does not give rise to the disease. (*b*) Where fleas are present the epizootic, if it does start, varies in severity and rate of progress according to the season of the year and the number of fleas present. The season in which epizootics are readily produced experimentally, and spread rapidly, corresponds with that of the plague epidemic. (*c*) An epizootic of plague can occur in a godown containing infected fleas without direct contact of healthy animals and infected animals.

(*d*) In an infected godown the infection is effective in proportion as the test animals are accessible to fleas. (*e*) Infection can take place without any contact with contaminated soil. (*f*) Aerial infection is excluded. (*g*) The experiments lead to the conclusion that fleas, and fleas alone, were the transmitting agents of infection." Turning next from experimentally infected godowns, to experiments made by placing susceptible animals in naturally infected native houses, we find —"(1) Guinea-pigs may contract plague if allowed to run loose in plague-infected houses; and many rat-fleas are found upon them. (2) In houses where all plague germs are killed by disinfectants, guinea-pigs still are in the same proportion, and an equal number of rat-fleas is found on them. (3) Fleas caught on rats dead of plague are capable of infecting healthy rats or guinea-pigs not otherwise exposed to infection. (4) Fleas from guinea-pigs which have been allowed to run loose in infected rooms are similarly infective to healthy rats or guinea-pigs not otherwise exposed to infection. (5) Guinea-pigs in cages which protect them from the floor or other source of infection, but which are exposed to the attacks of fleas in plague-infected rooms, contract plague in a certain proportion of cases. Those similarly placed but protected from fleas do not develop the disease. (6) Most of the fleas caught in the above manner are rat-fleas, and have plague bacilli in their stomachs in 19·7 per cent. of those dissected. (7) Almost all the primary buboes in animals thus infected are in the neck, and the commonest place for fleas to be found is also in the fur round the neck. (8) Plague-infected houses have twelve times the number of fleas in them than those free from suspicion of infection have" (Bannerman). In considering how man becomes infected it is important to remember that the avenue through which the germs gain entry is the skin, at least in the ordinary bubonic and septicæmic type of the disease. Pneumonic plague may be ignored, as it occurs in only about 2·5 per cent. of all cases. In man there is no seat of election for buboes; the primary bubo develops in connection with the area of skin attacked. There is a definite time relationship between the *rattus* epizootic and the human epidemic. First comes the epidemic among the brown rats, then the epidemic among the black rats, last the epidemic among men. When the epidemics are at their height the intervals between the maximum death-rate in rats, and the maximum death-rate in man is about 10-14 days. Lamb explains this interval thus: There is first a period corresponding to that between the disappearance of the rat and the time when the flea, pressed by hunger, will attack man. This has been experimentally proved to be about three days. After the fourth day fleas rapidly become less infectious. Second, there is a period corresponding to the incubation of plague—three days. Third, there is the period corresponding to the average duration of plague—five to six days. Adding these together we get a period of eleven to twelve days, corresponding to the interval between epizootic and epidemic.

Travellers are the chief agents in distributing plague. Fleas fed on man may remain alive for three weeks, and may remain infective for 15 days. There is thus ample time for their conveyance from place to place. In the new district the fleas escape to the abundant rats, infect them, and thus start an epidemic. Clothes containing fleas may, of course, transmit infection in the same way. Carriers of infected fleas may themselves escape infection.

The plague germ undergoes no transformation in the flea; they are excreted in the fæces on the skin of the host, and invade the wound made by the flea's pricker. They are not excreted by the saliva or mouth of the flea. The common cat and dog flea (*P. felis*) cannot transmit the disease, but both *ceratophyllus fasciatus*, the common rat-flea of Northern Europe, and *P. irritans*, the human species, can do so, the former with ease, the latter with difficulty.

The above is abridged from Col. Bannerman's paper (*Edin. Med. Journ.*, May 1908), which gives the literature of the subject.

Plasmon.—A proprietary food preparation consisting of the casein of milk, and containing over 80 per cent. of pure protein, along with phosphorus combined as it is in milk (to an amount equivalent to 2·66 per cent. of anhydrous phosphoric acid); plasmon can be procured as plasmon cocoa, plasmon custard powder, beef plasmon, etc. See *Brit. Med. Journ.*, i. for 1910, p. 452; *Lancet*, ii. for 1908, p. 99.

Poliomyelitis anterior acuta.—Owing to the epidemic prevalence of anterior poliomyelitis in certain countries in recent years, the infectious nature of the disease must now be regarded as certain. Both the Swedish and New York epidemics have afforded opportunity for much work on the pathology and clinical features of the disease, but the infective agent has not yet been discovered. Holt and Bartlett have collected records of 35 epidemics, the chief being those which occurred in Norway and Sweden in 1905-1906. There was also an epidemic in Australia in 1904 (108 cases), and in Vermont (132 cases), but nowhere has the disease been so widespread as in the Scandinavian peninsula, where over a thousand cases occurred during 1905 and 1906. The influence of season is very definite; most cases occur in July, August, and September, or in the corre-

sponding months in the southern hemisphere. There is no evidence that epidemics are followed in ensuing years by an increased number of sporadic cases, as occurs in cerebro-spinal meningitis. Epidemics cover a wide extent of country, and the incidence of the disease is little influenced by locality and surroundings. The mortality is somewhat high—12 per cent. "The discrepancy between these figures and the opinions drawn from a study of the sporadic form of the disease is, we believe, explained by the fact that cases with bulbar symptoms, which make up most of the fatal cases in epidemics, have not been recognised as poliomyelitis when they occur in scattered instances" (Holt and Bartlett). Most patients are under four, but during epidemics a large number of older children and adults are attacked than at other times. Wickmann states that in the Norwegian epidemic the incubation period was in most cases one to four days. The disease spread by direct contact and through the intermediary of healthy persons. It spread along lines of communication (roads and railways); it tended to occur in foci, beginning with one or two isolated cases, and to linger on in a district in which it had once taken hold. Holt and Bartlett are more guarded as to the communicability of the disease; they regard it as an open question, and think that it can only be communicable "to a very slight degree."

Morbid Anatomy.—The chief point is that the lesions of anterior poliomyelitis must no longer be considered as limited to the anterior horns of grey matter, but are widely spread throughout the central nervous system—cord, medulla, and brain. The primary lesion is in the pia mater, and even in mild cases there is a generalised inflammation of the cord, brain, and cerebral and spinal meninges. There is a diffuse infiltrative myelitis chiefly of the grey and also of the white matter; the cellular infiltration spreads along the vessels. The cortex and cranial nerve nuclei may be involved. The process is not embolic. Bacteria have not been demonstrated. Wollstein could find no evidence of antigens or antibodies in the cerebre-spinal fluid.

Clinical Features.—These have been carefully studied by Medin of Stockholm. The disease, indeed, is now called by some authors "Heine-Medin's disease," in recognition of Heine, who first described the classical type in 1840, and Medin, who has elaborated the clinical picture by including the atypical cases which occur in seasons of epidemic. Medin adopts the following classification of cases:—(1) Spinal form. (2) Ascending or descending paralysis (Landry's paralysis). (3) Bulbar or pontine form. (4) Cerebral form (5) Ataxic form. (6) Polyneuritis. (7) Meningeal form.

Emphasis is laid on the occurrence of initial symptoms pointing to widespread early implication of the meninges—fever, headache, stiffness of the back, and tenderness over the spine.

1. *Spinal Form.*—The symptoms of this, the classical type of the disease, are so well known as to need no description except in one particular. Wickmann points out, as has also been done by Ibrahim, that paralysis of the abdominal muscles is not very uncommon. Either the whole abdomen, or merely one segment of it, may be paralysed. The paralysis shows itself by a marked ballooning of the affected area when the patient cries or strains. If the paralysis is localised and permanent it leads to a hernia. Previous to 1905 Oppenheim had stated that there was no evidence of segmental innervation of the abdominal muscles. He thought that a lesion between the eighth and eleventh dorsal segments would paralyse the musculature of the whole of one side of the abdomen, and described an "abdominal symptom-complex" characterised by unilateral diminution of the abdominal reflexes, deviation of the umbilicus to the healthy side, and bulging of the paralysed half of the abdomen. Ibrahim and others, however, have recorded cases of localised paralysis and wasting of the abdominal muscles from anterior poliomyelitis, thereby proving that a segmental innervation exists.

2. *Landry Type.*—These are very often fatal—45 out of 159 deaths were due to ascending or descending paralysis in Wickmann's series of cases. "Landry's paralysis" in the adult is, according to Medin, the same as "ascending anterior poliomyelitis" in the child.

3. *Bulbar or Pontine Form.*—The nerves most frequently involved are the facial and hypoglossal; the muscles of the eyes, of the throat, or of the larynx may be paralysed. Any of the medullary centres may be affected.

4. *Encephalic Form.*—This is rare; it corresponds with Strümpell's polio-encephalitis.

5. *Ataxic Form.*—In this an ataxic gait and paresis of groups of muscles are the chief symptoms. The reflexes are often increased. The lesion is uncertain.

6. *Polyneuritis.*—The cases which are suggestive of this type are—(1) Such as recover rapidly and completely; (2) those with evidence of lesion of a single nerve; (3) acute ataxias.

7. *Meningeal Forms.*—These must obviously resemble cerebro-spinal meningitis somewhat closely. The following table of distinctions is abridged from one drawn up by Wickmann:—

Heine-Medin's Disease.	*Epidemic Meningitis.*
1. Residual paralysis is usually of limbs; permanent.	Usually of eye muscles; transitory.
2. Fever of short duration.	Prolonged.
3. Herpes rare.	Common.
4. Rashes absent.	Freqent.
5. No sequelæ.	Deafness common.
6. No hyrocephalic stage.	Hydrocephalus common.

Heine-Medin's Disease.	*Epidemic Meningitis.*
7. Puncture fluid clear.	Usually turbid.
8. Meningococci absent.	Present.
9. Lymphocyte infiltration of pia.	Leucocyte infiltration.

8. *Abortive forms* characterised by fever, headache, and stiffness of the neck can only be diagnosed, even with probability, during the prevalence of epidemics.

Prognosis.—The most important points in prognosis as to life are—(1) The Landry and bulbar types are often fatal. (2) The general mortality (12·1 per cent.) is fairly high. (3) The mortality rate increases with the age of the patient. Up to 11, it is about 10 per cent.; from 12 to 14, 28 per cent.; from 27 to 29, 33 per cent. (Wickmann's statistics). (4) Most deaths occur on the fourth day.

As opposed to Medin's extension of the term poliomyelitis anterior acuta to cover the above wide range of atypical cases, Berg, basing his opinion on the New York epidemic of 1907, asserts that sporadic anterior poliomyelitis is radically different from the epidemic disease. He points to the difference in the morbid anatomy, in the symptomatology, in the age of the patient, in the mortality, in the presence of infection in one case, and its absence in the other, as justification for distinguishing clearly between sporadic anterior poliomyelitis and epidemic meningo-myelo-encephalitis.

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Poliomyelitis, Acute Anterior—Polioencephalitis, Acute.—The latter term is the more correct one, so far, at least, as the epidemic variety of the disease is concerned, for in these cases the brunt of the lesions is by no means exclusively borne by the anterior cornua, but they are, as has been said, widely distributed throughout the nervous system.

Although the exact nature of the cause of the disease is not yet known, great advances have recently been made towards the solution of the problem. We now know that acute polioencephalitis is one of the infective diseases, and further, that the infective agent is not one of the ordinary micro-organisms, because it passes through a Berkfeld filter. The disease has been successfully communicated to animals—apes being by far the most susceptible to it. The infective agent employed is an emulsion made from the spinal cord of an acute case, inoculated into the subdural space or sciatic nerve. Serial transmission through animals has also been accomplished. Paralysis occurs in four or five days, as a rule; it may be delayed, up to a period of forty-six days. The disease is fatal in about 40 per cent. of cases; some animals recover with residual paralysis. The changes in the nervous system are identical with those of the disease in man. The organism has not yet been cultivated outside the body, though Flexner has had some interesting results suggesting the possibility of this.

In all probability the naso-pharynx is the site of entry. The nasal mucosa has been shown to contain the infective agent, and Leiner appears to have succeeded in infecting animals through this channel (Flexner, *Journ. Amer. Med. Assoc.*, 13th Nov., 4th Dec. 1909; 1st Jan., 12th Feb., 2nd April 1910; Levaditi, *Comptes rendus*, 29th Nov. 1909; Romer, *Munch. Med. Woch.*, 15th Feb., 8th Mar., 15th Mar. 1910; Leiner, *Wien. klin. Woch.*, 3rd Mar. 1910).

Polonium.—A radio-active metallic element which may be obtained from pitchblende, one-tenth of a milligramme being got from several tons of pitchblende; it is so-called from the Polish nationality of Madame Curie, one of its two discoverers (the other being Prof. Curie) in 1898; the radio-tellurium of Prof. Marckwald.

Poltophagy.—The thorough and prolonged chewing of all food before it is swallowed. *See* Higgins, *Humaniculture*, New York, 1906.

Polychromasia.—A synonym of polychromatophilia, the tendency which erythrocytes possess, in some pathological conditions, of taking up basic stains. *See also* Polycythæmia Vera (*Pathology*).

Polycythæmia Vera.—This is only one of the names given to a rare disease of middle life, which is characterised by splenic enlargement and a persistent excess of the red corpuscles of the blood. The symptom-group was first described by Vaquez in 1892; important additions have been made to our knowledge of the disease by Osler, Türck, Parkes Weber, and others. In France it is sometimes known as Vaquez's disease; in America and elsewhere as Osler's disease; it has also been called "chronic polycythæmia with cyanosis," "splenomegalic polycythæmia," and "myelogenous polycythæmia." Türck suggests the name "erythræmia," and for several reasons this seems the best proposed; it brings out the analogy to leukæmia (for polycythæmia vera is probably a primary disease of the marrow), and the contrast with "erythrocytosis," a term which may be applied to any secondary increase in the red corpuscles, comparable to leucocytosis.

Clinical Features.—The disease is not hereditary; the sexes are about equally liable;

the disease usually occurs between the thirtieth and fiftieth years. A relative large number of the patients have been Jewish, but the evidence of racial proclivity is slender. The characteristic features may be discussed under the heads of (1) plethora, (2) splenomegaly, (3) blood changes, (4) general symptoms.

(1) *Plethora.*—Cases of polycythæmia vera always present a plethoric appearance. The face is deeply congested or cyanosed. In some cases cyanosis, in others unnatural floridness, predominates. The engorgement or cyanosis is most conspicuous in the face, ears, and extremities; it seldom affects the general surface of the body. A similar condition of the mucous membrane of the mouth, tongue, and conjunctivæ is present; the retina shows the same change. The degree of congestion varies from time to time in the same person; cold increases the cyanosis, warmth tends to make the face more ruddy. Under the influence of emotion cyanosis may give place to flushing.

(2) *Splenomegaly.*—Some degree of splenic tumour can generally be made out. The organ may only reach a few finger-breadths below the ribs, or it may extend down to the umbilicus. On the whole, the enlargement is moderate, and the enormous hypertrophy met with in some cases of leukæmia does not occur. The spleen may vary in size from time to time, and complete subsidence of the enlargement has been observed. The organ is small and firm. There is moderate increase in the size of the liver in most cases; excessive enlargement is rare.

(3) *Blood Changes.*—The red corpuscles and hæmoglobin are always, the leucocytes usually, increased. The specific gravity, and, what is of more practical importance, the viscosity, of the blood are high. The red corpuscles generally number from 7,000,000 to 9,000,000 per c.mm., though counts of 13,000,000 have been recorded. Mackey gives 8,900,000 as the average. As a rule the cells show few changes otherwise; poikilocytosis, polychromasia, or the presence of a few normoblasts are mentioned by some authors. The hæmoglobin is raised, but not proportionately the red corpuscles; the colour index, therefore, is below 1·0. Moderate leucocytosis is the rule; Mackey found that the average in 40 cases was 14,250. The percentage of polynuclears is high—70 per cent. or so. A few myelocytes may be present. Blumenthal has recorded a case in which 36 per cent. of myelocytes were found, but the case was an exceptional one in other respects as well.

(4) *Other Symptoms.*—Subjective symptoms vary considerably, and may be absent. Headache, vertigo (suggestive of Menière's disease), fulness in the head, paroxysmal dyspnœa, abdominal pain, dyspepsia, thirst, and constipation are all common. Hæmorrhage from the gums, nose, uterus, and other mucous membranes occur. The arterial pressure is often high (180 mm. Hg); there is sometimes cardiac hypertrophy. Distension of the superficial veins is common. Albuminuria is present in the majority of patients. As among the more frequent complications, jaundice, cirrhosis of the liver, erythromelalgia, and arteriosclerosis may be mentioned.

Morbid Anatomy. — The only constant lesion, apparently, is the evidence in the marrow of excessive erythropoiesis. This will again be referred to. Infarcts of the enlarged spleen, obvious distension of the abdominal veins, and thromboses are also characteristic. In not a few cases cirrhosis of the liver, portal obstruction, or tuberculosis of the spleen has been found, and, of course, many other complicating lesions—*e.g.* cerebral hæmorrhage. The relationships of these pathological changes will become more apparent as the pathology of the disease is considered.

Pathology.—Polycythæmia, using the word in a general sense to imply an increase of the red corpuscles in the blood, may be either relative or absolute. *Relative polycythæmia* results from concentration of the blood by loss of fluid from the body, and with it we have nothing further to do. *Absolute polycythæmia*, however, occurs either as a primary or a secondary condition. As secondary polycythæmia, we reckon the polycythæmia of high altitudes, and the polycythæmia of stasis. It is well known that in many cases of chronic cyanosis, whether from congenital heart disease, acquired heart disease, emphysema of the lungs, or, in fact, any condition leading to interference with the oxygenation of the blood, the red corpuscles may rise and remain very much above the normal figure. At high altitudes the same occurs, and in both the explanation usually accepted is that the hyperglobulia is a compensatory response of the organism to lack of oxygen. In secondary polycythæmia of this description there is evidence, after death, of increased erythropoietic activity of the marrow.

As other possible causes of secondary polycythæmia Weber enumerates the following:—1. Stasis due to portal obstruction. 2. Toxic conditions, such as phosphorus poisoning, and chronic intoxication with coal tar derivatives—antipyrin, etc. 3. Chronic infectious diseases—tuberculosis, syphilis, malaria. 4. Ill-defined conditions—suprarenal lesions, affections of the marrow—*e.g.* in osteitis deformans), arteriosclerosis of the vessels of the limbs.

In erythræmia proper there is always evidence of increased formation of red cells by the marrow—this is the sole constant anomaly found. It may thus be regarded as analogous to leukæmia, in which there is increased leucoblastic activity. It is, however, remarkable that in cases of polycythæmia vera there

is increase in the leucoblastic, as well as the erythroblastic tissue of the marrow. In Blumenthal's case, referred to above as exceptional, the marrow is described as bearing a superficial resemblance to fœtal marrow, but the principal change was a leucoblastic degeneration. The marrow lesion being the only constant change, we are able to put on one side Vaquez's view that the disease was due to tuberculosis of the spleen, and to rule out chronic visceral lesions as causes of stasis, at least in the majority of cases, though it is admitted that occasionally portal obstruction gives rise to a very similar symptom-complex, in which splenomegaly and polycythæmia are the prominent features. It is less easy to eliminate the possibility of a chronic toxæmia, but there is at least no evidence of any single special source of toxic mischief in these cases.

But it must be remembered that in addition to the marrow lesion the patients all exhibit very marked signs of stasis and impeded circulation, and the question arises, Is this the cause, or is it an effect, of the erythræmia? Saundby believes that the stasis, impaired peripheral circulation, and generalised "asphyxia" of the skin are sufficient to cause a compensatory reaction of the marrow. The condition is "a cerebro-spinal neurasthenia, causing vasomotor spasm, with engorgement of the capillary and venous circulation and congestion of the internal organs, especially of the liver and spleen, with muscular weakness, loss of knee-jerks, and mental impairment, shown by loss of memory, apathy, and drowsiness." Mackey regards the splenic enlargement as in some cases primary, and suggests that, "owing to the stasis and imperfect oxygenation of an enormous quantity of blood in the enlarged spleen, the same compensatory forces are set in motion as in the case of congenital and other forms of heart disease, and probably by stimulating the bone marrow produce the polycythæmia."

According to the view of Weber (which is also that generally held) the erythræmia is the cause of stasis. The increased blood viscosity necessarily accompanying polycythæmia must, however, favour the development of a secondary condition of blood stasis, whether there be a compensatory increase in blood pressure (as there usually is in erythræmia) or not. Delayed circulation in its turn favours the occurrence of thrombosis in the various viscera, and the occurrence of thrombosis further hampers the circulation. Again, delayed circulation, and congestion, in the blood-vessels of the lungs and branches promote the development of chronic catarrhal changes, which induce cyanosis and throw extra work on the right side of the heart. So that in erythræmia an elaborate vicious circle is established; the polycythæmia in various ways tends to impede the circulation, and the blood stasis thus produced favours cyanosis and increases the circulatory difficulty by giving rise to a further (compensatory secondary) polycythæmia in addition to the primary (myelopathic) polycythæmia. Thus the connection and sequence of the main symptoms is:—(1) Increased marrow erythropoiesis; (2) excessive viscosity of the blood; (3) dilatation of the small vessels to lessen resistance to abnormally viscous blood; (4) plethora compensatory for increased viscosity; (5) arterial hypertonus from the strain on the circulation; (6) cyanosis due to inadequacy of compensatory changes which precede.

There is no evidence that polycythæmia can be caused by increased resistance and longer life of the red corpuscles.

Another theory, held by Lommell, is that the polycythæmia is compensatory to low oxygen capacity of the hæmoglobin. Lommell estimated the power of the hæmoglobin to fix oxygen, and found that the oxygen quotient was ·903, as compared with 1·24 in a normal control. Herringham suggests that there may be some fault in the cytoplasm, or in the hæmoglobin of the red cells, which prevents them from being good oxygen carriers, or that there is some abnormal reducing agent in the blood which reduces oxyhæmoglobin but does not turn it into methæmoglobin or sulphohæmoglobin. The want of oxygen might stimulate the bone marrow to form fresh cells, as it does where high altitudes or heart disease is the cause.

On the whole, taking the four principal hypotheses as, (1) primary overproduction of red corpuscles; (2) stasis; (3) increased longevity of red corpuscles; and (4) deficient oxygen-carrying power, the balance of evidence seems to incline towards the first being the true explanation of the disease.

In erythrocytosis, from whatever cause, the blood is always abnormally viscous; it flows through the capillaries with difficulty, and thus cyanosis readily occurs. The total volume of the blood in erythræmia, estimated by Haldane and Lorrain Smith's carbon-monoxide method, is above normal (Weber, Haldane, Boycott). This fact is associated with the distension of the abdominal veins which is so marked a feature at post-mortem examination. In some cases the arterial blood-pressure is high (erythræmia hypertonica), with cardiac hypertrophy; in others it is low. Enlargement of the spleen is occasionally absent.

Diagnosis.—From what has been said it will be seen that although in its main outlines the symptom-group is sufficiently well defined, difficulties in diagnosis will often arise. (1) In the first place the possibility of portal obstruction or organic intra-thoracic disease — *e.g.* adherent pericardium, fibroid phthisis, or

emphysema—must be considered. The history of an illness capable of causing enlargement of the spleen will render the diagnosis uncertain. Weber states that in polycythæmia an enlargement of the liver without much enlargement of the spleen is in favour of polycythæmia secondary to stasis. (2) In some cases chronic polycythæmia is apparently due to primary tuberculosis of the spleen. (3) In any obscure case of cyanosis the possibility of chronic poisoning with coal tar products (acetanilide, etc.) should be investigated.

COURSE, DURATION, AND TREATMENT.—Mackey states that the average duration of the disease from the time of the appearance of the first symptom to the date when the patient came under observation or died is four years. Remissions may occur.

Treatment is unsatisfactory. The diet should probably be as free from iron as possible; "sour milk," or some preparation of lactic acid bacilli, might be used to influence the intestinal flora. Arsenic, quinine, thyroid, and vasodilators have proved of no use. Inunction with unguentum hydrargyri iodidi is said to have benefited one case. Splenectomy is useless, and often fatal. The X-rays generally fail; in one or two cases they seem to have done good. Inhalations of oxygen have been tried fruitlessly. Venisection sometimes relieves the symptoms for the time being. Drugs which are likely to produce cyanosis (acetanilide, etc.) should be avoided.

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Polyglobulia. — An increase in the number of red cells in the blood; polycythæmia.

Polyplasmia. — An increase in the volume of the blood due to its liquid and soluble constituents being in excess; a serous plethora; the converse condition is oligoplasmia.

Porcupine Patch (*see also* PALÆOGENETIC).—The name given by Sir Jonathan Hutchinson to a hair-covered area in the lumbosacral region, which is occasionally noted in the human subject, and which is believed by him to be the remains palæogenetically of the patch of quills seen in the porcupine; it may be associated with spina bifida occulta (Hutchinson, *Brit. Med. Journ.*, ii. for 1910, p. 857).

Porges-Meier Reaction. — *See* SYPHILIS (*Serum-Diagnosis*).

Postural.—Pertaining to position, *e.g.* postural albuminuria is that which depends upon the position of the patient, hypostatic albuminuria coming on when the patient is lying and orthostatic only when he is erect.

"Prana" Apparatus.—An apparatus for producing the freezing caustic carbon dioxide snow used in the treatment of several cutaneous affections (naevi, lupus erythematosus, etc.); it is described and figured in the *Lancet*, ii. for 1910, p. 1840.

Precipitin Test.—A test for determining the origin of a blood-stain, *i.e.* from what animal it has come. Precipitins are antibodies (other antibodies being antitoxins, agglutinins, lysins, etc.) which arise in the blood and tissues as the result of the entrance of certain foreign bodies of albuminous or proteid nature (antigens). In this test the antigen is serum albumin or globulin, and when a liquid containing antibody is added to one containing the antigen the clear liquid shows opacity, and finally a precipitum or cloudy deposit; but, further, the antigen has an action which is specific, *i.e.* the antigen derived from any other species of animal will not produce the result. For details of technique, etc., *see* M'Weeney, *Lancet*, i. for 1910, pp. 1669-1674.

Pregnancy, Management of.

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DURING the past few years increased attention has been paid to the physiology and pathology of pregnancy, and the medical profession is beginning to regard pregnancy as a period during which supervision is required if the health of the mother and her unborn infant is to be secured. The days have passed when in better-class practice the medical attendant was satisfied that he had done all his duty to his pregnant patient if he went at once to attend her at her confinement when sent for. Now it is beginning to be realised that the obstetrician's services may be of value in pregnancy, and that it may be well for the patient to have the advice of her doctor upon even the minor ailments of gestation, for, indeed, out of them may grow such major disasters as eclampsia and hyperemesis.

Articles dealing with the management of pregnancy from the pens of Professors Davis,

G. M. Boyd, and Cooke Hirst, and Dr. Richard C. Norris (*Therap. Gaz.*, xxxi. pp. 74-86, 1907), all emphasise the importance of the medical supervision of pregnant patients. The vaginal examination in early pregnancy is of value in enabling the attendant to diagnose and correct displacements of the uterus (retroversion and anteflexion), to estimate pelvic contractions and deformities, and to detect the presence of tumours, *e.g.* ovarian dermoids. Letters in the *British Medical Journal* (ii. for 1905, pp. 681, 833, 906) record cases in which fibroid tumours of the uterus and ovarian cysts had proved formidable complications of labour; the writers point out that early vaginal examinations in pregnancy would have led to their discovery and treatment under more favourable circumstances. Even as late as the seventh month vaginal palpation may reveal a degree of pelvic contraction which may be safely overcome then (by induction of labour), but which, if met with at full term, may necessitate Cæsarean section or pubiotomy.

The diet of the pregnant woman requires supervision, for we now know that it is of great importance in the cases in which there is the risk of renal inadequacy and albuminuria. Further, Prochownick and his followers (*Therap. Monatsh.*, Hefte 8 and 9, 1901) have collected clinical evidence which sufficiently shows that the food of the mother influences the size and condition of the unborn infant; and experimental results are being accumulated in support of his contention (*vide* article in *Brit. Med. Journ.*, ii. for 1901, pp. 1187 and 1368; Lochhead's papers in the *Trans. Edin. Obstet. Soc.*, xxxiii. pp. 120, 267, 1907-8; etc.).

In albuminuria a strictly milk diet is essential until the albumen has disappeared or is very small in quantity, and thereafter a modified dietary may require to be continued till the birth of the child. "While milk, fruit, and bread form an ideal diet for the pregnant woman, very few will accept it," is the opinion of an American obstetrician. The food of the patient also is of great importance in cases of hyperemesis gravidarum, where rectal feeding may have to be long continued. "The use of water as a beverage is most important during pregnancy; few patients who suffer from nausea in the early months are not benefited by the use of vichy, apollinaris, soda, or any other slightly aerated and pure water." There is danger in the commonly given advice that the pregnant woman must eat "enough for two," the second person being her unborn infant; Bar's researches (*vide* PREGNANCY, PHYSIOLOGY OF) go to show that the additional nourishment necessary for the fœtus is obtained by a better assimilation of material in the mother's intestine, and by a smaller excretion of the same. Most women probably eat quite enough for their unborn infants as well as themselves, and are not called upon to make any marked change in the quantity of the food taken, although its nature may require revision. Dietetic indiscretions are much more dangerous in a time of strain, such as pregnancy, than in the non-pregnant state.

Urinanalysis is, of course, of immense importance in pregnancy, and especially in first pregnancies where the capabilities of the kidneys to do more work without suffering injury are unknown factors. Further, in doubtful cases, the simple testing for albumen is not sufficient; its quantity must be estimated, as must also that of the urea, and perhaps of the chlorides. The modern obstetrician can hardly regard his duties to his pregnant patient as faithfully carried out unless he makes careful analyses of her urine at regular intervals.

Further, the patient should be instructed to come to her doctor for advice when her pregnancy is complicated in any way. She should be told to report such deviations from the normal as headache (especially persistent headache), marked diminution in the amount of urine passed, eye symptoms, troublesome constipation, puffiness below the eyes, swelling and tenderness of the veins of the legs, etc. A great field of usefulness is lying ready for the enterprising obstetrician to enter on, if only women could be got to understand that medical attention may be very helpful in overcoming the minor ailments of pregnancy and in preventing the major disasters. "Women should be taught to seek their doctors early in pregnancy," writes an American authority, "after the second missed period an office consultation should be arranged for." This may be difficult of accomplishment, for, in the past, the medical man has left his pregnant patients very much to themselves, or has thrown them for advice upon their nurses; he has now to demonstrate that his attentions are both needed and helpful. Most women still are under the impression that they are doing the best for themselves if they send for their medical attendant when the pains of labour supervene.

A great impetus has been given to the understanding and management of morbid pregnancies by the institution of hospital treatment for the same. A full review of the movement for the establishment of pre-maternity hospitals will be found in Ballantyne's Valedictory Address to the Edinburgh Obstetrical Society in 1907 (*Trans. Edin. Obstet. Soc.*, xxxiii. pp. 24-60), and an account of thirty cases of morbid pregnancy treated in the pre-maternity ward of the Edinburgh Royal Maternity Hospital during 1908 was published early in the present year (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. pp. 93 and 169, 1909). The following suggestions have been made for pre-maternity beds, wards, and hospitals. First, with regard to beds in maternity hospitals: the pre-

maternity bed or beds should be strictly reserved for the reception of cases of morbid pregnancy; if a patient suffering from one of the maladies of pregnancy pass into labour within forty-eight hours of her reception into the pre-maternity bed she shall not be regarded as a pre-maternity case, for, obviously, such a brief stay does not permit of any satisfactory attempt towards the effective treatment of her malady; the pre-maternity beds should be placed in a ward by themselves, and should not be located in the ordinary ward used for the puerperal patients; a sister should be in charge of these beds who has a surgical and medical as well as an obstetric experience, for the nursing required will in most instances be more strictly medical or surgical than obstetrical; no attempt should be made to adapt the diet of puerperal patients for the use of the pre-maternity patients, for, as a rule, the latter require quite different food; special case-taking forms should be used for the pre-maternity cases; a special case-book should be kept in which every patient who has been in the pre-maternity bed for the period of more than forty-eight hours, for such cases, if successfully treated, will sometimes not remain in the hospital for delivery, *e.g.* retroversion of the gravid uterus at the third month; in pre-maternity cases special attention should be paid to urine analysis, to examination of the blood and of the blood pressure, to that of the nervous system, to ophthalmoscopic investigations, to a detailed and thorough examination of the signs and symptoms of pregnancy, including estimations and descriptions of the fœtal heart and of the fœtal movements. Then, with regard to pre-maternity wards or hospitals: the ward or hospital should be connected with the maternity hospital, but should not be included in it; the pre-maternity portion should resemble more closely an ordinary general hospital in its construction and arrangement than a maternity hospital; the management of the pre-maternity should be kept as far as possible distinct from that of the maternity, the nursing, diet, regimen, and to some extent the medical treatment required being different; there should be a resident physician whose business it would be to take charge of the pre-maternity hospital, whilst the physician of the maternity hospital would make a daily visit; and the supervention of labour would always be the signal for the transference of a patient from the pre-maternity to the maternity hospital, her record would go with her, and would serve as a guide for diagnosis and treatment in the other part of the building. Suitable cases for treatment in pre-maternity beds, wards, or hospitals are pregnant patients suffering from albuminuria, heart disease, intractable vomiting, pulmonary disease, hepatic disease, anæmia and other blood disorders, and various nervous maladies (especially epilepsy, chorea gravidarum, hystero-epilepsy, hysteria, and paralysis), diseases of the reproductive organs (such as retroversion of the gravid uterus, threatened abortion, pruritus and œdema vulvæ, uterine prolapse, cystocele, vulvar inflammation and abscess, uterine myomata, and suspected ectopic gestation), and hydramnios and other conditions leading to over-distension of the uterus; and cases of suspected hydatid mole, of placental hæmorrhage, missed labour, or of antenatal death or deformity might with advantage be kept under observation. Further, patients who had suffered in past pregnancies from habitual abortion, "habitual" fœtal death or disease, habitual prematurity or post-maturity, or from eclampsia, might be dieted, kept at rest, or treated with medicinal means, etc., in future pregnancies in order, if possible, to prevent the recurrence of these reproductive disasters. Patients who have already had one or more eclamptic seizures are not so suitable for pre-maternity treatment; but even in them labour does not always supervene immediately, and purely medical treatment for a few days may be possible and may serve to save the mother's if not also the child's life (vide *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 98, 1909). Cases which are unsuitable for treatment in a pre-maternity bed or ward would seem to be infectious fevers occurring as complications of pregnancy and cases of insanity; cases of syphilis, gonorrhœa, and gonorrhœal vaginitis and vulvitis might be dealt with if care were used to avoid infection; alcoholism and dipsomania, in the absence of delirium tremens, might also be admitted, but they would necessitate more watching and nursing than could be easily given.

Pregnancy, Physiology of.—Since the beginning of the twentieth century many contributions have been made to our knowledge of the physiology of pregnancy, but it cannot yet be said that we have enough information regarding the inter-relation of the lives of mother and unborn infant to enable us to understand the maladies peculiar to pregnancy and to take adequate means for their prevention or cure. This is true in a very special way of eclampsia (*vide* ECLAMPSIA), and applies also to hyperemesis gravidarum, to jaundice in pregnancy, and to chorea of the pregnant woman. For this reason there is no uniformity of belief regarding such means of treatment as the emptying of the uterus in the diseases which have been named, as well as in pregnancies complicated by heart disease, by pneumonia, by tuberculosis, and by epilepsy. But every contribution that is made to the better knowledge of the physiology of pregnancy is of value, and no single work is of greater importance than that which has recently

come to us from Professor Paul Bar of Paris.

Bar's work (*Leçons de pathologie obstétricale* (Paris), 1907) contains between 900 and 1000 pages of clinical observations and experimental reseaches, and, although there is much in it relating to eclampsia and the morbid changes found in that disease, there is also a great mass of materials for the formation of more correct views regarding the physiology of pregnancy than those at present existing. The author has endeavoured to determine the modifications in the nutrition of a healthy mother produced by a normal pregnancy, employing for that purpose *the study of the urine*. With regard, in the first place, to the existence of a *polyuria* of pregnancy, a matter about which there had been doubt, Bar came to the conclusion that it was not a constant phenomenon at the close of gestation, but that it was observed in some primiparas, and that it was common in multiparas; from experimental work upon dogs he discovered that the excretion of water by the kidneys was more abundant during pregnancy than when the animal was not pregnant; and he was therefore of opinion that pregnancy by itself was a cause of polyuria. The *density of the urine* was diminished towards the close of pregnancy; the *solid extractive matters* of the urine were also less in quantity, and Bar ascribed this reduction largely to the fact that the fœtus subtracted from the mother certain materials for its upbuilding.

The question of the *nitrogenous interchanges* between mother and fœtus was a difficult and complicated one. From observations made upon four pregnant women fed upon a mixed diet, the elements of which were known and in fixed amount, it was found that there was a tendency to a reduction of the residual fæcal nitrogen; in a word, there was more complete utilisation of nitrogenous materials in the alimentary tract. These results were confirmed by experiments upon dogs, and this experimental work showed further that the increased utilisation of the nitrogenous material was not regular and steady but occurred in phases. With regard to the urinary nitrogen, and especially to the urea, it was found from experiment that, in pregnant dogs, submitted to a constant dietary, there was diminished excretion of urea in the second half of gestation, and that the decrease was in proportion to the development of the fœtus; it was the same in the human subject, and the differences in the results obtained by authors were often to be explained by variations in the amount of food taken. With regard next to the equilibrium of the nitrogenous exchanges during pregnancy, Bar found that the healthy pregnant woman, under a rational regimen, retained some nitrogen and that she retained more than if she were not pregnant (the other conditions of health, diet, etc., being the same); further, the nitrogenous material that she retained was often greater than was required for the needs of the fœtus. The mechanism of this disturbance of the equilibrium of the nitrogen exchange could not be precisely stated; it might be due to a degree of renal impermeability which prevented the excretion of nitrogen, or it might be due to the fixation of nitrogen in the form of albumen. If the latter explanation were the correct one then there would be a real increase in the nitrogen capital (so to say) of the mother in pregnancy.

This peculiarity of the chemical interchanges taking place in gestation led Bar to consider whether pregnancy constituted for the mother a period of loss or of gain. From his own observations, and from those of Hagemann and others, he drew the conclusions that pregnancy did not constitute a period of sacrifice for the mother; that when she was healthy, she found in her diet the necessary elements for the development of the fœtus; that when the diet was sufficiently plentiful the healthy mother pregnant of one or more healthy fœtuses retained more albumen than the fœtus or fœtuses required, and of this excess she kept a part for herself; and that therefore the healthy mother carrying one or more healthy fœtuses profited from the period of gestation. To this associated condition of the mother and fœtus, in which the latter does not live in a parasitic fashion at the expense of the former, Bar gave the name of "harmonious homogeneous symbiosis" (*symbiose harmonique homogène*). The term *symbiosis* was not used in its strict biological sense, which is, that association which gives life to two individuals incapable of living by themselves in the conditions in which they are found, for, of course, the mother could live without the fœtus; but Bar had been unable to find a better name. It was a harmonious symbiosis, thus differing from such an inharmonious association as parasitism, in which one of the individuals is a source of injury to the other. Further, it was homogeneous, for the association was that of two individuals of the same and not of different natures. This is a very important deduction for Bar to have made, and is contrary to the idea which is widely held, that fœtal life is a parasitic or semi-parasitic state of existence. Apparently it is a unique sort of association. Gestation in the mammalia, says Professor Bar, is perhaps the only, certainly it is the best, example of homogeneous harmonious symbiosis between two beings; the fœtus lives upon the mother but also gives to her the power of giving him life without suffering damage herself, indeed she sometimes gains by it. But these deep-seated modifications of nutrition, developing so quickly, maintain the nitrogenous equilibrium or cause a gain to the mother only if the latter be

healthy and have a regular dietary. The least weakness of the organism may derange the process and lead to a loss; and the disturbance may come from the side of the fœtus as well as from that of the mother. Consequently "fœtus sanus in matre sanâ" is the indispensable condition if we would see happy results following the gestational modifications of the nitrogenous nutrition of the individual. If this condition do not obtain, and if the maternal organism becomes supersaturated, so to say, with nitrogenous material in the first half of pregnancy, or if, on the other hand, too little nitrogen is retained, then pathological states (*e.g.* digestive troubles) may arise.

Bar found, further, that the weight of urinary ammonia appeared to increase during pregnancy, and the relation of the nitrogen of the ammonia to the total nitrogen was above the normal. These facts were due to the pregnant woman taking, by instinct, more food, and to a part of the nitrogen, which ought to have been excreted in the urine as urea, passing to the fœtus instead. Primiparous patients excreted more uric acid than multiparous ones, the former excreting a little more than the normal and the latter a little less. In primiparas the relation of the uric acid to the urea and the relation of the nitrogen excreted in the form of uric acid to the total nitrogen were above the normal; these conditions were due to increase in the absolute weight of the uric acid and to a decrease of the urea and of the nitrogen.

Passing to other chemical constituents of the organism, Bar found that the urinary *phosphorus* diminished towards the end of pregnancy, and that the diminution was proportionate to the demands made by the fœtus. On the other hand the utilisation in the intestine of phosphorus-containing food was better during the second half of pregnancy than in the first (although it was very good in the first half also); thus the maternal organism was able to store up phosphorus. During pregnancy, therefore, the mother found in her food the phosphorus necessary for the development of the fœtus; if she were furnished with sufficient food she did not require to break in upon her capital of phosphorus; and thus there was a harmonious symbiosis in respect to the phosphorus as well as the nitrogen. At the same time Bar believed that the phosphorus equilibrium was, so to say, more precarious than the nitrogen one. With regard to *lime*, it was shown that the pregnant woman's food was generally too poor in that substance to supply the needs of the fœtus in the last two or three months, and that the mother, therefore, had to draw from her calcium reserve the greater part of the lime required by her unborn infant. In normal circumstances the loss was not marked; but occasionally the decalcification of pregnancy was prominent and showed itself in the presence of an excess of bases in the blood and in the formation of osteophytes, the occurrence of painful laxity of the joints, and even in osteomalacia. An interesting illustration of these morbid results of gestational decalcification has been given by Marquis (*L'obstétrique*, n. s. i. p. 275, 1908), who found pain in and mobility of the bones of the symphysis pubis, pain on pressure over the iliac crests, etc., in a primipara, 27 years of age, who was excreting $\frac{4}{5}$ of the lime taken in the food through the fæces; at the eighth month of her pregnancy she was put on a diet rich in lime with the result that the difficulty in locomotion, the progressive loss of strength, etc., were arrested. The patient's blood, in this case, showed nearly double the amount of lime in circulation as compared with a pregnant patient who had no signs of decalcification. The bearing of these observations on the cause and significance of the calcareous placenta is not very evident, for Merletti (*Ann. di ostet. e ginec.*, xxx. p. 577, 1908) found that this abnormality of the afterbirth was met with in healthy as well as in diseased mothers and with fœtuses of normal, of excessive, or of deficient development. Merletti, however, observed that, on the whole, the calcareous placenta was most often met with in post-mature labours, and it is possible, therefore, that the lime passing from the mother's reserves to the fœtus, being no longer needed by the infant, was deposited in the placenta.

To return to Bar's work. The fœtal demand for *iron* was great throughout pregnancy but was especially marked in the third trimester. This supply of iron was got directly from the mother's blood. The pregnant woman made provision for this call upon her iron reserves perhaps by obtaining more iron from her food and certainly by increased activity of the hæmatopoietic organs which had as its result the passage of the iron in reserve into an active form. There was always a risk that this process might overstep normal bounds; then the liver excreted more iron-containing pigments, the fæces contained more iron than was usual, the blood contained more of the iron pigments, and there was a tendency to jaundice. The *sulphur* interchanges were associated with the iron ones. Generally the mother was able to supply the wants of her fœtus by obtaining more sulphur from her food and by utilising more thoroughly what she absorbed; but this was not always so, and then the amount of sulphur in the fæces and urine increased. A pathological cycle of events was met with: there was first the fœtal demand for iron, followed by excessive hæmatolysis and its results, polycholia, the simultaneous loss of iron and sulphur by the intestine, and finally cholæmia.

As a general rule, Bar found that there was perfect correlation between the needs of fœtus for *chloride of sodium* and the retention of that salt by the mother; but the useful and necessary degree of retention was soon exhausted (perhaps from a disturbance of the circulation in renal glomeruli). Urobilinuria was not uncommon towards the close of pregnancy, but the presence of *bile pigments* in the urine was distinctly pathological. There was a slight decrease in the amount of *carbon* excreted by the urine at the same period of pregnancy, due probably to an increase in the retention of sugar, fat, acetone, etc. In pregnancy the glycolytic power was lowered and *sugar* appeared in the urine in about 10 per cent. of primiparas and in about 30 per cent. of multiparas; most often it was glucose, but it was sometimes lactose. Bar was of opinion that the fœtus demanded from his mother the *fat* which he fixed, and that a correlation existed between gestational hyperglycæmia in the mother and the presence of a large quantity of fat in the fœtus. He came to the following conclusions: the glycæmia of pregnancy was in direct relation to fœtal glycogenesis, and indirectly to the development of fat in the fœtus; when this glycæmia was proportionate to the power of absorption of the fœtus, no glycosuria appeared in the mother; when, however, there was hyperglycæmia, the first result was an increased deposit of fat in the fœtus and a large and fat infant was born; and when from any cause (increased glycæmia, morbid states of the fœtus, etc.) the passage of sugar through the placenta was insufficient, glycosuria appeared, the "floating" glucose (so to say) finding no employment. Finally, Bar noted that there was frequently a slight degree of *acetonuria* when the pregnant woman was quite healthy and even when the fœtus was not dead.

By his prolonged and valuable researches Bar has shown that the physiological condition of pregnancy is a special one and one in which there is a very delicate and easily disturbed equilibrium in the metabolic processes of the body. Under ordinary circumstances, for a healthy mother carrying a healthy fœtus and supplied with sufficient food, the period of pregnancy is not one of sacrifice; indeed, under the best conditions, she may draw profit from it; but deviations from the normal are easily set up and may have the most serious effects, among which we must specially keep in mind nitrogenous disassimilation with hyperazoturia and gastro-intestinal disturbance, decalcification, and excessive hæmolysis with cholæmia, etc. It is by means of scientific investigations, such as these, that we may yet be able successfully to combat such serious maladies of pregnancy as hyperemesis, icterus, albuminuria, and eclampsia.

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SEVERAL important sections of this volume have already been devoted to the consideration of the pathology of pregnancy, *vide* the articles on ABORTION, ANTENATAL PATHOLOGY, CHOREA GRAVIDARUM, ECLAMPSIA, and ECTOPIC PREGNANCY; but there remain certain other sections dealing with morbid states associated with gestation to which some space must here be given.

TRAUMATISM AND SURGICAL OPERATIONS DURING PREGNANCY.—The list of cases of grave injury during pregnancy has been added to during recent years, and amongst the recorded cases are several in which gestation was not interrupted although the traumatism was of a very serious nature. R. P. Harris drew attention to this abdominal and uterine tolerance in pregnant women as shown by the low rate of mortality under severe lacerated and other wounds, in a book published in Philadelphia in 1892; and of recent years several striking confirmatory cases have occurred. Gloninger (*Phil. Med. Journ.*, viii. p. 958, 1901), for instance, reported a pistol-shot wound of the stomach, liver, and transverse colon in a pregnant woman, with recovery and delivery at term; Dreyfoos (*Lancet-Clinic*, n. s. liv. p. 162, 1905) put on record a case of fracture of the base of the skull in a pregnant woman, with recovery, and without the occurrence of abortion; and Wyder (*Corr.-Bl. f. Schweiz. Aerzte*, xxxv. p. 429, 1905) met with the case of a patient (pregnant at term) who fell from a second floor window and received a wound of the head, dislocation of the head of the left radius, and fracture of the pelvis, and who was spontaneously and normally delivered 6 days later, with recovery. To these might be added the remarkable cases of Steele (*Surg., Gynec., and Obstet.*, vi. p. 293, 1908), Smirnoff, (*Prakt. Vrach*, ii. p. 1101, 1903), and Hood (*Brooklyn Med. Journ.*, xvi. p. 395, 1902); but it may be regarded as fully proven that severe injuries, even when they affect the abdomen, need not necessarily lead to the premature termination of pregnancy or to the death of the mother or fœtus. At the same time much depends upon the skill of the surgeon who is called upon to deal with the case and upon the asepsis of his technique. Having in mind the experiences recorded above and others like

them, operators have become bolder in their surgical interference during pregnancy. It is no uncommon procedure nowadays to remove ovarian tumours (cystic, solid, or dermoid) which may be found complicating pregnancy, and many articles dealing with this subject have appeared. Dührssen (*Deutsche med. Wochensch.*, xxx. pp. 1529, 1570, 1904) is of opinion that such growths should be removed in pregnancy (or in labour) by vaginal ovariotomy; but if the tumour have developed adhesions, this operation may become suddenly difficult and not free from danger from hæmorrhage. C. Greene Cumston (*Journ. Obstet. and Gynæc. Brit. Emp.*, xiv p. 159, 1908), although operating in four out of his five cases by the abdominal route, is inclined to recommend vaginal ovariotomy in some instances; he points out that the sudden cooling of the peritoneal cavity (in abdominal ovariotomy) may, by relaxing the muscular structure of the uterus, lead to expulsion of the fœtus. Operation early in pregnancy would seem to be safer than in the later months; and A. Martin (*Normandie méd.*, xxii. p. 22, 1907) found in a young primipara at the seventh month of gestation that a dermoid cyst of the right ovary had ruptured and suppurated, necessitating Cæsarean section, ovariotomy, and, ultimately, total abdominal hysterectomy; ovariotomy early in pregnancy would probably have prevented this dangerous sequence of grave operative procedures. But even when the cyst ruptures in pregnancy surgical interference may be successful, thus H. Morestin (*Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 602, 1907) operated (by laparotomy) on a patient at the fourth month of pregnancy and found that there was a ruptured multilocular cyst of the right ovary; labour set in on the second day and the placenta had to be removed, and yet the woman ultimately recovered. It is on account of such experiences that Lobenstine (*Bull. Lying-in Hosp.* (New York), iii. p. 88, 1906-7) advises operation during pregnancy as soon as the diagnosis is established; and the same advice is given by many others (M'Kerron, 1903; Munro Kerr, 1908).

But even tumours of the uterus itself have been successfully operated on during pregnancy, *e.g.* Doran's case of sessile subserous fibromyoma removed by myomectomy at the third month (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 297, 1905), Potocki's case of amputation of the hypertrophied cervix in the fourth month (*Compt. rend. Soc. d'obstét., de gynéc., et de pædiat. de Paris*, vii. p. 186, 1906), and Hewetson's double myomectomy at the tenth week of gestation (*Birmingham Med. Rev.*, xii. p. 55, 1908). Amputation of the cancerous cervix during pregnancy has also been performed, but in 58 per cent. of the reported cases abortion followed (Oui, *Echo méd. du Nord*, xi. p. 229, 1907). There can be no doubt that in some instances fibroid tumours form a very grave complication of pregnancy, and this is especially true of the cases in which torsion of the fibroid or of the whole uterus occurs (Lepage and Mouchotte, *Ann. de gynéc. et d'obstét.*, 2 s. iii. p. 99, 1906; Ivanoff, *Ann. de gynéc. et d'obstét.*, 2 s. iv. p. 311, 1907). Glockner (*Zentralb. f. Gynäk.*, xxxi. p. 156, 1907) has suggested that a myomectomy scar will be a probable cause of uterine rupture in subsequent pregnancies, but Littauer and Abel did not see reason to join in these fears.

Digestive Disorders during Pregnancy.—Quite a considerable literature has grown up round the subject of *appendicitis* as a complication of pregnancy. Schoemaker (*Zentralb. f. Gynäk.*, xxix. p. 596, 1905), in a series of 150 cases of appendicitis (of which 80 were women), noted pregnancy in two, and in one of these death resulted, whilst, in the other, a gangrenous appendix was removed, followed by a slow convalescence. Renvall (*Finska läk.-sällsk. handl.*, Helsingfors, I. i. 1908) has published a valuable summary of over 250 cases of appendicitis occurring either alone or along with peritonitis as a complication of pregnancy and labour; in 163 of these instances an operation took place; he was of opinion that the uterus should generally be emptied before the abdominal section is carried out, especially when the fœtus was alive and the pregnancy far advanced. Rostowzew (*Zentralb. f. Gynäk.*, xxvii. p. 1485, 1903), however, and many others, have been opposed to the preliminary induction of abortion; and Monod (*Compt. rend. Soc. d'obstét., de gynéc., et de pædiat. de Paris*, v. p. 70, 1903), for instance, had to free many adhesions and extricate the appendix from behind the cæcum before he could remove it, and yet pregnancy went on to term. Mauclaire, Segond, and others (*Ann. de gynéc. et d'obstét.*, ii. p. 243, 1905) have summed up strongly in favour of immediate operation in cases of appendicitis in pregnancy, and the first-named operator made, on one occasion, as many as four incisions to let out pus, removed a gangrenous appendix, and yet pregnancy was not interrupted. Further, there is evidence that appendicitis, if not operated on during pregnancy, is apt to be aggravated by the traumatism of labour and to become very dangerous in the puerperium (Michel, *Rev. méd. de l'est*, xxxviii. p. 257, 1906).

Hyperemesis gravidarum continues to be one of the most dreaded complications of the pregnant state. Its *causation* is still a mystery. Whitridge Williams (*Johns Hopkins Hosp. Bull.*, xvii. p. 71, 1906; *Trans. Amer. Gynec. Soc.*, xxx. p. 229, 1905; *Amer. Journ. Med. Sci.*, n. s. cxxxii. p. 343, 1906) recognises three causal varieties—the reflex, the neurotic, and the toxæmic—of which the last-named is the

most serious type and shows a distinct rise in the ammonia coefficient (above 10 per cent.) and calls for the termination of pregnancy. There are, of course, other causes, such as gastric ulcer and gastric cancer and uræmia; but these can generally be excluded, and the diagnosis narrowed down to vomiting of the nervous or of the toxæmic type. Tuszkai (*Berl. Klin.*, xviii. p. 218, 1900) is opposed to the toxæmic theory, and would explain true hyperemesis gravidarum as due to peritoneal irritation, the result of the great stretching to which that membrane is subject by the growing uterus and of the defective nutrition following upon the stretching; but it has to be remembered that great enlargement of the uterus, as in twin pregnancies and hydramnios, is not always accompanied by vomiting. Dufour and Cottenot (*Rev. neurol.*, xvi. p. 1345, 1908) also look to the nervous system for the cause, and record two cases in which the intractable vomiting of pregnancy seems to have been due to locomotor ataxia. There are certainly several facts which point to a neurosis, *e.g.* the cure of certain cases by the performance of a small operation, such as stretching the cervix or applying caustic to it, by suggestion or by the rest cure (Fieux, *Bull. et mém. Soc. de méd. et chir. de Bordeaux*, p. 406, 1907; Scholomowitsch, *Russ. med. Rundschau*, v. p. 517, 1907); but, on the other hand, the toxæmic theory is favoured by the cessation of the vomiting when there is timely emptying of the uterus. The safest conclusion to which to come (in the present state of our knowledge) would seem to be to regard most cases as nervous in origin, but to be prepared for the occasional occurrence of toxæmia as a cause. Under the circumstances *treatment* must necessarily be unsatisfactory, but K. Baisch (*Berl. klin. Wochensch.*, xliv. p. 297, 1907) lays down certain useful rules. Believing, as he does, that there is a special predisposition to intractable vomiting in some pregnant women and that this predisposition resides either in the uterus (overproduction of or alteration in some chemical substance therein), or in the central nervous system (abnormal irritability), or in the stomach (weak digestion in the past), Baisch orders complete rest in bed, sometimes with an icebag on the abdomen; then he withholds all food, solid and fluid, for twenty-four hours, giving saline fluid subcutaneously to relieve the consequent thirst; thereafter food is given with great care, iced milk in teaspoonfuls, dry biscuit, then later tea and coffee with milk, and so on, the return to ordinary diet being very gradual; after these means have been tried, the patient, if uncured, should be placed in a hospital (*e.g.* in the pre-maternity ward of a maternity hospital). Baisch regards scopolamine as the best sedative. When all these remedies fail and the symptoms continue to threaten the life of the patient, the pregnancy should be interrupted, and Baisch prefers to empty the uterus at one sitting. H. Freund (*Deutsche med. Wochensch.*, xxxiii. p. 1625, 1907) also discusses the treatment of the uncontrollable vomiting of pregnancy in great detail; he looks for a predisposing cause in congenital or acquired anomalies of the stomach, in blood diseases and cachectic conditions, in the nervous and hysterical temperament, and in nasopharyngeal affections. When a woman with such a predisposition becomes pregnant, treatment ought to be begun before the appearance of the vomiting; her medical attendant must keep her under observation and there ought to be a nurse in charge; at first the treatment must be physical and any discoverable anomalies in the genital sphere should be corrected; thereafter, when the hyperemesis is in existence, rest in bed, the wearing of a tight abdominal binder, warm rectal injections of saline, the application of hot alcohol to the epigastrium, and the administration of cacodylate of sodium per rectum or subcutaneously should be relied on. Freund's dietetic and psychical treatment resembles that recommended by Baisch; and the termination of pregnancy is to be a last resort.

Among the rare complications of pregnancy (affecting the digestive system) must now be placed axial torsion of the large intestine, a fatal case of which was recorded by Georg Becker in 1908 (*Monatssch. f. Geburtsh. u. Gynäk.*, xxviii. p. 155, 1908). The patient was 45 years of age, and was pregnant for the fifteenth time. She had twice given birth to twins. In the eighth month of gestation abdominal pain came on followed by vomiting, and there were all the signs of intestinal obstruction; the cervix was dilated and a dead female fœtus was removed; the mother died five hours later. At the necropsy the sigmoid flexure, which had a long mesocolon, was found to be twisted on the axis of the mesentery and to be in a gangrenous state. Becker has gathered together from literature seven other cases, all of them, with one exception, fatal.

Acute Yellow Atrophy of the Liver is associated in some measure with both eclampsia and hyperemesis gravidarum. Like them, it is obscure in its etiology and generally fatal in its issue. Amongst several contributions of value which have been made to the understanding of it within the past few years may be named Bertino's paper (*Ginecologia*, v. pp. 417-448, 1908). In this article ten cases of icterus gravidarum were recorded, of which seven were benign, one was serious from the first and proved fatal, and two became serious although benign at first and both ended in death. Bertino came to the conclusion that in cases of epidemic or sporadic icterus in pregnancy the disease, although apparently benign, might very easily

be transformed into the grave type and run the course of acute yellow atrophy of the liver. The prognosis, therefore, should always be doubtful. The presence of twins in the uterus (as in the immediately fatal case recorded by Bertino) or of diseases of the blood help to determine hepatic inadequacy in pregnancy, and so change a simple jaundice into the grave type. When the symptoms are well established, neither medical nor obstetrical treatment is of much avail. The hepatic complications of pregnancy have also been discussed by Brauer (*Zentralb. f. Gynäk.*, xxvii. p. 787, 1903), Charles (*Journ. d'accouch.* (Liége), xxvii. p. 73, 1906), Kehrer (*Arch. f. Gynaek.*, lxxxi. p. 129, 1907), Lulle (*Journ. de méd. de Paris*, 2 s. xviii. p. 201, 1906), Rudaux (*Arch. gén. de méd.*, i. for 1905, p. 1191), and Hofbauer (*Med. Klin.*, v. p. 239, 1909).

Renal Disorders during Pregnancy.—In addition to their relation to Eclampsia (*q.v.*), the kidneys may be at fault in pregnancy in other ways. The *movable kidney*, for instance, may become impacted in the pelvis during pregnancy. Von Guérard (*Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 1160, 1903) has recorded such a case: the patient suffered from a fall on the nates, followed by great pain; a tender mass impacted in the pelvis was discovered on examination; it was thought to be ovarian, and was reduced under anæsthesia; two months later the same conditions were redeveloped; the abdomen was opened, the tumour (the right kidney) was reduced, and both the Fallopian tubes were ligatured; the patient aborted three hours later. *Pyelitis* and *pyelonephritis* may occur as complications of pregnancy. Cumston (*Journ. Obstet. and Gynæc. Brit. Emp.*, viii. p. 221, 1905) has ably summarised our knowledge on these maladies and has recorded a personal observation of persistent pyuria in which decapsulation of both kidneys was performed but without saving the patient; prior to decapsulation the uterus had been emptied (the gestation was at the sixth month), and, prior to this, ovariotomy had been performed successfully at the fifth month. Opitz (*Berl. klin.-therap. Wochensch.*, p. 1357, 1904), Fournier (*Bull. Soc. d'obstét. de Paris*, viii. p. 9, 1905), Rudaux (*Clinique* (Bruxelles), xx. p. 522, 1906), Bar and Daunay (*Bull. Soc. d'obstét. de Paris*, ix. p. 136, 1906), and Esselbruegge (*Med. Fortnightly*, xxxiii. p. 17, 1908) have made contributions to this department of the pathology of pregnancy. There have been several important articles on glycosuria in the pregnant state, amongst which may be named those by Rudaux (*Clinique*, i. for 1906, p. 281), Jackson and Torbert (*Boston Med. and Surg. Journ.*, clii. p. 159, 1905), Brook (*Trans. Obstet. Soc. Lond.*, xlviii. p. 192, 1907), Loviot (*Rev. d. mal. de la nutrition*, 2 s. ii. p. 173, 1904), Eshner (*Amer. Journ. Med. Sci.*, cxxxiv. p. 375, 1907), and Williams (*Amer. Journ. Med. Sci.*, cxxxvii. p. 1, 1909).

The Goulstonian Lectures on the influence of pregnancy upon certain *medical diseases* and of certain medical diseases of pregnancy by Dr. Herbert French (*Brit. Med. Journ.*, i. for 1908, pp. 1029, 1100, 1165) are worthy of special consideration; pyelonephritis and the fevers are specially dealt with.

Preparator.—In immunity this term has been employed as a synonym of amboceptor or immune body.

Pressor.—Stimulating or exciting, *e.g.* pressor nerves, are those whose stimulation excites increased vasomotor activity, pressor bases are chemical substances whose retention in the body raises the blood pressure; the antonym is depressor. On *pressor bases*, see W. Bain, *Lancet*, ii. for 1909, p. 365; i. for 1910, p. 1190.

Probilin. — A trade name for phenolphthalein (*q.v.*).

Proctoclysis.—The giving of rectal saline injections.

Prolamins.—Gliadins or alcohol-soluble proteins; simple proteins insoluble in water or absolute alcohol but soluble in relatively strong alcohol and other neutral solvents; hordein from barley and zein from maize are prolamins.

Propagative Part.—The name given by Berry Hart to that part of the animal or plant body which is not the soma; in the adult it is the sexual gland, and in the zygote (fertilised ovum) it is the primitive germ or sperm-cell mass. *See* Berry Hart, *Evolution and Heredity*, p. 38, 1910.

Propepsin.—Pepsinogen, the zymogen which is secreted by the peptic glands, and which is converted by free hydrochloric acid into pepsin.

Prophase.—The first stage in mitosis (indirect cell division) during which the nuclear chromatin forms a skein and then divides into chromosomes, the nuclear membrane disappears, and the amphiaster appears in the cytoplasm.

Propion. — A hypnotic of the ketone group; it is not highly spoken of.

Proponal (*see also* Drugs, Recent).—A hypnotic drug chemically closely allied to veronal and resembling it in its action; the dose is from 2 to 8 grains, and, as it is easily

soluble in dilute alkalies, it may be given in sodium bicarbonate solution; but it has to be remembered that its "toxic dose is only a very little greater than the effective hypnotic dose." *See* Fortescue-Brickdale, *Newer Remedies*, pp. 165-166, 1910.

Prostate, Surgery of.—At the time of issue of the *Encyclopædia Medica* prostatectomy as a means of treating prostatic hypertrophy was considered by many, if not most, surgeons, to be a questionable operation on account of the high mortality it involved. Nowadays it has come to be looked upon as an almost routine treatment for cases requiring frequent catheterisation with its attendant dangers of sepsis. The pioneer of suprapubic prostatectomy in this country was Freyer, and in his hands the mortality of the operation is as low as 3 per cent. In the operation of suprapubic prostatectomy it is advantageous to have the empty rectum distended by a bag filled with air or water so as to raise the floor of the bladder. The first steps in the operation are the same as in suprapubic cystotomy. A sound is then passed into the bladder, and the dimensions of the prostate are examined by the finger. The capsule of the prostate is then incised with blunt scissors, and the gland is enucleated by separating it from the capsule with the finger. In some cases it can be removed entire; in others piecemeal enucleation is required. If there is much oozing from the bleeding cavity a gauze packing may be required, ordinarily it is sufficient to drain the bladder through the suprapubic wound. One of the most important points in the after-treatment of cases of prostatectomy is the management of the drainage of the bladder. This may be most effectively carried out by using Cathcart's method. This is a modification of Sprengel's air-pump, the essential feature being the insertion of an **S**-tube into the pump in the lower drainage-tube. Other surgeons have employed a simple suprapubic drain, or a retained catheter, or a combination of both these.

While the majority of English surgeons appear to prefer the suprapubic to the perineal operation, the latter has strong supporters among foreign operators. While it is less easy to perform, drainage is said to be more efficient, and the risk of severe bleeding is obviated. On the whole, however, the suprapubic operation is steadily gaining ground at the expense of the perineal method, and in the hands of equally expert operators there is not much to choose between the two operations so far as risk to the patient is concerned. Among the advantages of the suprapubic operation, putting aside the ease and rapidity with which it can be performed, are the facilities it affords for a thorough exploration of the bladder, including the detection of calculi, and for the removal of the middle lobe.

Walstein has introduced a modification of the suprapubic method which consists in a temporary resection of the symphysis pubis. A curved transverse incision, with its convexity downwards, is made across the lower part of the hypogastrium close to the root of the penis. The tissues are then cut through down to the pubes, and the bladder is separated with the finger. The symphysis is then resected by passing a wire saw round the pubes on each side and dividing the bone through the pubic spine. A small portion of bone attached to the root of the penis and subpubic ligament is detached from the rest with the chisel. The symphysis is then displaced upwards, and the bladder, distended with air, is pushed into the wound by the finger of an assistant in the bladder. After the bladder condition has been dealt with, the wound of the organ is closed by separate suture of the mucous and muscular coats. The incisions are so planned in these two coats that they do not coincide. The symphysis is then replaced and fixed with two silver-wire sutures. The operation is specially indicated in diseases of the prostate, in recto-vesical fistulæ, and in tumours of the fundus of the bladder.

Prostatectomy is indicated when retention, necessitating frequent use of the catheter, is present. Some advocate an earlier operation; others advise that when symptoms of prostatic enlargement are present the catheter should have a fair trial before operation is recommended. Frequent micturition, with pain and hæmaturia, even without retention, probably render prostatectomy desirable. De Quervain gives the following indications:—(1) Uninfected bladder, capable of being emptied: delay operation; (2) incomplete retention with residual urine: operate to prevent infection; (3) chronic retention, with overflow: operate; (4) acute retention, supervening on (2) or (3): operate; on (1) delay, to give catheterisation a chance.

Prostatectomy is contra-indicated by (1) bad general condition of the patient; (2) general arterial sclerosis; (3) long-standing catheter life; (4) diffuse bronchitis; (5) renal inadequacy.

"Prostatism." In some cases all the symptoms of hypertrophy of the prostate (conveniently designated as "prostatism") are present without enlargement of the gland. In such cases the neck of the bladder is surrounded by a ring of fibroid tissue which interferes with the opening of the urethral orifice during micturition. If this is diagnosed before opening the bladder, the Bottini operation with the galvano-cautery—canalisation of the base of the prostate—is the method of choice. This operation was introduced for prostatic hypertrophy, and is still advocated by some surgeons

in preference to prostatectomy. The advantages claimed for it by Freudenberg are—the patient is willing to submit to it early; a local anæsthetic is sufficient; there is little risk either of impotence or incontinence.

Among the possible sequelæ of prostatectomy are—persistence of a fistula; incontinence from destruction of the vesical sphincter; stricture; impotence; psychical disturbances.

For further details as to suprapubic prostatectomy, Freyer's papers in the *Brit. Med. Journ.*, 24th July 1901 and 7th October 1905, should be referred to.

Protamins.—Very simple proteins, the simplest found in nature, resembling in this respect synthetically produced polypeptids.

Proteans.—Primary derived proteins or bodies showing only slight alteration of the protein molecule.

Proteoses.—Secondary protein derivatives, showing a greater amount of alteration of the protein molecule than do the proteans.

Prothrombase.—A zymogen taking part in the coagulation of the blood; it is present in the leucocytes and is changed into thrombase, the active agent in coagulation.

Protozoa.—During late years our knowledge concerning the pathogenicity of the protozoa has received many additions, and we have now to recognise in many of these organisms infective agents second in importance only to the bacteria. They are higher life forms than the bacteria, and while no hard-and-fast line can be drawn between the two, the following characteristics serve generally to distinguish the protozoa. The protozoa are unicellular organisms endowed usually with organs for locomotion as well as for the capture, devouring, and digestion of food. Their bodies have either no cuticle, or, if there be one, it is rarely of cellulose; they invariably contain nuclear material. Reproduction takes place by cell division, which is in most cases supplemented by some form of conjugation. This alternation of asexual and sexual phases is one of the chief characters distinguishing the protozoa from lower forms; it is the feature, also, which renders their study so difficult, because the different phases of an organism are often so dissimilar as for long to escape identification. Reproduction may take place by (1) *simple fission*, resulting either in the formation of two symmetrical organisms (binary fission); by (2) asymmetrical fission—*budding*, or *gemmation;* or by (3) multiple fission—sporulation—in which the nucleus breaks up simultaneously, or divides successively, into a number of individuals. This asexual generation may go on for many generations, but cannot continue indefinitely. Like the metazoa, the protozoa ultimately become senescent and die, unless rejuvenation takes place by sexual conjugation. Such weakening with age has been experimentally demonstrated in the paramœcium, by isolating the individuals as they are reproduced by fission, and thus eliminating sexual conjugation. After a number of generations unmistakable signs of old age appear, and the race dies out. Sexual reproduction (*zygosis*) may occur at different points in the life cycles of different forms; it consists in the fusion of the nuclei of two individuals (*gametes*), which may be either young individuals or adults, and may be similar or dissimilar. Nuclei which are about to conjugate are called *pronuclei;* the nucleus which is formed is a *synkaryon*, and the new individual, a *zygote*. Gametes probably always undergo a process of maturation, with extrusion of polar bodies, before zygosis takes place. In the case of union of dissimilar gametes (*anisogamy*) one is usually smaller and more motile, the other larger, and full of reserve material; the former is regarded as the male, the latter as the female, partner. Not only may the gametes differ from one another, but the generation (*gametocytes*) which produces the gametes may be differentiated from the ordinary members of the species. Thus a species may be highly polymorphic with a recurrent cycle of different forms: ordinary asexual or vegetative cycle, and gametocytes, gametes, male and female of the sexual cycle. Under special circumstances a sexual individual may revert to asexual reproduction (*parthenogenesis*).

Protozoa are divided into four classes—sarcodina, mastigophora, sporozoa, and infusoria.

I. Sarcodina.—This group includes the *amœbæ*, some of which (*e.g.* amœba coli) are pathogenic to man. The cytoplasm has no envelope, and movements for the capture of food are effected by pseudopodia. Reproduction takes place by simple fission, the latter being associated with some form of zygosis. There are three parasitic species of amœbæ—*entamœbæ buccalis*, *entamœbæ coli*, and *entamœbæ histolytica* (Schaudinn). Schaudinn proved that the amœba of dysentery was not identical with the amœba coli. The organisms differ in their life histories, and the spores of amœba dysenteriæ (histolytica) are infective to cats.

II. Mastigophora.—This group consists of protozoa with flagellæ. It is a large group, with many subdivisions, of which the Trypanosomatidæ are by far the most important from a medical standpoint.

The Trypanosomatidæ include various genera, all having as a common feature the

possession of an undulatory membrane. They exist as parasites in the fluids of the body, not in the cells. A typical trypanosome has a spindle-shaped body with a more or less centrally-placed macronucleus, and a micronucleus near one extremity. The body is furnished with an undulatory membrane, and a single flagella which originates near the micronucleus and runs along the edge of the undulatory membrane, from the extremity of which it is prolonged. The same general description applies to the trypanoplasma (which is parasitic in the blood of fishes), but the latter has in addition a second flagella, also arising near the micronucleus, but emerging directly from the body without being attached to the undulatory membrane. The trypanosomes are purely blood parasites of the vertebrata, but have the power of passing into the lymph and other tissue fluids.

Among pathogenic trypanosomes, *T. Brucei*, the cause of nagana or tsetse-fly disease of horses and cattle in Africa, *T. equiperdum*, the cause of dourine in horses, *T. equina*, the cause of mal de caderas in horses, and *T. Evansi*, the cause of surra in horses, may be mentioned. Far more important than these, however, is the *T. gambiense*, the parasite of sleeping sickness (*q.v.*) in man. A number of harmless parasitic trypanosomes are also known—e.g. *T. Lewisi*, in the rat.

All species of trypanosome, except T. equiperdum, have an intermediate invertebrate host. T. equiperdum is transmitted directly by coitus. In all cases studied the sexual cycle takes place in the invertebrate host. The general life cycle is as follows:—Indifferent, and sexually differentiated male and female individuals can be recognised in the blood of the vertebrate host, but complete differentiation takes place only in the invertebrate. All types may multiply by simple fission. The females are the most resistant forms, and if by chance the males and the undifferentiated forms perish, parthenogenesis occurs and the host is repeopled. Zygosis is preceded by maturation of the nuclei. The zygote is a simple organism which develops micronucleus, flagella, and undulatory membrane and becomes an ordinary trypanosome which begins a new vegetative cycle. In one species, according to Schaudinn, an intracellular stage of development occurs. The *trypanosoma noctuæ*, of the owl, the general cycle of which resembles the above, after entering the blood of the vertebrate host penetrates the blood corpuscles during the day, loses its power of locomotion, and changes into the parasite which has long been known as the *Halteridium Danilewskii* (see *Encycl. and Dict.*, Vol. VII. p. 341). During the night it escapes from the corpuscle, resumes its trypanosome shape, and is found chiefly in the internal organs. The entire cycle takes from six to eight days.

Spirochætes.—The genus spirochæta, often confused with the spirilla, are possibly allied to the trypanosomes, but great uncertainty exists as to their zoological position. A number of parasitic spirochætes have been described—*s. refringens*, *s. plicatalis*, and, in particular, *s. pallida*, the causal agent of syphilis (*q.v.*). There is also a *s. pertenosis* (Castellani), believed to be the cause of yaws. The organism of relapsing fever (spirillum obermeieri) is now generally regarded as a spirochæte, and Dutton and Todd found a similar, though not identical organism (*s. Duttoni*) in the relapsing or tick fever of the Congo. In connection with the relation of the spirochætes to the trypanosomes it is of interest to refer to Mott's observations on the morbid anatomy of the nervous system in sleeping sickness and general paralysis. The lesions are identical; in the one case the disease is assuredly due to a trypanosome, in the other almost certainly due to a spirochæte. The spirochætes are flexible spiral organisms with an undulatory membrane but no flagellæ. The s. pallida is described in the article SYPHILIS.

Leishman-Donovan Bodies.—These bodies, now recognised as the cause of kala-azar (*q.v.*), probably fall into the same group of organisms, though there is considerable doubt as to their exact position. They were originally regarded as a species of trypanosome, Donovan and Laveran thought they belonged to the group piroplasma, Ross regarded them as a new form of sporozoa, and Rogers states that the late Professor Schaudinn, shortly before his death, took them for a new species of flagellata, for which he proposed the name "Leishmania-Donovani." Rogers succeeded in cultivating them outside the body, and found that they underwent changes which led to the appearance of herpetomonas-like forms. In a recent communication (*Lancet*, 30th Jan. 1909) W. S. Patton states that they belong to the genus *Herpetomonas*, the type of which his *H. muscæ domesticæ*. His description of the life cycle of the parasite of kala-azar in the bed-bug closely resembles that of the fly herpetomonas. The cycle of H. muscæ domesticæ consists of a pre-flagellar stage, in which the round or oval organisms multiply by fission or segmentation. Each organism so formed develops a flagella, becomes elongated, and divides longitudinally. After this the organisms become rounded and lose flagellæ (post-flagellar stage), and are shed in the excreta of the fly. They are again sucked up by flies while feeding. The whole cycle occurs in the fly. Patton supposes that the parasite of kala-azar passes through its pre-flagellar stage in man, and completes its cycle in the bed-bug. He proposes to call the group of diseases produced by these organisms the Herpetomoniases — *Herpetomonas Donovani* causing kala-azar; *H. infantum* the parasite

of infantile splenomegaly (Nicolle); *H. tropica*, the parasite of oriental boil (Wright).

III. Sporozoa.—This group of organisms have no organs of locomotion or organs for the capture of food. Reproduction is by sporulation. They are parasites—cytozoic, or intracellular (including hæmatozoic), cœlozoic, or in the body cavities, or histozoic, in the tissues, generally between the cells. The chief pathogenic sporozoa are: 1. Coccidiidea; 2. Hæmosporidia; 3. Sarcosporidea; 4. Haplosporidea; 5. Cytoryctes.

The Hæmosporidia include the plasmodium malariæ; the hæmogregarina, common in cold-blooded vertebrates, and lately described in a warm-blooded vertebrate (H. Balfouri of the jerboa); the halteridium (mentioned above as probably a trypanosome); and the piroplasma.

Piroplasma is a parasite of mammals, the invertebrate host being the tick. It causes a group of diseases known as piroplasmoses, of which hæmoglobinuria is the leading symptom. The best known species is one which infests cattle. One form (*P. hominis*) is alleged to be the cause of the "tick fever" of the Rocky Mountains.

One member of the *Haplosporidia*—Rhinosporidia Kinealyi—has been found in vascular pedunculated tumours of the nasal septum in Indians.

Cytoryctes.—This sub-group comprises a series of intracellular parasites found in various infectious diseases and considered by some to be the causal agents. Cytoryctes variolæ, cytoryctes vacciniæ, cytoryctes aphtharum (foot-and-mouth disease), cytoryctes scarlatinæ, and cytoryctes luis (Siegel's parasite of syphilis) have been described.

Cytoryctes variolæ et vaccinia.—Councilman and Calkins's recent work on the cytoryctes leads them to suppose that the organisms of variola and vaccinia are identical. In variola the cytoryctes passes through two phases—an asexual, during which it inhabits the cytoplasm of the stratified epithelium of the skin, and a sexual, which takes place in the nuclei of the cells. In vaccinia only the former, asexual, cycle occurs. Councilman and Calkins postulate a further, hypothetical, stage during which minute spores travel throughout the body from the seat of primary infection. Calkins (cited in Osler's *System of Medicine*, vol. ii. p. 259) gives the life history as follows:—"The first development of the germ in the host is unknown. It probably takes place in the seat of primary infection, forming an organism which reproduces by germs." These are probably carried to the skin in the blood, and from this point the observations are fairly complete. "The gemmules become cytoplasmic amœboid organisms which give rise to similar gemmules. This process, which Councilman has designated the 'vaccine cycle,' must continue for some time, for in variola the gemmules are distributed to all parts of the skin. Ultimately the germs derived in this way give rise to forms which penetrate the nuclear membrane and develop into gametocytes of two types, one forming the supposed male gametes, the other the female." From the conjugation of these gametes a zygote forms from which in turn spores develop. The spores infect other nuclei, perhaps spread widely throughout the body, and may transmit the disease to other parts.

Protylin.—A preparation of the nuclein group, being a compound of phosphoric anhydride (P_2O_5) with protein; it is a yellowish-white powder, easily soluble in alkalies, and it is said to contain 80 per cent. albumin and 2 per cent. of phosphorus; for children the dose is from one to three teaspoonfuls with the food, and more for adults; it has been combined with bromine and iron (*bromprotylin*, *ferriprotylin*). *See* Fortescue-Brickdale, *Newer Remedies*, p. 57, 1910.

Pseudohæmoglobin.—A loose combination of hæmoglobin with oxygen, regarded by some as an intermediate body between hæmoglobin and oxyhæmoglobin.

Pseudostrophantin.—A variety of strophantin, chemically identical with ouabain; it is also called strophantin gratus, and it is a crystallised form.

Pseudotropine.—A name given (1) to a decomposition product of hyoscine, and (2) to an isomer of tropine; the former is more often called *oscine*.

Psomophagy.—The practice of bolting the food, swallowing it quickly without mastication (Gr. ψωμός, a morsel; φαγειν, to eat); the dog is a typically psomophagic animal, whilst the horse is poltophagic. *See* Hubert Higgins, *Lancet*, i. for 1905, p. 1334.

Psoriasis.—The eruption of psoriasis often persists on the elbows and knees after it has been cured elsewhere. Such chronic spots are often very rebellious to treatment. In these cases a good application is an ointment introduced by Dreuw and consisting of—ac. salicyl., 10 parts; chrysarobin and ol. rusci (birch-tar), āā 20 parts; sapon. virid. and vaseline, āā 25 parts. This is to be well rubbed in morning and evening for four to six days, and then vaseline applied for two to three days. The treatment is repeated as often as necessary till the spots have all disappeared. The salicylic acid and green soap are very effectual in removing the scales and allowing the chrysarobin and tar to act on the lesion. Like all chrysa-

robin ointments, it has the disadvantage of staining the clothes.

Another drug which has been much employed in those inveterate spots of psoriasis is eugallol, which is pyrogallol-mono-acetate. Like ordinary pyrogallic acid, it is a reducing agent. It is most easily applied dissolved in an equal bulk of acetone, forming, when painted on the skin with a brush, a firm varnish. This same application is also useful in chronic patches of scaly eczema.

X-rays will also cause the disappearance of psoriasis spots, leaving a marked pigmentation; but as the "cure" in such cases is not any more prolonged than after other less dangerous applications, it is not a method to be generally recommended.

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Psycho-therapy and Psycho-Analysis.

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Not only have the past few years seen a great development of such systems, or so-called systems of treatment as faith-healing, mind-cure, and Christian science outside the medical profession, and of the Emmanuel movement partly outside and partly within the profession, but there has also been a quickening of interest among medical men themselves in the possibilities of psycho-analysis and psycho-therapeutics. No men have done more to enlighten and stimulate the investigation of these subjects than Pierre Janet, of Paris; and Sigmund Freud, of Vienna; and already, to-day, there is a large and increasing body of what may be called Freudian literature dealing with different aspects of the matter. To some extent the subject has been prejudged and condemned in many minds by the undoubted fact that the Freudian theories recognise a sexual element in the etiology of the psycho-neuroses; but this is hardly fair, and certainly no theories can be either disproved or substantiated by simple disregard or obliviscence.

The doctrine of mental analysis had its origin in an observation made in 1881 by Dr. J. Breuer, also of Vienna, and an older colleague of Freud's. The patient was a woman, suffering from a serious form of hysteria, viz. paralysis and contracture of the arm and a peculiar affection of the speech; she named certain occurrences in her past history which she believed to have been instrumental in producing her present disease, and she believed that she had made a full recital of the past; but by means of a special mode of inquiry it was discovered that experiences, some of them painful, in her former life, although apparently forgotten by her, had been active in producing, and were still active in maintaining, the hysterical affection from which she was suffering. As these buried, unconscious, or forgotten things were brought to light, talked about, and lived over again, so to say, the distressing symptoms dropped away and disappeared, showing that, although unconscious, they had been far from inactive in the patient's psychical life. Gradually Breuer and Freud came to recognise that in many nervous states there was a hidden, forgotten, repressed life which was active in producing the symptoms and signs that the physician saw and the patient suffered. Experiences in early, even in very early life, were in a sense ineradicable; but they might be forgotten as one "forgets" unpleasant events in, say, a holiday tour, and remembers delightful emotions and experiences occurring during the same; yet they constitute an unconscious, a forgotten life running on synchronously with our conscious and willed existence, and capable of seriously influencing it without their influence being at all obvious, at any rate without analysis. As has been said, "the flow of phenomenal consciousness is conditioned by psychological causes of whose existence the individual is altogether unaware." The Freudian or psycho-analytic method of treatment is "an attempt to enable the patient," not necessarily by means of hypnotism or the hypnoidal state, "to penetrate with tireless zeal, increasing skill, and fearless honesty, upon the details of his own emotions, life, and thought, in the belief that nothing becomes less sacred, or fails to become less painful, through being clearly seen."

Among these forgotten experiences of the past life, although not by any means coextensive with them, are sexual phenomena, and to these some reference must be made, for they constitute the basis of Freud's theory of infantile sexuality. It is, however, matter of regret that no other word than "sexual" could be discovered to denominate them; for they are not necessarily "sensual" although "sexual," and indeed, although they comprise many common emotions as of affection or the opposite, they also include "a great variety of apparently indifferent sentiments, longings, and physio-

logical habits, having no obvious connection with the reproductive functions." It is very necessary to state this, otherwise the investigator of the Freudian hypotheses may turn away in disgust or disbelief, knowing of course that the whole psychical life of an individual cannot be determined by his truly sexual experiences. But this dislike of the theories of Freud is unjustifiable, for a psychical trauma (*e.g.* a fright), not in any way of a sexual nature, and not even necessarily occurring in childhood, may, according to Frank of Zurich, be the possible cause of a psycho-neurosis. At the same time, it would be wrong to minimise the importance assigned by Freud himself to what he terms the sexual cause of a psycho-neurosis. When one thinks of the haphazard fashion in which the sexual life of children, both boys and girls, is allowed to develop, of the conflict between the desire for the gratification of desires, and the discipline of the outward life, of the intrusion of entirely erroneous or grossly perverted notions derived from other children or from adults, it is not difficult to imagine such a *bouleversement* of the whole inner sexual life as may well leave its mark upon the whole future health of the individual, and especially upon that of the sensitive nervous system and its mental phenomena. Freud has shown that "the sexual life of children, though widely differing from that of adults, is far richer and more significant than is commonly supposed"; further, "the early development of the sexual instinct is a highly delicate one, and one peculiarly prone to errors both of direction and intensity"; can anyone, knowing the way in which children's questions on reproductive subjects are answered, realising the manner in which, therefore, their notions of sexual matters are built up, doubt that this development of the sexual instinct which is so "highly delicate" is often arrested, deflected, deranged, or exaggerated? Is not the common prurient attitude of the young towards sexual subjects the evident sign of the absence of healthy and sufficient instruction in these matters? Is there not need of an intelligently devised and wisely applied psycho-prophylaxis in childhood, and might not the mental health both of childhood and of adult life be preserved by psychical means? These, at any rate, are questions which are intimately associated with and possibly capable of being answered by Freud's investigations and theories.

Closely associated with Freud's views upon psycho-analysis and psycho-therapeutics is his theory of dreams. He divides dreams into two parts, the dream itself or the manifest content of it (*i.e.* the dream as related by the dreamer), and the latent content or "dream-thoughts"; both are mental processes, and the explanation of dreams, according to Freud, rests upon the appreciation of the difference between them. Ernest Jones and Schwab explain the theory as follows:—"The latent content, or dream-thoughts, is a logical and integral part of the mental life of the individual, and contains none of the incongruous absurdities and other peculiar features that characterise the manifest content of most dreams. This manifest content is to be regarded as an allegorical expression of the underlying dream-thoughts or latent content. The distortion of the dream-thoughts into the dream proper takes place by certain well-determined psychological laws and for certain precise reasons. The core of Freud's theory, and the most original part of his contribution to the subject, resides in his tracing back this distortion to a 'censor' which interposes an obstruction to the becoming-conscious of unconscious psychical processes. . . . A dream is thus not a confused and haphazard congeries of mental phenomena, but a distorted and disguised expression of highly significant psychical processes that have a very evident meaning, although, in order to appreciate this meaning, it is first necessary to translate the manifest content of the dream into its latent content in the same way that a hieroglyphic script yields its meaning only after it has been interpreted." The theory goes on to state that the manifest content or dream proper has been derived from the underlying latent content or dream-thoughts (*Traumdeutung*) by certain mechanisms; one of these is *condensation*, by which many dream-thoughts are compressed into one element of the manifest content, and so "the material obtained by analysis of a dream is far richer and more extensive than the manifest content of that dream"; another distorting mechanism is *displacement*, the psychical intensity of an element in the latent content differing from that of the same element in the manifest content; a third mechanism is *dramatisation*, or the tendency of the manifest content to be of a visual nature; and a fourth is that of *secondary elaboration*, whereby the activity not of the latent content, but of the more conscious mental processes interferes, giving some degree of order, sequence, and consistency to the dream. Freud's dream-theory is of considerable importance, for the principles underlying it extend into his explanation of other mental processes; indeed, Freud himself states that "dream interpretation is the golden way to the knowledge of the unconscious in mental life"; and it is upon this "unconscious" element and its resuscitation that so much of the knowledge of psycho-analysis and of the value of psycho-therapeutics depend.

The application of these theories and the explanation of dreams to nervous disorders has caused Freud and his followers to alter considerably their classification and pathogenesis. A specific cause for each disease is

to be sought for and distinguished from predisposing and exciting factors; thus the specific cause of general paralysis is maintained to be syphilis and the subordinate factors to be heredity, alcoholism, mental strain, etc.; in the same way Freud thinks the specific cause of the neuroses is a disturbance of the sexual function. This generalisation leads on to a new classification of the neuroses, and there are two groups—the "actual neuroses" and the "psycho-neuroses"; in the former the individual symptoms cannot be further reduced and explained by any form of psychological analysis, whilst in the latter they can be so reduced and shown to be the last links in a long chain of mental processes. There are two "actual neuroses," viz. neurasthenia and the "anxiety-neurosis." Now there is neurasthenia and neurasthenia, and many of the so-called cases are really toxic (*e.g.* post-influenzal) or are instances of dementia præcox, or of anxiety-neurosis, or of hysteria; still, there remain some cases which are to be regarded as true neurasthenia, *i.e.* a condition with pure fatigue, sense of pressure on the head, irritable spine, flatulent dyspepsia, and constipation. True neurasthenia, according to Freud, is to be ascribed definitely to masturbation; "the specific cause is the inordinate repetition of some form of auto-erotic activity, of an unsatisfactory nature, which occurs in spite of a painful mental conflict," and so the psychical energy of the individual is unduly taxed. The "anxiety-neurosis" is characterised in an acute attack by intense dread of something, by a feeling of congestion in the head, by rapid heart's action, by nausea, free flow of urine, asthmatic seizures, and nightmare; in a masked form it appears as vertigo, palpitation, an imperative desire to micturate or defæcate, sweating, etc., and a less marked degree of anxiety. Anything of a terrifying nature may be the apparent cause of it (*e.g.* a thunderstorm, the dark, snakes, etc.), but, according to Freud, it is the result of "sexual excitation occurring under circumstances in which the mental constituent (desire) is not allowed to reach consciousness" (*e.g.* preventive measures in connection with sexual commerce, etc.), and thus "morbid dread is sexual desire that the person does not wish to feel."

The second group contains the psycho-neuroses, including the classical hysteria ("conversion-hysteria" of Freud), "anxiety-hysteria" (the commonest type), and the "compulsion-neurosis" (seen most commonly in the obsessions). In all these we are to suppose that the symptoms result from the "activity of certain unconscious mental processes, that is, of processes which the patient is unable spontaneously to recall to memory." It is this activity that produces the sense of discontinuity in the patient's mental life: obsessive thoughts, causeless fears, unexpected outbursts of anger arise and seem to have no source of origin. The explanation, however, is to be sought in the theory that one part only of such a life is conscious, and that the other part, equally important, is unconscious. The unconscious mental processes are the cause of the apparent discontinuity of the life; they are the unseen factors in the production of the unexpected acts, just as the coral insect and volcanic action bring to the surface some of the islands of the Pacific. Freud explains that they have been made unconscious by a defensive act on the part of the patient himself or herself. "They concern memories which the patient wishes to forget, and cannot bear to recall, from which the patient has striven to get away; they are disagreeable to him for reasons such as shame, disgust, conscience, and so on." They always represent a "striving, a tendency, or most simply expressed, a wish," and their forcible keeping under the surface is termed "repression." This view, of course, is opposed to the current notion that sudden grief, mental shocks, and the like are the causal agents in the production of hysterical symptoms; in its place we have this theory of mental conflict. "The symptoms arise as the result of a conflict between two forces, one of which is a wish that is striving to realise itself consciously, the other of which is an effort to keep back all knowledge of this wish, to 'repress' it. Neither of these forces is entirely successful, and the result is a compromise, which, clinically, is called a symptom. The repressed wish comes to fulfilment in the patient's unconscious fantasy, but is not admitted to external expression until it has been distorted by the repressing action of the opposite force, which is termed the endopsychic censor. We can therefore formulate the general statement that every psycho-neurotic symptom is the disguised manifestation of a repressed wish-fulfilment. Neither force altogether succeeds, or altogether fails. The wish is not expressed in its native form, but undergoes distortion; and the censor fails to achieve its object of preventing the wish from reaching consciousness, but succeeds in preventing the significance of this form being recognised." With regard to the nature of the underlying forces, the wishes which the patient tries to repress, Freud is of opinion that they are in every case of a sexual nature (using "sexual" in the wide sense and not as equivalent to sensual); thus the somewhat startling view-point is reached that all the symptoms in these true psycho-neuroses represent a perverse form of unconscious sexual gratification. This is a conclusion which cannot be expected to be accepted without controversy, especially when it is accompanied by the further statement that any one

symptom arises not from one, but from many, of these submerged, repressed wishes, and that the most essential of them belong to the first half of childhood. This leads, if accepted, to the general statement that nothing happening to a child after the age of six can cause a psycho-neurosis.

Having reached this point, most readers will demand a pause, and will ask whether these conclusions have been rigorously examined. That they have been denied and scouted is certain, but it can hardly be said that they have been either scientifically examined or logically refuted. An Editorial in the *Lancet* (i. for 1910, p. 1425) puts some doubts forward. "Of what nature," it asks, "are these unpleasant, unbearable incidents, feelings, or ideas that would appear to be so prolific in the establishment of psychical ill-health? In all cases that Professor Freud has analysed it has been the sexual life that has furnished the material. Be it hysteria, obsession, phobia, or anxiety-neurosis, it matters not; the painful, repressed idea is always and only sexual, according to the Viennese professor. Again, he naively remarks, that it is not possible theoretically to exclude its arising in other spheres; he, however, has not found it so. The reader who has hitherto been unfamiliar with Professor Freud's work may be reasonably excused for expressing surprise that every case of hysteria, even in earliest childhood, has for its origin some sexual experience; that acquired anxiety-neurosis (a form of neurasthenia, but to be distinguished from it) is the result of coitus interruptus, or of insufficiently gratified libido, or of other sexual factors which need not be specified here; and that very many, if not all, phobias and obsessions have the same etiology. Professor Freud is candid enough to admit that he cannot deny the occurrence of other causal elements in the development of the defence neurosis, but these pale into insignificance compared with the sexual. If he thinks so, the difficulty of maintaining an open and unbiassed mind in the course of a long and intimate psycho-analysis must be enormous. The temptation to fasten on the most trifling sexual incident must be overwhelming. Wherever one looks for these incidents of the sexual life, they can be found near at hand. In fact, Professor Freud's hypothesis explains too much. At the same time there is little attempt to deal seriously with those instances of hysteria the etiology of which is palpably not sexual, cases in which cures result without any application of the psycho-analytic method." For the non-sexual cases and for patients who are incapable of psycho-analysis, the Freudian theory explains too little.

These criticisms on Freud's work are so far just, and his genius has been fairly described as that rather of the poet than of the scientist; but his conclusions are none the less deserving of careful analysis, and it is true that many of the greatest advances in medicine have had more than a soupçon of imagination in them. At any rate it will not be unprofitable to look for a moment or two at the application of Freud's beliefs to treatment as expressed in psycho-analysis. Psycho-therapy, it must be remembered, is not treatment of the mind, but treatment by psychical means, and psycho-analysis is an important part of it in this sense, and has for its watchword, "You can do better when you know."

Psycho-analysis is the method employed to bring into the bright light of the patient's attention the disagreeable experiences of life which have been, so to say, pushed into a dark corner but not prevented from influencing the conscious life of the individual. These experiences have been repressed but not destroyed, they have been crowded out of clear consciousness into a sort of quasi-independent existence, and they constitute "the submerged complexes" of the mental life. Psycho-analysis attempts to discover and uncover the submerged complex, to cure the disease by revealing it. The first step is a detailed conversation with the patient, during which the physician leads him or her to talk not only about symptoms, but also about the main events of the whole life. From this an idea is gained of the personality of the individual, and at a later interview the information gained is expanded in directions which seem likely to prove fruitful. One may, of course, make false starts and have to retrace one's steps, and, equally, of course, time is required, for what it has taken a lifetime to build up cannot be analysed in an hour or two. The next step is to institute a more penetrating search for the submerged complexes, and this may be done by "free association," "word association," or analysis of dreams the patient may have had. In the "free association" method, the attempt is made to put the patient in a comfortable position, to prevent such distracting influences as sounds (banging of doors, footsteps, chiming of clocks) or bright lights, whilst all other persons, save the physician, are excluded from the room; the result is "a general state of quiescence and passivity," which resembles in some particulars the hypnoidal condition (*q.v.*, p. 189), and which can usually be made to pass into it by causing some monotonous sensory stimulus (*e.g.* the buzzing of a faradic coil) to act upon the patient's brain. Now the patient's thoughts are directed to some occurrence in his or her past history, and he or she is told not to try to remember but simply to hold the occurrence in mental view and announce the thoughts which follow, however inconsequential, unimportant, or apparently absurd they may be.

In some of these awakened thoughts the psychologist may find the key to the riddle of the patient's anomalous mental state. Another plan (specially developed by Jung) is to read out words from a list, and note the thought or thoughts which follow the hearing of a word and the time (by stop-watch) it takes to come; and yet another method is to investigate the dream life of the patient, for it is believed that in dreams the censor of consciousness is less watchful, so to say, and may allow the submerged complex to come to the surface. During the whole process the physician must remain non-critical, he must express no surprise at anything he hears, he must neither be sympathetic nor fault-finding, but he must never pass out of the attitude of alert watchfulness for any statement which may serve to throw light upon the case.

Now, what is the effect upon the patient of these inquiries and of the answers made to them? They enable him or her to translate symptoms into more direct language, to drag ghosts, so to say, into the light of day, and to know for certain that they are only ghosts, to appreciate how they originated. Thus, to quote Ernest Jones, "We give the patient a deeper insight into the workings of his mind, so that he is enabled to correct abnormal deviations, to overcome internal inhibitions and impediments, and to acquire a more objective standpoint towards the repressed mental complexes, the automatic functioning of which has produced the morbid manifestations. He is in this way able to free his personality from the constraining force of these complexes, and, by taking up an independent attitude towards them, to gain a degree of self-control over his aberrant thoughts and wishes that was previously impossible." It is clear, therefore, that true psycho-analysis is not suggestion-treatment, for by suggestion the physician adds something to the patient's mental possession. "The psycho-analytic method does not add; it takes away something, namely inhibition." The patient is *educated* in the fullest sense of the word, for not only does he develop will-power and self-control, but he also gains a knowledge and understanding of the workings of his own mind, and is thus able to prevent new morbid developments in the future. "He grows both in capacity to know and in ability to do."

Time must be allowed to elapse before one can pronounce upon the value of the psycho-analytic method in contrast with hypnosis, suggestion, and simpler plans. Obviously, it makes a large demand upon both the time and patience of both patient and physician; but if the hopes it holds out both of prevention and cure are in any measure realised, neither time nor patience will be grudged or ill spent.

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Puerperium, Management of.—Allusion has already been made to the criticism to which the practice of binding the abdomen in the puerperium has been recently subjected, as well as to the almost universal abandonment of routine vaginal douching of the puerperal patient (*see* Labour, Management of); but of late years a very important modification of the management of the lying-in period has been suggested and practised to some extent, viz. permitting the patient to rise much earlier in the puerperium than had previously been customary.

In 1899 Küstner (*Zentralb. f. Gynäk.*, xxiii. p. 705, 1899) raised the question of prolonged rest for women in the puerperium at the meeting of the German Society for Gynecology in Berlin. He thought that for strong, healthy puerperal patients who had come through a normal labour, and had neither been infected nor had suffered lacerations, a rest in bed for several weeks was not only needless but actually harmful; they ought to rise on the third, fourth, or even on the second day after delivery. If, however, there had been lacerations (vestibular, perineal, vaginal, or cervical), if the patient had entered the clinique showing signs of infection, if she had a profuse gonorrhœal discharge, if operative means had been employed in the delivery, or if the labour, although terminated by nature, had been tedious, the longer rest in bed should be permitted. Küstner reported that patients thus treated did not suffer in any way: they did not develop prolapse or retroversion of the uterus, the involution of that organ was not delayed but hastened, the functions of the digestive tract were greatly improved (good appetite, natural action of the bowels), and there was no difficulty with micturition, which occurred spontaneously and more frequently. In the discussion which followed the hearing of Küstner's experiences fears were expressed by Olshausen and others lest the involution of the supporting ligaments of the uterus might be interfered with, lest the abdominal walls might remain relaxed, lest thrombosis might be more frequent, and lest

the pelvic musculature might suffer. At first Küstner's new method of treatment, breaking, as it did, through a practice so firmly established as rest in bed during the puerperium, met with little support; indeed, in many parts of the world it was not even discussed. Of late years, however, it has found advocates in various places, and has consequently excited animated controversy. Reference may be made to the following articles which have recently appeared:—Edmonds (*Mass. Med. Journ.*, xxvi. p. 351, 1906); Pierra (*Rev. prat. de gynéc., d'obstét. et de pédiat.*, ii. p. 340, 1907); Wallich (*Rev. prat. d'obstét. et de pædiat.*, xx. p. 129, 1907); Bouchacourt (*Presse méd.*, xv. pp. 307, 410, 1907); Heil (*Arch. f. Gynaek.*, lxxxi. p. 95, 1907); E. Martin (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. p. 248, 1908); Von Winckel (*Deutsche med. Wochensch.*, xxxiv. p. 49, 1908); Brisset (*Union méd. du Canada*, xxxvii. p. 200, 1908); Rosenfeld (*Gynaek. Rundschau*, ii. p. 401, 1908); von Alvensleben (*Zentralb. f. Gynäk.*, xxxii. p. 1184, 1908); Hinchey (*Interstate Med. Journ.* (St. Louis), xvi. p. 26, 1909); Gellhorn (*ibid.*, p. 33, 1909); K. Mayer (*Münch. med. Wochensch.*, lvi. p. 273, 1909); Simon (*ibid.*, p. 47, 1909); Fromme (*Zentralb. f. Gynäk.*, xxxiii. p. 15, 1909); Hofmeier (*ibid.*, p. 21, 1909); E. Opitz (*Med. Klin.*, v. pp. 5, 48, 1909); Fehling (*Strassb. med. Ztg.*, vi. p. 14, 1909); and Haultain (*Brit. Med. Journ.*, ii. for 1909, p. 307).

So far nearly all the records have been favourable, and seem to show that after normal labours there is no need for prolonged rest in the horizontal posture. Karl Mayer allowed his patients to rise when they liked, with the result that 4 rose on the third day, 40 on the fourth, and 100 on the fifth day; the morbidity was lower by 10 per cent. than among those who followed the old-established rule. Von Alvensleben found that out of one hundred cases 3 rose on the first day, 61 on the second, 19 on the third, and 18 on the fourth; the morbidity was less amongst them than that of the general clinique (10 per cent. in the one case, 17 per cent. in the other). Dealing with 235 parturients, Opitz found that 56 got up on the first day, 65 on the second, 27 on the third, 52 from the fourth to the sixth day, 21 on the seventh and eighth days, and 14 later; his results showed that retroflexion of the uterus was not made more likely by the early rising, that involution was satisfactory, and that convalescence was not interrupted. Opitz, however, admitted that it was difficult to prevent the newly-delivered woman leaving the hospital too soon, and referred to the fact that in private practice there might be danger owing to the puerperal patient being under less constant observation. Krönig (*Deutsche med. Wochensch.*, xxxiii. p. 1528, 1907) does not seem to have been influenced by this fear, for 70 per cent. of his private patients (250 in number) got up during the first day; he also still further shortened the resting period for patients delivered under the influence of scopolamine and morphine injections, allowing a certain number to get up from eight to ten hours *post partum*. His published results have been very good, and he did not meet with any cases of thrombosis or embolism; he was of opinion that his patients were better able to nurse their babies, that uterine involution went on quite as well, that the lochia came away more readily, that there was less risk of accumulation of fæces in the rectum, that the appetite was better, and that, speaking generally, the bodily system was better able to resist infection. Rosenfeld (*loc. cit.*) also was able to report good results, but he restricted his patients to rising for one hour on the third or fourth day; the time was gradually increased till they left the hospital on the eighth or tenth day. Somewhat similar was Simon's plan (*loc. cit.*); he kept his patients in bed for three days, allowed them to get up to pass water, if there was any difficulty with micturition; they got up for an hour on the fourth day, and for two hours on the fifth, if there was no fever; he insisted on the wearing of a binder, and instituted gymnastic exercises to strengthen the abdominal muscles (bending and rotating the trunk, etc.); and he believed that his patients made better recoveries. In America Hinchey (*loc. cit.*) wrote in favour of early rising in the puerperium, whilst Gellhorn was of an opposite opinion (*loc. cit.*). The latter cited the observations of Müllerheim on more than a thousand women in Berlin, many of whom, although they were all discharged from the hospital as being in perfect condition, required weeks of rest and treatment for disturbances coming on after their return home. He also referred to the frequency of embolism and prolapsus uteri among Javanese women (as noted by Wagener and himself), and pointed out that, by an old law, these women were compelled to get up immediately after confinement and walk about, but not to attend to their domestic duties. A still more serious criticism of the early-rising régime is contained in the occurrence of a death from thrombosis and embolism in the case of a patient who was allowed to get up for one hour on the second day of the puerperium (Fromme, *loc. cit.*). It has been maintained by some that early getting up, instead of predisposing to thrombosis and embolism, will actually tend to prevent these accidents, but Fromme's observation must be regarded as a serious blow to such an argument. Hinchey (*loc. cit.*) is of opinion that "inasmuch as no cases of death from hæmorrhage or embolism have occurred on account of early rising, and as there are even no good theoretical reasons for fearing such an accident, the subject may be dismissed until we have cause for

alarm." The cause for alarm has been provided by Fromme's recorded case.

It may be found that a careful combination of systematic exercises in the horizontal posture during the early days of the puerperium, with rising not at the third, but about the seventh or eighth day, will give the best method of managing the puerperium; and Ballantyne has, during the autumn quarter of the past two years (1909-10), used such a combination-treatment at the Edinburgh Royal Maternity Hospital in more than 200 cases.

Pulmotor.—A means of resuscitating by artificial respiration persons apparently dead from drowning, carbonic acid, gas poisoning (in mines), chloroform poisoning, etc.; it is known as the "Draeger" Automatic Pulmotor.

Purdy's Method.—The use of the centrifuge in determining the amount of chlorides, phosphates, sulphates, and albumin in urine. *See* Webster, *Diagnostic Methods*, pp. 186, 193, 199, and 259, 1909.

Purdy's Solution.—A modification of Fehling's solution for the quantitative estimation of glucose in urine. The formula is: chemically pure copper sulphate, 4,752 grams; potassium hydrate, 23,500 grams; strong C.P. ammonia (sp. gr. 0·88), 350,000 c.c.; glycerine, 38,000 c.c.; and distilled water q.s. ad 1,000,000 c.c. *See* Webster, *Diagnostic Methods*, p. 283, 1909.

Purgatin.—A purgative drug, the diacetate of anthrapurpurin (trioxyanthraquinone), forming a tasteless powder insoluble in water but soluble in alkaline solution; its ingestion is followed by the appearance of a reddish-brown pigment in the urine; the dose is from 8 to 15 grains; it is also known as *purgatol*. *See* Fortescue-Brickdale, *Newer Remedies*, p. 74, 1910.

Purgatol.—*See* PURGATIN.

Purgelin.—A trade name for phenolphthalein (*q.v.*).

Purgella.—A trade name for phenolphthalein (*q.v.*).

Purgen.—A trade name for phenolphthalein (*q.v.*).

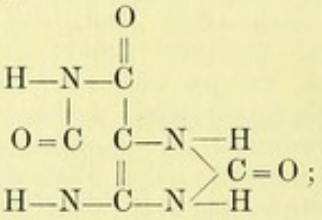
Purgo.—A trade name for phenolphthalein (*q.v.*).

Purgolade.—A trade name for phenolphthalein (*q.v.*).

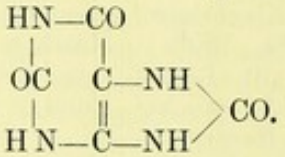
Purgylum.—A trade name for phenolphthalein (*q.v.*).

Purinometer.—An apparatus for estimating the amount of purins in urine.

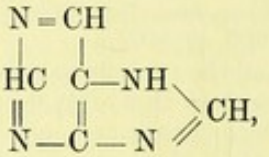
Purins (*see also* ARTERIO-SCLEROSIS; DIET (*Purin-Free*)).—The purin bodies are diureides, substances consisting of two unmodified or modified urea molecules, linked together by an acid nucleus, and in the case of the purin bodies in particular the linking molecule is an oxi-acid with three carbons in series. They are all derived from purin (C_5H_4N), or have it as their nucleus (Adami, *Pathology*, i. pp. 375 ff., 1910). The most important of them is uric acid, whose constitution (as above described) may be thus represented:—



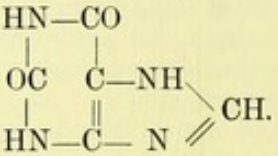
or more briefly—



Uric acid is really trioxypurin; and other purin bodies are purin itself, which may be represented thus:—



and dioxypurin or xanthin:—



Then there are purins which act as diuretics, and which are derived from xanthin by the introduction of methyl (CH_3) groups. There is, for instance, dimethylxanthin, which is theobromine or theophylline (theocin) according to the relative position of the methyl groups in the molecule. There is also trimethylxanthin or caffeine. These purins along with certain double salts of theobromine (*e.g.* agurin, diuretin, etc.) have been used as diuretics. *See* THEOBROMIN, THEOPHYLLIN, THEOLACTIN, etc. The purins are supposed to play a large part in the production of gout, and it is interesting that from them so many valuable diuretic drugs should be obtained.

Pycnometer.—An instrument for determining the specific gravity of liquids such as urine and blood (Gr. πυκνός, thick); it is weighed

first empty, then filled with distilled water, and then with the liquid (blood, urine, etc.) to be determined; the weight of the empty pycnometer is subtracted from that of it filled with the liquid (*e.g.* blood), and then this figure is divided by the difference in weight between the pycnometer filled with water and the same empty; the result is the specific gravity of the liquid, water being regarded as unity. *See* Webster, *Diagnostic Methods*, pp. 386-7, 1909.

Pyelitis, Acute, in Infants.—Acute pyelitis is not very rare in infants and young children. Its symptoms are misleading to those unacquainted with the disease. If undiagnosed it is an alarming illness, but it responds promptly to proper treatment. Little girls are much more often affected than boys, the reason being that the disease is due to an ascending infection with *b. coli*, to which the urinary tract in the female is obviously more liable than that of the male. The constitutional symptoms overshadow the local ones. There is sudden pyrexia, which persists until the pyelitis subsides. The temperature curve is remittent, and somewhat resembles that of typhoid. The children are much distressed, sometimes delirious, and sometimes show squinting. These head symptoms are apt to suggest the presence of a meningitis. Rigors are not uncommon; as they are very rare in infants except in this disease and malaria, their presence is highly suggestive. Dr. Thomson, to whom we owe the best treatment of pyelitis, says: "The four cases [of pyelitis] here referred to are the only instances in which I remember to have seen young children who had rigors; and I have not been able to find an account of any case in which this symptom occurred in a child under two years, who had not malaria, without there being pus in the urine." Local symptoms are so slight as readily to escape notice. There may be frequent and painful micturition, excoriation of the vulva, or fissure of the anus. Tenderness in the loin may be made out. The urine is always acid, generally extremely so, contains pus, and swarms with *b. coli*. The treatment is to render the urine neutral or alkaline by the administration of alkaline remedies as speedily as possible, and to keep it so until all the symptoms have disappeared (Thomson). Potassium citrate must be given in large doses (48 to 60 grs. or more in the twenty-four hours). Under this treatment the temperature speedily falls, and though the drug causes nausea and depression, it should be persevered with, because if it is prematurely discontinued, the temperature may rise again and the symptoms occur. Phosphate of soda may be given as a laxative if one is required.

REFERENCE.—Thomson, *Scott. Med. and Surg. Journ.*, July 1902.

Pyocyanase.—A germicidal liquid, prepared from cultures of the pyocyaneus organism, and used as a mouth disinfectant in diphtheria, scarlet fever, etc. See *Lancet*, ii. for 1909, pp. 1376, 1678. Bronner has used it locally in ulceration of the cornea (*Brit. Med. Journ.*, i. for 1910, p. 1175).

Pyramidon.—A drug of the antipyrin group, being dimethyl-amido-antipyrin ($C_{13}H_{17}N_3O$); it is a crystalline powder soluble in water; in doses of from 3 to 8 grains it is given as an analgesic and antipyretic; it has a more powerful effect than antipyrin, but it is said not to have any dangerous action on the heart and circulation, and to have few unpleasant by-effects (rashes, vomiting, cyanosis, etc.); it has been given in an enema and even hypodermically. There are also camphorates and a salicylate of pyramidon, recommended in pulmonary tuberculosis and in acute rheumatism respectively. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 232-235, 1910.

Pyrantin.—A drug of the phenacetin group, being a succinic acid derivative of phenetidin; it is recommended for hypodermic use in the form of a soluble sodium salt; for its antipyretic effect it is given in doses of from 15 to 45 grains, and part of the loss of heat which follows its employment has been ascribed to its action as a protoplasmic poison. *See* Fortescue-Brickdale, *Newer Remedies*, p. 224, 1910.

Pyrenol.—A proprietary preparation recommended as a remedy for whooping-cough, and said to contain benzoic acid, thymol, sodium benzoate, and sodium salicylate.

Pyretogenic Stage.—The stage of fervescence (rising temperature, etc.) in the process of injection.

"Quartzlite" Lamp.—A mercury quartz lamp suitable for the illumination of large open spaces, and said to effect a chemical and bacteriological purification of the air (by the production of ozone and by the action of the ultra-violet rays); the electricity is discharged through attenuated mercury vapour. See *Lancet*, ii. for 1910, p. 953.

Quinaphenin.—A quinine substitute, being a compound of that drug with phenetidin; it is tasteless, and the dose is from $2\frac{1}{2}$ to 5 grains.

Quinaphthol.—A quinine substitute consisting of a sulphate of β-naphthol and quinine; its dose is 8 grains, and it is slightly soluble in hot water.

Quinic Acid.—A reputed uric acid solvent, which has itself a bitter taste, but has been used in the form of a compound with urotropin (quinotropin), with urea (urol), and with piperazine (sidonal); the dose of quinic acid is 8 grains.

Quinine-Hydrochloro-Carbamide.—A quinine substitute, being a compound of quinine and urea; it has the advantage of being soluble, and may therefore be used hypodermically (dose, 10 grains).

Quinine Substitutes.—*See* Quinaphthol, Quinaphenin, Quinopyrin, Saloquinine, Thalline, Thermifugine, etc.

Quinopyrin.—A quinine substitute, being a compound of antipyrin with quinine hydrochloride; it is only for hypodermic use, being too toxic to give by the mouth. *See* Fortescue-Brickdale, *Newer Remedies*, p. 210, 1910.

Quinotropin.—A reputed uric acid solvent, being a compound of quinic acid and urotropin; 90 grains a day may be given.

Quinquaud's Sign.—*See* Alcoholism.

Race-Culture.—*See* Eugenics.

Race-Suicide.—*See* Abortion; Natality and Depopulation.

Rachianæsthesia.—Spinal anæsthesia. *See* Anæsthesia and Anæsthetics (*Regional, Spinal*).

Radium.—*See* Röntgen Rays and Radium; Lupus Vulgaris, etc.

Rasmocine.—A resinoid obtained from the root of cimicifuga racemosa, recommended (in doses of 1 to 6 grains) in rheumatism, neuralgia, lumbago, dysmenorrhœa, etc., as an anti-rheumatic, antispasmodic, and tonic; it can be had in palatinoid form combined with euonymin and quinine sulphate.

Rat-bite Fever.—The name proposed by T. J. Horder for cases of irregularly periodic fever associated with the bite of a rat. *See* Horder, *Quart. Journ. Med.*, January 1910, and Middleton, *Lancet*, i. for 1910, p. 1618.

Ray Therapeutics.—The treatment of disease by radium emanations (alpha, beta, gamma rays), X-rays, etc. *See* Röntgen Rays and Radium.

Reactivity of Blood.—A term used to express the property possessed by the blood of combining with both alkalies and acids in such a way as not to raise its ionic composition. *See* Webster, *Diagnostic Methods*, p. 383, 1909.

Receptors.—*See* Immunity (*Ehrlich's Theory*).

Recessive.—In Mendelism this term is used to describe the characters that are non-dominant in heredity; those that are latent. *See* Heredity (*Mendel's Law*).

Rectal Feeding.—The influence of rectal alimentation on metabolism has been carefully investigated by Boyd and Robertson.

Absorption of Nitrogen.—Using white of egg, or white of egg and milk, they found that extremely little nitrogen was absorbed from nutrient enemata. The absorption, however, was as good when small quantities of proteid were given as with larger amounts—*e.g.*:—

Obs. VI. N of enema, 4·9; N absorbed, 2·22; Caloric value, 56.

Obs. I. N of enema, 11·43; N absorbed, 1·54; Caloric value, 39.

In Observation VI. the absorption of N was better than in any other case, though milk (which is generally regarded as being very poorly assimilated by the bowel from enemata) was used. In all the cases observed by Boyd and Robertson the N-balance was negative.

Absorption of Fat.—There is a definite relation between the amount of fat given and the amount absorbed—*e g.*:—

Obs. I. Fat of enema, 103·37 grm.; Fat absorbed, 45·85 grm.; Caloric value, 426.

Obs. VI. Fat of enema, 14·35 grm.; Fat absorbed, 3·47 grm.; Caloric value, 32.

The amount absorbed varied from 12 per cent. to 51 per cent. of that given. Fat absorption is an important factor in sparing nitrogen; emulsions of fat are very useful ingredients in enemata, and are much better absorbed than is generally supposed.

Absorption of Sugar.—Pure dextrose was used. The amount of sugar lost by bacterial action is small, and the substance is well absorbed—*e.g.*:—

Obs. II. Dextrose in enema, 38 grm.; Dextrose absorbed, 38 grm.; Caloric value, 155.

Obs. V. Dextrose in enema, 88·14 grm.; Dextrose absorbed, 81·1 grm.; Caloric value, 332.

The proportion of sugar absorbed varied according to the different capacities in different individuals. Commercial dextrose may cause

irritation of the bowel on account of impurities (*e.g.* H_2SO_4), but pure dextrose is free from this drawback. Alimentary glycosuria is not produced by its use Boyd found that in his cases the value of the food absorbed varied between 240 and 645 calories per diem, the average (389 calories) being only a quarter of the amount necessary, on the lowest computation, to maintain equilibrium. Even under very favourable circumstances rectal feeding is subnutrition of the most pronounced character. Given a patient in poor condition, it cannot be relied on to produce any material improvement—as, for example, in preparing patients suffering from pyloric or œsophageal obstruction for operation. The gain in weight which may, and often does, occur is due to absorption of water; the best results are got from enemata of sugar and fat; the absorption of proteid is so poor as to deprive this substance of any value. For practical purposes a good enema consists of:—Yolk of two eggs; 30 grm. pure dextrose; 0·5 grm. salt; pancreatised milk to 300 c.c. The approximate value of such an enema is 300 calories; given every 6 hours, the total represents 1200 calories, of which 500 might be absorbed under favourable circumstances. The method of administration is important. Nutrient enemata should never be given with a syringe, but should be slowly siphoned in with a small catheter and funnel. If the bowel is irritable, a small dose of morphia may be added. A daily cleansing saline injection is absolutely necessary. If an enema be given slowly, from 8 to 10 ozs. can be retained, and the patient absorbs sufficient water to quench thirst. Edsall arrives at very similar conclusions as to the limitations of rectal feeding. He suggests that in future better results may be looked for by work in the following directions:—Improvements in the emulsification of fat; the use of the ultimate digestion products of proteins — amino-acids, etc.; replacement of sugars by dextrins; the introduction of substances which tend to produce reverse peristalsis, and to pass through the ileo-cæcal valve into the small intestine.

In patients fed exclusively by the rectum *secondary parotitis* may occur. The side first affected is determined to a great extent by the position assumed by the patient, the gland which is most frequently in contact with the pillow being first attacked (Soltau Fenwick). An examination of the pus obtained from the abscess in the parotid, should suppuration occur, shows a variety of micro-organisms, the most constant of which—*s. pyogenes aureus* and *m. lanceolatus*—are also present in the thick secretions of the mouth. This secondary parotitis is most likely to occur when nothing at all, not even water, is allowed by the mouth, as in the treatment of hæmorrhage from a gastric ulcer. Oral starvation seems to be the principal factor in producing this parotitis. It depends on oral sepsis, with an ascending infection of Stenson's duct, the ascending infection being favoured by the lessened flow of saliva, and the difficulty in keeping the mouth sweet, when the functions of mastication and insalivation are in abeyance. Rolleston and Oliver state that it occurs ten and a half times more frequently in cases of gastric ulcer treated by absolute oral starvation than where water is allowed by the mouth. It is not prevented by antiseptic mouth-washes. Fenwick adopts the method of giving to the patients horse-radish, pellitory, or pieces of raw meat to chew, so as to promote a flow of saliva and prevent an ascending infection. A rubber teat is equally satisfactory. He states that where, as previously, a very large number of cases fed solely on large nutrient enemata developed secondary parotitis, he has not met with it once in his last 300 cases since adopting this simple device.

REFERENCES.—Boyd and Robertson, *Scott. Med. and Surg. Journ.*, March 1906.—Rolleston and Oliver, *Brit. Med. Journ.*, 29th May 1909.—Soltau Fenwick, *ibid.*—Edsall, *Amer. Journ. Med. Sci.*, Nov. 1906.

Rectones.—Nutrient and medicated suppositories, containing, among other things, peptonised beef, peptonised milk, cocaine, hydrochloride, glycerine, renaglandin, lead and opium, morphine, and bismuth subgallate.

Red Degeneration. — A form of necrosis sometimes found in fibroid tumours of the uterus, and especially during the course of pregnancy.

"Red Water."—*See* Protozoa.

Reed's Operation. —*See* Broad Ligaments of the Uterus.

Reflexes.—Since the great diagnostic importance of Babinski's sign (extensor plantar response) has been recognised several other reflexes connected with the foot have been described, but none of them is so generally useful as Babinski's. Oppenheim and White[1] have both pointed out that in many cases Babinski's sign may be elicited by stimulation of the skin of the middle of the leg, or the inside of the thigh, as well as by stroking the sole of the foot.

Gordon's Paradox Flexor Reflex[2] is a reflex extension of the great toe produced by firm pressure on the relaxed muscles of the calf. The reflex does not occur in health; it has the same significance as an extensor plantar response—disease of the pyramidal tracts. To elicit the paradox flexor reflex the patient is seated with his feet on a low stool,

the legs being flexed and slightly rotated outwards. The examiner stands on the outer side of the leg, and presses firmly over the middle and lower third of the calf muscles.

BECHTEREW'S DORSAL FOOT REFLEX.[3]—When the outer aspect of the dorsum of the foot in the region of the cuboid bone is tapped with a percussion hammer, a more or less distinct extension of the toes, from the second to the fifth, or of some of these, occurs. In many cases of organic nervous disease, accompanied by spastic paralysis of the legs, the extensor movement is replaced by flexion. The reflex is abolished in tabes, polyneuritis, and poliomyelitis. A flexor reflex is accompanied by positive Babinski, but positive Babinski is not always associated with Bechterew's flexor reflex. Osann, after a careful study of the reflex, concludes (1) that it is a direct muscular reflex, depending on stimulation of the extensor brevis digitorum; (2) that its absence is not important; (3) that the flexor reflex is pathological, and occurs in spastic paralysis, often with Babinski's sign; (4) that although these two are often associated, they are not essentially related: the plantar reflex is purely cutaneous, and independent of muscular tone; Bechterew's reflex is purely muscular, and depends on the presence of tonus.

ACHILLES TENDON REFLEX.[4]—This is most easily tested by making the patient kneel on a padded stool or chair with the feet hanging over the edge, and tapping on the tendo-Achilles with a stethoscope or percussion hammer. It is as constantly present in health as the knee-jerk, and its abolition has the same significance as loss of the knee-jerk. Out of 3290 patients, Congen found that it was diminished or absent only under pathological conditions.

TOE-REFLEX (ROSSOLIMO).[5]—This is a pathological reflex which, according to Rossolimo, is observed only in affections of the pyramidal tract. It is elicited by gently stroking the plantar surface of the great toe, whereupon, after a longer or shorter time, flexion or abduction of the toe occurs. The great toe, the other four toes, or all five, may show movements. It is said that the toe-reflex never occurs in neurosis, and that it may be present when Babinski's sign is absent.

REFLEXES IN CHILDREN.[6]—Engstler examined the plantar reflex in 1000 children. In newly-born children an extensor response is normal; from the sixth to the eighteenth month plantar and dorsal flexion are equally common; after the second year there is usually a flexor response. Anything which delays development—*e.g.* rickets—tends to hinder the transmutation of the one type of response into the other, but the flexor type may be found in children who have never walked. Practically, the examination of the plantar reflex is valueless below the third year.

The knee-jerk is constantly present from birth, and the Achilles jerk from the fifth or sixth month. The abdominal reflexes are absent in 80 per cent. of cases during the first month, in 65 per cent. during the second month, in 45 per cent. during the third month, and in 50 per cent. during the fourth month. The cremasteric reflex is constant after the eleventh month (Bychowski).

The lip-reflex of newly-born infants is referred to in connection with SPASMOPHILIA (*q.v.*). Moro has described another reflex in newly-born infants; it consists of a contraction of the orbicularis palpebrarum, which is brought about by tapping over the glabella or root of the nose. It is a protective reflex.

REFLEXES IN INFECTIOUS DISEASES.[7]—The abdominal reflex in typhoid fever is referred to under TYPHOID FEVER. This reflex is often abolished in cerebro-spinal fever. In pneumonia the knee-jerk is often lost; its early disappearance (before the third day) is a sign of severe infection. Absence of the knee-jerk is of some use in diagnosing between lobar and broncho-pneumonia in children, for in the latter it is seldom abolished.

KERNIG'S SIGN.[8]—Normally, the extended leg can be flexed on the trunk almost to a right angle. In certain diseases, especially meningitis, when the thigh is flexed to a right angle with the trunk, the leg cannot be extended at the thigh; this is known as Kernig's sign. It is easily tested for with the patient lying on his back. The knee is raised until the thigh is vertical, and an attempt is made to raise the heel until the leg is horizontal. When the sign is well marked the hamstring muscles prevent the leg being extended beyond a right angle. Kernig's sign is so constantly present in meningitis as to be of considerable value in diagnosis, but it is not pathognomonic. It also occurs in meningeal hæmorrhage, in some infectious diseases, especially typhoid, in uræmia, and occasionally in sciatica and lumbago. Kernig's sign is due to contraction of the hamstring muscles, and this in its turn has been ascribed to hypertonicity, either from increased pressure of the cerebro-spinal fluid, or irritation of the cord or nerve roots. Another explanation is that it is simply a reflex due to pain, its object being to prevent dragging on the roots of the sacral plexus. A different explanation is propounded by Moncano. According to him, flexion of the extended limb in the trunk involves rotation of the pelvis round a transverse axis; when the spine is rigid this cannot take place, hence complete flexion is impossible. Moncano believes that Kernig's sign is due to rigidity of the lumbar region of the spine, which is often met with in cerebro-spinal meningitis.

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Rev. Neurol., 15th and 30th Nov. 1904.—3. MENDEL, *Neurolog. Zentralb.*, 1st April 1906.—OSANN, *Münch. med. Wochensch.*, 10th Dec. 1907.—4. CONGEN, *Münch. med. Wochensch.*, 12th May 1908.—5. ROSSOLIMO, *Neurolog. Zentralb.*, No. 10, 1908.—6. ENGSTLER, *Wien. klin. Wochensch.*, No. 22, 1908.—BYCHOWSKI, *Deutsche Zeitsch. f. Nervenheilk.*, xxxiv. p. 116, 1908.—THOMSON, *Rev. Neurol. and Psych.*, March 1903.—MORO, *Wien. klin. Wochensch.*, No. 21, 1906.—7. BARNES, *Birmingham Med. Journ.*, April 1906.—8. SAINTON, *Gaz. des. Hôp.*, 27th Dec. 1904.—MONCANO, *ibid.*, 10th Dec. 1907.

Refrigeration.—*See* CARBON DIOXIDE SNOW.

Regulin.—A proprietary preparation recommended by A. Schmidt for the treatment of chronic constipation, consisting of flake agar-agar, with a small proportion of an aqueous non-bitter extract of cascara sagrada; it is believed to act mechanically, absorbing water in the stomach, carrying it on, and so making the intestinal contents soft, whilst the cascara acts locally upon the intestinal mucous membrane; it consists of brownish scales, and the dose is from a teaspoonful to a tablespoonful once daily with food. *See also* PARAREGULIN, For Report see *Brit. Med. Journ.*, ii. for 1910, p. 1725; *Lancet*, i. for 1910, p. 1545.

Remineralisation. — The replacement of the lost mineral constituents of the tissues of the body (due to various conditions, including errors in dieting which produce demineralisation) by their addition to the food, in the form of calcium carbonate, magnesium oxide, magnesium chloride, iodine in organic combination. *See* H. Higgins, *Lancet*, i. for 1910, pp. 482-491.

Renaglandin. — This preparation is described as a concentrated natural solution of all the active principles of the suprarenal glands, standardised so that each drachm of the solution equals 5 grains of the fresh gland; it is specially recommended in various hæmorrhagic states.

Renestypticin. — One of the many trade names for the active principle of the suprarenal gland.

Residuum Rubrum. — The dried residue of ox blood, recommended in anæmia, scurvy, osteo-arthritis, etc.; the dose is 5 grains thrice daily, and it is made up as 5-grain "tabloids" (*Tabloid Residui Rubri*).

Resistance.—As applied to red blood corpuscles this term means specially resistance to variations in the osmotic pressure of the blood and to hæmolysis; it is the tendency which the red cells have not to shrink or swell or undergo hæmolysis.

Rhabdonema Strongyloides.—A synonym of *Strongyloides intestinalis*, one of the angiostomidæ; *Anguillula intestinalis*.

Rheumatin.—A trade name for the salicyl-quinine ester; a colourless, almost insoluble powder, recommended (in doses of 30 to 90 grains per diem) in acute rheumatism. *See* Fortescue-Brickdale, *Newer Remedies*, p. 249, 1910.

Rhinoculin Cream.—A preparation, coming from Germany, for the relief of hay fever, which consists of a pure fatty basis and a non-poisonous local anæsthetic. *See* Report in *Lancet*, ii. for 1909, p. 302.

Rhinosporidia Kinealyi.—*See* PROTOZOA (*Sporozoa*).

Rhythm, Nodal.—*See* HEART, DISEASES OF (*Nodal Rhythm*).

Ribbert's Theory. — A theory of tumour-formation, according to which cell displacement (cell-rest) is the first step, and the active growth which may follow results from diminished external resistance; in accordance with this theory it must therefore be postulated that changes in the surrounding tissues abrogating the restraining tissue tension precede the cell overgrowth. *See* Adami, *Pathology*, i. pp. 837-838, 1910.

Ricketts' Organism.—A pleomorphic polar-staining bacillus alleged to be the causal agent in Rocky Mountain Spotted Fever. *See* H. T. Ricketts, *Journ. Amer. Med. Assoc.*, lii. p. 379, 1909; *Trans. Chicago Path. Soc.*, vii. p. 254, 1907-9.

Riegel's Method.—A test for chymosin (rennin), the second ferment of the gastric juice; the neutralised gastric juice (3 to 5 c.c.) is added to fresh milk (5 to 10 c.c.), and placed in the incubator for fifteen minutes, and if distinct coagulation occur chymosin (rennin) is present.

Riegel Test Meal.—A meal given in the middle of the day and consisting of about 400 c.c. of soup, 200 grams of beefsteak, and either two slices of white bread or 150 grams of mashed potato, with one glass of water; it is removed at the end of three or four hours by the stomach tube, and is used to determine whether the gastric relations are normal or abnormal. *See* Webster, *Diagnostic Methods*, p. 50, 1909.

"Riesenwuchs."—Giant growth; this term is used not only in Germany, but also in this country for a number of conditions of overgrowth whose pathogenesis is obscure.

Rising, Early. — *See* PUERPERIUM, MANAGEMENT OF.

Robert's Method. — A method for determining the amount of sugar in urine; it depends upon the fact that the specific gravity of the urine is changed in a quantitative way when its sugar is fermented. *See* Webster, *Diagnostic Methods*, p. 289, 1909.

"Roboleine."—A proprietary preparation described as "a scientific reconstructive tonic food, containing a palatable combination of fresh red bone marrow, expressed juice of calves' rib bones, cream of malt with hypophosphites of lime, soda, and potash"; it is recommended as a substitute for cod-liver oil, the dose being from a teaspoonful to a tablespoonful after meals.

Roborat.—A proprietary food preparation stated to consist of unaltered vegetable albumen, containing also nutritive salts and lecithin; an analysis showed 73 per cent. of protein, 4·7 per cent. of fat, 10 per cent. of water, 2·9 per cent. of ash, and 9·4 per cent. (by difference) of carbohydrate (*Brit. Med. Journ.*, i. for 1910, p. 1241).

Rocky Mountain Spotted Fever.—Tick fever, a malady due, it is believed, to a parasite in the red blood corpuscles called piroplasma hominis, whose host is the wood tick.

Rocla Natural Tonic Water.—A natural water containing iron in the form of soluble protosulphate (which becomes persulphate after a time), and traces of copper and arsenic. *See* Report in *Lancet*, ii. for 1909, p. 1443.

Rodagen (*see also* GRAVES'S DISEASE).—The dried milk of thyroidectomised goats with 50 per cent. of milk sugar added; it is recommended in cases of exophthalmic goitre. See *Brit. Med. Journ.*, ii. for 1905, p. 1251; i. for 1906, p. 326.

Romanowsky Stain.—A stain for the chromatin substance of malarial organisms, obtained by adding a watery eosin solution to an aqueous methylene-blue solution till an insoluble precipitate began to form.

Römer's Experiment.—The experiment (on the action of abrin on the conjunctiva) by which Römer demonstrated the local development of antitoxins.

Roncegno Water.—A water containing arsenic and iron which has been recommended in cases of Graves's disease.

Röntgen Rays and Radium.—1. RÖNTGEN RAYS. Many of the advances which have enlarged the sphere of usefulness of the X-rays in medicine and surgery—*e.g.* the shortened exposure which is now required to obtain satisfactory skiagrams; the greater ease with which deeply seated strictures, such as the hip-joint or stones in the pelvis of the kidney, can be photographed; the more accurate localisation of foreign bodies in the eye and elsewhere—are due to improvements in technique and in the apparatus available. For information on these points a standard modern text-book, and the special journals on X-rays, must be referred to. Here only a general description of some of the advances will be given.

Dangers of X-rays.—The effect of the rays on normal skin is to produce (*a*) pigmentation, (*b*) erythema, and (*c*) blanching and loosening of the hairs. If exposures are continued an X-ray burn may occur. According to their severity, four degrees of burns are recognisable (Pusey and Caldwell). 1. Dry dermatitis without destruction accompanied by burning or tingling. It begins as a punctate redness round the follicles. If the process stops at this stage, there is some desquamation, and except for more or less residual pigmentation, recovery ensues. 2. Dermatitis with vesicles which rupture and leave a weeping surface. Healing is gradual. 3. Intense vesicular and bulbous dermatitis with superficial necrosis. The necrotic skin bleeds readily. Ulcers form, which heal slowly; recovery in from three or four weeks to as many months. The skin is left thin and softer than normal. 4. Intense congestion of the skin with necrosis of the skin and subcutaneous tissue. The sloughs separate very slowly, possibly requiring months to do so. Healing like an ordinary ulcer, except that the scar is more vascular.

Workers with X-rays who do not take precautions against unnecessary exposure are liable to develop a chronic dermatitis with atrophy of the deeper layers of the skin. The backs of the hands are chiefly affected; the skin becomes thin and cracked, telangiectases develop, the nails become loose and brittle and the nail bed may suppurate. In not a few cases malignant disease has ultimately developed in such lesions.

The action of the X rays on deeply-seated organs and tissues is referred to in connection with the treatment of LEUKÆMIA (*q.v.*). A further effect of exposure to the rays is sterility. Sexual power is unimpaired, but there is complete azoospermia. The changes in the testicle seem to require several months for their development, and the sterility which results is of considerable duration, or may perhaps be permanent.

The dangers of X-rays can be guarded against by avoiding unnecessary exposures, by the use

of lead screens, and by a due regard to dosage. There is no specific treatment for the lesions; red light, blue light, high frequency currents, and, latterly, radium, have been tried. The earlier workers, ignorant of the potency of the radiations, have suffered, but with proper care these unfortunate results ought to become things of the past.

Dosage of X-rays.—Sequeira points out that after the application of the rays to an area of skin there is a latent period before reaction occurs. An evanescent erythema, probably due to actinic rays developed in the tube, appears a few hours after exposure. The true X-ray reaction follows this, in a week or more. Kienbock's classification of the degree of the reaction is useful:—

First degree: Latent period three weeks; no visible inflammation; temporary shedding of hair; diminution of lupus nodules.

Second degree: Latent period of two weeks: swelling and redness of the skin lasting one or two weeks; shedding of hair.

Third degree: Latency of ten days; redness, vesication, superficial erosion and exudation; the parts are restored to their natural condition in from three to four weeks.

Fourth degree: Latent period of a week or less; necrosis with ulceration, healing sometimes after six weeks or longer.

In all conditions except the first, there may be telangiectases in the scar. They are almost inevitable after an inflammation of the third degree. Such telangiectases may not appear for six to eighteen months after the exposure.

The output of X-rays from a tube can be estimated by Holzknecht's chromo-radiometer or of Sabouraud's pastilles. In the former a capsule containing the reagent is placed near the part under treatment, and as it changes colour under the influence of the rays it is compared with a graduated colour scale which reads from 3 to 24 "Holzknecht units." Sabouraud's pastilles are more generally used. They consist of little discs of barium platinocyanide in an emulsion of collodion and acetate of starch, and with them a standard tint is supplied. The pastille is placed midway between the anode and the skin. In treating ringworm the standard "B" tint cannot be exceeded without causing erythema. It is equal to 5 Holzknecht units.

X-ray Therapeutics.—Among the diseases in which the rays are most successfully employed are rodent ulcer, lupus, ringworm, mycosis fungoides, and other skin affections, in operable sarcoma, and leukæmia. Further information will be found under the various rubrics.

X-ray Diagnosis.—In addition to the diagnosis of diseases and injuries of the bowels and diseases of the thorax, as described in the *Encyclopedia and Dictionary of Medicine* (Vol. X. p. 571), the position of the abdominal viscera can now be made out by the X-rays. As air-containing organs like the stomach and intestines cast no shadow, it is necessary to introduce into them some substance which will do so, and for this purpose bismuth carbonate or subnitrate is generally employed. In some cases a flexible tube filled with bismuth or mercury has been introduced—*e.g.* into the rectum or œsophagus—and information obtained from skiagrams taken with it *in situ*. Lilienthal, however, states that it is not possible to introduce a sound into the colon. Cannon adopted the bismuth method in his work on the movements of the stomach (*see* DIGESTION). For X-ray examination of the stomach Rieder's bismuth meal may be used. It consists of about half a pint of thick soup—potato purée—containing an ounce and a half of bismuth subnitrate. Instead of this a simple emulsion of bismuth in mucilage may be used. If the colon is to be examined the bismuth is given as a high enema—300 to 400 c.c. oil with 40 to 50 grms. of bismuth. Schule's radiograms prove that in many cases the whole colon up to the ileo-cæcal valve can be demonstrated in this way.

It is obvious that this method of mapping out the internal organs may at times prove useful—*e.g.* in cases of dilatation of the stomach, enteroptosis, diverticulum of the œsophagus, etc. Hemmeter, of Baltimore, has suggested that it may be utilised in the diagnosis of gastric ulcer. Bismuth tends to adhere to the surface of ulcers after it has left the intact mucous membrane. Hemmeter gives to the patient a heaped teaspoonful of bismuth in a glass of water, and examines by the rays three or four hours later, by which time the bismuth will have left the stomach, except for such a part as clings to the surface of an ulcer and casts a circular shadow.

When large doses of subnitrate of bismuth are used as described above, it is advisable to wash out the stomach and remove as much of the bismuth as possible as soon as the desired end is attained. The reason for this is that from time to time cases of bismuth poisoning have been recorded, particularly in young infants. Apparently the nitric ion is responsible for the action; in the intestine it is converted into a nitrous ion, and leads to methæmoglobinæmia. Lewin has recently recounted a number of other untoward symptoms—gingivitis, albuminuria, etc., after the administration of these large doses of bismuth. He regards the other salts as just as toxic as the subnitrate, and advises that bismuth should be replaced in X-ray work by ferric oxide.

Voelker and Lichtenberg describe a method for skiagraphy of the kidneys based on the same principle. A ureteral catheter is passed up to the pelvis of the kidney, and a 5 per

cent. collargol solution (which is impervious to the rays) is slowly introduced. The amount which can be injected without pain is from 5 to 40 c.c.

Tumours of the hypophysis in cases of acromegaly have been detected by means of skiagrams.

It has not yet been found possible to obtain skiagrams showing gall-stones.

X-rays in Pædiatrics.—Rotch suggests that for many purposes a physiological and anatomical standard of development is superior to a mere age standard. As an index of development he proposes the development of the carpal bones and the lower epiphyses of the radius and ulna as ascertained by X-rays. He believes that such an index would form a sounder basis for classification, as in connection with school work, athletics, child labour, etc. —than the age standard in use.

Plastic Röntgengrams.—So-called "plastic X-ray photographs," in which the bones, instead of being mere shadow-pictures, show out their details in apparent relief, were exhibited for the first time by Alexander at the Medical Society of Buda-Pesth in 1906, and, as the method by which they were produced was kept secret for a time, a good deal of curiosity was excited and a number of papers on the subject appeared. The procedure, shortly, is this: The object to be photographed is exposed twice on the same plate, first with a hard, then with a soft tube. From the negative a positive is made, and the two are adjusted in contact and exact register. From the combined negative-positive a print or positive is then made. Plastic röntgengrams are certainly striking; whether they depict what actually exists, and how far they are merely results of a clever photographic dodge, is doubtful.

Röntgen Kinematography.—Having succeeded in getting skiagrams with exposures of $\frac{1}{20}$–$\frac{1}{10}$ sec., Geordel has devised an apparatus for obtaining serial views of the heart and stomach, which, when suitably projected, give a kinematographic representation of the movements of the organ.

Orthodiagraph.—The use of the orthodiagraph for the exact delineation of the boundaries of the heart is described on p. 173. The instrument has also been used to outline the stomach, etc.

2. RADIUM.—This remarkable substance was discovered by M. and Mme. Curie in 1898. The discovery was not made suddenly, but was led up to by researches extending back to the middle of the nineteenth century, when Geissler showed that an electric discharge through a vacuum tube caused the tube to glow. In 1879 Crookes discovered that the luminosity was produced at the negative end of the tube, and in 1895 Röntgen, finding that the rays from a Crookes's tube caused barium cyanide to fluoresce, was led to further experiments which culminated in the discovery of the Röntgen rays. J. J. Thomson proved that Crookes's cathodal rays consisted of a stream of negatively charged material particles, and that Röntgen's X-rays were a series of disconnected, non-periodic pulsations caused by the impact of the particles forming the cathodal rays against the glass of the tube. In 1896 Becquerel found that certain uranium compounds emitted a radiation akin to that of the Röntgen rays, but in very feeble amount. Following up this clue the Curies discovered that certain ores of uranium and thorium—the pitchblendes—were even more radio-active than the former element itself. After a laborious research, which involved separating pitchblende into its constituents and testing each separately, Mme. Curie showed that this radio-activity was due to two new elements — polonium, which about equals uranium, and radium, which in its pure state is about two million times as active.

Radium belongs to the group of alkaline metals; it is intermediate between barium and thorium, and has not been isolated in the pure state. It would probably behave like sodium and oxidise rapidly. The bromide and chloride of radium are the salts employed. These are extracted from pitchblende, and in the successive stages of this isolation Mme. Curie used an electroscope by which the ionisation of air by radio-active bodies can be detected. In this way she learned whether the radio-active substance she sought was in the precipitate or in the filtrate after each step in the process. Pure radium chloride is a white crystalline salt with an atomic weight of 225. The amount present in different minerals bears a constant ratio (1:1,000,000) to their uranium content. A ton of Joachimsthal pitchblende yields about ·17 gramme of radium.

Radium has the peculiarity of maintaining itself at a temperature of 2° to 3° Fahr. above the surrounding air—100 calories per gram per hour; it thus gives off enough heat every hour to melt its own weight of ice, and goes on doing this indefinitely without undergoing appreciable change. It also has the power of ionising gases; that is, it converts the air between the terminals of an electric current into a conductor —a property made use of in measuring radio-activity. Its third property is that of giving off an emanation, and emitting rays. The emanation is of the nature of a luminous gas which can be condensed by cold, and which imparts radio-activity to objects in its path. The radiations are divided into alpha, beta, and gamma rays. They all act on photographic plates, excite phosphorescence, and discharge electrified bodies. The α rays consist of a stream of positively charged particles about twice the size of a hydrogen atom, projected at

the rate of 20,000 miles a second. They have little penetrative power, being checked by a plate of aluminium ·05 mm. thick, or a sheet of mica. They are slightly deflected in a magnetic field. The β rays are also material; they are only $\frac{1}{1000}$ of the size of the α particles, are negatively charged with electricity, and travel at the rate of 1,000,000 miles a second. Their penetration is a hundred times as great as that of the α rays; they will pass through 5 mm. of aluminium, or 1 cm. of lead. They are readily deflected in the magnetic field. The gamma rays are not material; they carry no electric charge, and are consequently not deflected in a magnetic field. Their velocity is enormous, being about that of light, and their penetrating power is very great—10,000 times that of the α rays. They pass through 50 cm. of aluminium, or one inch of steel. Rutherford and Soddy have shown that the α rays are, if not identical with helium, at least very closely related to that element. Their equivalent rays in the Crookes's tube are the "di-cathode rays," *i.e.* the streams of light which pass back when holes are made in the cathode. The β rays are identical with the cathodal rays of a Crookes's tube, and the γ rays nearly resemble the X-rays produced by a high vacuum tube. Thus the processes taking place in a particle of radium are very complicated. "In a compound of radium there occurs a rapid expulsion of α and β particles, accompanied by the generation of the γ rays [for γ rays are dependent on β rays, just as the X-rays depend on the cathodal rays], a rapid emission of heat, the continuous formation of an emanation or gas, and the formation of an active deposit which gives rise to 'excited' activity" (Rutherford). The most feasible explanation of these phenomena is afforded by the "disintegration theory" of Rutherford and Soddy. "It is supposed that the atoms of the radio-active substances are unstable, and that a certain fixed proportion of them become unstable every second, and break up with explosive violence, accompanied in general by the expulsion of an α or β particle, or both together. The residue of the atom, in consequence of the loss of an α particle, is lighter than before, and becomes the atom of a new substance, quite distinct in chemical and physical properties from its parent."

The emanation is, as Rutherford says, the concentrated essence of the radio-activity of radium; and is about 100,000 times as radio-active as radium. In a dry atmosphere radium emits very little emanation; the emanation is stored up in the mass of the radium bromide or chloride, but is released by heat or solution. It behaves like a heavy gas, but is not permanent, and undergoes disintegration with the further expulsion of α particles and their deposit on surrounding bodies. Its transformation is accompanied by an enormous evolution of heat; 1 c.c. would probably at once melt down a glass tube containing it. Radium which has been freed from emanation and the active deposit by heat or solution, suffers great diminution in its activity and emits only α rays. It recovers, however, as more emanation is produced and stored up in its mass. As has been said, bodies which come in contact with the emanation become temporarily radio-active.

Medical Uses of Radium.—On the whole, the medical uses of radium are not very dissimilar to those of the X-rays. As radium is usually applied in a capsule protected by a mica shield, it seems impossible that the α rays have anything to do with its action. M'Intyre, writing in 1903, expresses the opinion that its great activity was due to the β rays, seeing that the γ rays were present in such small amount as compared with the X-rays given off by a Crookes's tube. In a recent address Treves alludes to the necessity of further experiments with the view of ascertaining which radiations ought to be employed in different conditions, and quotes the favourable results obtained by Dominici using long exposures to the ultra-gamma rays. The different rays can, of course, be cut off by suitable thickness of screen.

Radium can, of course, be used to take skiagrams, but its cost, and the small quantities in which it is procurable, militate against this use of it.

Physiological Effects.—Exposure to radium causes dermatitis, which may go on to intractable ulceration. A latent period of 8 to 10 days elapses before these effects are produced. Application of radium of 1,000,000 strength for 3 hours will cause dermatitis; for 10 hours, ulceration. When radium is brought near the closed eye, and even, in some cases, near a blind eye, a sensation of light is produced; this is due to fluorescence of the ocular media. Radium is inimical to animal life. The introduction of a tube containing 1 mg. of radium bromide under the skin of a mouse causes convulsions, paralysis, and death. After prolonged exposure the growth of tadpoles is checked, seeds fail to germinate, and other larval forms of life lose their power of development. The radiations are said to inhibit the growth of some bacteria, and to kill others. Their bactericidal power, however, is feeble: three days' exposure to 25 mg. radium is required to destroy the germs of anthrax, cholera, and typhoid. Attempts to sterilise milk in this way have failed. It should be noted that the action is greatest in young forms—a fact which may be related to the rather selective effect of the rays on cancer cells. Thies found that the rays affect all animal tissues, the adenoid tissues and skin being most susceptible. The epidermis dies, or, under certain circumstances, undergoes

proliferation and produces a species of neoplasm. The arteries contract; striped muscle undergoes colloid degeneration; elastic fibres are most resistant. Heinecke, to whose work so much of our knowledge of the tissue changes caused by the X-rays is due, states that the effects of radium are identical; the action on hair, skin, and testicles is the same in both cases.

Therapeutic Uses. — Treves speaks of the following conditions as curable by radium:—1. Angiomata, including "port wine" stains, nævus, pigmented moles, hairy moles, and fibrous angiomata. 2. Skin affections, including chronic eczema with itching, keloid following operations, and acne keloid. 3. Rodent ulcers, even when they are of old standing, adherent to bone, and have resisted treatment by Finsen light, X-rays, and cataphoresis. 4. Epithelioma of the tongue and lip and adjacent parts. In one case of epithelioma cured by radium the face was perfectly sound at the end of two years. Butcher states that small tumours wilt and wither away after a few exposures. There is first spasm of the vessels, congestion, cutaneous reaction, and then pigmentation. Good results have been reported in lupus vulgaris, particularly lupus of the mouth (Walker), lupus erythematosus, scleroma of the nose and larynx, melanoma (Lassar), tics, neuralgia, optic atrophy, tuberculous ulcer of the tongue, cancer of the œsophagus, trachoma (Dinger).

Dr. Louis Wickham, in an address to the Dermatological section of the Royal Academy of Medicine, stated that naked radium gives off 90 per cent. of α, 9 per cent. of β, and 1 per cent. of γ rays; whereas when fixed in the apparatus used for therapeutic purposes in the Paris Institute, the ratios are altered to 1 per cent. α, 90 per cent. β, and 9 per cent. γ. The β rays are divided into soft, with little penetrative power, middle, and hard, with a penetrative power approaching that of the γ rays. A lead screen filters off all the α and most of the β rays, leaving only 10 per cent. of hard β and 90 per cent. of γ rays. The soft α and β rays are those which injure the skin; for the hard lead-penetrating β and γ rays an elective power over cancerous tissues is claimed. This specific action has been demonstrated towards eczema, angioma, keloid, and cancer.

Wickham summarises the advantages of radium under the following heads, with the reservation that they are not of universal application:—1. The treatment can be applied without inconvenience to the patient in his daily work. 2. The interposition of the lead screens renders the action of the rays on tumours slow and on healthy tissues harmless. 3. "Crossfire" application (*i.e.* the attack on the tumour from different sides, as, for example, in epithelioma of the lip) compensates for the great diminution in radiations caused by lead filtration. 4. The radiations exert their special action at a depth. 5. In cancer of the breast radium can—(*a*) cause retrogression to such an extent as to give the appearance of a cure; (*b*) transform an inoperable into an operable cancer; (*c*) act on recurrences following operation; (*d*) act on cancerous glands if not too extensively involved; (*e*) prolong life in incurable cases by relief of pain, hæmorrhage, and discharge; (*f*) act as a prophylactic against recurrence after surgical intervention.

Method of Application.—An active preparation must be used—at least 10 mg. of pure radium bromide of 1,000,000 strength. The average sitting is from 20 to 45 minutes, but some authorities advise much shorter sittings —1 to 4 minutes. Radium may be enclosed in a glass or aluminium capsule, or a lead capsule with a mica or aluminium window. Treves recommends the form of apparatus used at the Radium Institute in Paris—plates coated with radium so as to utilise as large a surface as possible. The exposure is about an hour, or, if screened so as to cut off all but the ultra-gamma rays, several hours at a time. Exposure may be made daily, then weekly.

Treves also quotes a statement that a solution of the radium emanation injected into a mouse infected with mouse cancer cured the cancer. The idea of utilising the emanation has been adopted by exposing saline solution to radium and using the radio-active solution for douches, etc. The waters of many mineral wells—*e.g.* Bath — are radio-active; possibly some part of their action is due to this. Of a number of radio-active bodies, the only ones which require mention are thorium and uranium. The latter has been employed as a plaster in skin disease (Walker). Thorium, which is the principal ingredient in incandescent gas mantles, was suggested by Soddy as worthy of trial in phthisis, and he described a method of producing it in a form suitable for inhalation. Thorium has been employed as an ointment in malignant and other ulcers.

REFERENCES.—The literature will be found in the *Archives of the Röntgen Ray* and similar journals. The following are some of the references in the text:—Morton, "Radium and X-rays," *Brit. Med. Journ.*, 23rd April 1904.—Sequeira, "Dosage," *ibid.*, 14th Sept. 1907. — Walsham, "Orthodiagraph," *ibid.* — M'Intyre, "Electro-Therapeutics," *ibid.*, 24th April 1904. — Treves, "Radium," *ibid.*, 6th Feb. 1909.—M'Intyre, "Radium," *ibid.*, 12th Dec. 1903.—Dawson Turner, "Radium," *ibid.*—Rutherford, *Radio-Active Transformations* (London), 1906. — Soddy, "Radium and Thorium in Phthisis," *Brit. Med. Journ.*, 25th July 1903.—M'Leod, "Radium and Thorium," *ibid.*, 11th June 1904.—Rotch, "X-rays in Pædiatrics," *Proc. Mass. Med. Soc.*, 12th June 1907; *Journ. Amer. Med. Assoc.*, 10th Oct. 1908.—Lawson, "X-rays in Lung Disease," *Lancet*, 25th July 1903.—Groedel, "Röntgen Kinematography," *Deutsche med. Wochensch.*, No. 10, 1909; *Brit. Med. Journ.*, 24th April 1909.—Gergo, "Plastic Skia-

grams," *Wien. klin. Wochensch.*, No. 47, 1907.—JAKSCH, "X-ray Diagnosis," *Berl. klin. Wochensch.*, Nos. 14-15, 1905.—RIEDER, "Topography of Stomach," *Fortsch. a. d. Geb. d. Röntgen Strahl.*, viii. p. 3.—SCHULE, "Topography of Stomach," *Arch. f. Verdauungsk.*, 18th Dec. 1906; "Topography of Colon," *ibid.*, 30th April 1904.—LILIENTHAL, "Topography of Colon." *ibid.*, 25th April 1906.—HEMMETER, "Gastric Ulcer," *ibid.*, 27th Oct. 1906.—SCHUTZ, "Gastric Cancer," *Wien. klin. Wochensch.*, 5th April 1906.—WICKHAM, "Radium," *Lancet*, 29th May 1909.—V. NOORDEN, *Metabolism and Practical Medicine* (London), 1907, vol. iii. p. 1220-1242, "X-rays and Radium."—LEWIN, *Münch. med. Wochensch.*, 30th March 1909, "Toxic Effects of Bismuth."

Rosacic Acid.—Prout's term for purpurin or uroerythrin, a pigment found in a large number of normal urines.

Rouge's Operation.—An operative procedure by which access is got to the nasal cavities without making a scar on the face; the flow of blood into the larynx and pharynx is prevented by plugging and doing laryngotomy; the upper lip is drawn up and freed from the maxilla; the cartilaginous septum is detached from the anterior nasal spine, and the alar cartilages separated from the maxilla; thus the nose can be turned up and the anterior nares exposed; later the parts are replaced without sutures.

Roux's Experiment.—The experiment (in artificial teratogenesis) by which Roux showed that destruction of a blastomere in the developing frog's egg was followed by absence of a definite region of the body in the resulting (monstrous) embryo; the theory of mosaic development is largely founded upon this and similar forms of experimental blastotomy or blastomerotomy. Chabry also carried out such experiments. *See* Ballantyne, *Antenatal Pathology*, ii. pp. 615-616, 1904.

Rubber Gloves.—*See* LABOUR, MANAGEMENT OF; SURGERY, ASEPSIS IN.

Rubinat - Llorach Water.—A natural mineral water containing 10·3 parts of anhydrous salts in 100 parts by measure, consisting principally of sodium sulphate along with magnesium sulphate, sodium chloride, and calcium sulphate; a wineglassful is the dose as an aperient. For analysis see *Brit. Med. Journ.*, ii. for 1910, p. 84.

Rubner's Test.—A not very delicate test for lactose in urine; the urine with an excess of lead acetate is boiled for a few minutes, the yellowish or brown solution is then filtered and ammonia added till a slight permanent precipitate remains, and the result is a brick-red fluid which deposits a cherry-red precipitate. *See* Webster, *Diagnostic Methods*, p. 298, 1909.

Ruppell's Serum.—*See* CEREBRO-SPINAL MENINGITIS (*Treatment, Curative*).

Russo's Test.—A test for typhoid fever said to be more reliable than the diazo reaction; four drops of a 1 to 1000 aqueous solution of methylene-blue are added to 4 or 5 c.c. of the urine in a case of suspected typhoid; the suspicion is confirmed by the mixture becoming of an emerald or mint-green colour (positive reaction), and negatived by its turning light green or bluish-green (negative reaction); the positive reaction is also got in measles, smallpox, and tuberculosis. *See* Webster, *Diagnostic Methods*, p. 321, 1909.

Sabouraud's Pastilles.—*See* RÖNTGEN RAYS AND RADIUM.

Sabromin.—A bromine compound, being the calcium salt of dibromine behenic acid $(C_{22}H_{41}Br_2O_2)Ca$; it is a white, odourless, tasteless powder, which is insoluble in water; the dose is from 5 to 15 grains given from 1 to 1½ hours after food; it is recommended in the same maladies as those for which the bromides are prescribed, and has been described as an advantageous substitute for them (*e.g.* in epilepsy, hysteria, neurasthenia, eclampsia, etc.); it contains 29·3 per cent. of bromine and 3·8 per cent. of calcium.

Sahli's Hæmometer.—A modification of the hæmoglobinometer of Gowers; the standard colour solution for comparison is an acid hæmatin solution.

Sahli's Reaction.—*See* DIGESTIVE FUNCTIONS, TESTS.

Sahli's Test Meal.—A soup, prepared according to a definite plan and from fixed amounts of flour, butter, water, and salt; the test depends on the amount of fat which is digested. *See* Webster, *Diagnostic Methods*, p. 51, 1909.

Sajodin.—A substitute for the alkaline iodides, in which iodine is combined with calcium (26 per cent. of the former and 4·1 per cent. of the latter) and an organic acid; it is recommended in syphilis, in angina pectoris, arterio-sclerosis, asthma, and in joint affections, etc.; the dose is 8 grains, and the drug forms an insoluble white soapy powder. *See* Fortescue-Brickdale, *Newer Remedies*, p. 20, 1910.

Salacetol.—A remedy used in acute rheumatism, being the acetol (CH_2COCH_3) ester, and having the form of a white, insoluble powder; the dose is from 30 to 45 grains every morning.

Salen.—*Salen* is a mixture of methyl and ethylglycolic esters, forming an odourless liquid, soluble in ether, alcohol, castor oil, and a mixture of chloroform and olive oil; the 33·3 per cent. ointment is named *salenal*.

Salenal.—*See* SALEN.

"Salies Cure."—The treatment of utero-ovarian complaints by a course of the baths at Salies de Béarn; the spring is called the "uterine spring," and the water contains sodium chloride, bromides, and iodides. For reports of cases of menstrual disorders, uterine fibroids, etc., so treated, *see* David, *Clinique* (Paris), v. p. 107, 1910.

Saliformin.—A salicylate of urotropin, acting as a urinary antiseptic, given in doses of 8 to 30 grains; it is a bitter, soluble, crystalline body. *See* Fortescue-Brickdale, *Newer Remedies*, p. 98, 1910.

Salimenthol.—The ether of salicylic acid with menthol, constituting an oily yellow liquid soluble in alcohols and oils; recommended in acute rheumatism in 4 grain doses (in capsules) or externally as an ointment (*samol*). *See* Fortescue-Brickdale, *Newer Remedies*, p. 249, 1910.

Salmine.—A basic amino-acid (simple protein) obtained from fish sperm.

Salocreol.—A compound of salicylic acid and creosote, forming a brown, oily fluid, soluble in alcohol; it is used externally in acute rheumatism.

Salomon's Test.—A test for carcinoma of the stomach founded on the fact that albumin is secreted from the carcinoma itself, and so finds its way into the gastric contents; so for 24 hours nothing but protein-free diet is given, then the stomach is washed out with salt solution, and then some hours later the gastric contents are tested for albumin. *See* Webster, *Diagnostic Methods*, p. 89, 1909.

Salophenin.—A tasteless and odourless crystalline substance (salicyl phenetidin or acetyl-para-amido-salol), also known as *salophen*; it is recommended as an analgesic and anti-rheumatic, in doses of 10-15 grains (for an adult); it is nearly insoluble in water, but readily soluble in alcohol and ether; it is said to be safer than salol.

Saloquinine.—The salicylic acid ester of quinine, in the form of colourless, insoluble crystals. *See* Fortescue-Brickdale, *Newer Remedies*, p. 209, 1910.

Salt-free Diet. — *See* NEPHRITIS, TREATMENT OF (*Chloride-free Diet*).

Salus Water.—A slightly saline and alkaline, effervescent mineral water, obtained from Larvik Spa, on the Norwegian coast, recommended as a table beverage, and in cases of urinary disorders, gout, rheumatism, etc. *See Lancet*, ii. for 1910, p. 35.

Salzer's Test Meal.—Two meals are given with an interval of four hours; the stomach contents removed one hour after the second meal ought to show no remains of the first meal, if the gastric digestion and motility are normal; the first meal consists of cold roast meat, milk, rice, and a soft-boiled egg, and the second of stale wheat bread and water. *See* Webster, *Diagnostic Methods*, p. 51, 1909.

Samol.—*See* SALIMENTHOL.

Sand-Baths.—Baths of sea sand, hot or cold, moist or dry, best taken on the sea-shore itself, with the sand heated by the direct rays of the sun; they are believed to act beneficially by drawing blood to the skin and so relieving internal congestion, and also by leading to the absorption through the skin of the alkaline iodides and bromides of the sea-water with which the sand is impregnated; the head should be shaded during the taking of the bath, and the face occasionally bathed in water; sand-baths are recommended in rheumatism, gout, lead, and morphine poisoning, neurasthenia, hysteria, spinal curvature, etc. (G. Boutin, *Gaz. hebd. d. sc. méd. de Bordeaux*, XXX. pp. 145-148, 1909).

Sandfly Fever. — *See* PHLEBOTOMUS FEVER.

Sanitas Preparations.—A series of preparations, including sanitas-bactox, sanitas-okol, and sanitas disinfecting fluid; their chemical and physical characters and bactericidal powers are reported on in an article on the standardisation of disinfectants (*Lancet*, ii. for 1909, pp. 1527-1529).

Santyl. — The salicylic acid ester of santalol, almost tasteless, and odourless; recommended in gonorrhœal affections.

Sarcosporidia.—*See* PROTOZOA.

Satchel, Obstetric.—*See* LABOUR, MANAGEMENT OF.

"Sauerin."—The trade name for what is described as "a pure active culture of the

Metchnikoff Bulgarian bacillus (Bacillus of Massol)."

Sauerin Liquid Culture.—A pure active culture of the Metchnikoff Bulgarian bacillus for souring the milk in the soured-milk treatment. *See* Report in *Lancet*, i. for 1910, p. 1545.

"Saxin."—A sweetening agent, described as "about 600 times sweeter than sugar," recommended in gout, diabetes, obesity, etc.

Scaphoid Scapula.—A malformation of the scapula, in which the vertebral border of that bone below the scapular spine is more or less concave; it is apt to be associated with the early development of arterio-sclerosis, and with other anomalies which, according to W. W. Graves (*Interstate Med. Journ.*, xviii. p. 109, 1911), constitute a scaphoid scapula syndrome with syphilis in the parents as one of its causal agents.

Scherer's Method.— A quantitative test for albumin in urine, the precipitate (got by acetic acid and boiling) being weighed. *See* Webster, *Diagnostic Methods*, p. 257, 1909.

Scherer's Test.—A test for leucin in urine, applied to the solid residue obtained by concentration; the residue is evaporated with concentrated nitric acid, when, if leucin be present, a yellowish residue is found, which, when heated with a few drops of sodium hydrate solution, causes a yellowish or brown colour. *See* Webster, *Diagnostic Methods*, p. 329, 1909.

Schimmel's Needles.—*See* Anæsthesia and Anæsthetics (*Regional*).

Schlatter's Disease.—Enlargement or malformation of the tuberosity or tubercle of the tibia, which usually comes under observation as the result of overstrain (*e.g.* in football), and can be recognised by the use of the Röntgen rays.

Schlösser's Method.—A plan of treating tic-douloureux by injecting alcohol into foramina of exit (ovale and rotundum) of the branches of the (fifth) trigeminal nerve. *See* Treves and Hutchinson's *Surgery*, ii. p. 75, 1910.

Schmidt's Test Diet.—*See* Digestive Functions, Tests for (*Schmidt's*).

School Clinics.—The inspection and treatment of children for school complaints (short-sight, squinting, ear disease, skin diseases, etc.) at the school or at some centre convenient thereto by a qualified medical officer.

School, Open-Air.—*See* Open-Air School.

Schüngner's Granules.—Basophile particles which appear in the gamete of the parasite of malaria during its development; also called Plehn's karyochromatophilic granules.

Schultze's Granular Cells.—A name given to the polymorphonuclear neutrophile leucocytes of the blood; they are sometimes called the finely granular cells of Schultze to distinguish them from the polymorphonuclear eosinophiles which are termed the coarsely granular cells of Schultze.

Sclero-proteins. — Simple proteins resembling the gliadins in chemical structure; they are the chief organic constituents of the skeletal structures and connective tissues and of the external coats of animals.

Scotomagraph.—An appliance introduced by J. H. Tomlinson for mapping out blind or anæsthetic areas of the retina and automatically recording the result. See *Brit. Med. Journal*, ii. for 1909, p. 985.

"Screws."—*See* Caisson Disease.

Sebelien's Method.—A method for determining the total protein in milk; a saturated sodium chloride solution and Almén's tannic acid solution are used; the fat is separated from the precipitate and the nitrogen determined. *See* Webster, *Diagnostic Methods*, p. 605, 1909.

Secretin. — *See* Digestion (*Pancreatic Secretion*).

Sedimentation.—The process which allows or compels the settling down of sediment in such a fluid as urine; the methods in common use are letting the urine stand for some hours and the employment of the centrifuge. *See also* Spengler's Method.

Sedimentum Lateritium.—The brick-dust deposit of urine, consisting chiefly of acid urate of sodium ($C_5H_3NaN_4O_3$).

Segregation, Law of. — In the Mendelian theory this law means the sifting out of unit-characters in the plants of combined generations in the Mendelian ratio, 1 : 2 : 1; Mendel explains this law on the theory of gametic segregation and combination according to the law of chance.

Seliwanoff's Test.—A test for levulose in urine consisting in the addition of a few crystals of resorcin and 10 c.c. of concentrated hydrochloric acid to 10 c.c. of urine; the warming of the mixture causes a brilliant red colour to appear if levulose be present, whilst glucose produces no coloration. *See* Webster, *Diagnostic Methods*, p. 291, 1909.

Sensation. — Afferent Nervous System.—One of the most important contributions which have been made to our knowledge of the physiology of the nervous system in recent years is Dr. Henry Head's work on the conduction of sensory impulses in the peripheral nerves and spinal cord. His observations are based on the effects of disease of the nervous system, on the results of nerve injuries, on referred pain in visceral disease, and on the phenomena produced in his own person by division and subsequent suture of a divided nerve.

Broadly, what Head has done is to trace the different forms of sensory impulses through their different paths in the peripheral nerves —the "primary level"—and to show that in the cord—the "secondary level"—the different impulses are redistributed and recombined in different paths; he suggests, further, that in the brain—"tertiary level"—a further redistribution and recombination takes place. For the almost innumerable detailed observations supporting his argument his original papers must be referred to.

Sensory Peripheral Mechanism.—There are three sets of sensory impulses: — (1) *Deep sensibility*—sensations of muscular and articular movement, and sensations of deep pressure, the last culminating in pain when the pressure is severe. (2) *Protopathic sensibility*—sensations of painful cutaneous stimuli, and of temperatures below 20° and above 50° C. Protopathic sensations are characterised by the impossibility of accurately localising them. (3) *Epicritic sensibility*—tactile sense in its restricted meaning, *i.e.* the power of appreciating gentle touches, of localising stimuli, of discriminating adjacent compass points, and of distinguishing warmth and coolness between 20° and 50° C. These three sets of impulses travel by different sets of nerves—deep sensibility in the muscular nerves; protopathic sensibility in many of the somatic and visceral afferent nerves; epicritic sensibility in the peripheral cutaneous nerves. All the protopathic fibres from any area converge to the corresponding nerve root, which is, therefore, the *unit of protopathic supply;* the epicritic fibres from an area of skin converge to a peripheral cutaneous nerve, which is therefore the *unit of epicritic supply.*

When a peripheral nerve is divided there is a large area of lessened sensibility, and, within the confines of this, a smaller area of complete anæsthesia. In the latter, of course, both epicritic and protopathic sensibility are abolished; in the former only epicritic sensibility is gone, protopathic is preserved. The area of epicritic anæsthesia has a well-defined margin which corresponds with the distribution of the cutaneous nerve divided; there is no overlap of fibres from adjacent nerves, hence, as has been said, the peripheral nerve is the unit of epicritic supply. The zone of protopathic anæsthesia—*i.e.* the smaller area of complete anæsthesia—has an ill-defined outline, which does not correspond with that of the area of distribution of the peripheral nerve; the difference in the distribution of the epicritic and protopathic anæsthesia is due to overlapping of protopathic fibres from adjacent nerves. If, however, a nerve root, instead of a peripheral nerve trunk, is divided, the areas of epicritic and protopathic anæsthesia coincide, whence it follows that the root is the unit of protopathic supply.

Over the area of partial (*i.e.* epicritic) anæsthesia light touches are not felt, adjacent points are not discriminated, and temperatures between 20° and 30° are not distinguished. Protopathic sensations are preserved: a prick causes indefinitely-localised tingling pain, and only temperatures below 20° or above 50° are described as cold, or hot.

Over the area of complete (*i.e.* epicritic and protopathic) anæsthesia only deep sensibility is preserved.

After suture of a divided nerve the protopathic fibres are the first to be repaired—*i.e.* the analgesic area disappears. The area of epicritic anæsthesia (light touch, and moderate variations in temperature) may persist for months or years. The hyperalgesia which so often succeeds nerve injuries follows the course of the protopathic fibres, and, on account of their wide distribution and overlapping, it greatly exceeds the area of epicritic anæsthesia. Nutritional changes run parallel in extent and duration to the abolition of epicritic sensibility.

Sensory Spinal Mechanism.—In the cord the threefold grouping of sensory impulses just described ceases to exist: the groups are dissociated, and redistributed into a group of sensations of pain, a group of sensations of temperature, a group of sensations of touch, and a group of sensations of passive position and movement and discrimination of adjacent points. Instead of the three groups of deep, protopathic, and epicritic, we have four—pain, temperature, tactile, and spacial. Sensations of pain and temperature pass up the side of the cord opposite to their point of entry; they are closely, but not inextricably associated. The group of tactile sensations are also crossed; the group of spacial sensations pass, uncrossed, up the side of the cord at which they enter.

The following scheme represents what occurs :—

AFFERENT IMPULSES IN

Peripheral Nerves.			Spinal Cord.		
Muscular and Articular Nerves.	DEEP SENSIBILITY.	PRESSURE.	PRESSURE.	Combined Tactile.	Opposite side of Cord.
		DEEP PAIN.	*LIGHT TOUCH.*		
		POSITION.	*CUTANEOUS LOCALISATION.*		
Afferent Branches of a Posterior Root (unit of supply).	PROTOPATHIC.	**HEAT AND COLD.**	**HEAT AND COLD.**	Combined Thermal.	Adjacent. Opposite side of Cord.
		SUPERFICIAL PAIN.	*WARMTH AND COOLNESS.*		
Peripheral Cutaneous Nerve (unit of supply).	*EPICRITIC.*	*LIGHT TOUCH.*	DEEP PAIN.	Combined Painful.	
		CUTANEOUS LOCALISATION.	**SUPERFICIAL PAIN.**		
		WARMTH AND COOLNESS.			
		DISCRIMINATION OF POINTS.	POSITION.	Uncombined.	Posterior Columns of same side of Cord.
			DISCRIMINATION OF POINTS.		

For a detailed proof of the accuracy of these statements, Dr. Head's original observation must be referred to. In general terms, he finds that a cord lesion which abolishes pain, abolishes it entirely—we never have cutaneous analgesia with retention of pain on deep pressure, as occurs when a peripheral nerve is divided. Similarly, when from a cord lesion sensibility to light touch is destroyed so also is sensibility to deep touch ; when the temperature sense is affected, both moderate warmth and coolness, and extremes of temperature, fail of recognition. Further, the loss of sense of position goes hand in hand with the loss of power to discriminate between adjacent points.

The impulses which recombine—thermal, painful, tactile—cross to the opposite side of the cord ; the impulses we have grouped as "spacial"—position and tactile discrimination—are less closely related, and do not cross in the cord, but pass up on the long extrinsic fibres of the homolateral posterior columns. Some, or all, ultimately cross at the level of the nucleus gracilis and nucleus cuneatus, but it may be that those which subserve equilibration, and do not overstep the threshold of consciousness, enter the same side of the cerebellum without ever undergoing decussation.

REFERENCES.—Head, *Brain*, No. 119, 1905 ; *ibid.*, No. 116, 1907.

Serotherapy.—Under the general head of sero-therapeutics we include (1) treatment of disease by vaccines, and (2) treatment of disease by serums proper.

Vaccines.—The use of vaccines in the treatment of bacterial infections is more general in this country than on the Continent. This is due to the fact that we owe the introduction of vaccines largely to Sir A. E. Wright and his collaborators. In the early days of vaccine therapeutics the estimation of the opsonic index was looked upon as an almost essential antecedent to treatment, and was regarded as a very important, if not indispensable means of controlling the use of vaccines. Now, however, the estimation of the opsonic index has (almost of necessity, on account of its laborious nature) fallen into the background, while vaccines have come to occupy a correspondingly more prominent place in the esteem of the profession. The fact may be insisted on once and for all that the merits of opsonic determinations and the merits of vaccine therapeutics are quite independent of one another. Whether the former stand or fall, the test of the value of the latter will be their effect on disease, apart from their relation to the opsonic index.

A vaccine is a suspension or emulsion of dead bacteria, and contains the intracellular toxines of the micro-organism. Such a vaccine may be prepared from a culture made from the organism infecting the patient whom it is desired to treat—an "autogenous" vaccine ; or it may have been prepared from another strain,

or other strains, of the same species already stored in the laboratory—"stock" vaccine. On the whole, the best results are got by using autogenous vaccines, and for some diseases, *e.g. coli* infections, a stock vaccine is of little use; on the other hand, staphylococcal and gonococcal infections often respond well to stock vaccines. Bosanquet and Eyre lay down the following principles concerning the preparation of vaccines:—(1) Autogenic strains are preferable. (2) Cultures must be virulent, and as few removes from the original source as possible. (3) The subculture used to prepare the vaccine must be grown under optimum conditions. (4) The bacilli must be killed with the minimum of heat. (5) The vaccine must be accurately standardised.

The actual preparation is, briefly, as follows:—A culture of the organism is made in a suitable medium, and its purity determined. Five c.c. of ·1 per cent. saline is added to the tube, and the growth is emulsified as thoroughly as possible with a stirring rod. The turbid emulsion is then transferred to a second tube and shaken for a quarter of an hour. The number of bacteria per c.c. is estimated, mixing equal volumes of normal blood and suspension, and staining a smear with Jenner or Leishman. By enumerating the number of bacteria and red cells respectively present in a series of microscopic fields the ratio of the former to the latter (which number about 5,000,000,000 per c.c.) can be determined, and from this the actual number in the emulsion calculated. Enough salt solution is added to bring the bacteria down to 100-1000 million per c.c., and the mixture is well shaken. It is then sterilised at the temperature corresponding with the thermal death point of the bacillus for half an hour. The sterility is tested by inoculating culture tubes with the vaccine. A small quantity of an antiseptic (5 per cent. carbolic) is added, and the vaccine is then stored in rubber-capped bottles or glass capsules hermetically sealed.

Vaccines may be given subcutaneously or by intramuscular injection. Some authorities prefer one, some the other route; so far as subsequent discomfort is concerned, it is immaterial which is selected. The oral administration of vaccines, which has been practised by a few, is of very doubtful value.

Following upon the administration of a vaccine certain local and general effects are produced. The *local reaction* varies according to the dose and the amount of endotoxines present. Generally speaking, according to Horder, a mild reaction is aimed at in cases of chronic and local infection but not in cases of acute, generalised infection. A mild reaction is constituted by local tenderness and redness lasting for from 18 to 48 hours after injection. A more marked reaction usually occurs after prophylactic vaccination (*e.g.* against typhoid) in which large doses are given. The *general reaction* is evidenced by the alterations on the opsonic power of the blood which ensue, and in some cases by pyrexia and malaise. After inoculation the opsonic index first falls (negative phase), then rises (positive phase) and, after a longer or shorter time, declines again (*see* IMMUNITY, p. 194).

Vaccines may be employed in almost any microbial infection. Hitherto the following are the chief conditions in which they have been found serviceable:—

1. *Staphylococcus Infections.*—Here autogenous vaccines are preferable to "stocks," and if the latter are employed it is desirable to know which variety of staphylococcus is the infecting agent. Mixed vaccines of staphylococcus aureus and albus are said to be of little value. Furunculosis, periostitis, osteomyelitis, pustular acne, otitis media, sycosis, sinuses of all kinds, are among the diseases which have been treated. The method is particularly successful in the case of boils. After vaccination there may be a crop of fresh boils, but these usually abort and have no successors. *Dosage.*—Bosanquet gives as an average initial dose in a localised suppuration 50 millions. Horder, on the other hand, recommends 1000 millions as an initial dose, followed by doses of 250-500 millions at intervals of 7-10 days. If relapses occur, it is probably either due to the dose being too small, or to inoculations being too frequent. In generalised infections the doses should be about one-tenth of the above.

2. *Streptococcus Infections.*—There is much difference of opinion as to the relationship of the various strains of streptococci met with, hence an autogenous vaccine is always to be preferred where possible. Streptococcus vaccines have been used with success in pyorrhœa alveolaris, otitis media, suppuration in the nasal sinus, erysipelas, abscesses, and cellulitis. Benefit has also been ascribed to vaccines in cases of septicæmia and ulcerative endocarditis. The doses are smaller than those of staphylococcal vaccine, in accordance with the general principle that "the more virulent the micro-organism, and the more acute and generalised the disease process, the smaller should be the dose of the vaccine employed" (Horder). Doses of 5 million may be given in acute cases; 10 million, increasing to 100 million, in more chronic or localised cases.

3. *Pneumococcus Infections.*—Vaccines are often useful in furthering the healing of the sinuses left by empyema, and ought to be tried in all cases where favourable progress is not being made. Doses of 10-20 million (autogenous) pneumococci may be given at weekly intervals. Good is said to have followed vaccines in pneumonia, and in acute pneumococcal periton-

itis, but the vaccine treatment of these diseases is on a much less certain basis than that of chronic discharging empyema.

4. *Gonococcus Infections.*—Owing to the great variations in the virulence of different strains of gonococci, and consequently of the activity of vaccines, the dose should be small, 5-10 millions. Very small doses are desirable in gonococcal iritis. Some cases of chronic gleet fail to be benefited by vaccines because the gonococci have died out, and staphylococci of low virulence are responsible for the discharge (Bosanquet and Eyre). *See also* GONORRHŒA.

5. *Bacillus coli Infection.*—In acute infections, doses of 10-20 million; in chronic, doses of 20 million, increasing to 100 million or more may be used. Autogenous vaccines should be employed. Good results have been obtained in chronic infections of the urinary tract.

6. *Miscellaneous Infections.*—Vaccines have also been tried in the following diseases of bacterial origin:—*Meningococcus meningitis.* Only a few attempts have been made, and the vaccine treatment of the disease has been superseded by the meningococcus serum (*vide infra*). *Rheumatic diseases.* — Treatment of rheumatic manifestations with vaccines of the micrococcus rheumaticus has not been satisfactory. *Nasal catarrh.*—Vaccines consisting of 25-150 millions of micrococcus catarrhalis have been used by Allen (*Lancet*, 1909, ii. pp. 1589, 1659). *Actinomycosis* has also been treated by a vaccine. *Chronic infective endocarditis.* — Horder advises a vaccine of 10 million of the infecting organism repeated every 4-7 days, increasing the dose if no good is obtained by these quantities. *Tuberculosis.* —The vaccine treatment by tuberculin is discussed under the head of "Tuberculosis." *Chronic dysentery* has also been treated with vaccines of Shija's bacillus. Vaccines have been used both in the treatment and prophylaxis of *Malta fever.*

It may be noted, in conclusion, that sometimes where an autogenous vaccine fails, a stock vaccine of a more virulent character will be successful, *e.g.* a stock vaccine of staphylococcus aureus instead of an autogenous vaccine of staphylococcus albus.

Prophylactic Vaccination.—Inoculation with vaccines has been used as a prophylactic against plague, typhoid fever, and cholera. It has also been tried, though much less extensively, before operations with a view of preventing infection. In the latter instance staphylococcus, streptococcus, and *b. coli* vaccines have been employed. The results are said to warrant further trial of the method in cases in which septic infection is feared. A further group of cases in which prophylactic inoculation has been used consists of acute infections which have a marked tendency to recur, *e.g.* influenza, acute nasal catarrh, acute sore throat, etc. The success, or lack of success, which attends efforts to secure in this way immunity from these troublesome maladies, depends, apparently, in large measure upon the specificity of the vaccine. Horder reports gratifying results in the prophylaxis of acute sore throat from inoculation with an autogenous vaccine.

Antityphoid Vaccination (*see also* TYPHOID FEVER). — Wright introduced a prophylactic vaccine, consisting of dead cultures of *b. typhosus*, in 1901. Two injections, of 500 and 1000 millions respectively, are given at a fortnight's interval. They cause local reaction (lymphangitis) and some fever. Inoculation does not produce absolute immunity, but seems to confer a very considerable degree of protection, and if the person who has been inoculated does subsequently contract typhoid, the disease generally assumes a mild form. The following illustrative figures may be given :—

British army in India, 1901—

Inoculated, 4883; cases of typhoid, 32 (·66 per cent.); deaths, 3 (·06 per cent.).

Uninoculated, 55,955; cases of typhoid, 744 (1·33 per cent.); deaths, 199 (·36 per cent.).

More complete statistics are given by Sir A. E. Wright in *The Practitioner*, 1904, p. 370.

Anticholera Vaccination.—Haffkine's method of anticholera inoculation is referred to in the article CHOLERA (*Encyclopedia and Dictionary*, II. p. 123). He has now given 70,000 injections in 42,179 individuals without accident. Two injections are given at intervals of 5 days. There is local and general reaction, and each injection is followed by an increased susceptibility of a few days' duration. Immunity is attained in five days. It seems, therefore, that while it would be advisable to inoculate against cholera when a person has to go into a district where the disease is prevalent, it should not be done unless ten days can be allowed for immunity to develop. For the same reason it is probably unwise to inoculate in the actual presence of an epidemic.

Antiplague Vaccination.—Haffkine's prophylactic is used. Protection is rapidly acquired within 24 hours. Bannerman thinks that the injection does not aggravate an attack even if made during the incubation period. He states that in a total of 6000 cases the mortality among the inoculated was 43·5 per cent.; among the uninoculated, 73·7 per cent. Haffkine sums up the results (*Bull. Inst. Pasteur*, iv. p. 825) thus:—Inoculated, 186,797; 3399 (1·8 per cent.) infected with plague; 814 (0·4 per cent.) died. Uninoculated, 639,630; 49,433 (7·7 per cent.) infected with plague; 29,733 (4·7 per cent.) died. In the Annual Reports of the Sanitary Commissioner with the Government of India for 1904 and 1905 it is said "that its value is great is certain; not only does it largely diminish the danger of

plague being contracted, but if it fails to prevent the attack, the probability of a fatal event is reduced by one-half." The use of the prophylactic has no ill effect on the health, and a marked protective influence lasts for six or even twelve months.

SERUMS. — It would be impossible in the short compass of this article to enumerate, much less to particularise, all the serums which have been used or introduced during the past five or ten years. Some of the most important of these (*e.g.* antidiphtheria serum, "antitoxin" *par excellence*) have already been described in the *Encyclopedia and Dictionary*; of the rest only the chief need be referred to here.

1. *Antimeningococcus Serum* (*see also* CEREBRO-SPINAL MENINGITIS).—Flexner's serum is apparently the best remedy for cerebro-spinal meningitis that we possess. A number of papers have appeared giving the results of its use; one of the most recent and exhaustive is by F. J. Sladen (*Johns Hopkins Hosp. Reports*, xv., 1910, pp. 397-540, with bibliography). Of Flexner's last analysis of 393 cases treated in America and Great Britain with his serum, 295, or 75 per cent., recovered, and 98, or 25 per cent., died—a case-mortality considerably below that of untreated cases; though, of course, it is difficult to state an exact mortality rate for a disease which varies so much in severity in different localities. Ker, for instance, reduced his mortality rate in Edinburgh, where the disease was of a very severe type, from 80 to 44 per cent.; whereas in the Mount Sinai Hospital, New York, Koplek's death-rate was only 13·3 per cent. The serum is a specific antiserum produced by immunising horses against the meningococcus. It has not yet been standardised. The secret of success is to inject it into the spinal canal, where it reaches the organisms in sufficient concentration to destroy them—a thing not accomplished by the subcutaneous route. The instruments used are a 15 c.c. syringe with a long (10 c.m.) needle. Sladen also employs a pressure tube to measure the intraspinal pressure by determining the height in millimetres to which the fluid rises in it. Lumbar puncture (in the fourth or third interspace) is performed in the usual way, and cerebro-spinal fluid is allowed to escape until the pressure on the subarachnoid space is subnormal. On an average about 30 c.c. must be withdrawn to effect this. Serum warmed to about 100° F. is then injected. From 10 to 30 c.c. is the amount injected. If larger quantities are administered discomfort may follow. Inoculation with Flexner's serum is indicated in any case of meningitis reasonably suspected of being the epidemic type; it does no harm. Before a second injection is required time will have allowed of a bacteriological diagnosis.

The earlier in the course of the disease the serum is given the greater chance has the patient of recovery. After an injection of the serum the *temperature* most commonly rises slightly, then falls. In a smaller number of cases it falls at once. Sometimes after having fallen it rises again. In very severe fulminating cases the temperature may not be affected. The temperature curve is the most important guide to the administration of serum. Ker advises giving injections daily for the first four days, when improvement and fall of temperature will probably have taken place, and repeating the treatment should there be any exacerbation or relapse. The *blood*, after serum, shows diminution of the pre-existing leucocytosis. The *spinal fluid* becomes more cloudy, from an influx of polynuclear leucocytes. Evidence of phagocytosis becomes more apparent, and the diplococci cease to stain clearly. When there is evidence of metastatic foci of infection—*e.g.* arthritis—it seems advisable to try the effect of a local, or a subcutaneous injection of serum as an adjuvant to intraspinal administration.

If Flexner's serum is not available, Kolle and Wasserman's serum or some other preparation should be tried. *See also* CEREBRO-SPINAL MENINGITIS, p. 98.

Antiplague Serum.—Yersin's antiserum must be distinguished from Haffkine's prophylactic, which is a vaccine. The former is prepared by inoculating horses with cultures of plague baccili. In a small epidemic in Glasgow in 1902 Cairns found it of value. In severe attacks it should be injected intravenously as well as subcutaneously. It is bactericidal as well as antitoxic (*Lancet*, 1903, i. p. 1287). The dose is about 100 c.c. Lustig's serum is mainly antitoxic. In Bombay, 1898-1901, the difference in the mortality of cases treated with and without the serum was from 11 to 22 per cent. in favour of the serum; 985 patients were treated. Lustig's serum is regarded as of less proven value than Yersin's.

Antistreptococcus Serum.—On the whole the results of treatment with this serum have been disappointing. This is mainly due to the variety of organisms belonging to the group of streptococci. It is also, no doubt, in part to be ascribed to the use of the serum in forms of sepsis not due to streptococci at all; to the fact that it is a bacteriolytic serum and deteriorates by keeping; and also to delay in injecting the serum in suitable cases. The difficulty in deciding whether the serum is efficacious has been enhanced by lack, in many instances, of proof that cases of alleged recovery were really septicæmia at all. In future it is desirable that before "cure" is ascribed to the serum there should be bacteriological proof of the nature of the infection. It does not, however, follow that the serum

must not be administered until bacteriological evidence is forthcoming. When antistreptococcus is used 20 c.c. of polyvalent serum should be given and repeated in twenty-four hours. If there is no obvious improvement different brands should be chosen for the second and later injections.

Among other bacterial diseases for which antiserums have been prepared are pneumonia, typhoid (Chantemesse's serum), rheumatism (Menger's serum), tuberculosis (Marmoreck's serum), and dysentery. Evidence of the efficacy of these serums is absent. Sclavo's anti-anthrax serum is in a better position; there is some reason for believing that it is of value. Anti-tetanus serum is also of undoubted benefit in some cases of the disease (*see* TETANUS). Of analogous, though non-bacterial, remedies, Dunbar's antitoxin for hay fever (*see* HAY FEVER), and Mœbius's serum for exophthalmic goitre, may also be mentioned (*see* GRAVES'S DISEASE).

Much information on serum therapy will be found in Bosanquet and Eyre's *Serums, Vaccines, and Toxines in Treatment and Diagnosis*, 2nd edit., London, 1910, which contains many references. Vaccine therapeutics is discussed most admirably and succinctly in T. J. Horder's *Clinical Pathology in Practice*, London, 1910. Many papers on vaccines, including several from A. E. Wright's Laboratory, will be found in the files of the *Lancet* and *British Medical Journal* for the past few years. The literature is extensive, and cannot be given at length in this place. *See also* art. IMMUNITY.

Shock, Treatment of.—Following upon the enunciation of the statement by Crile that the one essential character of conditions of shock is a low blood pressure, certain new principles have been introduced into its treatment whether it occur after operations, after labour, after severe injuries, or in connection with the administration of anæsthetics. The use of ether (for its pressor action) is therefore recommended in place of chloroform as an anæsthetic. Then, during and before the administration of the anæsthetic, saline transfusion is highly spoken of, and the extract of the pituitary gland (pituitary fluid (Duncan), or pituitary extract (B. W. & Co.), or pituitrin) may be given for the prevention of shock. When shock has actually developed the patient's head must be kept low, the limbs and abdomen should be bandaged, saline injections should be freely given (subcutaneous or intravenous), and either adrenalin or, preferably, extract of the infundibular portion of the pituitary gland should be injected hypodermically. Both adrenalin and pituitary fluid raise the blood pressure and increase the arterial tone, but the effect of the former soon passes off, whilst that of the latter is more permanent; for this reason the latter is preferable. In this system of treatment neither strychnine nor stimulants find a place; in fact, morphine in small doses is said to be of more value than any stimulants. There is much experimental evidence in favour of this new plan of dealing with shock, and if clinical results prove satisfactory the whole treatment of this dangerous complication of operations will be revolutionised. *See* Wray, G. G., *Brit. Med. Journ.*, ii. for 1909, p. 1745; Rowell, G., *Brit. Med. Journ.*, ii. for 1910, p. 757; Crile, G. W., *ibid.*, p. 758; Mummery, P. L., *ibid.*, p. 759; Malcolm, J. D., *ibid.*, p. 760; Adami, *Pathology*, i. p. 580, 1910.

Sicco.—An organic preparation of iron, forming a brown soluble powder, and said to contain 89·52 per cent. of protein, ·332 per cent. organic iron, 2·6 per cent. salts, and ·11 per cent. fat. *See* Fortescue-Brickdale, *Newer Remedies*, p. 68, 1910.

Side-Chain Theory.—*See* IMMUNITY (*Theories*).

Sirolin.—A 10 per cent. solution of thiocol in syrup, given in doses of a tea to a table-spoonful in phthisis.

"Six Hundred and Six" (606).—*See* SYPHILIS (*Treatment*).

Sjoqvist Method.—A plan for determining the amount of urea in urine, also known as the Mörner-Sjoqvist method; it consists in the use of a baryta mixture, the effect of which is to leave no nitrogenous body save urea in the urine; the nitrogen is next determined and the urea calculated therefrom. *See* Webster, *Diagnostic Methods*, p. 213, 1909.

Skin Diseases.

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BIER'S CONGESTION TREATMENT as used in various surgical conditions is also applicable to skin diseases. It will be found helpful in all acute and chronic suppurative conditions associated with the finger nails, and especially in the chronic indolent perionychia so often seen in delicate strumous children. A piece of lint is wrapped round the base of the finger, and then a thin elastic band applied for one hour night and morning. If any pain is caused it shows that the elastic band is too tight and should be loosened. By applying it to each finger separately better results are obtained than by putting on an elastic bandage higher up the limb. This method of treatment is also very

useful in cases of chilblains, acting both on the chilblains themselves and on the pain and itching which are so often associated.

A modification of this method of treatment is the use of a Klapp's cup, which consists of a glass cup like an ordinary cupping-glass connected by an indiarubber tube to an indiarubber ball. The cups are of various sizes. Their chief use is in the treatment of furuncles and carbuncles. The cup, after having its edge smeared with vaseline, is applied over the boil with one hand, whilst the indiarubber ball is squeezed with the other. The indiarubber ball is slowly allowed to expand till the cup adheres. Considerable suction is thus exerted on the diseased area and a local congestion produced. It causes a marked suction of lymph into the part, thus bringing the bactericidal bodies in the serum into better contact with the germs. If applied early over a threatening boil it often aborts it. After the boil has once formed, it acts best after the boil bursts or is incised, causing a much more rapid separation of the core than normal. It should be applied daily in successive short applications of five minutes, with about three minutes' interval between each application, gives better results than one longer continuous application. The total duration of the applications should be about half an hour.

For carbuncles the same method is to be used, and is found, besides having a curative effect, to give great relief from pain. It rapidly controls the spread of the process, and when using Klapp's cup no further incision as a rule is necessary and rapid healing takes place after the slough separates. Between the applications the boil or carbuncle is kept dressed with the usual boracic poultice.

REFERENCE. — MEYER and SCHMIEDEN, *Bier's Hyperæmic Treatment*, 1908.

RADIUM TREATMENT OF SKIN DISEASES.— Radium therapy is still in its infancy, as the quantities of radium as yet available are so small that comparatively few have been able to use it. The chief diseases in which it has been definitely proved to be useful are carcinoma, lupus, and nævi. Its use in the first two diseases has already been referred to. Of the pigmented nævi the flat ones are more amenable to radium than the prominent ones. In vascular nævi, especially the "port-wine stains," excellent cosmetic results are obtained. The treatment is slow and the duration and frequency of the applications must be determined by experiment with any given sample of radium.

STAPHYLOCOCCAL VACCINES IN SKIN DISEASES.—In the vaccine therapy of skin diseases no better results have been obtained in any set of diseases than those obtained in staphylococcal infections. Excellent results may be got in carbuncles and boils. As a rule a stock vaccine of staphylococcus aureus or a mixture of aureus and albus does quite well; but occasionally cases are met with which prove rebellious, and it is well in such cases to get a vaccine made from the patients' own organisms.

Injections of 250-500 million staphylococci are given every 14-18 days. It is agreed by nearly all that it is not necessary to have the treatment controlled by estimations of the opsonic index.

Sycosis is another disease where a suitable vaccine is often very successful. Everyone who has seen much of this disease knows how difficult it is to cure the condition. At the Edinburgh Royal Infirmary very good results have been obtained from vaccine treatment, but it is too soon to form a definite opinion as to the permanency of the cures. Local treatment by antiseptic ointments should of course be carried on in addition to the administration of the vaccine.

In acne vulgaris Allen says that the opsonic index to the staphylococcus is consistently below normal, and he recommends the use of a staphylococcal vaccine, beginning with doses of 250 million organisms and increasing up to 750 million, giving injections every 14 to 21 days. As the disease gets better the dose should be gradually diminished and given at longer intervals. As is to be expected, this method of treatment is only beneficial in cases where there is much suppuration, and it has no curative effect on the comedo and other early lesions.

REFERENCE. — ALLEN, *Vaccine Therapy and the Opsonic Method of Treatment*, 1908.

Sleeping Sickness (see *Encyclopedia and Dictionary of Medicine*, Vol. IX. p. 219).— In May 1901 Forde detected in the blood of a man suffering from chronic irregular fever an extra-corpuscular organism, which Dutton identified as a trypanosome, and thus for the first time demonstrated the occurrence of trypanosome infection in man. The observation was confirmed early in 1902 by Manson, who found a similar organism in a patient suffering from irregular pyrexia contracted in the Upper Congo. Dutton had named the parasite *Trypanosoma gambiense*, and the disease to which it gave rise "Trypanosome fever." In December 1902 Castellani observed the trypanosome in the blood of a sleeping-sickness patient, and in the ensuing year he detected it in the cerebro-spinal fluid of patients suffering from the disease. Dutton and Forde did not associate trypanosomiasis with sleeping sickness, and regarded the organism as a harmless parasite. Manson's patient, referred to above, developed symptoms of sleeping sickness and died in December 1903, and the diagnosis was verified on post-mortem examination by Mott. In March 1903, Colonel Bruce and Dr. Nabarro, subsequently joined

by Dr. Greig, arrived in Uganda to study sleeping sickness, and were met there by Castellani's report of his discovery of the trypanosome in the cerebro-spinal fluid. The subsequent work of the Commission, whose report is summarised here, conclusively settled the nature of sleeping sickness.

1. The cerebro-spinal fluid of every case of sleeping sickness taken by lumbar puncture during life contains trypanosomes. 2. Trypanosomes are found in the cerebro-spinal fluid of cases of sleeping sickness occurring outside Uganda. 3. Cerebro-spinal fluid from diseases other than sleeping sickness does not contain trypanosomes. 4. The peripheral blood of all cases of sleeping sickness contains trypanosomes. 5. The trypanosome of sleeping sickness and the trypanosome of trypanosomiasis are probably the same; if confined to the blood they give rise to slight fever, whereas if they reach the cerebro-spinal fluid they cause sleeping sickness. Trypanosome fever is therefore an early stage of sleeping sickness. 6. In an area infected with sleeping sickness a considerable proportion of apparently healthy natives harbour trypanosomes; in non-sleeping sickness areas not a single trypanosome is found. 7. When monkeys are inoculated with the blood or cerebro-spinal fluid from trypanosomiasis or sleeping sickness, they manifest symptoms of the disease, and trypanosomes can be recovered from their blood and cerebro-spinal fluid.

Sleeping sickness was introduced into Uganda from the Congo in 1900 and spread widely round the north shore of Lake Nyanza, being roughly limited to a 20-mile radius round the coast. The distribution, taken along with the nature of the parasite, led the Commission to conjecture that the infection might be conveyed by a biting insect, and on the analogy of Nagana they suspected a tsetse fly. The distribution of a species of tsetse (*glossina palpalis*) was found to correspond with that of the disease. Feeding experiments then showed that the tsetse fly could convey the trypanosome to monkeys.

Detection of Trypanosoma Gambiense.—The parasite is present in such small number in the peripheral blood as to render its detection in ordinary smears very difficult. Bruce adopted the method of repeated centrifugalisation, using about 10 c.c. of blood, to detect it. The greatest number of trypanosomes were found as a rule in the sediment of the third centrifugalisation; in this living trypanosomes can usually be seen with a low power. Details of the trypanosome are best brought out by Leishman's stain (*vide* p. 66), which is allowed to act for 10-15 minutes. The macronucleus appears red, the micronucleus black, the flagellum red, and the body protoplasm blue. When once the symptoms of sleeping sickness have developed the parasite is comparatively readily detected in the deposit obtained by centrifuging 10-15 c.c. cerebro-spinal fluid for half an hour. Enlargement of the lymph glands is an early sign of infection, and Greig made the important observation that the organism could be recovered with great ease from a drop of the gland juice removed by a hypodermic syringe.

Nature of Infection.—The trypanosome is introduced into the blood by the bite of an infected tsetse fly (*glossina palpalis*, and possibly other species), but not by other suctorial flies. It first reaches the lymph glands, causes a general adenitis, and thence enters the general blood and lymph stream. It lives in the fluids of the body, and does not enter the cells. In the later stage of the disease it gains access to the cerebro-spinal fluid. The trypanosome reproduces itself in the body by longitudinal fission. It does not leave the body by any of the natural channels, but is withdrawn by the bite of the tsetse. After one of these flies has fed on an infected subject, trypanosomes can be seen in its proboscis, and at a later period (up to 118 hours) they are still active in its stomach, but after 140 hours no live parasites can be seen. They do not undergo metamorphosis in the glossina, but apparently die, and are excreted by the intestine. The trypanosome rapidly loses its virulence in the glossina, and an animal cannot be infected by the bite of a fly longer than two days after the latter has fed.

T. gambiense has not yet been grown on artificial media; it is rapidly destroyed by a temperature of 45° C. Blood containing the organism loses its virulence forty-eight hours after withdrawal from the body. *T. gambiense* is pathogenic to monkeys, cats, dogs, guinea-pigs, rats, mice, and rabbits, but on the whole the disease is more chronic than in man; sheep, horses, and cattle are very slightly susceptible.

It was believed (on the analogy of what obtains in Nagana) that the game in a sleeping-sickness district harboured the trypanosome, and that the tsetse fly conveyed it from them to patients as well as from man to man. Koch has recently ascribed special importance to crocodiles as reservoirs of trypanosome infection. According to the Ninth Report of the Sleeping Sickness Commission of the Royal Society, however, there is no ground for supposing such to be the case.

There is reason to suppose that in man a second phase in the development of the trypanosome occurs, and a special line of treatment is based on this supposition (*vide infra*).

Symptoms.—The symptoms of the disease were well known before its cause was discovered, but since the parasite has been recognised it has become possible to make the diagnosis before the characteristic symptoms develop. After the organism enters the body a considerable time elapses before it gains

access to the cerebro-spinal fluid. Bruce puts this period at from three months to three years, and the chief symptoms during this the first stage of the disease are polyadenitis with early affection of the post-cervical glands, and in some cases irregular pyrexia. At this stage there are no other symptoms, and the lassitude characteristic of developed sleeping sickness is very insidious in its onset.

TREATMENT.—So far as is known trypanosomiasis is invariably fatal in man, though there is reason to hope that in the near future a remedy will be found. The remedies which appear to be most effective in checking the disease are arsenic, mercury, and trypan-red. These act by destroying the organism. Arsenic is now generally given in the form of atoxyl (see p. 120), which is administered intramuscularly in 5-10 per cent. solution. The initial daily dose may be ·2 gram of the drug, increasing by ·05 gram daily until ·8 gram is being given. If there are no toxic symptoms, this dose may be maintained for a fortnight, when the drug is gradually discontinued in the same manner as it was begun. Three or more such courses, at intervals of a few months, are advised. The dose of trypan-red is 5 grains; it may be given along or alternating with the atoxyl. Balfour reports favourably on the trypanocidal action of chrysoidine in doses of ½ grain daily.

Some interesting work in experimental therapeutics must also be referred to. Ehrlich finds that in animals trypanosomes may be caused to disappear temporarily by the administration of parafuchsin; after an interval the parasites are again found, and can again be banished by a second course of treatment. As time goes on, however, the trypanosomes are found to be less and less affected by the drug, which finally loses its effect. The trypanosomes have acquired immunity to it—have become "fuchsin-fast." Such fuchsin-fast strains of trypanosome (*a*) retain their immunity to fuchsin when injected into a second animal, (*b*) transmit their immunity through many generations (over a hundred, at least), but (*c*) are not immune to other trypanocidal drugs. In the same way "atoxyl-fast" and "trypan-red-fast" strains can be produced. These observations point to the advisability of giving trypanocidal drugs in large doses as early as possible instead of small doses spread over a longer time. It would also seem desirable to change the remedies used, as resistant strains may develop, and a remedy which proved efficacious when first administered may cease to have any trypanocidal action.

What promises to be a distinct advance in the treatment not only of trypanosomiasis, but of protozoal diseases generally, has been made by Moore, Nierenstein, and Todd. The principle underlying the method they recommend is that when an infecting organism shows two distinct phases in its life history, these two phases ought to be attacked by two different drugs, for it is probable that a drug which is operative against the first will be inoperative against the second, and *vice versâ*. These workers found (*a*) that one or two large doses of atoxyl drive the parasites from the blood of rats (trypanosoma brucei infection), but that fatal relapse is invariable; (*b*) that mercury alone has no effect on the trypanosomes ordinarily met with in the blood, but (*c*) that if rats infected with *t. brucei* have the parasite first expelled from the blood by atoxyl, and then receive injections of perchloride or iodide of mercury, a considerable number recover completely. Of 25 rats so dealt with, 2 died from trypanosomiasis, 4 died from other causes, 2 were killed and gave no evidence of infection, 17 survived (68 per cent.). The results of this combined treatment of sleeping sickness in man are, of course, still *sub judice*, but Boyce states that they are distinctly encouraging.

PROPHYLACTIC MEASURES.—Reports from Uganda seem to render the prospect of controlling sleeping sickness brighter than we have hitherto dared to believe. It seems that the distribution of *glossina* is peculiarly limited. The favourite natural habitat of the fly is near open water, with definite banks shaded by scrub and underwood. It does not infest swamps. The natural range of the fly is limited to a belt from 10 to 30 yards broad along the water edge, and it does not leave this area except when following, and feeding on, its victim. Even its "following range" does not seem at the outside to exceed 300 yards, and is usually less. Tsetse fly does not cross an artificial clearing 25 or 30 yards wide made in a natural fly belt. The chief prophylactic measures which are about to be tried, or have to some extent been enforced, in Uganda are—(1) Clearance of areas 30 yards broad along such portions of the lakeside, at fords, and other places frequented by natives. (2) Segregation of infected persons outside a fly area, so that flies may not act as carriers from them. (3) Provision of clothing for natives who are compelled to work in fly areas. (4) Prolonged treatment with atoxyl.

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Society (London: Stationery Office), Nos. 1 to 9 (No. 9 contains a general index to the whole series).

Soamin. — Sodium para-amino-phenyl-arsonate, or the sodium salt of amido-phenyl-arsenic acid, or atoxyl; it is recommended in syphilis, malaria, trypanosomiasis, anæmia, and certain skin diseases (*e.g.* psoriasis). *See* DRUGS, RECENT (*Atoxyl*).

"Solmedia."—A dry concentrated form of bacteriological culture medium. See *Lancet*, i. for 1910, p. 1206 (*Rep. Royal. Microsc. Soc.*).

Solurol.—An alleged uric acid solvent, being nucleotin phosphoric acid, a brownish-yellow, amorphous powder, soluble in cold water; the dose is 4 to 8 grains thrice daily. *See* Fortescue-Brickdale, *Newer Remedies*, p. 106, 1910.

Soma. — In the language of heredity, especially in Mendelism, the soma is that part of the animal or plant body which is separate and distinct from the propagative part; thus in the transmission of unit characters from parent to child, some may be passed on which the soma of either parent did not contain; they were, however, in the propagative part (*e.g.* in the gametes, ova, or spermatozoa).

Sophol.—An organic silver compound, being a formo-nucleinate of silver, a soluble brown powder, recommended in eye diseases as being a safe, non-irritating, and antiseptic remedy; solutions of from 2 to 5 or even 10 per cent. are used. See *Lancet*, ii. for 1910, p. 1143.

Spallanzani's Law.—The fact that regeneration of lost parts is more complete in the younger individual.

Spasmophile Diathesis. — This name has been used by Heubner, Thiemich, Finkelstein, and others to describe a very common affection of infancy, namely, that which is characterised by increased mechanical and electrical irritability of the peripheral nerves, by laryngismus, by convulsions, and by tetany. These four nervous manifestations are, as is well known, often associated with rickets. They are not, however, due to rickets, but are probably induced by the same kind of dietetic errors as tend to cause that disease.

The clinical features of infantile convulsions, laryngismus, and tetany have been described under these heads in the *Encyclopædia Medica*. Increased mechanical irritability of the peripheral nerves is most easily detected by tapping the cheek below, and a little in front of, the ear, whereupon, if it is present, a rapid twitch of the muscles about the angle of the mouth occurs. In well-marked cases almost any muscle in the body can be stimulated to contract in the same rapid way by tapping in the neighbourhood of its motor point. Increased mechanical irritability can be especially easily demonstrated in the biceps, extensors of the forearm, quadriceps, pectorals, and calf muscles. Facial irritability as described above (Chvostek's sign) must not be confused with the lip-reflex, a phenomenon described by Thomson (*Rev. Neur. and Psychiatry*, March 1903) and others. The lip-reflex consists of a pouting movement of the lips, which is produced in young infants by tapping near the angle of the mouth. It can rarely be elicited except during sleep, and is a normal phenomenon in the newly born, but tends to disappear about the third year. The lip-reflex is a quasi-purposive, co-ordinated movement, and both sides of the mouth pout in response to unilateral stimulation. Repetition of the taps has a cumulative effect on the movement of the lips.

In children who suffer from spasmophilia there is hyper-excitability of the nerves to galvanic stimuli, and the detection of this is held to justify the diagnosis even if neither tetany, eclampsia, laryngismus, nor facial irritability is present ("latent tetany"). Thiemich gives the following table of reactions. The values are in milliampères. The indifferent electrode (50 sq. cm.) was placed on the chest, and a Stinzing normal electrode (3 sq. cm.) was used as the active one. The median nerve at the bend of the elbow was tested.

	K.C.C.	A.C.C.	A.O.C.	K.O.C.
Average normal child	1·41	2·24	3·63	8·22
Manifest tetany. .	0·63	1·11	0·55	1·94
Latent tetany . .	0·70	1·15	0·95	2·23
Previous tetany .	1·83	1·72	>2·3	>7·9

The K.O.C. reaction is the most important. Values below 5·0 ma. are pathological, while values above 5·0 ma. are normal.

ETIOLOGY OF SPASMOPHILIA.—The cause of the spasmophile diathesis is not properly understood. It is very often associated with rickets, and is most common in the colder months of the year, especially the early spring. The symptoms are liable to be induced by two different faults in diet—the prolonged use of farinaceous food, and over-feeding with cow's milk. It is found, accordingly, that children with the spasmophile diathesis fall into two groups—the large, obese, over-fed infants, and the puny, ill-nourished, dyspeptic ones. The former are usually much more amenable to treatment than the latter. Spasmophilia is rare in breast-fed children; when it does occur in them it seems to be associated, in many cases at least, with over-feeding. Thiemich attaches great importance to a hereditary tendency which shows itself both by direct trans-

mission of the diathesis from mother to child, and by the occurrence of several cases in a family.

Finkelstein, endeavouring to ascertain which constituent of milk was harmful, concluded that the whey must be blamed. It is most probable that the disease is in some way connected with faulty calcium metabolism. Here, again, there are two opposing theories: on the one hand Stoelzner asserts that it is a sort of calcium poisoning, while Guest, Sabbatani, and others believe that the tissues are suffering from calcium starvation. More recently attempts have been made to show that tetany, at least, is due to disturbance of parathyroid function by hæmorrhage into the glands (Yanase, Escherich), and MacCallum's work suggests that animals suffering from tetany following parathyroidectomy are in a condition of calcium starvation. On the whole, the majority of observations point in the direction of there being deficit, rather than excess, of calcium in the tissues, and Stoelzner's theory has few supporters. *See also* PARATHYROIDS.

TREATMENT.—The first step is to correct any digestive disturbance which may be present, and for this purpose a dose of castor oil, followed by powders containing a grain of grey powder, half a grain of rhubarb, and a few grains of sodium bicarbonate may be given. Next, the diet requires attention. Breast milk is best, if it can be obtained. Failing this, the diet selected will depend on the previous feeding, and on the nutrition of the child. In obese, over-fed babies, which have habitually consumed excessive quantities of milk, the diet should be restricted for a day or two to a cereal decoction such as barley or rice water, and then limited to carbohydrates (Mellin's or Savory & Moore's food) for four or five days longer. At the end of this time milk is cautiously added. The chief point is to avoid over-feeding. In ill-nourished children the indication is to fatten the patient; if the diet has previously consisted of carbohydrate the indication is to fatten the child; if his diet has contained an excess of carbohydrates this should be diminished, replaced by milk. Cod-liver oil should also be given. If the convulsions are severe and recur frequently a sedative is required. Chloral (i.-ii. grs.) and antipyrin (gr. i.) are more useful than bromides. Phosphorus and cod-liver oil (1:10,000) is extolled by Finkelstein.

Cold douches are most useful in checking the tendency to convulsions. After the infant has had his bath one or two spongefuls of cold water are squeezed over the neck and spine, and then the body is quickly dried with a warm towel. Douching in this way is often very effectual in curing the manifestations of spasmophilia.

The prognosis is not unfavourable; most cases recover. It is worst in poorly-nourished infants, and in cases in which there is much laryngismus. Children suffering from the spasmophile diathesis have less resistance than healthy ones, and if by chance they contract pneumonia or bronchitis matters often go hardly with them.

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Spasmophilia. — *See* SPASMOPHILE DIATHESIS.

Spengler's Method.—A method of sedimentation for sputum, especially when it is very thick and tenacious; equal parts of sputum and lukewarm water which has been alkalinised with sodium carbonate solution are mixed; next, from 0·1 to 1 gram of pancreatin powder is added and the mixture shaken; then from 0·2 to 1 gram of crystallised carbolic acid is added, and the mixture placed for a short time in the incubator at 37° C.; finally, the supernatant fluid is poured off and the sediment examined (for tubercle bacilli, etc.). *See* Webster, *Diagnostic Methods*, p. 21, 1909.

Spermatoxins. — The cytotoxins which are developed in one animal when the spermatozoa of another species are injected into it, *e.g.* when the spermatozoa of bulls are injected into rabbits.

Sphacelotoxine.—A constituent of ergot, now believed to owe its activity to ergotoxine.

Sphingomyelin. — One of the phosphatides, the most important constituent of protagon (found in brain substance).

Sphygmomanometer. — *See* BLOOD PRESSURE.

Sphygmo-Oscillometer.—An instrument, devised by Dr. V. Pachon, for the clinical estimation of blood pressure, and the study of the variations which occur in the cardiac cycle as manifested by the pulse wave; it is described in detail (*with illustrations*) in the *British Medical Journal* (ii. for 1910, p. 1765).

Spinal Anæsthesia. — *See* ANÆSTHESIA AND ANÆSTHETICS (*Spinal*).

Spinal Cord, Surgery of.

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AMONG the chief contributions which have been made to the surgery of the spinal cord during the past quinquennium, papers dealing with the possibility of treating transverse wounds by suture, with the operative treatment of tumours, and with the relief of certain forms of meningitis, may be mentioned.

Suture of the Cord.—The possibility of successfully suturing a divided cord has been discussed by Haynes (*New York Med. Journ.*, 22nd Sept. 1906). He deals especially with injury due to bullet wounds, and reports a successful case of myelorraphy. Laminectomy is indicated:—(1) To remove the bullet, or other foreign bodies; (2) to remove clots and arrest hæmorrhage; (3) to allow drainage in traumatic œdema and sepsis; (4) if paralysis is advancing; and (5) to suture the cord. He discusses:—(1) The anatomical possibility of suturing the cord, and states that it is feasible when the ends are separated by three-quarters of an inch; (2) the possibility of a severed cord uniting, quoting cases of stab, and experimental section in animals to prove that it does occur. He points out that in every case of complete transverse lesion of the cord not operated on the patient dies in less than a year, and argues that all patients with complete division should be operated on at the earliest moment after recovery from the immediate shock of the injury before degeneration takes place. The following are the main points in the technique of the operation:—The dura is exposed by laminectomy, from three to five vertebræ being dealt with; it is opened to the full extent of the wound and four traction sutures are placed on its cut edge. After removing the bullet, and washing away clots with a stream of saline, the cord is brought into view by raising the dura by the stitches. The bruised ends are carefully trimmed off, and the ends coapted by fine chromic gut sutures introduced well away from the ends. One suture may be placed antero-posteriorly and two transversely. To aid in coapting the ends the head and thighs should be fully extended. In the upper dorsal and cervical regions greater motility of the ends of the cord may be obtained by dividing the attachment to the dura of two pairs of serrations of the dentate ligament above and below the site of the lesion. When the sutures are drawn tight the dura is closed by two loose sutures and drained with strands of gut.

Murphy (*Surgery, Gynæcology, and Obstetrics*, April 1907) is not at all sanguine as to the possibility of suturing a divided cord. He lays it down that when the true cord is divided suture is useless, because functional regeneration of the grey matter and columns cannot occur. Only in injuries below the 11th dorsal vertebræ is there any prospect of successful union, because here we have to deal with the cauda equina, which consists essentially of peripheral nerves whose neuraxones are covered with neurilemma, and may therefore regenerate as a motor nerve does. The afferent nerves in the cauda equina are also capable of regeneration after accurate suture.

Tumours of the Cauda Equina.—The symptoms of tumour of the cauda closely resemble those of certain other conditions—hysteria, multiple neuritis, disease of the lumbar or sacral vertebræ, intra-pelvic tumour, hæmorrhage or tumour of the conus, and extradorsal lesions (Spiller, *American Journal Medical Sciences*, March 1908). The development of symptoms is very gradual, beginning with pain and loss of reflexes in the lower limbs, followed by paralysis, and anæsthesia especially in the perineum, genitalia, and around the anus. The pain is often unilateral at first, but as a rule soon becomes bilateral. If the tumour develops at the lower end of the cauda, it will implicate the nerves supplying the bladder and rectum. In *hysteria* a differential diagnosis is usually possible after carefully going into the case. *Multiple neuritis* is very rarely confined to both sciatic nerves and their branches — double sciatica is usually indicative of tumour; multiple neuritis of the lower limbs is often alcoholic, and the tenderness over the calves is very diagnostic; the bladder is very seldom implicated. *Intrapelvic tumour* may simulate a lesion of the cauda; the nerve plexus in the pelvis are much more spread out than the roots in the cauda, hence the symptoms are more likely to be unilateral. In pelvic lesions a tumour may be felt *per rectum;* the motor and sensory symptoms are more likely to synchronise than in caudal lesions, because in the pelvis motor and sensory fibres are combined in the nerves, whereas in the cauda they are separate. In *tumours of the vertebræ* pain is very prominent, and is likely to become bilateral sooner than in pelvic tumour. Pressure over the lower vertebræ or sacrum may be exceedingly painful. The fact that the symptoms are likely to be at first confined to the distribution of a few nerve roots when the tumour begins in a vertebra is of some differential value in the diagnosis from tumour of the cauda.

Lesions of the Conus. — The nerve tracts occupy so small a space that a lesion is likely to implicate most of them simultaneously. The symptoms are very much the same as in lesions of the cauda, the affection of the bladder and rectum, however, being of more constant and early occurrence. There is less pain in conus

lesions, and it does not radiate so widely as in root lesions.

Surgical Intervention. — Notwithstanding Müller's opinion that the prognosis from surgical intervention on the sacrum and lumbar vertebræ is better than on the other vertebræ and cranium, the results of operation for tumour of the cauda are not good. Six cases have died after operation, and in five there has been some benefit. The tumours are usually such as to make complete removal impossible—the well-defined fibromata, or fibrosarcomata, occurring at higher levels in the cord are rare in the caudal region. They are usually infiltrating sarcomata. It may, however, be possible to relieve pain by dividing posterior roots.

The whole question of the surgical treatment of tumours of the spinal cord and cauda equina is very fully discussed by Sturzberg in a critical review in the *Centralblatt f. d. Greuzgebiete d. Medizin u. Chirurgie*, 1908, Nos. 3, 4, 5, 6, and 7. According to his very complete statistical survey, the best prospect is afforded by tumours in the dorsal region, 46 per cent. of which were cured, or permanently improved by operation. In the case of tumours of the cervical region only 36 per cent. come into the above category, and in the case of lumbar, sacral, and caudal tumours only 16 per cent. The operative treatment of tumour is most dangerous in the cervical region (40 per cent. of deaths), next comes the dorsal region with a mortality of 26·4; last, the lumbar region and below with 16 per cent. The general conclusions arrived at are:—(1) Operation does good in about half of all cases, and produces permanent cure, or permanent improvement, in about one-third. The mortality is about 30 per cent. (2) Neglect to operate in the presence of a certain or highly probable tumour, which is not definitely recognisable as malignant, is a serious failure of duty. (3) When the diagnosis is doubtful, an exploratory laminectomy should be performed if there is any possibility of the existence of an operable tumour.

Resection of Posterior Roots for the Relief of Spasticity (Spiller and Frazier, *Univ. of Pennsylvania Medical Bulletin*, Jan. 1910).—By cutting the posterior roots an artificial tabes is produced—hypotonia, ataxia, loss of tendon reflexes, and shooting pains result. Most of these symptoms, particularly the pains, are temporary. The hypotonicity depends on the number of roots divided. The operation is permissible in almost every case where spasticity is great and motor weakness slight, provided the condition of the patient justifies it, whether the lesion be spinal or cerebral, unilateral or bilateral. It is useless where motor palsy is great. A case is recorded in which the operation was extremely beneficial. The voluntary power was about normal, but spasticity was extreme. The legs could not be separated, walking was impossible without the aid of sticks, as the patient stood his heels did not touch the ground on account of the spasticity of the calf muscles, the patellar tendon reflex was so exaggerated that a tap on the tendon threw the leg into closure. After the operation he could walk much better, could separate the thighs normally, could put his feet flat on the ground, and could go upstairs alone. The operation was performed under spinal (stovaine) anæsthesia by Dr. Frazier, the second, third, and fifth lumbar sensory roots being divided. Among technical details of the operation, stress is laid on the necessity for lowering the head and shoulders below the level of the pelvis to reduce the escape of cerebro-spinal fluid and to minimise hæmorrhage from the plexus of dural veins. For identifying the roots Förster's plan is simple and practical. Before the spinous processes are removed a pin or suture is introduced into the skin to one side of the incision on a level with the spinous process of the fifth lumbar vertebra. This corresponds to the level at which the first sacral nerve leaves the dural sac. Resection has also been undertaken for the relief of the crises of tabes (*Flörchen, Münch. med. Woch.*, 5th July 1910); the results are said to be good.

Chronic Spinal Meningitis—Circumscribed Serous-spinal Meningitis.—The credit of having emphasised the importance of a form of chronic meningitis of obscure origin is due to Sir Victor Horsley in this country (*Brit. Med. Journ.*, 1909, i. p. 513) and Dr. Spiller in America (*Amer. Journ. Med. Sciences*, Jan. 1909). The condition had previously been described by Spiller, Krause, Oppenheim, and others, but the point of practical importance which Horsley more especially brings out is that they are extremely amenable to operative treatment. Horsley has operated on twenty-one cases of the disease, in most cases with very marked benefit. Chronic spinal meningitis gives rise to symptoms resembling those of tumour of the cord. An adult (the disease is very rare before puberty) begins to complain of pain and progressive loss of power in the legs, and perhaps also a slight degree of kyphosis; he ultimately develops a progressive paraplegia, which runs the ordinary course and terminates fatally. Horsley has only had an opportunity of examining two cords, one of a patient who was not operated on, and one of a patient who had undergone laminectomy and died six weeks later of a cardiac lesion. In both a meningo-gliosis was found. The spinal cord was contracted, and exhibited typical glial sclerosis.

All the cases Horsley has seen have been sent to him with the diagnosis of tumour of the spinal cord, or disease of the vertebræ, but there are certain features which should lead to their being recognised as chronic meningitis and not tumour. In the first place, contrary

to what one might *à priori* expect, the symptoms (and the lesion) generally display a certain amount of unilaterality. Hence, finding that a case of paraplegia has had a unilateral origin should not prejudice the diagnosis in favour of tumour. Pain generally begins first in one limb, spreads to the other, and then up the back. There may be girdle pain. Anæsthesia is never complete, nor is there dissociation of sensation, because, the lesion affecting the roots, all form of impulses are caught together. Hyperæsthesia, extending over a large area—the whole of a limb—is common. The sensory disturbances, as a whole, are suggestive of the implication of a larger number of roots than in cases of tumour. Paralysis comes on gradually, and affects a whole limb at once; there is no restricted root paralysis. There may be early spasticity. In contradistinction to tumour cases, these patients show few trophic disturbances, except perhaps terminal bed-sores. In the large majority of Horsley's cases the meningitis began over the lower half of the back of the cord, and most were operated on (in consequence of the need of exposing the highest segment of the cord symptomatically involved) in the mid-dorsal (4th to 9th) region. With one exception all the patients were adults. The prognosis depends largely upon the age; below or at middle life recuperation is likely to be good; above that poor. Horsley's oldest patient was sixty; she did not improve after operation.

Pathology.—There is in these cases excess of cerebro-spinal fluid, thickening of the arachnoid, and matting of the nerve roots. The cerebro-spinal fluid, it will be remembered, is manufactured high up—by the lining membrane of the cerebral ventricles and choroid-plexus—under positive pressure, and escapes by the lymphatics along the nerve roots. In these cases the large collection of cerebro-spinal fluid around the spinal cord is under considerable pressure. At operation the theca bulges, and does not exhibit respiratory movements. The improvement which follows free opening of the theca and washing outs suggests that the pressure *per se* plays an important part in damaging the cord and producing symptoms. In an average (not early) case the cord appears shrunken, but the pathological changes are unknown, except in the two instances referred to, in which there was a general sclerogliosis of all the columns. Some cases certainly are, and a considerable number probably are not, syphilitic. The only case in a young subject (aged twelve) was probably due to hereditary syphilis. There is some evidence that gonorrhœa may play a part in the etiology.

Treatment.—The treatment adopted by Horsley was simple laminectomy, opening the theca and washing out the theca with a mercurial lotion. If there is much exudation, a solution of sublimate, 1-500, followed by 1-2000, may be used. The skin wound should be closed, not drained. The theca should not be sutured. If it is left open patients have less discomfort, pyrexia, and tachycardia after the operation; and possibly an artificial fistulous opening remains between the spinal canal and the lymphatics in and around the muscles. After the skin wound is healed free mercurial inunction of the spine is indicated.

The literature of circumscribed serous meningitis is referred to by Spiller (*op. cit.*); his paper is a short *résumé*, chiefly from the pathological point of view. A critical digest by Adler will be found in the *University of Pennsylvania Medical Bulletin*, March and April 1903, and a paper by Mendel and Adler with literature in the *Berlin klin. Woch.*, 31st August 1908.

Spinal Rigidity.—*See* SPONDYLOSE RHIZOMÉLIQUE.

Spinal Tapping.—*See* EMBRYOTOMY (*Hydrocephalus*).

Spine, Typhoid.—*See* TYPHOID FEVER (*Symptomatology*).

Spirosal.—The monoglycolic ester of salicylic acid, used as an external application in acute and chronic rheumatism, sciatica, lumbago, etc.; it is colourless and odourless, and readily soluble in alcohol, ether, or chloroform, and so it may be applied dissolved in rectified spirit; it is said to be non-irritating. See *Lancet*, ii. for 1910, p. 35.

Splenocytes.—The large mononuclear leucocytes of the blood; they are supposed to be derived from the spleen.

Spondylitis Typhosa.—Typhoid spine. *See* TYPHOID FEVER (*Symptomatology*).

Spondylose Rhizomélique (SPINAL RIGIDITY).—The name *spondylose rhizomélique* was applied by Marie to a particular group of cases of spinal rigidity to demarcate them from other cases in which the same symptom is a leading feature.

The general symptoms of this, and other forms of spondylitis, are, rigidity of the spinal column, either throughout its whole length, or in part, and in some cases ankylosis of the larger joints of the extremities. The rigidity of the spine may be so great as to abolish entirely all movement—lateral, antero-posterior, or rotary; there is generally, but not always, well-marked kyphosis of the cervico-dorsal region. In the type described by Marie as rhizomelic spondylosis there is ankylosis of the spine and of the hip and shoulder joints, and sometimes of the

ribs, leading to flattening of the chest and an abdominal type of respiration. The lesions resemble those of osteo-arthritis. There is no affection of the cord. In another form of spinal rigidity, previously described by Bechterew, the ankylosis is limited to the upper part of the vertebral column, and there is thickening of the cervico-dorsal meninges, causing atrophy of the spinal ganglia and degeneration of the nerve roots and posterior columns. The onset of this type is sudden; there is a hereditary predisposition, and often a trauma. For these reasons it is known as Bechterew's heredo-traumatic kyphosis. In addition to the spinal rigidity it is characterised by the existence of nervous symptoms—pain, paræsthesiæ, a wasting of muscles. Bechterew regards the cord lesion as the primary event.

There is much reason to doubt whether the two types sketched above are really so distinct from each other as to justify their description under separate names. Mixed forms have been described by Gordon and others—*e.g.* rigidity of the entire spine with joint involvement plus signs of cord lesion. Hunter recognises four groups of cases of rigidity of the spine (spondylosis). 1. Rheumatoid arthritis, in which there is ankylosis of other joints with osteophytes, generalised atrophy of muscles, fibrillary twitching, and sensory disturbance—in short, the features characteristic of rheumatoid arthritis. The onset is gradual; the disease begins either in the limb or spine. 2. Spondylosis following repeated attacks of rheumatism, or gonorrhœa. The spine is rigid; the ankylosis of the joints elsewhere is fibrous rather than osseous; there are no osteophytes (Marie's type). 3. Cases arising from a trauma, such as a fall on the buttocks or shoulder. There is no evidence of direct injury to the spine at the time of the accident, but some weeks later ankylosis begins (Bechterew's type). 4. Senile ankylosis in old people whose occupations have necessitated much stooping. A. E. Garrod doubts whether the several types described should be classed as separate maladies. He gives considerable prominence to the nerve-root symptoms in the clinical picture of the disease, but states that the manner in which pressure on the roots occurs requires further elucidation.

REFERENCES.—Gordon, *Med. Rec.* (New York), 13th Feb. 1904.—Hunter, *Glasgow Med. Journ.*, March 1907.—A. E. Garrod, Allbutt, and Rolleston's *System of Medicine*, 2nd ed., vol. iii. 1907.—Marie, *Nouvelle Icon. Salpêtrière*, i. p. 32, 1906.

Spondylotherapy.—*See* Abrams's Heart Reflex.

Sporotrichosis.—A disease due to the fungus *sporotrichum*, described by de Beurmann in 1903; it is said to produce a great number of cutaneous lesions (resembling those of syphilis and tuberculosis), and may affect also the internal organs (larynx, bones, joints); Bloch has obtained a cutaneous sporotrichin reaction (*Beihfte. z. med. Klin.*, v. p. 179, 1909).

Sporozoa.—*See* Protozoa.

Stage-Decompression.—*See* Caisson Disease.

Stalagmometer.—An instrument for counting drops. *See* Cancer (*Cancer Reactions*).

Standard Liquid Malt Extract.—A proprietary food preparation, recommended in doses of two teaspoonfuls twice or thrice daily, in the conditions for which malt extract is usually prescribed. *See* analysis in *Brit. Med. Journ.*, ii. for 1909, p. 1478.

Stercobilin.—The principal pigment of the fæces, probably identical with urobilin.

Stereotypism.—*See* Dementia Præcox.

Sterilisation, Sexual.—*See* Degenerates, Sterilisation of.

Still's Disease.—A variety of arthritis deformans in children, differentiated by G. F. Still; the condition of the joints (resembling rheumatoid arthritis) is associated with enlargement of the lymph glands and spleen.

Stomach, Acute Dilatation of the.—Acute dilatation of the stomach is a rare occurrence. It has been ascribed to sudden paralysis of the vagus, but is probably in most cases due to obstruction of the duodenum, and a knowledge of the mechanism by which it is brought about is important, because if the condition is properly treated many cases which would otherwise die may recover completely. The symptoms of acute dilatation are sudden vomiting accompanied by intense pain, marked abdominal distension, chiefly in the epigastric region, and collapse. The vomit is copious, and usually bile-stained, seldom feculent. There may be splashing sounds in the epigastrium, but visible peristalsis is rare. Death occurs in from a few hours to two days unless the condition is relieved. In a series of 102 cases collected by Conner the mortality was over 70 per cent. Acute dilatation is favoured by several groups of antecedent circumstances:—(1) Operations (not necessarily abdominal) under general anæsthesia. (2) Wasting diseases, or convalescence from an acute illness. (3) Injuries of the spine. (4) Excess in eating or drinking, especially copious draughts of cold fluids. (5) Spinal deformities. It some-

times occurs without any apparent cause in healthy persons. Nearly half of Conner's series of cases followed operation. It seems that the most important cause of acute dilatation is incarceration of the duodenum between the root of the mesentery in front and the spinal column behind. Normally, the terminal part of the duodenum is slightly flattened between the mesentery and the vertebral column, and if from any cause the small intestine is pulled down and backwards, towards the pelvis, the gut may be occluded. Acute dilatation is therefore rendered possible by such conditions as (*a*) favour compression against the spine—*e.g.* lordosis of the lumbar vertebræ—and (*b*) facilitate the descent of the small intestine into the pelvis. In order that the latter may take place the mesentery must be long, the intestines must be empty (as after an operation), and the patient must be lying on his back. The possibility of the occurrence of chronic duodenal obstruction by the mesentery is suggested by Codman. He thinks it may cause duodenal stasis, and hunger pain.

The treatment for acute dilatation must be prompt. The stomach should be washed out and the patient placed in the genupectoral position and kept in that attitude for several hours, so as to facilitate the return of the prolapsed small intestine from the pelvis. Smith reports a case which was cured by turning the patient over on the abdomen and raising the foot of the bed 12 inches. A high enema was also given. The patient responded quickly to this treatment, which has obvious advantages over the prolonged maintenance of the knee-elbow position.

REFERENCES.—Conner, *Amer. Journ. Med. Sci.* (literature), March 1907.—Smith, *Journ. Amer. Med. Assoc.*, 14th Sept. 1907.—Laffer, *Annals of Surgery*, Feb.-April 1908.—Codman, *Boston Med. Surg. Journ.*, 16th April 1908.

Strauss' Method.—A qualitative test for lactic acid in the gastric contents, depending on the action of ether and ferric chloride solution. *See* Webster, *Diagnostic Methods*, p. 71, 1909.

Strophanthin.—The name given to several preparations of the glucosides of strophanthus; there are three varieties, differing chemically, physically, and physiologically: (1) strophanthin gratus, crystallised strophanthin or pseudo-strophanthin (of the B.P. Codex); (2) amorphous strophanthin of Merck, weaker in action than the crystalline form; and (3) amorphous strophanthin of Boehringer, still less active physiologically. Great care must, therefore, be taken in prescribing these drugs. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 117-121, 1910.

Strophanthone.—A preparation, described as an "aseptic, non-alcohol, stable preparation of the active principles of genuine strophanthus seed"; it is standardised physiologically, and it is stated that 20 c.c. of it represent 1 gramme of strophanthus; the dose is 8 minims hypodermically, and 15 minims (1 c.c.) by the mouth.

Stump-Pregnancy.—*See* Ectopic Pregnancy (*Tubal*).

Styptol.—Cotarnine phthalate, a yellow crystalline powder, soluble in water; it has been recommended in doses of $\frac{3}{4}$ to $1\frac{1}{2}$ grains, as a vaso-constrictor in various forms of uterine bleeding, and it is said not to possess the ecbolic action of ergot, and therefore to be capable of employment in pregnancy. See *Brit. Med. Journ.*, i. for 1910, p. 388.

Subinfection.—The name given to the condition in which bacteria are taken into the system from the alimentary and respiratory tracts, and destroyed in the various tissues and organs without proliferating. *See* Adami, *Pathology*, i. p. 462, 1910.

Submucous Resection (Nasal).—An operation on the nasal septum introduced in 1904 by Killian and Freer, for the correcting of deviations; the operation may be done under a local anæsthetic (*e.g.* cocaine) or a general one; if the deviation of the septum bulge into the right nasal fossa, the incision is made on the right side on the convex side of the bulge from just above the vestibule down to the floor of the nose, passing through mucous membrane and perichondrium down to the cartilage; an elevator is then passed in, and the membrane is raised from the cartilage by its means; the cartilage is next cut, or scratched through in the line of the original incision till the perichondrium on the opposite (concave) side of the bulge comes into view, when the elevator is again introduced and the cartilage raised from the perichondrium and mucous membrane on this (left) side also; the plate of cartilage is now cut out, and the two muco-perichondrial flaps apposed, and the original (single) incision closed with a few (horsehair) sutures; the difficult part of the operation is the separation of the muco-perichondrium from the cartilage on the concave side of the bulge without making an opening into the fossa of that side. *See* H. Bell Tawse's description and review of 120 cases in *Lancet*, ii. for 1910, pp. 91-94; T. J. Fauldner, *Brit. Med. Journ.*, ii. for 1910, p. 1305.

Suction Cups.—*See* Bier's Method.

Sudanophiles.—The name given to

fattily degenerated forms of leucocytes in which the fat globules stain with osmic acid, and with Sudan, iii.

Sulphohæmoglobinæmia. — *See* ENTEROGENOUS CYANOSIS.

Sun Bath.—Exposure of the unclothed body to the action of the sun's rays as a therapeutic measure. *See also* SAND BATHS, and, for injurious effects, *Lancet*, ii. for 1909, p. 896.

Supersensitisation.—*See* ANAPHYLAXIS; IMMUNITY (*Theories*).

Supra-Acromiotomy. — *See* EMBRYOTOMY (*Cleidotomy*).

Suprarenalin.—One of many trade names for the active principle of the suprarenal gland.

Suprarenin.—One of many trade names for the active principle of the adrenal.

Suprasymphysary Section. — *See* CÆSAREAN SECTION (*Methods*).

Surgery, Asepsis in.

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DURING the years which have elapsed since the writing of the article on ASEPTIC TREATMENT OF WOUNDS (i. pp. 291-300), the principles upon which the aseptic procedure are based have perhaps changed little; but the details representing the translation of these principles into action have been altered or modified several times and in many ways. Consequently, the greater part of this article will be concerned with alterations in technique.

GENERAL PRINCIPLES.—There is no doubt that, at the present time, the aseptic methods, as they are called, have almost driven antiseptic plans from the field; but there are not wanting some surgeons who think the pendulum has swung too far in that direction, and who are lifting up their voice against the extremists. In the Bradshaw lecture given in the close of 1908 (*Lancet*, ii. for 1908, pp. 1797-1804) Sir Watson Cheyne reminded the profession that whilst Lister had proceeded on the main principle of preventing as far as possible the entrance of bacteria into wounds he had also placed stress on the avoidance of undue irritation of the latter in the process; his ideal had been efficient exclusion of bacteria with as little irritation of the wounded surfaces as could be secured. Some of the followers of Lister, however, had forgotten the second requisite of successful healing and had deluged their wounds with carbolic acid, thinking that if this were done all other precautions (especially the cleansing and re-cleansing of the operator's hands) might be neglected; the tissues were thus rendered germ-free at the time, but their vitality was so impaired that they readily became the seat of infective processes at a later date. Sir Watson Cheyne believes that the excessive use of antiseptics was one of the causes which led surgical opinion to the other extreme of rigid asepsis; but there were other causes, such as the statements, constantly made, that satisfactory results could be obtained by ordinary cleanliness (true enough of operative work in the peritoneal cavity), that antiseptics by their slow action on spores were inefficient under certain conditions, that the skin could not practically be disinfected (that gloves, therefore, were necessary), and that the resisting power of the tissues to the invasion of germs was very great. The Bradshaw lecturer criticised these statements and maintained that antiseptics should not be discarded altogether, that their judicious use was advisable and important. Trusting, as he did, to the disinfection of the skin of the patient and of the operator by means of carbolic acid he did not think that sterilised rubber gloves were absolutely essential; but he regarded them as an extra precaution adding security against carelessness in hand-disinfection, and as an absolute necessity for those who used aseptic methods only. He looked on boiling as a more satisfactory method of disinfecting instruments than the placing of them in 1 in 20 carbolic lotion; but since the former plan tended to blunt knives, scissors, and needles, he preferred to immerse these things in undiluted carbolic acid for a short time and then in 1 in 20 solution carbolic solution. This he thought was the safest plan, for even boiling was not instantaneous in its action. Sir Watson Cheyne thought that the use of marine sponges, although discarded by so many surgeons for that of swabs, was quite justifiable if they were immersed in 1 in 20 carbolic lotion for a week before employment; swabs did not absorb fluid readily, and threads from them were apt to be left in the wound. He criticised aseptic plans during a long operation, pointing out that dry sterilised

towels, instruments kept in salt solution, and the hands of the operator might easily become infected by dust, etc., and that antiseptic solutions were useful in preventing or correcting this failure of technique. For the same reason (risk of infection during operation) he recommended the placing of catgut in undiluted carbolic acid for a few hours, and then in 1 in 20 lotion for a week; before use the carbolic was soaked out in a weak sublimate solution. He thought, further, that drainage of wounds by tubes so widely replaced by drainage by gauze should be reconsidered, especially in cases in which pus was present. He criticised the after treatment of wounds with dressings which had been sterilised (often imperfectly) by heat but which contained in themselves no antiseptic, and attributed stitch abscesses to their use. The main contention was that antiseptic methods should not be entirely abandoned in favour of so-called aseptic ones, and that such an abandonment if carried out rigorously introduced unnecessary complications; the sterilisation of towels, instruments, etc. by boiling, and of dressings by superheated steam added security, but was insufficient by itself without the use of chemical disinfectants.

In a more recent article (*Lancet*, i. for 1910, pp. 15-18) Sir Watson Cheyne reiterates his warnings against the neglect of chemical antiseptics and the trusting entirely to aseptic plans. He believes that there is extravagance in the fittings of operating theatres, and that there may be much simplification of technique by the use of antiseptic solutions and the like. His contention that placing instruments on a dry sterilised towel during a lengthy operation does not keep them sterile, more especially if the operator himself does not re-sterilise his hands or gloves, seems a just one. Doubtless the weak point in the aseptic principle is the absence of effective re-sterilisation during operation and the exaggeration of the value of boiling and especially of short periods of boiling. The line of advance in the immediate future would seem to be the utilisation of the best in both plans of procedure, the aseptic and the antiseptic. In the long run the decision as to the best method must be founded on statistics, and into statistics there enters always the disturbing element of the individuality of the operator; the strictest asepsis in his surroundings will not save the surgeon who is careless as to his hands, and he who is scrupulously careful in this respect will get good results with a comparatively inadequate armamentarium in an old-fashioned operating theatre.

But not only is there the individuality of the operator, there is that of the patient, and it is significant of the changing times that Sir Frederick Treves and Mr. Hutchinson begin their *Manual of Operative Surgery* (3rd edit., vol. i. 1909) with a chapter on "The Patient," and quote Sir James Paget's words: "Never decide upon an operation, even of a trivial kind, without first examining the patient as to the risks of his life. You should examine him with at least as much care as you would for a life insurance." There is need for this precaution, for antisepsis and asepsis have so lessened the risks arising from the operation *quâ* operation as to obscure in the surgeon's mind the dangers that may lurk in the patient's constitution or habits; and yet these dangers are real, as Sir Frederick Treves found when he snipped off a small fibrous epulis from the gum of a little boy, who was then discovered to be the subject of hæmophilia. It is a fact to be borne in mind that the strong, robust man or woman who has never known a day's illness in his or her life does not make the best patient for operation; indeed, the feeble man or woman who has been for weeks in bed, and is, as it were, acclimatised to invalidism, will often pass satisfactorily through a severe operation. Fat and plethoric people of middle age make bad subjects, and so, most emphatically, do alcoholics; rheumatism and gout, cancer and anæmia, on the other hand, do not interfere with wound-healing; syphilis also, as as a rule, is no contra-indication to operation. Leucocythemia, however, and diabetes are most unfortunate complications of operation. Pneumonia, one of the exanthemata, or any other acute disease, makes operation dangerous; and the influence of heart disease, kidney disease, liver disease, and, to some extent, of pulmonary maladies (*e.g.* chronic bronchitis), has to be borne in mind by the surgeon. It is more than likely that the line of surgical advance in the immediate future will be in the direction of preparing or fortifying the patient against microbic attack, without at the same time diminishing any of the precautions, aseptic or antiseptic, which are now taken.

Special Technique.—*Operating Room.*—The introduction of strict asepsis into surgical practice has brought with it changes in the construction of the operating theatre, and in its fittings and adjuncts, which can only be called revolutionary. Some of the new operating rooms in modern hospitals have cost large sums of money, disproportionately large when we have regard to the actual improvement in results which can be claimed to have proceeded therefrom. In some cases it is not a single room one has to do with, but a suite; there is the operating theatre proper, a room off it for sterilising the patient, another for anæsthetising him, another for the assistants and dressers preparing themselves, and another for the surgeon's requirements. The theatre has walls and a floor of tiles or polished cement (wood, unless of a very hard type, is rigidly excluded), and there

are no angles in which dust can lodge, for all the corners are rounded; the floor has a slope so that fluids can run towards an escape pipe or drain, which facilitates the washing of the place by means preferably of a hose pipe; the fittings are all of metal, of marble, or of glass; the operating table, instrument cabinet, table for ligatures and sutures, the sisters' table (for lotions, etc.), the sterilisers, the boxes for dressings, and sometimes even the spectators' gallery, all run easily on wheels; the lighting is from a large north window and the roof, and by means of electric light so arranged as to be brought close to the field of operation; and the heating is largely by hot water or steam pipes, and to some extent also by warm filtered air, whilst the vitiated air is drawn out by means of an electric fan. If gas can be entirely excluded so much the better. The room in which the operator and his assistants prepare themselves is provided with self-emptying basins, supplied with taps with long handles, which can be turned on and off by the elbow. All the doors into the theatre are swinging ones, so as to obviate handling during ingress or egress. Such are the conditions found in the London Hospital, but very similar arrangements prevail elsewhere.

In Nursing Homes the operator must be content with less elaborate preparations for the attainment of asepsis, and with still less in private houses. Indeed, it is problematical whether strict asepsis can be obtained in the patient's own dwelling, although Treves and Hutchinson (*Manual of Operative Surgery*, i. p. 37, 1909) say: "Provided that the greatest care is exercised, there is no reason why as complete asepsis should not be secured in the patient's room as in the most elaborately fitted hospital theatre." Of course the house itself must be in a sanitary condition, and the patient should not sleep the previous night in the room in which the operation is to take place. The preparing of the room (removal of unnecessary furniture, of curtains and hangings, scrubbing of floor, brushing down of walls, dusting, etc.) should be done several hours before the room is required. The carpet may be lifted, but an easier plan is to cover it with waterproof, drugget, or a sheet. Ventilation should be good, and an open fire is most useful, for the after-treatment will be carried out in this room. Even when the surgeon is conscious of weak points in his aseptic precautions, he may recollect that in private houses, especially in the country, the bacteria causing wound-infection are not so common as in hospitals.

The Operating Table.—The operating table is now a much more elaborate piece of furniture than it was some years ago, before, for instance, the Trendelenburg position came to be so frequently used in abdominal operations. In a private house a narrow and strong kitchen table may still be employed, and a chair be placed upon to improvise the Trendelenburg position; but portable tables can now be had, and some surgeons prefer to take their table with them to their patient's dwelling. Comyns Berkeley has designed such a portable table (*Brit. Med. Journ.*, ii. for 1909, p. 154). In Hospitals and Nursing Homes more or less elaborate tables are used. They should not be too complicated, which means they should not be designed with too ambitious a scope. The head and foot rests should work smoothly, and so should the more complicated apparatus for placing the patient in the lithotomy or the Trendelenburg posture. The whole working should be tested just before the operation, so as to avoid unseemly and disconcerting struggles after the operator is ready to begin. The price of a "comparatively inexpensive table" is given as £25.

Preparation of the Patient.—Even in small operations it is well for the patient to spend a few days in bed before he actually submits himself to the knife; the bodily functions (bowels, kidneys, skin) are then regulated, the diet is limited in amount and made more similar in quality to that which will be necessary after the operation, and the patient is accustomed to invalids' ways. The bowels ought to be thoroughly evacuated by a purgative the day before the operation, and an enema should be given in the early morning to ensure the lower bowel being quite empty just before the operative procedure is commenced. No breakfast should be given, and, therefore, an early hour (8 to 10 A.M.) should be chosen, if at all possible. But the chief preparatory measure is concerned with the *skin of the operation area.* Most operators are agreed that the site of operation, if a hair-covered one, should be shaved, and that it should be well washed with soap and water, a nail brush being used unless the skin is too tender; but opinions differ as to further procedure; indeed, all are not at one as to the washing with soap and water.

A common procedure is to remove the fatty matter from the skin with ether, and again to wash with soap and water; next an antiseptic solution is applied to the skin on gauze or wool swabs. The antiseptic employed may be carbolic acid (1 in 20), or bichloride of mercury (1 in 500), or mercuric potassium iodide (1 in 500), the solution being an alcoholic one. Treves and Hutchinson specially recommend the last named (mercuric potassium iodide solution) as being easily prepared (with rectified or methylated spirit), less toxic than the bichloride of mercury, having no corroding effect on plated instruments, and not irritating the skin itself. After these applications, by which it is claimed that the skin is made really aseptic, have been made, a compress of moist

sterilised gauze or lint, soaked in carbolic solution (1 in 60), is placed in position and kept there by waterproof tissue and bandage until the time of the operation, when it is removed and the skin surface again gone over with ether and one of the alcoholic antiseptic solutions (mentioned above) and dried by sterilised pledgets.

Of recent years the tincture of iodine method has been coming to the front. It was employed by A. Grossich of Fiume in 1908 (*Vorläufige Mitteilung. Zentralbl. f. Chir.*, xxxv. p. 1289, 1908), and F. J. W. Porter (*Brit. Med. Journ.*, i. for 1909, p. 332, 1909) reported favourably upon it, using a 10 per cent. spirituous solution. Professor von Eiselsberg of Vienna was making use of it in 1907 (*Brit. Med. Journ.*, i. for 1909, p. 439). Waterhouse has written on this subject (*Lancet*, i. for 1910, p. 1063; *Brit. Med. Journ.*, ii. for 1910, p. 61). He found some years ago that soaking catgut (as it came from the manufacturer) for a week in a solution of 1 part of iodine to 500 of equal parts of rectified spirit and water sufficed to make it sterile; thereafter he combined the washing of the skin with soap and water and the painting of it with tincture of iodine, but did not get better results than with ordinary methods; then he suspected that the preliminary washing with soap and water might prevent the tincture of iodine penetrating between the swollen epithelial cells. So he abandoned the washing with soap and water and simply painted the skin with an alcoholic solution of iodine. At first he used unnecessarily strong solutions (8 or 6 per cent.), and finally he decided on a 2 per cent. solution in rectified (not in methylated) spirit; sometimes tincture of iodine was used, and occasionally a 2 per cent. solution of iodine in chloroform. By this method the preparation of the skin of the operation-area is begun much nearer the time fixed for the operation, a great saving of labour to the nurse and a sparing of the feelings of the patient. Of course the skin is shaved and washed first; then time enough to allow it to dry elapses; then the iodine solution is painted on; two hours later, when the patient is on the table, the painting is repeated; the surgeon may then begin his operation. There are two slight inconveniences: the skin is rendered more vascular, the wound bleeding more than usual; and knives are a little blunted; but the advantages are many and obvious. Other preparations of iodine have been used; thus A. J. Wallace, after abandoning iodine acetone (on account of its irritating, pungent odour), found iodine-dichloride-ethylene solution (2·48 per cent.) to give excellent results, especially in abdominal work (*Practitioner*, p. 501, April 1910; *Brit. Med. Journ.*, i. for 1910, p. 1288). J. Lionel Stretton, who had in 1909 (*Brit. Med. Journ.*, ii. for 1909, p. 368) reported on 57 operation cases in which the skin was prepared by being painted with tincture of iodine (B.P.) without previous bath, scrubbing, or shaving, gave details of 291 further cases in 1910 (*Brit. Med. Journ.*, i. for 1910, p. 1350). Many recent contributions have been made to the subject, including articles by Routier (*Bull. et mém. Soc. de chir. de Paris*, n. s., xxxiv. p. 1251, 1908), Walther (*ibid.*, xxxv. pp. 345, 394, 1909), Estor (*Montpel. méd.*, xxviii. p. 553, 1909), Gley (*Presse méd.*, xvii. p. 506, 1909), Jewett (*Med. Rec.*, lxxxi. p. 271, 1909), Lucas-Championnière (*Journ. de méd. et chir. prat.*, lxxx. p. 561, 1909), Grekow (*Arch. f. klin. Chir.*, xc. p. 1073, 1909), Ortali (*Gazz. d. osped.*, xxx. p. 1258, 1909), Pichevin (*Semaine gynéc.*, xiv. p. 361, 1909), Stone (*Surg., Gynec., and Obst.*, x. p. 216, 1910), and others.

Preparation of the Operator.—The preparation of his hands is the operator's chief concern; but before that matter is discussed, it may be well to refer to two or three other things. There seems to be no doubt that the surgeon should wear a sterilised cap of linen or gauze; and it is a wise precaution for the anæsthetist to do the same, as instruments or ligatures which are being handed to the operator may come in contact with the head of the man who is giving chloroform. Whether a face mask should likewise be worn is an open question; but a fair compromise may perhaps be found in covering the mouth with a gauze pad which can be tied over the ears and back of the neck. The coat, waistcoat, and collar are removed, and a waterproof apron (without sleeves) is put on; over this the operator wears a sterilised jacket, coat, or gown, the sleeves of which can either be rolled up to the elbows or fastened at the wrists. Some enthusiasts wear rubber boots which have been steamed, but Treves and Hutchinson (*Manual of Operative Surgery*, i. p. 33, 1909) place this procedure alongside of the reported precaution which one surgeon is said to have taken of having his carriage wheels washed over with ether and carbolic solution!

All are agreed that whether the operator intends to wear gloves or not his hands should be most carefully cleansed. The plans recommended in the *Encyclopedia and Dictionary of Medicine* (Vol. I. p. 293, 1906) are still in common use; but some operators (*e.g.* Stretton, *Brit. Med. Journ.*, i. for 1910, p. 1351) are feeling their way towards a preparation of the hands with some chemical agent such as tincture of iodine which shall cut short the long and elaborate scrubbings and soakings in vogue. If iodine be used, the stain can be removed by washing in a 3 per cent. solution of carbolic or a 1 per cent. solution of cyllin. Here may be given the details of scrubbing and disinfecting the hands of operator, assistants, and nurses as employed by Kelly of Baltimore.

"The nails are first trimmed to about 1 mm. in length; then the hands and forearms are vigorously scrubbed . . . for ten minutes. Green soap, or the common brown kitchen soap, or some other good detergent soap is used." The water is to be changed frequently, if running water is not obtainable. The first two or three minutes are given to general scrubbing, especially of the folds between the fingers; then the nails are to be attended to with a blunt-pointed nail-knife; then the rest of the ten minutes (by the clock) is occupied with continued scrubbing, when the soap-suds can be washed off and the next process commenced. In the Johns Hopkins Hospital this consists in immersing the hands in a hot saturated solution of permanganate of potash and keeping them there till they are stained of a mahogany-brown colour; they are next placed in a hot saturated solution of oxalic acid to remove the stain; then they are soaked in corrosive sublimate solution (1 in 1000) for five minutes; and finally they are rinsed in sterile water or saline solution. Another chemical disinfectant which may be used is nascent chlorine gas from chlorinated lime.

Although some surgeons in the first rank do not wear gloves, their use has become so common that it is obligatory to know the technique; perhaps their most important function is to cover the hands of assistants and nurses whose knowledge or conscience is less developed regarding strict asepsis than is that of the operator himself. Rubber gloves have been employed for years, but lately cotton ones have begun to be used; if they are made of the latter material they will require to be changed during an operation. It is, of course, of the utmost importance that the gloves be properly sterilised. Rubber gloves may be treated by boiling for 15 or 20 minutes in carbonate of soda solution; they should be put in a linen bag during the process, for it will not do to allow parts of them to float above the surface of the water. They should be tested for imperfections (*e.g.* puncture holes) by inflating them and putting them under water, when the escape of air bubbles will reveal the defect; this should be done before they are sterilised. They may be steamed instead of boiled; in this case they are first washed, then dusted with talc powder, and then packed loosely with absorbent cotton, wrapped in a sterilised towel, and placed in the steam steriliser for half an hour or three-quarters; before they are worn the powdered talc is washed away with alcohol. They can be drawn on the hands most easily by being distended first with sterile water; after use they are washed and dried, and during the drying process they should be distended so as to prevent contiguous surfaces adhering; they should then be well dusted with talc. It goes without saying that they should be a good fit, for if the tips of the fingers project, the sense of touch will be lessened and the risk of puncture greatly increased. Undoubtedly they are somewhat expensive and have to be frequently renewed, but if they are carefully handled and treated the cost can be kept down within reasonable limits. The objections to to the use of gloves include the loss of the delicate sense of touch and of skill in doing fine manipulations (*e.g.* tying ligatures) which they involve, the increased amount of perspiration of the hands which they cause, and the multiplication of germs within them. There can be no doubt that a glove which has been taken off and turned inside out during an operation is a most dangerous thing to come in contact with the wound, and this must be carefully guarded against; there is also a risk of the escape of germ containing sweat from a punctured glove; but the other objections may be got over by practice which makes perfect, and by the use of thin gloves with a roughened surface. Perhaps the chief real risk is the subtle influence which makes the operator or his assistant less rigid in the other details of his technique on account of the fact that he is wearing gloves.

Sutures and Ligatures and their Preparation.—The various materials used for sutures and ligatures enumerated in the *Encyclopedia and Dictionary* (Vol. I. pp. 295-296) have not been added to, with the single exception of *silver wire*, which some operators have been employing as a buried suture for the sure closure of the wound in abdominal section. Silk, silkworm gut, catgut, and kangaroo tendon still hold the field, although surgeons differ much as to the opinions they hold regarding their relative value. Some operators (*e.g.* Treves and Hutchinson) regard *silkworm gut* as the best suture material, and they name its advantages as strength, smoothness, solidity, and the fact that it can be left in the tissues for a comparatively long time (14 to 21 days if necessary). It is not, however, absorbed, and ought not to be buried in the tissues, and it requires to be placed in sterile hot water to make it pliable and less slippery before use. Silkworm gut is prepared by twisting it up in bundles of ten or a dozen strands and putting them under running hot water to wash off the excess of methyl blue or red which has been used to stain it (to make it easy of recognition in the tissues); it should then be boiled in water for ten minutes, and kept ready for use in a 5 per cent. solution of carbolic acid in water. It is of great value in suturing such wounds as require continued support (cleft palate, ruptured perineum, etc.). There is a variety of thin silkworm gut ("ophthalmic gut") which is recommended in operations on the face and neck, where it is important that the scar should be very slight.

Silk is another material which is not absorbable, but it is useful under certain circumstances (*e.g.* for tying pedicles). It can be obtained of any thickness, and it is best prepared by boiling (wrapped up loosely in gauze) in water for twenty minutes, by being then placed in rectified spirit for fifteen minutes, and then wound upon reels; it is to be again boiled in water for ten minutes and placed ready for use in absolute alcohol. It can be obtained ready in closed glass tubes; and considerable ingenuity has been shown in devising suture and ligature containers (glass tubes, boxes, etc.) in which the silk (or catgut) can be placed on reels, and from which lengths of the material can be taken off (through screw caps, etc.) without interfering with the aseptic condition of what remains. The disadvantages of being fibrous and of absorbing secretions by capillary action which silk has, may be got over to some extent by using Japanese silk or what is known as Turner's flat silk. On the whole, however, silk is not only apt to become infected, but may also carry the infection to another part of the wound.

Kangaroo tendon has special advantages as a buried suture, for it is absorbable, and it is stronger than catgut, but it has the disadvantages (possessed also by catgut) of being acted on by very hot water and of being somewhat difficult to sterilise; it is also expensive. The tendon is taken from the tail of the small kangaroo, is dried in the sun and kept dry till it is sterilised; it is softened in corrosive sublimate solution (1 in 1000); then the selected tendons are soaked in formalin solution (2 per cent.); it is next chromicised and preserved in sterilised carbolic oil; and just before use the carbolic acid is removed by soaking for half an hour in warm corrosive sublimate solution.

Catgut is a most useful suture material, but its sterilisation is full of difficulty, and the ease with which it is absorbed have led to the presence in the market of different varieties, *e.g.* Lord Lister's chromic catgut (*Brit. Med. Journ.*, i. for 1908, p. 125), Scott Riddell's iodised catgut, Johnson's bichromate catgut, etc. Some operators sterilise the catgut themselves which they are going to use, or get someone personally known to them to do so. The great difficulty is to preserve the strength and pliability of the catgut and at the same time to ensure its absolute sterility. It should also be prepared in such a way as to be easily carried from operation to operation. Dry heat may be used to sterilise the catgut; thus it may be put in a dry-air steriliser, heated slowly to 150° C., and kept at that heat for two hours. Or dry heat may be combined with the kumol treatment as recommended by Krönig; the gut, arranged loosely in rolls, is during two hours heated slowly up to 85° C. in dry air; it is then dried and placed in a vessel containing enough kumol to cover it, which is heated (over a sand-bath) to 165° C., and retained at that temperature for an hour; the kumol is then poured off, and the catgut dried by evaporation over the sand-bath but without the flame for another hour; rolls of the gut are then put in sterile tubes ready for use. Care must be taken that the kumol, which is inflammable, do not catch fire. This is the method used for sterilising catgut in the Johns Hopkins Hospital, Baltimore. Some operators prefer to have catgut sterilised by chemical means; one such method is to soak it first in ether for twenty-four hours, then in a 1 per cent. solution of biniodide of mercury in methylated spirit for twenty-four hours, and in this solution renewed for forty-eight hours longer; it is then put ready for use in a 2½ per cent. solution of carbolic acid in methylated spirit. If it be desired that the catgut resist absorption for more than ten days, it is well to soak it in formalin or to chromicise it. A. E. Johnson (*Lancet*, i. for 1907, p. 1074) places bichromate catgut in glass tubes containing xylol or xylol and absolute alcohol, seals the ends with the Bunsen flame or the blowpipe; he then puts the closed tubes upright in water at 212° F. for at least half an hour. At the operation the tubes must be broken between pieces of sterilised lint at the point which has been weakened by being filed.

Sponges, Swabs, and Dressings. — Whilst *sponges* are much less used than formerly on account of the fact that they cannot be sterilised by heat, there are still surgeons, some of them men of note, who employ them. As they cannot be steamed or boiled in water, some operators first soak their sponges in formaldehyde solution (40 per cent.), and then boil them for a few minutes in water; but Treves and Hutchinson (*op. cit.* p. 61) find the following method satisfactory. The sponges (new ones) are first beaten and shaken in calico bags to loosen and remove the particles of sand; they are then soaked for twenty-four hours in warm water, and are frequently rinsed out; they are next placed in glass bottles containing ethylic alcohol in which pure carbolic acid (1 to 20 of the spirit) is dissolved; and, when needed, they are wrung out and soaked in warm sterilised water. While in the ethylic alcohol they shrink greatly, but in the warm water they regain their original size. It is claimed that they may be used over and over again. Another method of preparing sponges is (after they have been mechanically treated and washed to get rid of all sand) to soak them first in a saturated solution of permanganate of potash, and second, in a saturated solution of oxalic acid; then they are rinsed in sterile water, and finally they are placed in corrosive sublimate solution (1 in 1000) for twenty-four hours; they can be kept

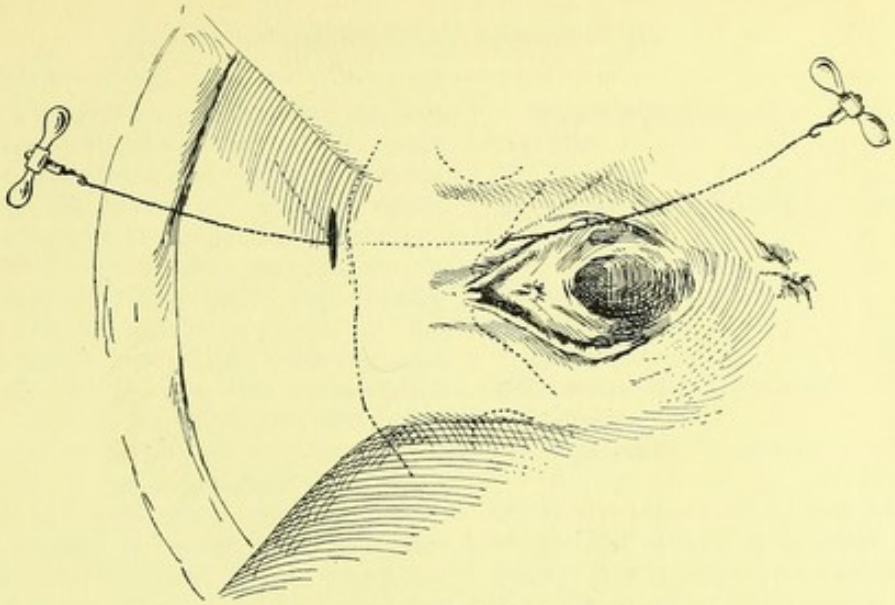
ready for use in a 5 per cent. solution of carbolic, but must be rinsed in sterilised water before they are actually employed to touch the wound. Large flat sponges are useful in abdominal work. It must be admitted, however, that gauze swabs or pads are more commonly used than marine sponges. Some prefer to have square *pads* made up of several layers of absorbent gauze stitched together at the edges or diagonally to hold them together; these are specially useful in abdominal operations, and when so used ought to have tapes attached to them to facilitate their removal. Others choose to have absorbent cotton wool pads covered with gauze tissue; these may be round, oval, or more or less flattened, and they are usually made in two sizes, small and large. Swabs and pads of these materials are to be sterilised by high-pressure steam.

Dressings consist of gauze, wool, or lint, and can nowadays be had in an aseptic or sterilised condition. There are various methods of preparing them; one plan, which seems to be satisfactory, is to submit the dressing to a temperature of 250° F. for half an hour at a pressure of 15 lbs. in a steam vacuum autoclave, after which it is enveloped in a sheet of cotton wool, wrapped up in parchment paper, and put in an air-tight tin or cardboard box. Otherwise the sterilisation is done just before operation. By compression certain dressings, *e.g.* cotton wool and gauze, can be had in small bulk for economy of storage room and for ease in transport. Various forms of *gauze* are in use, viz. absorbent gauze, iodoform gauze, boracic, carbolic, double cyanide and sal alembroth gauze. Gauze may be had packed in zigzag fashion to facilitate its withdrawal without handling from its box or tin.

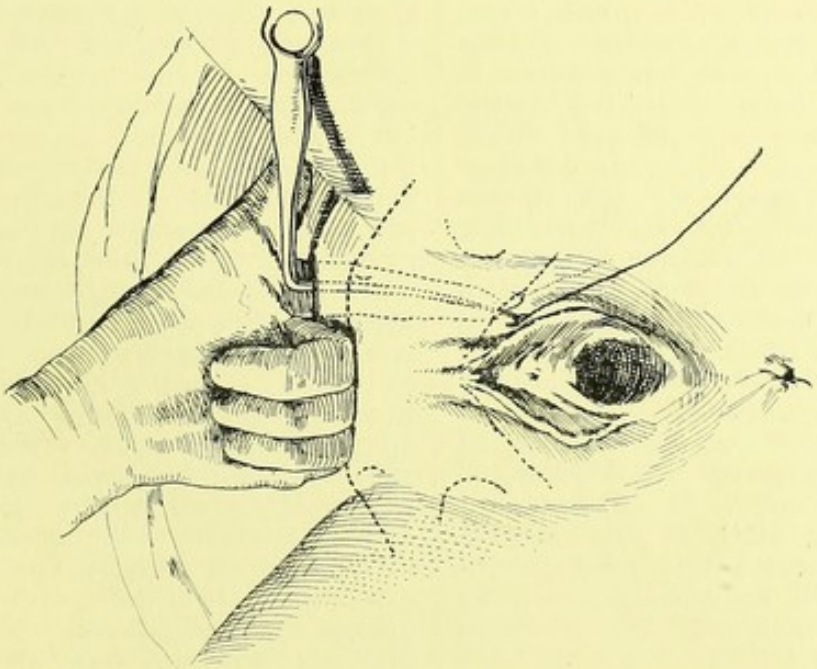
Similarly, *cotton wool* may be obtained in an absorbent or unabsorbent form; and there are different sorts of antiseptic wool, viz. boracic, carbolic, iodoform, double cyanide, eucalyptus, salicylic, and sublimate. *Bandages* are made of heavy gauze ("butter cloth"), of muslin, of calico, of open wove, of domette, of flannel, of flannelette, and of elastic web or rubber. Various antiseptic *lints* are in use, *e.g.* boracic, carbolic, salicylate, sublimate, alembroth, etc.; and ordinary absorbent or hospital lint of different degrees of fineness is much employed. *Protectives* are made of oiled silk, of mackintosh or jaconette, of gutta-percha tissue, or of oiled or waxed paper. *Tow*, for absorbing discharges, etc., may be had plain or antiseptic (*e.g.* marine lint, carbolised tow).

The actual dressing of wounds still differs much as carried out by different surgeons, but there is, speaking generally, a marked simplification. When the iodine method of sterilising the skin has been employed, and indeed in aseptic surgery generally, the dressing need consist only of several layers of sterilised gauze or of double cyanide gauze, covered with sterilised wool, and with a domette bandage to hold them in position. Sometimes the dressing need not be removed or touched for several days; but, of course, if there is oozing or discharge it will require to be changed. When the stitches are taken out it is a useful precaution to paint the wound again with the iodine solution.

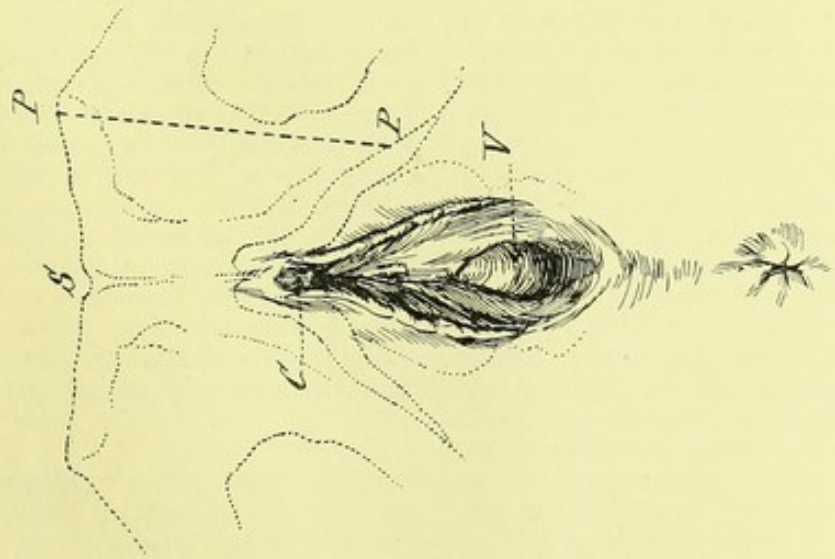
Sterilisers of various kinds, of varying degrees of complexity, and at very different prices are supplied by the instrument makers. For sterilising *instruments alone* tins on the fish-kettle principle are in common use; in them the process is carried out by boiling. The heating apparatus consists of a flat spirit lamp with two or three burners, or of a gas-burner which can be attached to a gas supply by tubing. Inside the tin (which should be large enough to contain all the instruments likely to be needed) there are one or two perforated trays, with detachable handles, for carrying the instruments; and the tin itself should stand on legs (folding or removable) which are just high enough to leave room underneath for the spirit lamp. The lid should be well fitting and may be made in such a way as to serve also as a cooling tray for the instruments. The material of which the steriliser is made may be tin, copper, brass, nickel-plated, or enamelled steel; and it is made in a portable form. For small articles such as needles, small knives, ligatures, etc., small pocket sterilisers can be had; but there is no great need for these, as the small things can be well enough treated in the larger steriliser. Sterilisation of *dressings, swabs, etc.* with steam demands a more complicated apparatus. The steam itself may be quiescent, or it may be in motion (circulating or "live" steam) which is generally to be preferred, or it may be under pressure, as is usually the case in hospitals. In such sterilisers as the "Arnold" the steam is generated from water in a shallow receptacle in the lower part of the apparatus by means of a gas-burner or spirit-lamp; it then passes through the sterilising chamber where the articles to be sterilised are placed; and then it finds its way into the space inside the surrounding tin or copper jacket where it is condensed and passes in the form of water back again into the shallow receptacle. As a rule, however, it is preferred to use steam under pressure, and for this purpose the Schimmelbusch or the Kny-Scheerer steriliser may be employed. In the former, the cylindrical boiler is usually vertical, but it can be had horizontal at an extra cost, and it is usually of such a size as to hold two kettles or drums. The drums which contain the dressings are fenestrated either in the sides or at top and bottom, and by a mechanism which should be as simple as possible the openings can be closed when the sterilisation



Giglo's saw in position behind the pubic bone.



Döderlein's needle introduced and ready to pull up Giglo's saw.



Symphysis pubis seen from the front.

P.P. Usual line of section in pubiotomy. *C.* Clitoris.
S. Symphysis. *V.* Vagina.

is finished. The drum recommended by Scot-Skirving (*Trans. Med.-Chir. Soc. Edin.*, xxiv. p. 17, 1905) has an inner wire cage, an interval of ¼ inch being left between it and the drum, and thus dressings in the cage are everywhere in contact with the steam; the holes are closed by simply pushing home the tightly-fitting lid. Canvas covers are put on the drums when taken out of the steriliser, and they can thus be carried to a private operation or the like. In the Kny-Scheerer the boiler is horizontal and is supported on a stand. It is usually made of brass polished or of brass nickelled and polished. It is somewhat complicated, and is also, of course, expensive; but many surgeons prefer it, and it is in daily use in many hospitals. The cylindrical chamber in which the drums (containing the dressings) are put is surrounded by a steam-jacket, and is closed by a tightly-fitting door, and it is important that the door should be opened or shut with as few movements as possible, otherwise the person opening it may have his hands scalded by the escaping steam; the "New Type" Kny-Scheerer has such a simple apparatus. The heat is conveniently obtained by gas, and there are stop-cocks opening into the steam-jacket and into the central chamber; there are also pressure gauges and a safety-valve. After the heat has been applied the stop-cock communicating with the steam-jacket and the outer air is opened and the air and steam are driven out; the stop-cock is closed as soon as the steam is issuing freely, when immediately the pressure in the jacket and in the sterilising chamber begins to rise and the sterilisation of the dressings goes on; after twenty minutes or longer the stop-cock between the steam-jacket and the central chamber is shut, and that between the latter and the outer air opened, when the articles which have been sterilised are dried by the heat of the steam-jacket. The drums, which may be similar to those used in the Schimmelbusch, are then taken out, the holes in them are closed, and the dressings in them are ready for use when needed. There is also a Kny-Scheerer steriliser for preparing *sterilised water*, so much used in aseptic surgery nowadays; it is made in different sizes to sterilise a greater or smaller number of gallons. There are also very large sterilisers for disinfecting *clothes and bedding* by steam. From what has been said it will be evident that the preparations for a modern aseptic operation are elaborate, and that the necessary apparatus, in the case of hospitals and operating homes at any rate, is expensive.

"Surmenage."—The state of over-strain or exhaustion as the result of work, "fatigue" being the name given to the ordinary physiological result.

Symbiosis.—*See* Pregnancy, Physiology of.

Symphysiotomy and Pubiotomy.

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Of late years much has been heard of symphysiotomy and allied procedures in cases of contracted pelvis; but even a superficial examination of the great mass of literature which has grown up round the subject will reveal the fact that it is mainly Continental, and only to a small extent British or American. There have been symphysiotomists, both in Great Britain and in America, and some of them (*e.g.* Herman, Munro Kerr, and Buist) have been able to report numbers of successful cases with no maternal mortality; the subject of pelvic section, also, has been debated, often and thoroughly, both in the medical and obstetrical societies of this country and of the United States; but, whilst all this is true, it cannot be said that the operation itself has assumed the importance given to it in France, Italy, and Germany, and it must be freely admitted that at present it is losing and not gaining ground. Possibly this is in part at least to be explained by the dislike to the induction of premature labour which our Continental brethren seem to have; and no doubt it is largely to be accounted for by the repugnance to cutting operations in midwifery exhibited by both the profession and the public in this country. That there is a very sharp line of cleavage between Continental and British obstetric practice in respect to symphysiotomy, hebotomy, and pubiotomy may be learned from the study of what Professor Schauta (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 318, 1909) has said regarding the management of labour in a contracted pelvis, although perhaps we ought to regard his views as those of the more extreme German school. Schauta is of opinion that "the management of labour in contracted pelvis will shape itself in the future in the following simple manner, provided it is carried out from the very commencement in a skilful manner and in an institution under strict asepsis. In cases with a conjugate above 8 c.m. there is a possibility of spontaneous birth, and therefore expectant treatment is to be adopted. In cases under 8 cm. Cæsarean section is to be kept in view. In cases bordering on the above, that is a conjugate of 8½ to 7½ cm., hebosteotomy is to be considered. . . . This method of treatment should be

looked upon in the future as typical. All other methods hitherto used in the treatment of labour in contracted pelvis should be looked upon as atypical." When it is borne in the mind that the atypical methods of treatment to which Schauta refers include craniotomy on the dead as well as on the living child and the induction of premature labour, and that he says that "the application of forceps above the brim and prophylactic turning should, if possible, be entirely removed from the list," it will be evident at once how far distant German obstetric theory and practice have removed themselves from British and American. Schauta speaks of the time in the future when the rules he has laid down shall be generally adopted as the "golden age of the treatment of labour in contracted pelvis"; and, truly, if the ideal method of dealing with difficult labours is to be by section (abdominal or pelvic) rather than by dilatation, and if the obstetrician of the next generation is to choose the knife rather than the forceps, we may join with him in looking for such an age, but with less enthusiasm in the outlook. In the meantime there are at least two circumstances which militate against any such wholesale adoption of the cutting procedures, two conditions which Schauta admits must be fulfilled before symphysiotomy or Cæsarean section can be performed, viz. "the patient must reach the expert in an absolutely aseptic condition without any obstetrical interference of any kind having been made," and the consent of the patient must be obtained. Schauta seems to doubt whether the patient has any right to refuse, and says that she claims no such right in the case of gynecological operations; but, again, if this be so, it simply demonstrates the deep-seated differences which exist between Continental and British practice.

The *method* of enlarging the pelvic capacity now commonly employed differs considerably from that in use when the article on SYMPHYSIOTOMY appeared in the *Encyclopedia and Dictionary of Medicine* (Vol. V. p. 297). At that time symphysiotomy, in the strict sense of the term, was going out of favour; it had been introduced and recommended with extraordinary fervour, but the first enthusiasm had subsided, its difficulties were recognised, its limitations were defined, its dangers were known and its inconvenient after-effects had been experienced; the circumstances were propitious for the advent of a new method, and the new method came, division of the bone (hebotomy, pubiotomy, pelvitomy, or hebosteotomy) taking the place of division of the joint (symphysiotomy).

As early as 1902 there were signs of the coming change. Zweifel (*Centralb. f. Gynäk.*, xxvi. p. 321, 1902) admitted that there was serious opposition to symphysiotomy in Germany based upon its dangers, and thought that these might be lessened by drainage with tubes and *per vaginam* of the prevesical space (cavum Retzii). Ayers (*Amer. Journ. Obstet.*, xxxvi. p. 1, 1897; *New York. Med. Journ.*, lxxv. p. 629, 1902), who had introduced the subcutaneous method of performing symphysiotomy, was able thereby to report good results, but he allowed that the growing prejudice against the operation was founded upon dangers which really existed. Buist (*Journ. Obstet. and Gynæc. Brit. Emp.*, ii. p. 32, 1902), who used Ayers's subcutaneous method, showed that the operation of division of the symphysis pubis could be carried out in domestic practice and so made more generally applicable; but in the same year Sandstein (*Trans. Edin. Obstet. Soc.*, xxvii. p. 68, 1902) published his experimental study of the pelvic changes produced by separation of the pubic bones in symphysiotomy, which demonstrated that the increase in pelvic capacity was due more to the movement downwards than to the rotation outward, that a separation of 6 cm. was all that could be safely allowed, and that the gain in the antero-posterior diameter thus obtained was only 1 cm., and that, therefore, the indications for the operation were somewhat narrow, while its dangers were real. Tissier's observations on the after-histories of patients upon whom symphysiotomy had been performed were far from encouraging (*Bull. Soc. d'obstét. de Paris*, 19th Feb. 1903). Interest in symphysiotomy was greatly lessened, and the first wave of enthusiasm had passed, so that, as Munro Kerr has put it (*Operative Midwifery*, p. 375, 1908), "it appeared as if history were going to repeat itself, and the operation were again to be forgotten."

In 1903, however, interest in pelvic section was again aroused by the proposal of Gigli (*Centralb. f. Gynäk.*, xxvi. p. 1298, 1902; *Bull. Soc. d'obstét. de Paris*, vi. p. 68, 1903) and of Van de Velde (*Centralb. f. Gynäk.*, xxvii. p. 969, 1902; *Nederl. Tijdschr. v. Geneesk.*, 2 R. xxxix. d. 1, p. 1303, 1903; *Wien. klin. Wochensch.*, xiv. p. 847, 1903) to divide not the joint but the bone of the pelvis, to perform what is now known as hebotomy, pubiotomy, pubotomy, hebosteotomy, lateral section of the pubes, ischio-pubiotomy, lateral pelvitomy, or extramedian symphysiotomy. Gigli, indeed, had proposed section of the pubic bone in 1893, and had invented the flexible wire saw named after him (*Ann. di ostet. e ginec.*, xv. p. 557, 1893; xvi. p. 649, 1894), and Bonardi (in 1897), Calderini (in 1899), Van de Velde (in 1901), and Gigli himself (in 1902) had carried out the procedure successfully; but with regard to the first suggestion of the operation we have to go as far back as 1786, when John Aitken of Edinburgh (*Principles of Midwifery*, 3rd ed., p. 83) proposed "sawing through the two rami of the

ischium and those of the pubis on either side of the pubic bone." Stolz also described the operation in 1844. Since 1903 a great mass of literature has gathered round pubiotomy, how great may be in part estimated from the fact that the *Zentralblatt für Gynäkologie* for the year 1907 contained eleven original articles on hebosteotomy and between thirty and forty references to articles occurring in other journals. It is unnecessary, however, to consider in detail the many contributions that have been made to the subject, for most of them are concerned with details which are hardly of the importance that the writers of the articles give to them.

The chief methods of performing hebotomy may be briefly described. The ordinary preparations are made and the skin over the symphysis, external genitals, and neighbourhood is rendered as nearly aseptic as possible. If *Gigli's plan* be adopted, an incision is made over the pubes and the soft parts are cut through down to the bone; the cut begins a very little to the left of the middle line and runs downwards and outwards obliquely down to the subpubic tubercle about half-way down the pubic arch. A carrier is then passed behind the pubic bone and the Gigli saw is drawn by it into position; the bone is quickly sawn through, and, as Gigli has said, the pelvis "opens like a book." The infant is usually delivered by forceps, or, in some cases, the natural efforts are waited for. *Van de Velde's method* differs slightly. The incision in the skin is made from the left pubic spine passing downwards and inwards to the outer surface of the left labium majus opposite the vestibule. The operator's finger is introduced at the lower end of the wound thus produced and is pushed below and behind the pubic bone; a curved, blunt-pointed needle, with a slot eye, is then guided up behind the bone (the point being kept close to the bone by manipulation of the handle) until it reaches the upper angle of the wound; the ring of Gigli's saw is then fixed to the needle which is withdrawn so as to bring the saw in contact with the posterior surface of the pubic bone; a few strokes of the saw cut through the bone; and the instrument is now withdrawn from the lower end of the wound and pressure applied to check the hæmorrhage. The child can then be delivered. It is claimed that by following Van de Velde's line of incision the internal pudic artery and the corpus cavernosum of the clitoris are less likely to be injured. *Döderlein's method* (*Arch. f. Gynaek.*, lxxii. p. 275, 1904; *Zentralb. f. Gynäk.*, xxviii. p. 1240, 1904; xxx. p. 84, 1906) has certain advantages. A colpeurynter is passed into the vagina to dilate the parts, to keep the membranes intact, and to prevent the head coming into the brim. When the cervix is fully dilated the membranes are ruptured, the bladder is emptied, and the section of the bone is carried out. A small transverse incision is made over the pubic bone between the symphysis and the spine, generally on the left side. The finger is passed into the incision and is directed downwards behind the pubes, separating the parts from the bone; then, the way having been prepared, Döderlein's curved needle is carried down along the back of the bone, which it is made to hug closely, until it can be felt under the skin of the labium majus free of the lower margin of the bone; a cut sets the point of the needle free, Gigli's saw is attached to it and is drawn up along the wound until it is in position, and then the bone can be cut through with six or ten strokes (keeping the saw vertical). At this stage the patient is in the dorsal position, and assistants press the pelvis together, although there is no great risk of the two segments suddenly flying apart; hæmorrhage is controlled by pressure as a rule; and now the legs of the patient are allowed to hang down (Walcher's position), and spontaneous delivery is waited for, or, if necessary, the forceps is applied. After the placenta has been expelled the vagina is tightly plugged with gauze and compresses are placed over the wounds. In this way hæmatoma, a troublesome complication, may be avoided. The plugging is removed in eight hours, and the bladder emptied. Adhesive plaster and a tight binder close the wounds and hold the pelvis together. Rest in the dorsal position for twelve days is necessary; thereafter the patient usually recovers as after an ordinary delivery (Gibson, *Journ. Obstet. and Gynæc. Brit. Emp.*, xi. p. 380, 1907). *Bumm's method* is somewhat similar; as described by Kroemer (*Berl. klin. Wochensch.*, xlv. p. 1044, 1908) it is as follows. A Bumm needle is passed in below the symphysis till it touches the bone; it is passed up with its point keeping in contact with the posterior surface of the pubic bone; it is brought out through the skin above the symphysis, close to the middle line; the Gigli saw is led along the passage thus made, and the bone divided with it from above downwards and outwards. It is the usual practice in Bumm's clinique to allow the labour to proceed naturally, unless there are special reasons for haste, and then forceps or version is employed. Bumm's method is practically subcutaneous, and Döderlein's nearly so. There seems to be a general tendency to adopt the latter plan, and so to get rid of long open incisions (Henkel, *Zentralb. f. Gynäk.*, xxx. p. 233, 1906). Various needles or carriers have been suggested, such as de Lee's (*Obstetrics* for 1906, p. 190), Seeligmann's (which is grooved, vide *Zentralb. f. Gynäk.*, xxix. p. 1206, 1905), and Walcher's (*ibid.*, xxix. p. 1102, 1905). In most of them the needle is used to pull the Gigli saw into the wound, but if Seeligmann's (which is hollow and grooved) be employed the sawing can be carried out with

the needle in position. It is difficult to express a preference; probably the operator will be advised to use a needle with which he is familiar. Berry Hart (*Trans. Edin. Obstet. Soc.*, xxix. p. 109, 1904) used a large sinus probe with an eye in it.

Whilst there is still much discussion going on in current literature regarding the best method of performing pubiotomy, the most important matter for decision is whether the operation is to be preferred to symphysiotomy. The following advantages are commonly claimed for hebosteotomy or pubiotomy. It is said to be easier and to be capable of being more rapidly performed, and this would seem to be correct if the operator has taken care to study the topography of the pubic region (*see* Tandler and Sellheim's articles, *Zentralb. f. Gynäk.*, xxix. pp. 889, 1097, 1905). The natural supports of the bladder, urethra, and vaginal walls are less interfered with than in symphysiotomy, and extension of the operation wound into the vagina is less likely to occur. It has also been affirmed that there is less risk of hæmorrhage; but there is much difference of opinion upon this point, Rosthorn having lost a patient from bleeding (*see* Williams's *Obstetrics*, p. 459, 1908), and Jessen (*Zentralb. f. Gynäk.*, xxx. p. 252, 1906) having had to finish by doing symphysiotomy after having begun a hebotomy. The wound does not communicate with the vagina, and the operation can therefore be performed in septic cases with less risk of general infection; unfortunately, however, tears communicating with the vagina may occur. It is claimed that a section through bone heals more quickly, safely, and thoroughly than one through a joint; but it must be remembered in accepting this advantage that the symphysis pubis is not an easily infected joint like the knee. The pelvis is said to be permanently enlarged after pubiotomy (Sellheim, *Monatssch. f. Geburtsh. u. Gynäk.*, xxiii. p. 362, 1906), and there is evidence that subsequent labours have been easier, but, of course, it would have to be clearly shown that the size and shape of the fœtal head were the same in the cases which are thus contrasted. The urethra is not so apt to be wounded in pubiotomy, and the bladder is less likely to be injured; but whilst this is true of the time when the section is being made, it is not so certainly true of the extraction period (Bar, *Bull. Soc. d'obstét. de Paris*, viii. p. 76, 1905). It is claimed that the mortality is less with pubiotomy than symphysiotomy; but this can hardly be regarded yet as an established fact. Carefully selected cases may show little or no maternal mortality, but when large numbers are considered it may be as high as 5·6 per cent. (Maier, *Diss. inaug.* (Tübingen), 1907). The dangers from hæmorrhage, septic infection of the wound, lacerations or perforations of the bladder and urethra, and subsequent vulvar and vaginal hæmatomata are real; among the earliest cases there were two deaths from sepsis (Baumm, *Monatssch. f. Geburtsh. u. Gynäk.*, xvii. p. 632, 1903), and one from the late effects of chloroform apparently (Berry Hart, *loc. cit.*), and there have been fatal terminations from hæmorrhage and other causes (Hammerschlag, *Zentralb. f. Gynäk.*, xxxi. p. 1001, 1907); and Seitz (*Münch. med. Wochensch.*, liii. p. 1993, 1906) is of opinion that it is much better to publish the dangers of the operation and its drawbacks than to be loud in its praises, and does not think that pubiotomy is yet to be recommended to the general practitioner.

Before the future of this operation is forecasted, reference may be made to what has been called prophylactic pubiotomy, *i.e.* section of the pubic bone performed during the pregnancy of a patient suffering from pelvic contraction. It is claimed that in this way the woman is saved from the double strain of labour and a serious operative procedure, and that the injuries have time to heal before labour comes on. Gauss (*Zentralb. f. Gynäk.*, xxxi. p. 857, 1907) thinks that the operation should not be done earlier than the thirty-fifth week of pregnancy; and he reports the case of a primipara of 19 years, whose pelvis was generally contracted with a conjugata vera of between 7·4 and 7·9 cm., upon whom he performed pubiotomy (by the open method) at the ninth month; she was delivered spontaneously of a living child, weighing 3000 grams at the full term. It is doubtful if this prophylactic procedure will commend itself to many obstetricians; but it is an interesting development, pointing, as it does, to a desire for earlier recognition of such pelvic contractions as may be expected to lead to difficult parturition. It may be added that hebotomy has been performed at least once (by R. H. Pomeroy) for impaction of the breech in a justo-minor pelvis (*Amer. Journ. Obstet.*, lvii. p. 511, 1908), surely a very exceptional indication.

In endeavouring to estimate the future of pubiotomy, it will be well to neglect the views at present being expressed in Germany, and take those of such an American obstetrician as Whitridge Williams. This author, while favourably disposed towards the operation, is critical, and would restrict the employment of the operation in various ways (*Obstetrics*, p. 459, 1908). "Pubiotomy is not indicated in cases in which the conjugata vera measures less than 7 cms. Accordingly, it scarcely enters into competition with Cæsarean section, except for the broadened relative indication. . . . I feel that one may look forward to pubiotomy practically displacing Cæsarean section in the so-called 'border-line' cases, as it enables one to subject the patient to the test

of labour and to operate after several hours of second-stage pains have demonstrated that the head cannot pass through the superior strait. Pubiotomy can be safely performed under such circumstances, while in Cæsarean section the prognosis becomes progressively worse the later in labour it is performed. If the future substantiates these views, pubiotomy will still further narrow the field for the induction of premature labour, and practically do away with the use of high forceps, version, or craniotomy in moderate degrees of contracted pelvis when the mother is in good condition. It is also indicated in certain cases in funnel-shaped pelvis, and possibly in face presentations when the chin has rotated into the hollow of the sacrum. . . . I do not believe that the operation should be undertaken when signs of infection are present, as the interests of the mother will be better served by craniotomy, or Cæsarean section followed by removal of the uterus. For the present, at least, I feel that the employment of pubiotomy should be limited to well-equipped hospitals or the practice of experts, since four well-trained assistants are necessary to its proper performance, and, moreover, serious complications may occur at any time, which will seriously tax the resources of even a competent surgeon." Williams's estimate may be taken as a fair one in respect, at any rate, to British and American opinion; and one cannot help thinking that little will be heard of pubiotomy in five years' time. Cæsarean section meets the requirements of high degrees of pelvic contraction, and the last word has not yet been spoken in favour of the induction of premature labour in the moderate degrees.

Syncytiolysins. — *See* ECLAMPSIA (*Theories*).

Syncytioma Malignum.—*See* UTERUS, MALIGNANT TUMOURS.

Syncytiotoxines. — *See* ECLAMPSIA (*Theories*).

Synkaryon.—*See* PROTOZOA (*Zygosis*).

Syphilis.

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ETIOLOGY.—On 17th May 1905 Schaudinn and Hoffmann communicated to the Medical Society of Berlin their discovery of a spirochæte (*spirochæte pallida*) in syphilitic lesions, and thus solved the problem of the etiology of syphilis. In the early part of the same year Siegel had described a protozoon-like organism as the cause of the disease (*cytorrhyctes luis*); and although the correctness of his observations was soon disproved, it was their publication which induced Schaudinn, a protozoologist of established reputation, to study the subject. It is also a matter of historic interest that, although the whole credit of the discovery rests with Schaudinn, it was by the merest accident that he was not anticipated by Bordet and Gengou. Two years before Schaudinn described his spirochæte, they had found a spirillum (in all probability the spirochæte pallida) in smears from a hard chancre, but did not appreciate the significance of their discovery; and Metchnikoff, failing either to verify their observation, or to find such spirilla in the experimental syphilis in apes at which he was then working, declared against syphilis being a spirillosis.

Very shortly after Schaudinn's account of his work, Metchnikoff reported that he had found in his infected monkeys a spirochæte resembling (and soon identified by Schaudinn as identical with) the new organism. Thus within a few days two important facts were made public, and very quickly a further link in the chain of evidence was furnished by Buschke and Fischer, who demonstrated the spirochæte in the organs of a congenital syphilitic infant, and by Levaditi, who detected it in the bullæ of congenital syphilitic pemphigus. In the former site, at least, a saprophytic parasite was unlikely to occur. Since that time observations all over the world have led to the same results. The spirochæte pallida is found in the primary sore, in the enlarged glands, in the secondary lesions, in the blood stream—and it has never been found except in syphilis. It has been found in the saliva, in the urine, in the ovaries, but not in the cerebro-spinal fluid, nor, curiously, in the semen. It has even been detected in the tertiary lesions, but not in the parasyphilitic group of diseases, such as tabo-paralysis. It is abundant in all the organs of syphilitic fœtuses; in the umbilical cord; in the placenta.

Schaudinn has differentiated the varieties of spirochæte which occur in healthy and diseased genital organs. He has shown that there are two—the *spirochæte refringens*, a normal saprophyte, and *spirochæte pallida*, in syphilis only.

Spirochæte Pallida.—A very delicate spiral organism, averaging 6 to 16 μ long; smaller and larger individuals are also met with. It consists of from 6 to 26 delicate spiral undulations, each measuring from ·8 to 1·6 μ. The diameter is about ·25 μ. The organism retains its spiral form when at rest. An undulatory membrane has not been demonstrated, and the

existence of a nucleus is doubtful. The peripheral part is thinned out at each end to form a delicate flagellum. Fission takes place by longitudinal division, beginning with the formation of two flagellæ at one pole. The spirochæte is capable of backward or forward motion by corkscrew-like rotation round its longitudinal axis; in addition to this undulations course along its whole structure; lashing movements also occur. Mobility is retained for several hours in salt solution, but is lost in glycerine; the organism rapidly dies when deprived of moisture. S. refringens is a larger organism than s. pallida, and is distinctly refractile. It may have a marked corkscrew shape and motion when alive, but when dried in films flattens out so as to show a wavy outline. The curves are flatter and longer than those of s. pallida, measuring from 1·5 to 2 μ or more. It varies in length, being most commonly from 8 to 10 μ. It possesses a vibratory membrane but no flagellæ.

Detection of Spirochæte Pallida.—The organism should be sought for in the deeper parts of lesions. The surface of a hard chancre should be thoroughly cleansed with soap and water, gently scraped, and then, from the fluid which exudes, smears made. The object of this is to avoid surface contamination with s. refringens. Another plan is to apply a vesicant to the skin and examine the serum; another, to puncture a bubo and remove some of the gland juice, as in searching for trypanosomes. Roseolar eruptions may also be scraped and punctured, or blood withdrawn from a vein (1 c.c. at least), diluted with ten volumes of ·3 per cent. acetic acid, and centrifuged. The tissue juices from cases of hereditary syphilis may swarm with spirochætes. Spirochætes are visible in fresh preparations; they do not stain deeply; they are more difficult to recognise in sections than in film preparations.

For examining fresh preparations incandescent gas is better than day or electric light (Metchnikoff). The ultra-microscope (dark ground illumination) shows the organism readily. For staining films Giemsa's stain (Grübler & Co.) is generally employed; modifications of Pitfield's flagellar stain give good results. For sections von Ermenghem's method is used. Sections are placed for twenty-four to forty-eight hours in ·2 to ·5 per cent. nitrate of silver solution, rapidly washed in distilled water, and immersed for a quarter of an hour in gallic acid 5 grams, tannin 3 grams, sodium acetate 10 grams, distilled water 350 c.c., until they are tinged yellow. They are then replaced in the silver solution until they turn brown, and are washed and mounted as usual. In staining films with Giemsa, the air-dried film is fixed in absolute alcohol for from ten minutes to one hour, and immersed for twenty-four hours in diluted stain—15 drops to 10 c.c. distilled water. Spirochætes are stained pale violet; nuclei, deep red.

Shennan gives the following "axioms":—1. Saprophytic spirochætes are always present on ulcerated lesions, on moist papules, and on mucous plaques. 2. The more thorough the previous cleansing the fewer of these are seen. 3. Spirochæte pallida may be somewhat deeply in the lesion, and apparently in clumps; on account of this six or eight films must be made. 4. A little blood on the film is an advantage in focussing, and, moreover, spirochætes are often seen in apparent relationship to red blood corpuscles. 5. In the case of excised chancres and papules s. pallida is not demonstrable after from six to ten hours. 6. Films should be thin and fixed as soon as possible. 7. With Giemsa's method nuclei of leucocytes should be deep purple, almost black, otherwise the spirochætes will not be seen. 8. Decolourisers (alcohol or weak acetic acid) rapidly discharge the stain from s. pallida, except where the mordanting (flagella) methods are used.

Biology.—The exact position of the spirochæte is still uncertain. Schaudinn, whose researches were cut short by his untimely death, inclined to the view that it was a trypanosome, and certain analogies between trypanosomiasis and syphilis exist; the matter, however, is uncertain. Schaudinn rechristened the organism "spironema" and then "treponema" pallidum, but probably it will continue to be known generally as the spirochæte pallida until its exact relationship is ascertained.

In the body the spirochæte enters the vessels and lymphatics and is found in the blood stream. Its chief predilection is for the walls of the lymphatics, whence it enters the intercellular and interfibrillary spaces of the tissues. It is found especially in connection with mononuclear infiltrations, and Metchnikoff believes that it exercises a chemotactic influence on these cells. It undergoes phagocytosis at their hands, and perhaps by the glandular and epithelial cells also. Nothing more is known as to its life history. It has not been cultivated outside the body.

It seems more than probable, almost certain, that s. pallida is the true cause of syphilis. Its almost constant presence in syphilitic, and its absence from non-syphilitic, lesions; its presence in experimental syphilis in apes; its abundance in the viscera in congenital syphilis —seem to exclude its being a saprophyte. The facts that the organisms disappear under efficient treatment; that, like the virus, they succumb to drying; that they are absent from fluids which are non-infectious (*e.g.* cerebro-spinal fluid), and present in those which are (saliva), point in the same direction.

Serum Diagnosis of Syphilis. — The original Wassermann test is described under

IMMUNITY DIAGNOSIS on pp. 197, 198. Since it was first introduced it has been the object of much research, and a number of modifications have been devised. Some of these are simpler than the original Wassermann, and may, in the near future, become available for ordinary clinical work.

It is now held by nearly all workers that the Wassermann reaction is not specific in the ordinary sense—*i.e.* the complement fixation is not dependent on the interaction of *bacterial* antibodies and antigens. What apparently happens is that in consequence of the action of the syphilitic virus tissue disintegration ensues, and lipoids are set free in the tissue juices. These lipoids play the part of antibody and antigen, the antibodies being possibly of the nature of cholesterin, the antigens being probably lecithin. However this may be, it has been shown that it is not necessary to use syphilitic fœtal liver to prepare the antigen, but that extract of normal liver or heart, and sodium oleate, bile salts, or lecithin and other substances may be employed with success. Thus one of the difficulties in the original method—the need for an extract of syphilitic fœtal liver—has been overcome.

Another modification facilitating the general use of the test is (*a*) either to take advantage of the normal property of human serum to lyse sheep's corpuscles, or (*b*) to employ the corpuscles of the patient, and to use a serum prepared by immunising a rabbit against human corpuscles. Of several tests based on these principles two may be referred to:—

1. *Fleming's Modification.*—Advantage is taken of the normal hæmolytic action of human serum on sheep's corpuscles: the serum to be tested is therefore made to supply complement and amboceptor. The materials required are alcoholic extract of heart, blood serum, and washed sheep's corpuscles. No more human serum is required than for the estimation of the opsonic index. Full details of the method will be found in the *Lancet*, 29th May 1909. An objection to this test, and others of the same type, is the variability, and occasional absence, of the hæmolytic-sheep-amboceptor in different specimens of human blood.

2. *Noguchi's Modification.*—In this use is made (1) of an anti-human amboceptor, prepared by injecting a rabbit with washed human corpuscles. There are also required (2) complement—fresh guinea-pig serum; (3) antigen—alcoholic extract of liver or 3 per cent. solution of lecithin; (4) suspension of human corpuscles prepared by mixing one drop of normal blood to 4 c.c. saline solution; (5) serum to be tested, collected from ten drops of the patient's blood. Six tubes are used in performing the test. In one pair a drop of the patient's serum is placed, in the second pair a control normal serum, in the third pair a control syphilitic serum. Each tube then receives blood corpuscles, amboceptor, and complement, and one tube of each pair antigen. The test has been further simplified for clinical work by using pieces of filter papers saturated with the reagents and dried. These can be standardised; they keep indefinitely. Anti-human amboceptor slips, complement slips, and lecithin slips are supplied. They are dropped by means of forceps into three pairs of tubes containing suspension of corpuscles, suspected serum, and the two control serums. The tubes are incubated in the breast pocket.

Porges Meier Reaction.—Equal parts of blood serum and 1 per cent. emulsion of lecithin in normal saline are mixed and allowed to stand at room temperature for five hours. The lecithin emulsion is precipitated by syphilitic, not by normal serum. The results are said to be fairly comparable to those of the original Wassermann test.

SYPHILIS IN RELATION TO NERVOUS DISEASES, ESPECIALLY TABES AND GENERAL PARALYSIS.—The discovery of the cause of syphilis has, if anything, strengthened the widespread belief that tabes and general paralysis are syphilitic in origin. Mott and Spielmeyer have pointed out the very close resemblance which exists between the lesions of general paralysis and sleeping sickness. As has already been stated, Schaudinn regarded the spirochæte pallida as a species of trypanosome, and the conclusion is supported by the analogy of the disease of horses, *mal de coït* or *dourine*, the lesions and course of which resemble syphilis, and which is due to a trypanosome. In mal de coït and in syphilis the organism multiplies in the lymphatics; the same is true of sleeping sickness.

The syphilitic nature of tabes and general paralysis is further supported by the fact that in a large percentage of cases of these diseases a positive Wassermann reaction is obtained (*see* IMMUNITY DIAGNOSIS, p. 198).

Mott points to the following facts showing that syphilis is the essential cause of tabes and general paralysis:—1. The remarkable statistics of Erb. 2. Very few eminent neurologists or psychiatrists believe otherwise. 3. The cerebro-spinal fluid of tabes, general paralysis, and syphilitic meningitis invariably contains lymphocytes, often plasma cells, and no polynuclears. This occurs in no other *chronic* affection of the nervous system except sleeping sickness. 4. The existence of antisyphilitic bodies in the serum and cerebro-spinal fluid of tabes and general paralysis. 5. Krafft-Ebing's failure to inoculate general paralysis with syphilis. 6. In 80 per cent. of 40 cases of juvenile general paralysis syphilitic antecedents were determined, and in *no case* could the disease be excluded. 7. The Argyll-Robertson pupil is practically only met with

in tabes, paralysis, and syphilis; it may be the only sign of syphilis. 8. In tabes the proportion of males to females affected depends on the social status—*i.e.* the liability to syphilis. In juvenile general paralysis, where the chances are equal, the sexes are equally affected.

Mott's view of the nature of parasyphilitic disease of the nervous system cannot be reproduced better than in his own words:—"Parasyphilitic disease of the nervous system depends on two factors, intrinsic, innate, and extrinsic, acquired—the soil and the seed; the vital resistance and the specificity of the virus, $\frac{V}{R}$. All those conditions, which may be inherited or acquired, and which tend to active metabolism of systems, communities, and groups of neurons functionally correlated, and which, owing to these conditions of stress which in one individual would cause spinal neurasthenia, in another central neurasthenia, will, in conjunction with the stimulating effect of the syphilitic poison, cause the nerve cells to exercise an abnormal metabolic activity in the production of the side-chain molecules necessary for immunisation against the toxic effects of the virus.

"Ehrlich points out that we cannot suppose that the cells of the body possess *per se* an executive defensive capacity to neutralise the noxious effects of all forms of organisms, and his work on hæmolysins shows that the hæmolysin for the corpuscles of a particular animal only occurs after incorporation of the molecules of those corpuscles. But we may suppose that there is an *inherent* aptitude for the cells of the body of certain individuals to readily adapt themselves to defence against the action of the syphilitic virus in a race that has been widely syphilised for generations; consequently a larger number will have a mild form of the disease.

"The nerve cells are perpetual elements incapable of regeneration, highly differentiated and complex in structure and function, their centre of nutrition is the nucleus, and when decay sets in, the regressive process attacks first the fine twigs and branches of the tree, the dendrites and dendrons, and the rootlets; in fact, the process is an inversion of its growth and development. But what should cause this premature decay and lack of durability? for the specific energy of the whole of the neurons in the healthy body is sufficient to last until the vital spark dies out.

"We know that one attack of syphilis confers immunity during the rest of the individual's life, and the experiments of Krafft-Ebing are important to remember in this respect. The nerve elements being perpetual, having acquired a habit of throwing off side-chain molecules, will continue to do so during life and will contribute largely to the immunity produced. When there is no longer metabolic equilibrium, and decay sets in, these immune bodies are thrown off in increasing numbers; this seems probable from the fact that in general paralysis and tabes the quantities increase with the progress of the decay. The process of decay will manifest itself in the earliest stages by an increased irritability and functional activity of the nervous structures, often manifesting itself in a *hyperæsthesia sexualis*, and not infrequently in striking intellectual activity, followed in each case by exhaustion and loss of function.

"The uselessness of antisyphilitic remedies is thus easily accounted for; indeed, they are generally positively injurious in true tabes and general paralysis, because they lower the vital energy in a system which has over-immunised itself against the syphilitic virus. The only hope of doing any good is by an early diagnosis of the disease and suppression of all those exciting causes which use up the nervous energy and tend to overturn the metabolic equilibrium of the central nervous system, causing its premature decay. This may explain a well-known fact, first pointed out by Benedikt, that tabetic patients who become blind from optic atrophy remain in the preataxic stage a great number of years. Neuro-potential or nerve energy is for the most part used up in mental processes involving attention. The loss of sight necessitates mental inactivity provided the patient does not worry. My experience is that these cases of optic atrophy generally either remain in the preataxic stage or develop general paralysis. I have found in the history of the latter great mental depression arising from the loss of sight. Possibly some remedy may be found which will allay this hypernutritive and metabolic activity of the nervous system. It is, in my opinion, a fact that general paralytics and tabetics are very frequently mentally and physically superior to the average individual who belongs to the same social status, and I have always considered it probable that the frequent indulgence of abnormally strong sexual desires stimulated by many causes, especially alcohol, is, after syphilis, the most important factor in the production of tabes and general paralysis. It acts in two ways—(1) directly by exhaustion of neuro-potential; (2) indirectly in the male by the excessive loss to the body of highly phosphorised nucleo-proteids contained in the sperm. These are bio-chemical substances possessed of great specific energy, and are not easily replaced."

Treatment of Syphilis by Intramuscular Injections of Mercury.—This method of giving mercury has been revived in recent years, especially in the army. Lieut.-Col. Lambkin states that the success which has attended it is out of all proportion to that which was obtained by the older methods.

Both soluble and insoluble preparations of mercury have been used. The disadvantage of the former is that, to be of any benefit, injections must be made daily, or at least three or four times a week; they are also painful, and the reaction is uncertain. The advantages of the insoluble preparations are that they are more active, reaction is more lasting, and that they need be injected less frequently—once a week or once a fortnight. Lambkin advises mercury cream, of the following composition:—

Hydrargyri	℥ss.
Adipis lanæ anhyd.	ʒii.
Paraffin liquid (2 per cent. carbolic) ad. .	ʒv.

Maximum dose, ♏x.=gr. i. Hg once a week.

Technique of Treatment.—Very thorough trituration of the mercury and lanoline is essential. Two hours should be spent on the process. The carbolised paraffin is then added, and the whole thoroughly stirred. It should again be thoroughly stirred before each injection. In hot climates it should be kept in an ice chest, as at a temperature above 90° F. the mercury tends to sink; in cold weather it should be warmed to about 90° F. so as to allow it to run through the needle.

Injections are made into the gluteal muscles with a platino-iridium needle attached to an all-glass syringe. The needle should be driven into the muscle with a single vertical thrust. Careful antiseptic precautions are required; the skin should be purified with 1 to 500 solution of perchloride, and the needle sterilised with boiling oil.

Lambkin's practice is to give a grain of metallic mercury every week until all symptoms have subsided—on an average, in six weeks to two months; then the injections are given once a fortnight for three months. A two months' rest is then allowed, then a second three months' course of fortnightly injections. During the second year these three-month periods of treatment are alternated with two-month periods of rest, as may seem indicated. The average duration of treatment is two years. As adjuncts to treatment, hot air or Turkish baths should be taken, or daily hot baths, with plenty of exercise. The diet should be liberal; spirits are interdicted, and smoking discouraged. The gums require special care; the teeth should be brushed twice or thrice a day with an astringent mouth-wash (lead subacetate and alum). The body weight should be noted weekly, and the urine examined for albumin.

REFERENCES.—Schaudinn and Hoffmann, *Arbeiten a. d. Kaiserlichen Ges. Amte.* (Berlin), xxii. 1905.—Buschke and Fisher, *Deutsche med. Wochensch.*, *passim*, 1905.—Bordet and Gengou, *Arch. Soc. Roy. de Med. de Brux.*, 1905.—Shennan, *Lancet*, 10th and 17th March 1906 (with bibliography).—An admirable account of the discovery of the cause of syphilis from the pen of Prof. Metchnikoff will be found in Keogh Murphy and D'Arcy Power's *System of Syphilis*, vol. i.—Spielmeyer, *Münch. med. Wochensch.*, 28th May 1907.—Mott, *Brit. Med. Journ.*, 4th Jan. 1908.—Lambkin, *ibid.*, 11th Nov. 1905.—Lane, *ibid.*, 21st March 1908.—Serum Diagnosis, Fleming and Others, *Lancet*, 29th May 1909.—Noguchi, *Journ. Exper. Med.*, Jan., March 1909.—Porges, *Wien. klin. Wochensch.*, No. 8, 1908.

Treatment by Salvarsan ("606").—Although at the time of writing it is impossible to say whether the new drug introduced by Ehrlich for the cure of syphilis will fulfil the hopes which are justly entertained for it, the discovery is of such scientific interest, the immediate results of treatment are so striking, and the steps which have led up to the production of the new drug are so suggestive of possible future developments along analogous lines of research, that "606," a name which became very familiar to readers of the medical journals during the latter part of 1910, merits more than a merely passing reference.

The full name of the drug is dioxy-diamido-arsenobenzol; it is more conveniently referred to under its number 606, or as the Ehrlich-Hata remedy for syphilis. It is used by subcutaneous or intravenous injection, and the idea underlying its use is to give in one dose sufficient utterly to annihilate the spirochætes in the body. Whether this is actually possible or no, it is an undoubted fact that after a single injection syphilitic manifestations—primary, secondary, and tertiary—may undergo rapid regressive changes and disappear in a manner which has never been seen under any system of mercurial treatment. In a disease which runs so protracted a course it is obvious that several years must elapse before the real efficacy of the remedy is determined; up to the present it is only possible to speak of its immediate action, and that is sufficiently striking.

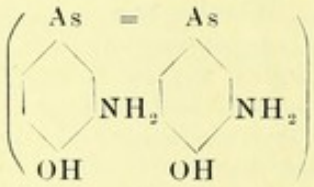
Dioxy-diamido-arsenobenzol was in no sense a "lucky hit" of its discoverer; it was led up to by years of patient work on trypanocidal and spirillicidal drugs. In experimental trypanosome injections in animals Ehrlich found that by giving trypanocides, such as atoxyl, or fuchsin, or trypan-red, he could destroy large numbers of the trypanosomes, but that ultimately the organisms became resistant to a drug to which formerly they were susceptible; in his own words, he produced "atoxyl-fast" or "fuchsin-fast" strains of trypanosome. It followed that the drugs in question had molecular groupings adapted to attaching them to certain receptors of the trypanosome, and further research showed that a parasiticide may anchor itself to a trypanosome by several sets of receptors—*e.g.* arseno-phenyl-glycin anchors itself by its acetic acid as well as its arsenic-containing group. It thus became a problem of "chemotherapy" to produce by synthesis drugs which should have a special affinity (by reason of containing appropriate

molecules) for parasites, while having comparatively little affinity for the tissues and cells of the host. In this way "606" was arrived at; it is the most potent known spirillicide. Ehrlich also showed that in experimental animal injections with trypanosomes and spirilla the best way of curing the animal is to give at one dose enough of the drug to destroy all the parasites; this is possible only in virtue of the drug possessing an affinity for the trypanosome greatly in excess of its affinity to the tissues and cells of the host. This act of sterilisation at a single blow is designated by Ehrlich "Therapia Sterilisans Magna."

The superiority of "606" over other drugs of the same series as regards their toxicity to the host is shown in the following table:—

	Dose tolerated per kilo. of body weight.	Curative dose per kilo. of body weight.
Atoxyl . .	·06	·03
Arsacetin . .	·1	·03
Arseno-phenyl-glycin	·4	·12
Dioxy-diamido-arseno-benzol	·2	·0035

The chemical formula of the new drug is—



At the time of writing, the drug is not procurable commercially, though we are promised that it will soon be so. *Dose and mode of administration.*—The dose is from ·2 to ·8 gram, the average for an adult being ·6 gram. It may be given either intravenously or intramuscularly. In the former case there is no local reaction, but there is a general febrile reaction of short duration. When given subcutaneously or intramuscularly some local tenderness may follow. After intravenous injection the drug is excreted rapidly, no arsenic being discoverable in the urine after four days. With intramuscular injection excretion takes place more slowly—five days in recent syphilis, ten days in general paralysis. In experimental work on animals it is found that the effect is more prolonged after intramuscular than after intravenous injection, the reason being that when the drug is injected into a muscle a depôt forms, from which gradual absorption takes place. One injection, or sometimes two, seem all that is required.

Technique.—The patient should be kept in bed for two or three days, and afterwards confined to his room for a week.

Dioxy-diamido-arseno-benzol is a yellowish powder contained in ampoules in which a vacuum exists. The injection is prepared before use, and as it cannot be sterilised after it is made up, rigorous asepsis is required in its manipulation. Instruments must be sterilised in the flame and solutions by boiling.

1. *Herxheimer's Process.*—The dose (·5 gram) is carefully triturated in a mortar with ·3 c.c. of 20 per cent. caustic soda; while continuing the trituration 10 c.c. water is added in small quantities, and the injection is given immediately so as to prevent separation and precipitation.

2. *Blaschko's Process.*—To ·36 c.c. of a 20 per cent. solution of caustic soda is added ·5 gram of "606." The powder undergoes prolonged trituration, and there is then added from 4 to 6 c.c. of hot boiled water.

3. *Michaelis Process.*—For a dose of ·5 gram of the drug from 1 to 2 c.c. of ethylic alcohol is poured over the powder in a test-tube. Twenty cubic centimetres of hot distilled water are gradually added with constant stirring. When solution occurs, 1 c.c. of normal caustic soda solution (40 per 1000) per decigram of prepared powder is added. To the liquid is added from 2 to 3 drops of 1:200 phenophthalein. The colour becomes red. A drop or two of normal acetic acid is added until the preparation takes the colour of yellow sulphur. Then add 2 or 3 drops of the alkaline solution to neutralise the excess of acid, stopping the operation when the upper part of the liquid shows a pink halo.

A sterilised syringe of 10 c.c. capacity is used, armed with a platinum needle of large calibre about 2 ins. long. The site of injection is disinfected by painting with tincture of iodine. Intramuscular injections are usually given into the glutei; subcutaneous in the interscapular, or inframammary regions.

Effect on the Lesions.—Improvement may occur within a few hours. Primary sores begin to regress within a few days, rashes fade, ulcers heal, mucous patches disappear. Large tertiary ulcers may be completely cicatrised in a few weeks. Good results have been obtained in syphilis of the nervous system, but so far the evidence of a beneficial action in parasyphilitic cases is slight. Herxheimer's reaction — a transient exacerbation of the eruption — is sometimes observed when the dose has been small and the roseola profuse.

Effect on the Spirochætes, and on Wassermann's Reaction.—There seems to be no doubt that the improvement of the lesions is associated with a disappearance of the spirochætes. Iversen failed to detect those in the juice of the lymphatic glands a few days after injection. The Wassermann reaction is also lost; sometimes as early as the fourth day, sometimes not until several weeks have elapsed. It is not, of course, possible to say that disappearance is invariable. In some cases there is an initial intensification of the reaction. The

abolition of the reaction is not due to the direct presence of the drug in the patient's blood serum.

Action in Congenital Syphilis.—The interesting observation has been made that the infants of syphilitic nursing mothers benefit by the injection of the mother with "606." This is not due to the drug passing over in the milk (for analysis has failed to show its presence in milk), but is probably due to the production of antitoxins in the mother's body from the great destruction of spirochætes.

Possible Evil Effects. — Several thousand patients have now been treated with arseno-benzol, and the misadventures have been surprisingly few. In particular, blindness, the most dreaded consequence of the use of atoxyl, has not been observed. Three deaths are recorded : two were in marasmic infants badly tainted with hereditary syphilis ; the other in a patient with extensive cerebral disease. Retention of urine, which occurred in the practice of one user of the drug, was probably not due to the arseno-benzol, but to the use of impure methyl alcohol in dissolving it.

Indications and Contra-indications. — The chief contra-indications are—(1) advanced cerebral mischief ; (2) non-syphilitic diseases of the retina or optic nerve ; (3) advanced renal, cardiac, or pulmonary (except tuberculous) disease. The indications are—(1) syphilis, including early parasyphilis, especially malignant cases, cases intolerant of or refractory to mercury, tuberculosis and syphilis, visceral syphilis, including epilepsy.

"606" *in other Diseases.*—Iversen reports very favourably of its effect on relapsing fever. A single injection cuts short the attack in from seven to twenty hours, and in 92 per cent. of his patients it entirely prevented a relapse. Spirilla disappeared from the blood in four to ten hours. It is also said to be an active anti-malarial, especially in the intermittent forms of the disease. A single dose of ·6 gram removes the plasmodium from the circulating peripheral blood in twenty-four hours.

Literature.—A large number of papers on "606" will be found in the *Münchener med. Woch.* for 1910, from 15th March onward. The files of the *Deutsche Medizinische Wochenschrift* for the latter half of the year also contain a number. An admirable summary by Ehrlich, Hata, and Hoppe and Schreiber, dealing with the theoretical, experimental, and clinical aspects of the question (on which this summary is largely based) will be found in the *Verhandlungen d. 17ten Kongresses f. inn. Med.*, Wiesbaden, 1910, p. 242 *et seq.* As the remedy has chiefly been employed in Germany, the number of English papers on the subject is small by comparison.

Indian Ink Method of detecting the Spirochæte Pallida.—A very simple method of detecting the spirochæte pallida for diagnostic purposes is by the use of Indian ink. The procedure is rapid, demands no elaborate stains or reagents, and is therefore well adapted for clinical work. The suspicious lesion—chancre, etc.—is washed and dried, and a little tissue juice is scraped from it with a sterile instrument. A drop of this is mixed with a drop of Indian ink, and a rather thick smear is made on a slide. It is allowed to dry, and examined without further preparation under an oil immersion lens. Spirochætes show up in white against a dark background. Any cells which are also present show up, and serve to indicate the size of the spirochætes. Ordinary liquid Indian ink, with an equal quantity of water, answers well, or a specially finely-prepared ink may be procured for the purpose from dealers in microscopic requisites.

Tabacosis.—The morbid state of the lungs seen in workers in tobacco, and due to the inhalation of the tobacco dust.

Tannacol. — A combination of tannic acid with gelatin ; it has the advantage of being without astringent effect on the gastric mucous membrane.

Tannal. — A basic aluminium tannate, insoluble in water, but soluble in dilute alkalies.

Tannalum Solubile.—This name is given to a soluble tartrate of aluminium and tannin ; it is recommended as a gargle, or for the painting of the throat.

Tannocase.—A combination of tannic acid with casein ; it is broken up in the small intestine without producing any astringent effect on the mucous membrane of the stomach.

Tannopin.—A tannic acid derivative, being a compound of hexamethylene-tetramine (urotropin) and tannic acid, constituting a "fine fawn-coloured powder, insoluble in water and weak acids" ; it is tasteless and odourless ; and the dose is from 4 to 15 grains as an astringent and antiseptic. *See* Fortescue-Brickdale, *Newer Remedies*, p. 84, 1910.

Tannothymol.—A condensation product of tannic acid with thymol and formaldehyde, forming a powder, insoluble in water and acids, but soluble in alkalies ; the dose is 15 grains.

Tatoo Marks.—The following method of removing tatoo marks is given by Park (*Principles and Practice of Modern Surgery*, London, 1908, i. p. 318). It is attributed to Ohmann-Dumesnil. Wash the skin with

soap and water, then tatoo the skin with eight or ten fine cambric needles tied together and dipped in glycerole of papoid [glycerinum papain], driving the needles into the tissues so as to deposit the digestive in the corium, where the carbon is located. Repeat as necessary. The pigment is liberated by the digestant.

Taylor's Diet.—An ash-free diet consisting of the whites of 18 eggs, 120 grams of olive oil, and 200 grams of crystallised sugar; it is given when it is desired to study the chlorides of the urine.

Telectro-Cardiograms. — *See* HEART, DISEASES OF (*Einthoven's Work*).

Test Meals.—*See* DIGESTIVE FUNCTIONS, TESTS FOR THE (*Schmidt's Test Diet*); RIEGEL'S TEST MEAL, etc.

Tetanus.—*Post-operative Tetanus.*—The accident of tetanus supervening after a surgical operation has been discussed in a paper by W. G. Richardson (*British Medical Journal*, 17th April 1909), who lost a patient, on whom he had operated for gall-stones, from this cause. The operation was performed on the last day of September, the initial symptoms of tetanus developed six days later, and the patient died within forty-eight hours of their onset. Richardson has collected records of twenty-one such cases, and in all of them, including his own, catgut was used for ligatures. In his case, and in fourteen of the others, the catgut was examined bacteriologically. In four cases a bacillus resembling *B. tetani* was recovered, and in one, though the catgut was sterile, a bacillus was cultivated from the pedicle of an ovarian cyst. Apparently none of the bacilli cultivated infected experimental animals. In Richardson's own case the catgut was sterile. Thus, in spite of careful search, there is no positive proof that catgut is to blame for the occasional occurrence of post-operative tetanus. Richardson also found that practically all the raw catgut used for ligatures throughout the United Kingdom comes from Germany, and if it were the vehicle of infection, tetanus ought to occur in all parts of the country. The south and east of England, however, are exempt. Now there exists among sheep a group of disorders allied to tetanus, the bacilli of which can scarcely be distinguished from *B. tetani*. In these diseases the bacilli are normal denizens of the bowel, but at certain seasons pass into the blood, and give rise to symptoms. During these seasons the bacilli are found in the peritoneum and in no other part of the body. These diseases are endemic in certain parts of Great Britain, and (*a*) the 21 cases of post-operative tetanus have occurred only in these districts; (*b*) more than 90 per cent. of post-operative tetanus follows operations involving opening of the peritoneal cavity. Richardson's suggestions are:—(1) Post-operative tetanus is not true tetanus, but one of this group of "sheep tetanus." (2) It is not introduced by catgut, but that the patient, at the time of the operation, harbours the bacillus. (3) The disease is idiopathic tetanus, but it is not to be assumed that it would have developed irrespective of the performance of an operation.

Treatment.—In America, where tetanus is so common a sequel of accidental gunshot wounds received on the 4th of July (1907, 73 cases; 1908, 76 cases; 1909, 150 cases.—Census compiled by the *Journal of the American Medical Association*) the practice of treating patients who have sustained lacerated wounds in which there is a possibility or probability of infection, by prophylactic injections of serum is becoming common. As regards serum treatment when the symptoms are actually present, opinions differ concerning the best channel of administration. Hessert states that none of the special methods have proved of any great value, and advises the subcutaneous route. Kuster (*Therapie d. Gegenwart*, Feb. 1907) points out that the poison of tetanus travels along the nerve trunks, and recommends intraneural injections into the nerves supplying the area wounded, especially in cases of localised tetanus, and intraspinal injections when there is trismus. (For experimental work in connection with intraneural injections of antitoxin, see Meyer and Rausom, *Arch. f. Exper. Path. u. Pharmacologie*, 1903; Marie and Morax, *Annales de l'Inst. Pasteur*, 1902-3; for clinical aspects, Rogers, *Journ. Amer. Med. Assoc.*, 1st July 1905.) Kenyoun (*Journ. Amer. Med. Association*, 18th Aug. 1906) has employed the dried antitoxin as a dressing. Intracerebral and intravenous injections have also been employed. It seems rational to employ a combination of methods—*e.g.* when the wound is being exposed for the purpose of purifying it to inject antitoxin into the main nerves leading to it, and at the same time to give an intravenous or intraspinal injection of 10-15 c.c.

Intraspinal injection of magnesium sulphate is one of the latest methods of treatment. Haubold and Meltzer (*Journ. Amer. Med. Association*, 3rd March 1906) show that this salt, which, when applied locally, lowers the conductivity and excitability of motor and sensory nerves, may be used as a spinal anæsthetic, and although it is probably too dangerous to compete with such anæsthetics as stovaine, eucaine, etc., it has been taken up in the treatment of tetanus, in which spinal anæsthesia by eucaine B. and morphine had already been successfully employed. The salt is used in solution of the strength of 25 per cent., 1 c.c.

for each 25 lbs. of body weight. M'Phedran (*Canadian Journal of Medicine and Surgery*, June 1909) had a successful case, and states that of 11 cases thus treated 5 have recovered. The risk of the proceeding is paralysis of the respiratory centre. The drug, therefore, must be used with caution, and it is probably advisable to raise the head, so as to prevent the solution from reaching the medulla.

Thalassin.—*See* ANAPHYLAXIS.

Theocine.—The trade name of theophylline, a derivative of theobromine; it forms a white crystalline powder and has a marked diuretic action; it is soluble in 180 parts of water at ordinary temperatures, and is, on this account, best given as soluble theocine (acettheocin sodium, a combination of acetate of sodium with dimethylxanthine sodium); it is recommended in cardiac dropsy in doses of 1½ to 5 grains, but care should be used, and some authors restrict the quantity to 3 grains every other day; it has been found to cause gastric irritation. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 90, 92, 1910.

Theocine Sodium Acetate (*see* THEOCINE).—It contains about 60 per cent. of theocine, is more soluble (viz. in 23 parts of water), and is believed to cause less gastric irritation.

Theolactine.—A double salt of theobromine, being theobromine-sodium lactate, and containing 57 per cent. of theobromine; the dose is from 8 grains, which may be gradually increased up to 15 grains, thrice daily; it acts as a diuretic. *See* Fortescue-Brickdale, *Newer Remedies*, p. 94, 1910.

Theophorine.—A theobromine compound, being a double salt (theobromine-sodium-formate) thereof; it contains 62·5 per cent. of theobromine; it acts as a diuretic, and the dose is 8 grains; but it is said to be contra-indicated in nephritis. *See* Fortescue-Brickdale, *Newer Remedies*, p. 94, 1910.

Theophylline.—*See* THEOCINE.

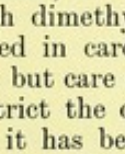
Thermifugine.—A quinine substitute, given in doses of 1½ to 3 grains; but it is little used.

Thermodin.—A drug (urethane derivative) of the phenacetin group, acting as a mild antipyretic and a weak diuretic. *See* Fortescue-Brickdale, *Newer Remedies*, p. 218, 1910.

Thermo-penetration.—*See* DIATHERMY.

Thiocol "Roche."—A proprietary preparation, described as the potassium salt of guaiacol sulphate, $C_7H_7O_2SO_3K$, and said to contain 52 per cent. of guaiacol; it is readily soluble in water; the dose is 15 grains, in pulmonary tuberculosis, etc.; Report in *Brit. Med. Journ.*, i. for 1910, p. 1242; *Lancet*, i. for 1910, p. 653. *See also* SIROLIN.

Thiodine.—A thiosinamine derivative, being produced by the action of ethyl iodide upon it; it is given in doses of from 3 to 6 grains in the twenty-four hours; but it does not appear to have any superiority to fibrolysin (the combination of thiosinamine with sodium salicylate). *See* Fortescue-Brickdale, *Newer Remedies*, p. 37, 1910.

Thiophene.—A colourless fluid, with the formula  ; it may be combined with iodine and bromine to form yellow crystalline substances, which are soluble in alcohol and are intended as ichthyol substitutes for external use. *See* Fortescue-Brickdale, *Newer Remedies*, p. 28, 1910.

Thiosinamine.—*See* DRUGS, RECENT (*Fibrolysin*); and FIBROLYSIN.

Third Corpuscles.—The blood plates, hæmatoblasts or blood plaques, colourless bodies in the blood containing no hæmoglobin, having a size of about 3 microns, staining like nuclear material, and considered by some authorities as the direct forerunners of the erythrocytes.

Thoracostomy.—An operation for freeing the heart from costo-pericardial adhesions, consisting in the resection of parts of certain ribs and costal cartilages, and sometimes of a portion of the sternum; Brauer's cardiolysis. See *Lancet*, ii. for 1908, p. 7; ii. for 1909, p. 1494.

Thorium.—*See* RÖNTGEN RAYS AND RADIUM.

Thorn-Apple Crystals.—Brown spherical bodies covered with spicules, found in alkaline urine and consisting of ammonium urate.

Thrombase.—A ferment which converts the fibrinogen of the blood into fibrin; its forerunner is prothrombase, present in the leucocytes.

Thyminic or Thymic Acid.—*See* SOLUROL.

Thyresol.—A proprietary preparation, being a methyl ether of santalol, constituting a colourless liquid, insoluble in water, but soluble in alcohol; it is stated to be non-toxic as compared with sandalwood oil and santalol, for it contains no free hydroxyl groups; further, it has no disagreeable odour; it is recommended (in doses of 5 to 10 minims in capsules or tablets) as an internal antiseptic in gonorrhœa, cystitis, urethritis, etc.; it is favourably reported on by E. Levin (*Deutsche med. Wochnschr.*, xxxv. p. 1356, 1909) and others. See *Lancet*, ii. for 1909, p. 788; *Brit. Med. Journ.*, i. for 1910, p. 209.

Thyroidectin.—*See* GRAVES'S DISEASE (*Treatment*).

Thyroid, Surgery of.—The Mayos, of Rochester, U.S.A., have contributed several important papers embodying the results of their experience in the surgical treatment of goitre (*Surgery, Gynæcology, and Obstetrics*, March, June, 1909; *Journ. Amer. Med. Assoc.*, 26th January 1907). The chief points of interest concern the question of operation for exophthalmic goitre, or as the Mayos prefer to call it, hyperthyroidism; and secondly, the technic of operations on the thyroid gland.

Hyperthyroidism.—In a series of 1000 goitres operated on, 405 cases of marked hyperthyroidism occurred, with 19 deaths. Most of these were treated by the extirpation of one lobe, usually the right, and part of the isthmus. In very mild early cases the treatment adopted was to ligature the arteries and veins at both upper poles. In very bad cases a similar operation was performed as a preliminary to removal of a part of the gland later. In very aggravated cases with cardiac dilatation, ascites, etc., a preliminary period of medical treatment by rest in bed, X-rays, and belladonna and quinine is advisable. In selecting a time for operation periods during which the patient is suffering from vomiting or diarrhœa ought of course to be avoided. The operations performed may be tabulated thus:—

		Deaths.
Double ligature of superior thyroid vessels	97	1
Extirpation of one lobe with subsequent ligature of opposite superior thyroid vessels .	14	...
Extirpation of a considerable part of the thyroid . .	295	18

The results of the surgery of exophthalmic goitre are good. Of those who survive the operation 50 per cent. make an early recovery, 25 per cent. improve on the main symptoms in the course of a few months, and 25 per cent., though improved, have occasional temporary relapses of tachycardia and tremor. The exophthalmos is one of the last symptoms to disappear.

Bloodgood (*Inter. Clinics*, ser. xvi., i. p. 280) adopts a moderate position as regards the surgical treatment of exophthalmic goitre. He divides cases into three groups:—1. Advanced cases, with exaggerated symptoms, and attacks resembling acute post-operative thyroidism (*q.v.*). These cases are rare; the prognosis is grave; operation is unjustifiable; medical treatment, X-rays, and serum-therapy should be tried. 2. Well-marked cases, without very acute symptoms. The results of operation are so good that it is doubtful whether delay in favour of medical treatment is permissible. 3. Mild cases. Medical treatment and X-rays should be tried, and will cure a certain number of these. Every patient with a simple goitre who develops symptoms of Graves's disease ought to be operated on at once.

Kocher, who opened the discussion on the surgical treatment of exophthalmic goitre at the meeting of the British Medical Association in 1910 (*Brit. Med. Journ.*, 1st Oct. 1910), declined to admit, as some American writers seem disposed to do, that hyperthyroidism is identical with Graves's disease. When a larger amount of thyroid secretion is needed by a healthy organism, as it is at the age of puberty, in pregnancy, and in some diseases, hypertrophic swelling of the gland is a useful physiological process, and to interfere with this by operation is simply to bring discredit on the operative treatment of real Graves's disease. Kocher lays great stress on the examination of the blood in Graves's disease. The malady is characterised by a diminution in the polynuclears, and an increase of the lymphocytes. It is very exceptional to find a case of true Graves's disease in which this state of matters is not present, and in a doubtful case a diagnosis of Graves's disease should not be made if the above blood picture is not found. After operation, if success is only partial, the lymphomatosis persists; complete cure goes along with a return of the blood to normal. The coagulation time of the blood is also usually prolonged in cases of the disease; after operation it becomes normal, while in cachexia, strumipriva, and myxœdema the coagulation time is diminished. Kocher has now performed 4394 excisions of goitre, of which 469 were cases of Graves's disease. The total mortality of these 469 cases is 3·4 per cent., but the mortality has gone down from 5 per cent. four years ago to 1·3 per cent. this year. *Contra-indications to operation.* — Long-continued poisoning with thyroid secretion brings on organic changes in the heart muscle, kidneys, liver, pancreas, and cerebral cortex. In Graves's disease operations everything must be done to avert increasing the already existent

damage to the brain, above all mental shock. This, probably, accounts for some deaths soon after operation (see a paper by Crile, *Annals of Surgery*, June 1910). When the pulse has become very irregular, especially in tension, there is danger of heart failure after operation. Operations on patients suffering from albuminuria and nephritis are also very dangerous, and should be postponed until the symptoms have improved under treatment. The greatest risk of all is the presence of the *status lymphaticus* — enlargement of the lymphatics, thymus, spleen. Status lymphaticus develops early in the course of the disease. Kocher states that he has not seen a single case in which the patient has not benefited from operation, and urges that the disease should be treated surgically in its early stage, not leaving to the surgeon, "after the ship has gone on the rocks, to deal with the wreckage." In the discussion which followed, Hector Mackenzie agreed as to the frequency of lymphatism in exophthalmic goitre. His experience of operation was much less favourable than that of Kocher; he has not seen any cases he should consider cured, and doubted whether Kocher got the same class of case to operate on as are found in England. A large proportion of the cases seen abroad seem to be of the mild type. Under medical treatment 36 per cent. of hospital cases recover completely, 23 per cent. die. In private the results are much better. Bruce of Toronto gave as collected surgical results 4 per cent. mortality, 16 per cent. absolute cures, 85 per cent. enough improvement to enable patients to lead a normal life. Most of the other speakers favoured operation in exophthalmic goitre.

In connection with the question of the operative treatment of Graves's disease, an interesting paper by Hale White (*Quarterly Journal of Medicine*, Oct. 1910) on "The Outlook of Sufferers from Exophthalmic Goitre" may be referred to. It is based on an attempt to follow up the after-history of a large series of hospital and private cases. Of 169 hospital cases, 21 died in hospital and 54 can be traced. Of these, 49 were not operated on. Added to these, 53 private cases not operated on—102 in all. The total deaths among them were 15, the expected deaths, according to the "Healthy Females Experience Table," should have been 8. These cases were all either ill enough (*a*) to go into hospital, or (*b*) to desire a second opinion, and probably the inclusion of all cases of goitre, therefore of many slight cases, would make a better showing. As it is, the mortality, though not high, is about double the expected death-rate. On the other hand, 18 cases died in hospital without operation—26 in all, of a known series of 68. This, however, is too high, because 94 hospital patients could not be traced; but, assuming the mortality to be the same as those who left hospital and were traced, we get a total mortality of 41 out of 161 hospital cases. Taking hospital and private cases together, we get a total of 48 deaths in 214 patients, or 1 to 4·5. Hale White comes to the conclusion that, apart from the most encouraging statistics (Kocher, Mayo), the figures given by most surgeons are not materially better than these, when it is remembered that cases selected for operation are usually mild cases, and that if the very bad cases are excluded medical statistics give a low mortality.

A large proportion of the cases followed up are not only alive, but absolutely cured; many have married, borne children without ill effect. Very few, only 5 out of 87, have not improved. Patients who are once cured do not often relapse. The most important factor in the treatment is rest in bed, with freedom from anxiety. Probably it is because private patients are better able to rest than hospital ones that the outlook for the latter is more serious than for the former.

Technique.—Ether is the best anæsthetic, preceded by $\frac{1}{6}$ gr. of morphia, and $\frac{1}{120}$ grain of atropine to diminish the amount of bronchial secretion. The patient is placed in the reversed Trendelenburg position (head raised), and a transverse incision is made midway between the thyroid cartilage and sternum (Collar, or Kocher, incision) through the skin and platysma. The hyoid muscles are then separated by a vertical incision, reaching from the thyroid cartilage to the sternum. If the tumour is not very large, access may be got to it by separating the muscles; if more room is required, the sterno-hyoid and sterno-thyroid may be divided near their upper insertions, so as to cut above their nerve supply, and turned down. The gland is now dissected out from above and without downwards and inwards, the superior thyroid vessels being tied as early as possible. The posterior part of the capsule should be preserved so as to protect the parathyroids and recurrent laryngeal nerve from injury. The inferior thyroid vessels must also be found and tied. The isthmus is clamped, divided, and closed by suture. Great care is necessary in tying the superior thyroid vessels, as hæmorrhage from them is a relatively frequent cause of death. This is usually due to the inclusion in the ligature of some fibres of the omohyoid, which may be dislodged by movements of the neck. If a large cut surface of the gland is exposed, it may be swabbed with pure carbolic followed by alcohol, or Harrington's solution (alcohol, 640; water, 300; hydrochloric acid, 60; mercury perchloride, 8) may be brushed over it to close the lymphatics. The wound should be freely drained. To delay absorption, large quantities

of saline are given by the bowel during the first three or four days after operation.

Thyroid Transplantation has been tried for myxœdema. The thyroid has been transplanted into the spleen, and the medulla of long bones. The results have been doubtful. *See also under* PARATHYROIDS, and a paper by Kocher in the *Zentralbl. f. Chirurgie*, 29th Aug. 1908.

Post-operative Thyroid Intoxications.—Three groups of general symptoms may follow thyroid operations (Bloodgood) :—1. *Tetany*, which is rare, because no one attempts complete thyroidectomy, and many, with the knowledge of the function of the parathyroid, save that portion of the remaining lobe near which these glands are situated. The symptoms occur within ten days of operation. The mortality is high—8 out of 10 cases in Bilbroth's clinic. The condition was formerly called acute post-operative myxœdema. When all the parathyroids are not removed, the symptoms are mild, and the patient recovers. 2. *Acute thyroid intoxication.*—The symptoms are high temperature, rapid pulse, and respiration, delirium, and sometimes coma. It is most common after partial thyroidectomy for exophthalmic goitre, and is probably due more to rough handling of the thyroid gland than to exposure of raw surfaces of thyroid tissue in the wound. 3. *Myxœdema.*—This is a late sequel, and may appear from months to years after operation. Slight cases are liable to escape recognition. It is curable by administration of thyroid.

Thyrotoxic Serums.—*See* GRAVES'S DISEASE (*Treatment*).

Tick Fever.—Texas fever ; ixodiasis. For its connection with Spirochæta Duttoni, *see* Sir W. B. Leishman's article in the *Lancet*, i. for 1910, pp. 11-14.

Tinea Capitis. — Tinea capitis is notoriously difficult to cure, but since the introduction by Sabouraud and Noiré of Paris four years ago of a definite method for applying X-rays, the difficulty has been to a great extent removed. The aim of their method of treatment is to produce epilation by a single long exposure instead of by repeated short exposures at short intervals, as had been the method tried by other workers before. The head of the child is placed at 15 cm. (about 6 inches) from the antikathode of the X-ray tube, the current for which may be obtained either from an induction coil or a static machine. The tube is enclosed in a shield of metal or other composition impervious to the rays, and having an aperture from which projects a metal or lead-glass cylinder. The length of this projecting cylinder is such that when the X-ray tube is in position in the shield, the antikathode of the tube is exactly 15 cm. from the free end of the cylinder. The part of the child's head to be exposed is placed against the free end of the cylinder. The dose of X-rays given is not measured by the time of exposure, as the quantity and quality of rays being given out by the tube are constantly changing, but by the effect on a "pastille" consisting of small discs of cardboard coated with platino-cyanide of barium. This pastille changes colour from a greenish-yellow to a brown when exposed to the rays. The pastille is placed in a holder so as to be exposed to the rays, but at exactly half the distance, at which the child's head is, from the antikathode of the tube. The exposure is commenced, and from time to time the tint of the pastille is compared in good daylight with a standard tint known as Tint B. To reach this given tint usually takes 15-20 minutes. The quantity of rays necessary to change the pastille to the given shade is exactly sufficient to cause epilation of the exposed area. If this dose is not exceeded there is no danger of producing an X-ray dermatitis. On the other hand, if the dose is not sufficient to alter the colour of the pastille sufficiently within 25 minutes or so, the hair will probably not come out. If properly applied, the hair should become loose and fall out all over the exposed area in 18 to 21 days. It remains out for 6 weeks to 2 months, and then grows in again, the regrowth being complete in from 3 to 4 months. Owing to the convexity of the scalp surface, only a comparatively small area can be exposed at a time. After the first area has been exposed it is marked with tincture of iodine or ink, and then covered with a disc of lead foil of the exact size, which is kept in position by a small elastic bandage. Another circular area, slightly overlapping the covered-up one, is then exposed till the tint on the pastille is obtained. This in turn is also covered with lead foil, and a third area exposed, and so on till all the area which it is desired to epilate has been exposed. There are various slight modifications of this method, which have been introduced by different workers, but the principle is always the same.

In all cases before the rays are applied it is advisable to have the hair cut quite short all over, so as to see how much disease is present. If there is only one diseased spot, the scalp should be rayed well beyond the diseased areas. It must be remembered that X-rays have absolutely no effect on the life of the ringworm fungus. Cultures of the fungus can be quite easily grown from the hairs which have fallen out after X-rays. If the area around a diseased area be not also rayed, before the hair has time to fall out the disease may have spread beyond the region exposed, and also diseased hairs, as they fall out after an X-ray exposure, are very apt to settle on a healthy part of the

surrounding scalp, and so infect it. Therefore, if the disease is at all extensive, it is advisable to ray the whole head. In such cases the exposures cannot be given all in one day, as the child gets too restless, but on successive days.

The beneficial action of the X-rays is purely due to the mechanical removal of the diseased hairs and the temporary cessation of the hair growth. Whilst the hair is out, energetic local treatment should be carried on so as to kill any fungus which may be in the empty follicles, and which might reinfect the hair when it grows again. Should the hair not fall out after the first exposure, the treatment may be repeated 4-5 weeks later with safety. The only risk attached to this method of treatment is that an overdose be given and the hair does not grow again, but with proper care and attention to details the risk is very slight. Although Sabouraud cures his cases in about 6 weeks, such rapid cures have not been obtained in this country. It is found that diseased stumps remain in the follicles. Such stumps should be sought for and squeezed out if necessary by a comedo-extractor. These diseased stumps, however, must not be confused with atrophied stumps, which are like those seen in alopecia areata, and are not infrequently seen after X-ray treatment. When the hair grows in again after X-rays it is often somewhat curly and slightly darker in colour than previously.

REFERENCES.—Sabouraud, *Extraits des Annales de l'Institut Pasteur*, xvii., Jan. 1904.—Sabouraud and Noire, *Annales de dermat. et syph.*, July 1904.—Belot, *Radiotherapy in Skin Disease* (Eng. trans.), 1904.—Bunch, *Brit. Journ. Derm.*, p. 265, 1904.—Morris and Dore, *Light and X-ray Treatment of Skin Diseases*, 1907.—Sichel, *Brit. Med. Journ.*, p. 256, 1906.

Tiodine.—*See* Thiodine.

"Tippee" Petroleum Emulsion.—A proprietary preparation containing purified liquid petroleum in a vehicle of malt extract; it is said to contain also iron and lime salts and free iodine. *See* Report in *Brit. Med. Journ.*, i. for 1910, p. 146.

Titration.—Volumetric analysis carried out with the help of standard solutions (Fr. *titre*, standard).

Tokelau.—A skin disease occurring in the Islands of the Pacific, resembling pityriasis, ichthyosis, and herpes circinata, and curable by antiparasitic preparations.

Tollen's Test.—A test for pentose in urine; concentrated hydrochloric acid and phloroglucin are added to tubes of suspected and normal urine, and these tubes are placed in a boiling water bath for a few minutes; in the presence of pentose an intense red zone appears in the upper part of the tube.

Tolypyrin.—A substance belonging to the antipyrin group, crystalline, and almost insoluble in water; it does not seem to possess any advantages over antipyrin.

Tolysal.—The salicylic acid salt of tolypyrin, recommended in 5 to 20 grain doses in neuralgia, articular rheumatism, etc.

Tonols.—The trade name for Schering's glycero-phosphates.

Tonometer, Gärtner's.—*See* Blood Pressure (*Measurement*).

Tonometer, Schiotz's.—An ophthalmological instrument for measuring intra-ocular pressure; a series of small weights is supported by the resistance of the eyeball, and a pointer on a scale indicates the result (*Norsk. Mag. f. Lægevidensk.*, 5 R., vi. p. 848, 1908).

Töpfer's Test.—A qualitative and quantitative test for free hydrochloric acid in the gastric contents, based upon the coloration (carmine-red) which a 0·5 per cent. alcoholic solution of dimethyl-amido-azobensol takes in the presence of the acid. Töpfer has also a test for estimating the amount of combined hydrochloric acid. *See* Webster, *Diagnostic Methods*, pp. 61, 63, 67, 1909.

Totipotential.—*See* Blastoma.

Town Planning.—The application of scientific forethought and the principles of hygiene to the establishment of villages, especially of those in the neighbourhood of large cities (such as London and Birmingham) where a rapid increase in population may be expected; a Housing and Town Planning Bill passed through Parliament in 1909, the objects of which were stated to be "the securing proper sanitary conditions, amenity, and convenience" in connection with the laying out and use of land. *See* J. Robertson, Hope, Horsfall, and Fremantle, *Brit. Med. Journal*, ii. for 1910, pp. 600-604.

Toxogenin.—*See* Anaphylaxis.

Toxoids.—*See* Immunity (*Theories*).

Toxones.—Modified toxins, bodies having little affinity to antitoxins (Ehrlich).

Trachoma Bodies.—The reputed cause of trachoma of the conjunctiva; the

Giemsa stain reveals them; they are also known as Prowazek-Greef bodies.

Trachyochromatic Erythroblasts. — Nucleated red blood corpuscles, known as normoblasts, similar in size, shape, and colour to the normocytes but differing from them in having a nucleus and in not uniting in rouleaux; they are not normally present in the blood after birth.

Treitz's Muscle. — The musculus suspensorius duodeni. *See* P. T. Crymble, *Brit. Med. Journ.*, ii. for 1910, pp. 1156-1159.

Treponema Pallidum.—The spirochæte pallida of syphilis, *q.v.*

Trexta.—Proprietary preparations, being concentrated tinctures with the alcohol so far as is practicable omitted. See *Lancet*, ii. for 1909, p. 788.

Trichocephaliasis. — The morbid state (viz. severe anæmia) resulting from the presence in the intestine of the parasitic nematode worm, the trichocephalus dispar.

Triferrin.—An iron preparation (the paranucleinate), containing 22 per cent. of iron and 2·5 per cent. of organically combined phosphorus; it is insoluble in water but soluble in alkalies; its absorption begins when it reaches the small intestine; dose, 5 grains thrice daily.

Triferrol.—A solution of triferrin (paranucleinate of iron).

Trigemin. — A compound of butylchloral and pyramidon, resembling pyramidon in its action, and recommended as an analgesic and hypnotic.

Trikresol.—A purified coal-tar disinfectant. For description, tests, etc., see *Lancet*, ii. for 1909, p. 1529.

Trimethylxanthine.—Caffeine. *See* PURINS.

Trommer's Elixir.—A proprietary preparation containing the active enzymes of malt, glycero-phosphates, and the alkaloidal extractives of cod livers. See *Lancet*, i. for 1910, p. 653.

Trommer's Malt Extract and Cod Liver Oil.—A proprietary food preparation, which contains, according to an analysis in the *Brit. Med. Journ.* (i. for 1910, p. 30), 29·9 per cent. of oil, 41·4 per cent. of reducing sugars calculated as maltose, and 2·4 per cent. of protein.

Tropeolin Test.—A qualitative test for free hydrochloric acid in the gastric contents, the reagent being a saturated alcoholic solution of tropeolin oo. *See* Webster, *Diagnostic Methods*, p. 62, 1909.

Trophoblastoma. — *See* UTERUS, MALIGNANT TUMOURS.

Tropical Broncho-oïdiosis.—*See* BRONCHO-OÏDIOSIS.

Trypanosome Fever.—*See* SLEEPING SICKNESS.

Trypan-Red.—*See* SLEEPING SICKNESS (*Treatment*).

Tsetse Fly.—*See* SLEEPING SICKNESS (*Cause*).

Tuberculin, Béraneck's. — *See* TUBERCULOSIS (*Tuberculin Treatment*).

Tuberculin, New. — *See* TUBERCULOSIS (*Tuberculin Treatment*). Koch's New Tuberculin (1897) or T. R.

Tuberculin Reaction.—Koch's subcutaneous reaction (1890), Pirquet's cutaneous reaction, or Calmette's oculo-reaction. *See* IMMUNITY (*Tuberculin Tests*).

Tuberculocidin.—Klebs's Tuberculin. *See* TUBERCULOSIS (*Tuberculin Treatment*).

Tuberculosis (*see also* CAMPTODACTYLY).—The literature of tuberculosis has assumed such enormous dimensions as to render it impossible in the available space to summarise even any single branch of it. All that is attempted here is to give some general account of the work which has been done in one or two directions—the relation of human and bovine tuberculosis, the question of the rôle played by alimentary infection, tuberculosis in infancy, and the treatment of the disease by tuberculin and other specific remedies. The diagnosis of tuberculosis by the various biological tests (oculo-reaction, etc.) is discussed in the section on IMMUNITY (pp. 200-202), where the opsonic index is also referred to. The more general aspects of the tuberculosis problem—the administrative control of phthisis, notification of the disease, sanatorium treatment, the control of the milk supply, the isolation of advanced and dangerously infectious cases of phthisis in rate-supported hospitals, municipal sanatoria dispensaries, and colonies for convalescent cases—are, each and all of them, questions which must

be omitted from further detailed mention. The list gives some idea of the manifold directions in which the disease is being attacked. The importance of the tuberculosis dispensary as a central point in the co-ordinated system of measures for dealing with the disease, so long and strenuously insisted on by Dr. R.W. Philip, is every year becoming more widely recognised —it acts as a receiving centre, an inquiry centre, a centre for disseminating information, and a distributing centre from which patients are drafted to hospitals; it serves as a link between the Public Health Department and the various philanthropic agencies which are concerned in tuberculosis. There is also a growing body of opinion in favour of compulsory notification of phthisis, though voices are not wanting to warn us that such notification may, in some cases, involve hardships no less than those it is intended to remove. It seems, however, that where the provisions of the law enforcing notification are applied sympathetically and with discretion, difficulties seldom arise. In connection with sanatorium treatment, the tendency at present is to depend largely on general hygienic conditions and fresh air, and the fashion of overfeeding patients is passing away. Zomotherapy, or a diet containing a considerable amount of raw meat, is the only special measure of the kind which has any considerable number of supporters. It is generally agreed that expensive and elaborate sanatoria are unnecessary; also that to make them fully effective a prolonged residence in them is essential, and that their sphere of usefulness can be greatly extended by the drafting of discharged patients to convalescent working colonies. In Germany the provision of sanatoria for the poorer classes is met to a considerable extent through insurance and state or municipal aid, and in this country some municipal sanatoria exist. For the most part, however, the curative work in connection with phthisis in Great Britain falls within the sphere of philanthropic agencies rather than that of the State; municipalities only admit their responsibility in so far as the isolation of infectious advanced cases in rate-supported hospitals is concerned. In no branch of medicine is there more widespread interest, and in none is the prospect so hopeful as in the crusade against tuberculosis.

Human and Bovine Tuberculosis.—The relationship of human and bovine tuberculosis has been the object of much investigation since Koch's famous dictum in 1901. At the Tuberculosis Congress in London in that year he advanced the view that human tuberculosis cannot be transmitted to cattle, and that, if man be at all susceptible to bovine tuberculosis, the susceptibility is not pronounced—the infection of human beings is but a very rare occurrence. Kossell sums up Koch's teaching as follows:—"The tuberculosis of man and the pearl disease of cattle owe their wide distribution not to the same germ. By injections of cultures of tubercle bacilli under the skin of cattle it is possible to determine whether one has to deal with a germ from a human or a bovine source. The tubercle bacillus derived from man cannot produce tuberculosis in cattle. Whether the bovine bacillus produces tuberculosis in a human being has not yet been definitely proved, but even if infection of humans by the bovine germ is possible, it is certainly of rare occurrence. To take measures against this remote possibility is therefore not advisable" (*nicht für geboten*).

The following three questions are then at issue, the third being subsidiary to the first and second:—(1) Is bovine tuberculosis spread by the same germ as human tuberculosis? (2) Are human and bovine tuberculosis reciprocally infectious? (3) If infection of human beings with bovine tuberculosis occurs, is this a frequent occurrence?

At the present time the evidence is that the bovine and human organisms are different; that human and bovine tuberculosis are reciprocally infective; and that, subject to certain qualifications, bovine tuberculous infection is fairly frequent in man. In amplification of these statements only the barest outline of the evidence can be given here.

Second Interim Report of the Royal Commission on Tuberculosis (1907).—The commission is able to assert that animals and man can be reciprocally infected. Two types of bacillus, the bovine and the human, can be distinguished, but the difference between them is, in the main, one of virulence. The histological and anatomical features of the lesions caused by each are the same, except in degree. The bovine type of bacillus is much more virulent than the human type. The viruses obtained from cases of tuberculosis in man were found to be divisible into two types, one corresponding to the human type of bacillus, the other to the bovine type. This fact is of particular significance when the source of the two groups of viruses is considered. Of 14 cases yielding a virus corresponding in all respects to the bovine type, 10 were primary abdominal tuberculosis, 3 cervical glands, 1 phthisis. Of 40 cases yielding virus of the human type, 8 were primary abdominal tuberculosis, 10 respiratory tuberculosis, 9 bone and joint disease, 2 genito-urinary tuberculosis, and the rest cervical glands. Most of the cases, therefore, yielding a virus resembling that of bovine tuberculosis, were instances of alimentary infection; most of the other group were instances of infection arising outside the alimentary tract. The possibility of the two types of bacillus being, or becoming under suitable conditions, interchangeable, is still under investigation by the

commission, and no definite statement can yet be made. The conclusions at which the commissioners arrive are:—(1) That a certain amount of tuberculosis, especially in children, is directly due to infection with the bovine bacillus. (2) That tuberculous milk is clearly a cause of tuberculosis, and fatal tuberculosis, in man. (3) That a very large proportion of tuberculosis contracted by ingestion is due to bovine bacilli. (4) That more stringent measures are required to prevent the sale or consumption of milk from tuberculous cows.

At about the same time as the appointment of the English commission, a German commission set to work on the same lines. According to the first report (*Tuberkulose-Arbeiten aus dem Kaiserlichen Gesundheitsamte*, Heft I. (Berlin), 1904) the scheme of work planned was as follows:—Separation of fresh strains of bacilli from human tuberculosis, and inoculation of calves. Inhalation experiments on calves and sucking pigs with the more virulent cultures. Testing the effect of passing weakly virulent strains through goats. Similar observations with bovine tuberculosis. It was shown that subcutaneous inoculation of calves with bovine bacilli caused fatal generalised tuberculosis. Forty-one strains of human bacilli were injected into 57 calves; no fatal case of tuberculosis followed. The calves inoculated with human bacilli fell into three groups. I. Shoulder glands showing no permanent change, or only traces of healed tubercle; no extension of the infection. II. Localisation less distinct; other adjacent glands affected. III. General disseminated tuberculosis was produced by four strains of bacilli. Of these four strains, one was from the lungs, three from mesenteric glands; all were derived from children. Of ten cases of primary alimentary infection, three appeared to be due to the bovine virus.

The subject was reviewed by Kossell, one of the members of the German commission, at the Tuberculosis Conference of 1905, who came to the following conclusions:—

1. By bacteriological investigation of tuberculous lesions in human beings, cattle, and swine, two types of tubercle bacilli can be detected which may provisionally be called typus humanus and typus bovinus.

2. The widely-spread tuberculosis of cattle is to be traced exclusively to infection with tubercle bacilli of the typus bovinus.

3. Swine are susceptible in a high degree to the tubercle bacilli of the typus bovinus, in a lesser degree to those of the typus humanus.

4. The tuberculosis of human beings chiefly arises from infection with tubercle bacilli of the typus humanus, which is transmissible from man to man.

5. Tuberculous lesions in human beings can be produced by tubercle bacilli of the typus bovinus.

6. Tubercle bacilli of the typus bovinus can be transmitted to human beings by food derived from tuberculous animals, especially by milk of cows affected with tuberculosis of the udder.

7. The part played by infection from bovine sources in spreading tuberculosis in man is small in comparison to the danger threatening from a consumptive human being.

The following resolution was adopted by the Congress:—"The congress, after hearing the *exposé* of the most recent investigations, declares that it is not only indispensable to avoid contagion from man to man, but also to pursue the prophylaxis of bovine tuberculosis, and to continue to take administrative and hygienic measures to avert its possible transmission to our species; and finally, that it is desirable to be on our guard against all forms of animal tuberculosis." In the discussion on bovine and human tuberculosis at the Washington Congress of 1908 the problem was not seriously influenced. We must put aside for the time being, as still *sub judice*, such questions as the exact meaning of the cultural and other differences between the bovine and human bacilli—are these different species? are they merely different types? or is there but one tubercle bacillus which may acquire modifications under suitable circumstances, or in appropriate environment, and lose them again when conditions change? Before these questions can be answered a great deal of painstaking and minute research will be required.

It is practically more important at present to try and give some answer to the third question raised at the outset, viz., Is infection of man with the bovine bacillus a frequent occurrence? Koch's position is, that desirable as it may be to eradicate bovine tuberculosis, the prevention of human tuberculosis depends essentially on checking its transmission from man to man through the agency of bacilliferous sputum. He objects to this central preventive measure being complicated by insistence on precautions directed towards securing a pure milk supply, and to the stamping out of bovine tuberculosis.

As regards phthisis, there is very little direct evidence that it is ever due to infection with the bovine virus. The cases in which bovine bacilli have been isolated from the cavities in lungs are few, and not free from doubt. On the other hand there is good reason to think that primary abdominal tuberculosis is not uncommonly of bovine origin. The findings of the Royal Commission on this question have already been mentioned. Weber, one of the German commission, in a later report, states that of 84 cases of tuberculosis in children which were exhaustively studied, no less than 21 were infected by the bovine bacillus; 6 of these were tuberculosis of the cervical glands, while 13 were cases of primary abdominal tuber-

culosis. In the whole series of 84 patients there were 21 cases of primary abdominal tuberculosis, of which 7 gave the human bacillus. Weber's results, therefore, are quite comparable to those of the Royal Commission, and they are rendered if anything more weighty by the fact that abdominal tuberculosis is less common in Germany than in England (*vide infra*).

Raw holds an extreme, and in some respects isolated position on this subject. According to his theory, bovine and human tuberculosis are essentially different infections. He points out (1) that in pulmonary tuberculosis the disease is nearly always strictly confined to the lungs, with, in a fair percentage of cases, secondary ulcers of the intestine, but seldom any other tuberculous lesion. Phthisis is essentially a disease of adult life. (2) Tuberculous joints, enlarged glands, spinal disease, and abdominal tuberculosis are essentially affections of infancy and childhood; moreover, it is rare for such patients to develop true phthisis pulmonalis. Raw believes that true primary pulmonary tuberculosis arises from the inhalation of tuberculous matter; other forms are probably caused by ingestion of bacilli. His main contentions are:—(1) Tubercle bacilli of the human type produce pulmonary tuberculosis, tubercular ulcers of the bowel, and tuberculous abdominal glands. (2) Bovine bacilli produce mesenteric tuberculosis, tuberculous peritonitis, acute miliary tuberculosis, tubercle of bones and joints, tuberculous meningitis, and probably lupus. (3) The two forms are antagonistic, and a mild attack of bovine tuberculosis protects against pulmonary phthisis. (4) Human tuberculin has a curative effect on bovine tuberculous infection; bovine tuberculin has a curative effect on the pulmonary form of the disease. Raw's theory is based on clinical observation; he regards the nature of the infection—alimentary or inhalation, as practically synonymous with its source—bovine or human. One difficulty in the way of accepting Raw's theory as it stands is the lack of evidence that bone and meningeal tuberculosis are due to ingestion of bacilli. Weber, whose results have been quoted, examined 27 cases of tuberculosis of bones and joints, and 48 cases of tuberculous meningitis and phthisis, and found that only one of the former, and none of the latter, were due to the bovine bacillus.

Behring's theory of tuberculous infection, though it has no direct bearing on the relative frequency of bovine and human tuberculosis, must also be referred to, because if carried to its logical conclusion it stands directly opposed to Koch's views. Behring believes that tuberculosis is invariably acquired in infancy. Phthisis in the adult is simply the last episode in a life-long infection—"the concluding verse of the infant's cradle song." This is really the essence of Behring's theory. The infant becomes tuberculous by ingesting bacilli; these may be bovine, as when the milk of infected cattle is used; they may also be derived from human beings, from dust, dried sputum, infected rooms, etc., but in any case they gain entry to the mouth in the first instance, and are swallowed along with the food. The need for accepting the latter possibility as well as the former is shown by the occurrence of tuberculosis in infants reared on the breast or on sterilised milk. The deduction Behring draws is that all efforts to eradicate tuberculosis must be primarily directed towards shielding children from infection, both by securing tubercle-free milk, and by keeping them away from infected adults and houses. Direct infection of adults he regards as relatively infrequent, and looks on the exaltation of systematic disinfection of sputum as tending to divert the attention of the public from the real source of danger.

Behring's theory is not very widely held. It is referred to here chiefly because it brings into prominence one aspect of the tuberculosis problem which has attracted renewed attention of late years, viz., the frequency and importance of tuberculous infection in infants and children. Without depreciating the importance of systematic disinfection of the sputum, it must be stated that in view of the enormous susceptibility of infants to tuberculosis they have very special claims to consideration in the campaign against tuberculosis. Holt goes so far as to say that when an infant or young child suffers from chronic cough and is known to have been exposed to a "house infection" it must be regarded as presumably tuberculous. He regards pulmonary tuberculosis as common in infants, and as probably due to infection from a case of phthisis (45 per cent. of cases in his own observation).

As has been said, there is little or no bacteriological evidence that ordinary pulmonary phthisis is ever due to the bovine bacillus, and there is a fair amount of evidence that primary abdominal tuberculosis is often due to the bovine bacillus. While bacteriological investigation is the only way of proving definitely to which virus a case is due, the fact that bovine bacilli are most likely to give rise to an alimentary infection, leads up to the question of the relative frequency of primary abdominal tuberculosis.

Alimentary Infection.—At the 1908 Congress there was a general consensus of opinion that tuberculosis could be acquired either by ingestion or inhalation. In his article on Tuberculosis in the *Encyclopedia and Dictionary of Medicine* (Vol. X. p. 137), Dr. Shennan gives 27 per cent. as the proportion of cases of alimentary infection in post-mortems on children in Edinburgh up to 1901; at the

Congress he reported on statistics up to date; the later figures substantiated the earlier ones. Harbitz of Christiania found that in 177 autopsies in children under 15 years there was a primary abdominal infection in 22 per cent. Calmette's work points to the alimentary canal as being a very important point of entry of the bacillus. His conclusions run as follows (Raw):—

1. Animals readily contract tuberculosis by way of the intestine, not only in youth, but also during adult life, without the passage of the bacilli through the walls of the digestive tube being marked by any visible lesions.

2. In the case of young animals bacilli are ordinarily retained by the mesenteric glands. Sometimes the infection remains localised there for a longer or shorter period, and is in the end cured; sometimes it ends in the formation of caseous tubercles, and is then propagated by the efferent lymphatics to the major lymphatic circulation.

3. In the case of adult animals whose defensive glandular reaction is much less active, the bacilli are more generally carried, with the leucocytes containing them, into the major lymphatic circulation and by way of the pulmonary artery towards the lung.

4. The so-called primary pulmonary tuberculosis is generally intestinal in origin.

5. Finally, of all methods of infection, that by way of the digestive canal is at once the most efficacious, and that which best agrees with the normal conditions of natural infection.

Despite the contrary opinions held by a few authorities (*e.g.* Holt and Coutts) there is at present a tendency to admit that alimentary infection plays an important part in causing the disease, and one cannot escape from the idea that this tendency is associated with the great interest which has recently been taken in tuberculosis in children. Only in late years has the great frequency of tuberculosis in infancy and childhood been properly realised. It is unnecessary to labour this point, but the following statistics, compiled by Dunn, may be quoted. They are based on post-mortem examinations.

Age.	Percentage of Cases of Tuberculosis.
0- 3 months	0 per cent.- 2 per cent.
4- 6 ,,	16 ,, -17 ,,
7-12 ,,	22 ,, -26 ,,
1- 2 years	42 ,, -44 ,,
2-10 ,,	67 ,,
10-15 ,,	64 ,, -77 ,,

Infantile tuberculosis is essentially a disease of the lymphatic organs; the bacilli do not, as a rule, cause a demonstrable primary lesion of the skin or mucous membrane, but localise themselves in a gland and set up a chronic process there. The spread is by lymphatics; sometimes there is a general miliary tuberculosis. The younger the child, the less the tendency to cure; if a definite tuberculous lesion is clinically demonstrated during the first year the prospect of recovery is small. Behring's theory has most of its supporters among those who have studied diseases of children—Schlossmann, for instance, thinks it is the most important advance made since Koch's discovery of the bacillus.

An interesting point in connection with tuberculosis in childhood is the relative frequency of abdominal tuberculosis in different countries. The disease is apparently much less common in America and Germany than in Great Britain; it is particularly common in Edinburgh and Glasgow. Drs. Thomson and Fordyce have collected statistics from a great number of hospitals bearing on this point. In Edinburgh and Glasgow the proportion of clinical abdominal tuberculosis among in-patients is 3·6 per cent. and 4·6 per cent. respectively, as against 1·8 per cent. in London (Great Ormond Street). In the United States it is under ·5 per cent., and in all the Continental hospitals which furnished statistics, except Buda-Pesth (2 per cent.), it is under 1 per cent. In Great Britain abdominal tuberculosis is more common among hospital in-patients than tuberculous meningitis; in Germany and America the reverse is the case.

It is impossible to say on what these variations depend. The obvious suggestion that they may be related to infection with tuberculous milk is fraught with difficulties. It is plausible enough to suppose that in Great Britain sterilisation of milk is less carefully attended to than in Germany, France, and America, but a great deal of comparative inquiry into the details of artificial feeding as practised in these countries is required before this point can be settled. Coutts points out that were milk a frequent source of infection abdominal tuberculosis would be extremely common, instead of rare, during the first year of life. He states that it has never been proved that the complaint is more common in hand-fed children than in those which are suckled, further than the more frequent occurrence of chronic intestinal disorders in the former would account for. In Rome the death-rate among children under 15 from tuberculous meningitis (1896-1905) was 4·7 per cent.; from tuberculous peritonitis, 3·0 per cent.; yet in Italy, among the poorer classes, artificial feeding of infants is almost never resorted to. In Japan, where cow's milk is not used, tuberculosis is said to be extremely common. One strong argument in favour of milk-borne infection being associated with these variations in the frequency of abdominal tuberculosis is furnished by the United States. There, the necessity of a clean milk has been more strongly urged than in any other country, and there

abdominal tuberculosis is least frequent. Moreover, it is the experience of so eminent an authority as Emmet Holt that tubercle is rarely conveyed by milk.

While, therefore, the relative frequency of human and bovine tuberculosis, of infection by ingestion and inhalation, is still unsettled, there is no doubt whatever of the great susceptibility of infants to the disease, and it follows that the protection of babies and children from all possible sources of infection must form an important part of the crusade against tuberculosis.

TUBERCULIN TREATMENT. — A number of different preparations pass under the generic name tuberculin. The most important of these are Koch's Old (1890) Tuberculin, Koch's New (1897) Tuberculin—known as O.T. and T.R. (R = residue) respectively; Tuberculocidin—Kleb's Tuberculin; Deny's Tuberculin—*Bouillon Filtre* (B.F.); Koch's *Bacillen-emulsion* (B.E.); and Béraneck's Tuberculin. Marmoreck's serum and Maragliano's serum are antituberculous serums. At the Tuberculosis Congress of 1905 Professor v. Behring announced a new remedy derived from the virus of tuberculosis, which he named T.C. This was stated to consist of tubercle bacilli freed from (*a*) toxic materials soluble in water, (*b*) toxic globulins soluble in salt solution, and (*c*) non-toxic principles soluble in alcohol, etc. The residue—*rest-bacillus*—can be so modified as to be directly capable of absorption by the lymphatic cells of an animal, during which process a state of immunity evolves. A fundamental fact in connection with T.C. is that it has the power of producing tuberculous nodules, which, however, do not caseate. Since Behring's original and very vague communication, practically nothing further has been heard of the matter.

Old tuberculin is a glycerine extract of tubercle bacilli from which the dead bacilli are filtered off. New tuberculin is prepared by treating the pounded bodies of dried bacilli with saline solution, and centrifuging the mixture. The deposit (T.R.) is made up with water. A mixture of T.R. and the opalescent fluid separated from it by the centrifuge is called Bacillen Emulsion (B.E.). Deny's tuberculin is a filtered Bouillon culture of bacilli. Béraneck's tuberculin is an extract. In all probability these tuberculins do not differ fundamentally from one another.

Of these remedies Koch's new tuberculin is that which is by far the most widely used in this country at the present time. It is manufactured by Meister, Lucius & Bruning, who supply it in small phials containing 10 mgr. of solid substance.[1] Before use it must be diluted with 20 per cent. glycerine in distilled water, and as great care is necessary both to secure sterility and exactitude in dosage, it is best to procure it from some firm of wholesale chemists which sends out single doses sealed in glass capsules ready for use.

A great impetus to the use of tuberculin in this country was given by Wright's researches on the opsonic index and on vaccine therapy (*vide* IMMUNITY, pp. 199, 202). Wright found that while the tuberculo-opsonic index in healthy persons was between ·8 and 1·2, in tuberculous patients with localised lesions the index was persistently low, while if the disease was widespread or active the index fluctuated greatly, the rises and falls being due to periodic auto-inoculation. When the index is raised in localised tuberculous lesions there is a tendency towards healing, and by the injection of small doses of tuberculin a rise in the opsonic index is brought about. The immediate result of inoculating a tuberculous patient with tuberculin is to lower the index (negative phase); the fall is succeeded by a rise ("positive phase"), and thus in a variable time the index returns more or less to its old level. The negative phase varies according as a larger or smaller dose of vaccine is inoculated. In the former case the negative phase may disclose itself by temperature reaction; in the latter case it may be unassociated with clinical symptoms. The positive phase is characterised by an increased antibacterial power of the blood, and may be accompanied by a very pronounced feeling of well-being. If serial injections be made during successive negative phases of reduced antibacterial power a cumulative effect in the direction of the negative phase occurs. It is not, however, possible in connection with antituberculous inoculations to bring about a cumulative effect in the direction of the positive phase by serial injections during positive phases (Wright). The object aimed at is to maintain the opsonic index at as high a level as possible for as long a period as possible, and therefore an accumulation of negative phases, or a too prolonged negative phase from a large dose of tuberculin must be avoided. Wright advises that each inoculation should be looked upon as a separate operation, and that no attempt should be made to lengthen the positive phase by reinoculation during the positive phase. In every case the smallest dose should be given which will elicit a satisfactory response. The dose should be repeated only when the effect of the preceding inoculation is passing off. The dose should be increased only when it is clear that the dose previously employed is ceasing to evoke a sufficient immunising response. As a rule inoculations are

[1] It seems that each phial actually contains only 2 mgrs. of solid substance = 10 mgr. tubercle bacilli. Thus the doses given required to be renamed; $\frac{1}{10\,000}$ mgr. = only $\frac{1}{5\,000}$ mgr. solid substance. In the text, however, the old nomenclature has been followed, $\frac{1}{10\,000}$ mgr. = $\frac{1}{10\,000}$ of a phial of T.R.

made about every tenth or fourteenth day. Wright begins with a dose of not more than $\frac{1}{1000}$ mgr. T.R. and never advances to doses of more than $\frac{1}{500}$ mgr.

While it is probably the case that the administration of tuberculin can be better controlled by estimations of the opsonic index than by any other method, it is apparent that if such estimations are held to be essential to the safe use of the remedy, many patients must be deprived of its benefits, on account of the laborious nature of opsonic methods. Moreover, the soundness of the opsonic theory is not unquestioned, and a clear distinction must be made between the value of the opsonic index on the one hand, and the value of vaccine therapy on the other. Whether the opsonic theory stands or falls, the value of antituberculous vaccination must and will be settled on its own merits. Many, probably most, physicians who employ tuberculin are guided as to dosage by the general principles deduced by Wright, and by the clinical observation of each case. It is probably inadvisable to employ tuberculin except in apyrexial tuberculosis. The patient should remain in bed under observation for some days before treatment begins, and for some time thereafter until it is certain that he is not reacting unfavourably. The initial dose should be small—$\frac{1}{2000}$-$\frac{1}{1000}$ mgr. T.R. for adults; $\frac{1}{7500}$-$\frac{1}{5000}$ mgr. for children. Its effects, particularly on the temperature, should be carefully watched, and it is not repeated, or repeated only in diminished dose, if reaction of any kind follows. Reinoculations are made at intervals of ten to fourteen days. This method of administration—the clinical method—is that generally adopted in America and Germany. There, however, larger doses ($\frac{1}{500}$ mgr.) are used to begin, and are increased up to several milligrams.

Treatment by tuberculin must be continued for several months to yield good results. Tuberculin is contra-indicated by persistent pyrexia above 99·5°, by persistent rapidity of the pulse (over 100), by rapid wasting, by miliary tuberculosis or tuberculous meningitis, and by hæmoptysis. Nephritis and epilepsy are further contra-indications.

In the preceding remarks reference has been made only to T.R., because this is the favourite preparation in this country, and is probably used many times as often as all the other tuberculins put together. The principles underlying the use of tuberculin are, however, the same whichever be chosen. Sahli, in a recent review, expresses the opinion that, however obtained—O.T., T.R., Béraneck's tuberculin, B.F., etc.—tuberculin is essentially the same; the skill of the physician using it is more important than the brand employed.

The following are the doses of some of the other tuberculins:—

Koch's Old Tuberculin, $\frac{1}{100}$-$\frac{1}{10}$ mgr. increasing to 1000 mgr. Reactions are said to occur chiefly after the earlier, small, doses; if this period be passed over there is less likelihood of reactions occurring. The intervals between the early inoculations are short—only a few days; between the later, large, doses, several weeks. Dosage increases rapidly—*e.g.* $\frac{1}{100}$ mgr., $\frac{1}{10}$ mgr., 1 mgr., 5 mgr., 10 mgr., 25 mgr., etc.

Bacillen Emulsion, $\frac{1}{20000}$-$\frac{1}{10000}$ mgr., increasing to a maximum of 5 mgr.

Deny's Tuberculin, $\frac{1}{1000}$ mgr. rising gradually to 1 mgr.

Béraneck's Tuberculin is praised by R. W. Philip and Sahli. The former begins with a dose of ·1 c.c. of a 1:100,000 solution. Injections are made at intervals of three to fourteen days, the effects being gauged by careful records of the temperature, pulse, general condition of the patient, and local manifestations. Regular estimation of the opsonic index is unnecessary. It is desirable to repeat the same dose more than once, so as to make sure that no reaction has been missed. If an external surgical lesion is being treated, the direct injection of a stronger solution (·1 c.c. of 1:100) may be made. This is not repeated until all local reaction (if any) has subsided; if there is no reaction the dose may be increased by tenths of a cubic centimetre. T.R. has been used as a 5 per cent. ointment in the local treatment of lupus.

In cases of tuberculosis, which fail to respond to T.R., and in which there is the possibility of infection with the bovine virus—*e.g.* in abdominal tuberculosis—*Perlsucht* tuberculin (P.T.R.) may be tried (cf. Raw's opinion, *antea*, p. 375). When there is a mixed injection, as in pulmonary phthisis, it is advisable to combine tuberculin with the appropriate vaccine treatment. Recently tuberculin has been used by oral and rectal administration, and good results have been reported by some.

Antituberculous Serums.—Attempts to produce efficient antiserums have failed. Maragliano's serum and Marmoreck's serum are the best-known members of this class.

It is not possible to estimate the real benefit of tuberculin treatment by statistics. Most physicians and surgeons who have employed it have convinced themselves that it does good in properly-selected cases. The fact that it has now overcome the prejudice which its use excited in the early nineties is perhaps the best proof that it is really a valuable remedy.

LITERATURE.—The literature of opsonins and antituberculous inoculation is very large, and numerous papers will be found in the journals from 1903 onwards. The following papers may be referred to:—A. E. Wright, *Lancet*, 2nd Dec. 1905.—Trudeau, *Amer. Journ. Med. Sci.*, Aug. 1906.—Latham (T.R. by mouth), *Proc. Roy. Soc. Med.*, i. p. 195, 1908.—Riviere (children), *Tuberculosis in Infancy and Childhood*, ed. Kelynack

(Lond.), 1908. — Bulloch, *Lancet*, 2nd Dec. 1905.— Sahli, *Corr.-bl. f. Schweiz. Aerzte*, 15th June, 1st July 1906.—R. W. Philip, *Edin. Med. Journ.*, Feb. 1909.

Tuberose Sclerosis.—Until comparatively recent years our knowledge of mental defect has remained very much at the level of what our knowledge of organic nervous disease was fifty years ago, when "paralysis" was considered a complete and sufficient diagnosis. The studies of neurologists showed that paralysis was merely a symptom, and that the cases grouped under the general head were really examples of a great variety of clinical and pathological conditions. In the same way we are now learning to recognise among idiots and imbeciles many different types, some of them, such as mongolism, distinguished mainly by their clinical features, others, such as syphilitic dementia, by their cause and course, others, such as amaurotic idiocy, by their well-defined symptoms and a characteristic anatomical lesion. There is every reason, however, to believe that the great group of idiots, imbeciles, and mental defectives is capable of still further classification on a clinico-pathological basis—in a word, that when they are submitted to the same searching investigation as other cases of nervous disease have been, we shall find that we have been comprehending under a generic name diseases which are essentially different from one another. It may, of course, be argued that since mental defect is incurable little good can be expected to ensue: the answer to this is found in the statement that only when we can recognise the varieties which undoubtedly exist shall we be able to give a definite prognosis as to the mental future, and as to the duration of life, or to give the best advice as to the line of treatment, institutional or otherwise, required.

The most recently isolated type of mental defect is that which has as its pathological basis a lesion of the brain first described by Bourneville in 1880 as tuberose sclerosis. In the twenty or twenty-four years following his paper only ten or a dozen further cases were recorded, and the condition was looked on merely as a rather rare pathological curiosity. During the last few years, however, since the inmates of imbecile institutions have received more attention from physicians and pathologists, it has been found that tuberose sclerosis is less rare than was supposed, and that the patients have sufficiently well-marked symptoms during life to render a correct diagnosis possible in a number of cases.

In the light of the work of recent observers, among whom the names of Vogt and Pellizzi must especially be mentioned, tuberose sclerosis may be characterised as a tumour-like lesion of the cerebral cortex, with the simultaneous occurrence of tumours of the kidney, and of the skin, and sometimes of the heart and other viscera. It is a congenital disease and is associated with a greater or less degree of progressive mental deterioration, almost invariably with epilepsy, and often with adenoma sebaceum. It is usually fatal at a comparatively early age.

Tuberose sclerosis has attracted more attention from the pathologist than the clinician, and the lesions have been the subject of a number of papers. The naked-eye appearance of the brain is so characteristic as to render the recognition of the condition easy. Scattered here and there over the surface of the cerebrum single convolutions, or adjacent parts of convolutions, stand up, broader than usual, above the rest of the surface of the brain-like little tumours. They are hard to the touch, and look and feel like hypertrophied brain tissue. The pia is normal and strips readily; there is no evidence of inflammatory change, and the general configuration of the brain is in no wise altered, save for the nodular appearance of many of the convolutions. On section the nodular areas are greyish-white in colour and merge insensibly into the white matter of the brain, the distinction between cortex and medulla being obliterated. In addition to this lesion, small tumour-like outgrowths are generally found on the walls of the lateral ventricles, chiefly in the thalamic region. In rare cases the cerebellum is also the seat of tuberose sclerosis, and sometimes little tumours occur in the fourth as well as the lateral ventricles. A very remarkable feature of the disease is the fact that in about half of the cases recorded tumours have been found in the kidneys, and as in many reports the kidneys were not examined it is probable that the association is actually more frequent. The renal tumours are usually described as of the nature of hypernephromata, and in one or two instances were the immediate cause of death. Among other internal organs liable to be involved by tumour growth, the heart comes next in frequency. Small whitish tumours of embryonic muscular tissue (rhabdomyomata) are described in its wall in several cases. In one case an adenomatous tumour of the thyroid was present. Without considering the histological appearances in detail, it may be said that the changes in the nervous system consist of maldevelopment and degeneration of the pyramidal cells of the cortex, and overgrowth of glial tissue. Sailer describes it as a nodular gliosis. The visceral tumours are variously described as sarcomata, liposarcomata, adenomata, etc.

The connecting link between these various lesions is that all are of a developmental nature. The disease is unquestionably congenital, because it may occur in a well-marked degree in infants only a month or two old; in these early cases there is distinct evidence of maldevelopment of the nerve cells, as well as

retrogressive changes and gliosis. The developmental origin of renal tumour in childhood is also generally admitted. Adenoma sebaceum is also regarded by Crocker as a maldevelopment of the glandular structures of the skin. Two types of adenoma sebaceum are recognised: one affecting chiefly the face, and consisting of small nodules symmetrically distributed, chiefly on the cheeks; the other, affecting the skin of the head and back as well as the face, in which the nodules are much larger, and are asymmetrically distributed. Adenoma sebaceum has been recognised by dermatologists as being most frequent in mentally defective children; it is common among the inmates of institutions for the care of imbeciles.

CLINICAL FEATURES.—Like so many other imbeciles, children with tuberose sclerosis often have a bad heredity. The degree of mental defect is usually considerable; some cases are merely vegetative idiots; others have intelligence enough to benefit from ordinary elementary education. What is more characteristic than the grade of mental defect is the fact that it is progressive. In many cases the intelligence appears to have developed fairly normally for the first year or so, until the first convulsions occurred. With the onset of epilepsy deterioration sets in, and with the progress of the disease the patient may sink into dementia. The epilepsy is not specially characteristic. At first the convulsions tend to remain limited to the head and eyes, but ultimately they become general. Minor epilepsy usually accompanies the major seizures. The fits tend to occur in small series of three or four at a time at intervals of a week or a fortnight. Many patients succumb in a *status epilepticus*. Some patients ultimately develop spastic paralysis and become bedridden. In a few cases epilepsy does not supervene; there is merely mental defect.

DIAGNOSIS. — The possibility of tuberose sclerosis has to be considered in all cases of epileptic imbecility, and search should be made for any sign of tumour of the kidneys or other viscera. Adenoma sebaceum is highly suggestive of the existence of tuberose sclerosis, if not, indeed, pathognomonic. Few of the patients survive to adult life; many die about puberty. Death may result directly from the renal tumours, or from epilepsy. Most cases in which there is a lesion of the heart appear to die in infancy, sometimes before convulsions or symptoms of mental defect have occurred.

LITERATURE.—References to the older literature will be found in most of the following recent papers:—VOGT, *Münch. med. Wochensch.*, 29th Sept. 1908; *Zeitsch. f. d. Erforschung u. Behandlung des jugendlichen Schwachsinns*, Bd. ii. Heft 1, 1908; *Monatssch. f. Psychiatrie u. Neurologie*, Bd. xxiv. p. 106, 1908.—JACOBAEUS, *Nord. med. Archiv.*, Abt. ii. Nr. 2, 1903.—SAILER, *Journ. Mental and Nervous Diseases*, p. 402, 1898.—MARKUSE, *Nevrol. Zentralb.*, 2, p. 104, 1909.—VOLLAND, *Zeitsch. f. d. Erforschung u. Behandlung d. jugendlichen Schwachsinns*, Bd. iii. Heft 3, 1909.—FOWLER and DICKSON, *Quart. Journ. Med.*, Oct., 1910.

Tumenol.—A substance (an artificial ichthyol) got from the action of sulphur and sulphuric acid on mineral oils; it is used in eczema and lupus as a 2 per cent. dusting powder.

Turbinectomy.—Excision (partial or total) of the inferior and middle turbinates of the nose, as recommended by Moure, Berbineau, Lack, and others in obstinate cases of hay fever and paroxysmal sneezing, etc.

Türk's Stain.—An iodine solution in potassium iodide of the strength of 1:300; it is used for the staining of polymorphonuclear basophilic leucocytes. *See* Webster, *Diagnostic Methods*, p. 480, 1909.

Tussol.—A remedy lauded for its action in whooping-cough; it is the mandelic acid salt of antipyrin (antipyrin amygdalate) and probably owes its action to antipyrin; it is a soluble white powder, incompatible with milk and alkaline mixtures; the dose is from 1 to 8 grains, and for infants from $\frac{1}{2}$ to $\frac{3}{4}$ grain. *See* Fortescue-Brickdale, *Newer Remedies*, p. 235, 1910.

Tylmarin.—A cinnamic acid derivative, being acetyl-coumaric acid, recommended in 5 grain doses for phthisis.

Typhoid Fever.—The conception of typhoid fever in vogue a few years ago, namely, that of a disease due to an intestinal infection by a specific organism, which proliferates in the bowel, whence it invades the body through the intestinal wall, causing a general infection, has undergone considerable modification recently. In the first place, typhoid fever must now be regarded as a primary bacterial infection of the blood with secondary involvement of the intestine, and, in the second place, it has to be admitted that the clinical group of symptoms known collectively as typhoid is not always due to the Eberth bacillus.

1. TYPHOID A BACILLÆMIA.—The bacillus of typhoid is constantly present in the blood from the onset of an attack of typhoid fever. Coleman and Buxton [1] found that out of a total of 1602 cases examined 75 per cent. showed bacilli in the blood. A positive result is most constantly obtained towards the beginning of the disease—during the first week in 89 per cent.; during the second, 73 per cent.; during the third, 60 per cent.; during the fourth, only 38 per cent., of those examined. So many observers have found the organism in approximately 100 per cent. of their cases, that probably the failure of the minority to detect them is due to faulty

technique. Bacilli can always be found in the blood before a positive Widal test is obtained; in some cases they have been cultivated from it during the incubation period. They disappear from the blood as the temperature falls. The bacilli are excreted by the liver into the bile, by which they pass over into the gall bladder and bowel; in both these structures they set up local lesions—cholecystitis and ulcers. In the bowel some die, some are expelled in the stools; probably they do not multiply. They are not found in the fæces during the early stage of the disease, and can be regularly demonstrated only when ulceration is established. On post-mortem examination they are most abundant in the duodenum, and diminish in number as we pass down the intestine; they are not found in the rectum. Relapses are due to reinvasion of the blood stream. On these facts, the pathology of the disease may be briefly stated as follows: — Typhoid bacilli enter the blood stream directly (possibly by the pharynx or stomach), and multiply there during the incubation period. At this time their presence can sometimes be demonstrated directly, or, before they themselves can be isolated, their products can be detected by the precipitin test (Fornet). At or before the onset of the symptoms, they enter the gall bladder and bowel, ultimately set up cholecystitis and ulceration of the Peyer's patches, and are excreted in the fæces. The symptoms of the disease are caused by the destruction of enormous numbers of bacilli in the blood and liberation of their endotoxins. When the bacilli invade the body locally (*e.g.* in typhoid abscess or meningitis) the liberation of the endotoxins does not cause the general symptoms of typhoid fever.

Blood Cultures in Typhoid.—Kayser's ox-bile medium is used. Peabody[2] procures 1-2 c.cm. blood from a puncture of the lobe of the ear, and adds it to 5 c.c. sterile ox-bile, then incubating for fifteen hours. Microscopic examination of a drop may show the organisms, otherwise a tube of coagulated serum is inoculated with the bile and incubated for several hours, when the motile bacilli can be found in the water of condensation.

2. Clinical Syndrome "Typhoid Fever" due to more than one Organism. — The existence of so-called "paratyphoid" has now been recognised for a number of years, and the position now taken up by many authorities is that (*a*) a disease clinically indistinguishable from typhoid fever may be caused by several varieties of organism, and (*b*) both the Eberth's bacillus, and the other organisms to be referred to, may cause local diseases—*e.g.* meningitis, cholera-nostras, etc. — which have no resemblance to typhoid fever. Staübli,[3] in discussing the question of paratyphoid, gives as causes of the typhoid symptom complex — Eberth's bacillus, *b. paratyphoid* A, *b. paratyphoid* B, and the *bacillus enteritidis* of Gärtner, which is closely allied to the paratyphoid B. Brion and Kayser[4] found the *b. flavosepticum* (an organism of the *pyocyaneous* group) in some cases. Thus some paratyphoid bacilli closely resemble those which give rise to certain forms of meat poisoning. There are three main forms of meat poisoning — (1) Botulism, in which nervous symptoms predominate, due to the toxins produced in preserved meat, sausages, etc., by a non-pathogenic anaerobe, *b. Botulinus*. (2) Acute diarrhœa due to putrid meat, from *b. proteus*. (3) Meat infection due to the presence of *b. enteritidis*. It may cause epidemics of acute gastric enteritis or "typhoid"; in some cases the symptoms of the latter succeed the former. In the one case the infection is mainly local; in the other, general. As a rule, epidemics of "typhoid" due to *b. paratyphosis*, are milder than those due to Eberth's bacillus.

It might seem as though this departure from an insistence on the specific nature of typhoid fever, and the return from the bacteriological to the clinical definition of the disease, is rather a retrograde step, but this is only apparent. The difficulty is that only by careful bacteriological examination is it possible to distinguish between the different infections causing clinical typhoid. Even the agglutination test is of little use on account of the occurrence of "group agglutination" (*vide* Immunity, Diagnosis, p. 193). It is, therefore, impossible to establish a clearly defined group of "paratyphoid" infections by reference to the agglutinating power of the patient's serum, and it is equally impossible to do so from the post-mortem appearances. Courmont and Lesceur[5] urge that the words "paratyphoid," etc., should be allowed to drop. The Widal test being inapplicable to the differentiation of the various typho-colon infections, the diagnosis should be made from blood cultures, on which an etiological classification can be based.

Transmission of the Infection of Typhoid.

Flies and Dust.—There is no doubt that the infection of typhoid may be conveyed both by flies and by dust. In the South African War both these factors played an important part in the spread of the disease. The bacilli may simply adhere to the limbs of flies, or may be swallowed by them and subsequently deposited in the excreta. It is stated that the bacilli may live in the body of the fly for more than three weeks. Typhoid bacilli soon perish if they are dried, but where dust storms are frequent, as was the case in South Africa, some organisms may survive and be deposited on food in this way.

Typhoid Carriers.—As has been stated above, typhoid bacilli, after entering the blood stream, are excreted by the liver, and some penetrate

to the gall bladder, where they flourish luxuriantly. Their growth is especially favoured by the catarrh of the gall bladder which their presence usually excites. The discovery that the gall bladder is a favourite nidus for the organism is of great importance in connection with the perpetuation of the disease, for it has now been abundantly proved, first by the researches of Kayser and Förster [6] and other hygienists in Strasburg, and later by observations made here and in America, that a certain number of typhoid patients, women more especially, continue to harbour in their biliary passages, and to excrete by the bowel, numbers of virulent bacilli for months and even years after recovery from the disease. A point of minor interest is the possibility of there being in some cases a relation between typhoid cholecystitis and the subsequent occurrence of gall-stones. The proportion of female to male bacilli carriers is about 3 or 4 to 1, almost the same as that which exists between female and male sufferers from gall-stones. Moreover, Blumenthal and Kayser have discovered typhoid bacilli in the interior of gall-stones.

It is obvious that the existence of these healthy bacilli carriers explains the occurrence of outbreaks of typhoid in localities where infection from a typhoid patient can be excluded, and many instances of this have been discovered of late years. The now classical case of a Strasburg female baker was described by Kayser in 1906. Almost every new employee in her bakery contracted typhoid sooner or later, and two died. The fæces of the proprietor, who had had typhoid ten years before, swarmed with bacilli. In other cases reported by Friedal, a bacilli carrier (cook) served in eight houses during eight years, and during that time infected 24 persons. A. and J. C. G. Ledingham [7] describe the case of an asylum in which, since 1893, a series of small outbreaks of typhoid (31 cases in all) occurred. All external sources of infection having been excluded, the fæces of the females in the establishment were examined, and three bacilli carriers were found.

Bacilli carriers can be divided into two classes—those who get rid of the organism in the course of a few weeks, and those who harbour bacilli for months or years. The latter are known as "chronic bacilli carriers" or "continuously infective" (*dauerausscheider*) as opposed to simple "bacilli carriers" (*Bacillen träger*). According to Frosch [8] women form 60 per cent. of all bacilli carriers, and 82 per cent. of the continuously infective; children under 15 are seldom continuously infective (4 per cent.); more frequently bacilli carriers (35 per cent.). When it is remembered that women form a numerically small percentage of all cases of typhoid, and yet contribute a large quotum to carrier cases in general; further, that most of them engage in domestic work and cookery, we see that a woman who has had typhoid is not unlikely to be a source of danger. Bacilli carriers have only been recognised for about five years, so that it is impossible to obtain bacteriological evidence as to the extreme limit of time for which a person may remain infectious. In 310 cases observed 144 were infectious up to 3 months, 64 for 3 months to 1 year, 102 for 1 to 3½ years. In 25 cases in which the beginning of the infection was based on the history alone, it lasted from 4 to 9 years in 14, from 10 to 20 years in 6, and from 20 to 30 years in 5. A noteworthy point in connection with bacilli carriers is that they excrete enormous numbers of bacilli, and that the bacilli disappear from and reappear in the fæces in a highly irregular manner. A single negative examination, therefore, is inconclusive. The bacilli are as virulent as those in patients actually suffering from typhoid fever. Frosch gives the following statistics as to the frequency of bacilli carriers in S.-W. Prussia. Among a total of 6708 patients, 310 (4·6 per cent.) excreted bacilli for more than 10 weeks after convalescence. Of these 310, 144 ceased to be infectious within 3 months; 166 remained continuously infective. Out of a population of 2,300,000 souls 276 cases of typhoid were traced to the 310 carriers. In a series of 978 cases of typhoid the source of infection was ascertained as follows:—71·2, another patient; 23·7, food or milk; 5·1, a carrier case.

There is, unfortunately, no known method of dealing effectively with bacilli carriers. Cholecystectomy has been performed in cases with gall-stones; even this is not always successful in curing the infection. Attempts at intestinal disinfection, and at active immunisation, have proved equally futile. The detection of bacilli carriers, and the instructions given to them as to the need for disinfection of the hands and stools, have, in S.-W. Prussia, greatly reduced the morbidity from typhoid from this particular source.

Bacilluria.—According to Easton [9] and Knox [10] typhoid bacilli are found in the urine of about 21 per cent. of patients. They are usually very abundant—many millions in each c.cm. The invasion of the urine takes place during the later stages of the disease, and the organisms may persist for months or years. In most cases the bacilluria is curable by urotropin, even if cystitis is present.

Symptomatology.—Little has been added to the clinical picture of typhoid during the past few years. We may refer, however, to the now numerous observations on local typhoid infections which do not give rise to the general symptoms of typhoid fever. Thus nephritis (Napier and Buchanan [11]), pyelitis (Brownlee and Chapman [12]), pleurisy, jaundice, and menin-

gitis (Arzt[13]) due to Eberth's bacillus, or the bacillus of paratyphoid, may occur. The fact that typhoid fever predisposes to the development of arterio-sclerosis has been referred to elsewhere (*see* ARTERIO-SCLEROSIS).

Typhoid Spine.—This has attracted some attention. It is an acutely painful affection of the spine, which occasionally comes on during an attack of typhoid fever. Wilson[14] has collected records of 21 cases. It is almost limited to males, is predisposed to by hard manual work, and usually begins during the first fortnight of the disease. There is severe pain in the lumbar region accompanied by rigidity of the spine; the pain is paroxysmal and radiates in different directions. The duration of the symptoms varies, but there is a considerable tendency to chronicity, up to a year or more, with remissions and exacerbations. Pyrexia is common. There is sometimes tenderness over the spine, and in some cases scoliosis or kyphosis develops. Many of the patients are described as "hysterical"; the reflexes may be abolished; in a few cases patchy anæsthesia of the legs, or incontinence, have occurred. The best treatment is to immobilise the spine, and to give morphia for the relief of pain. Recovery seems always to take place. The nature of typhoid spine is not quite certain. It has been looked on as a neurosis similar to irritable spine (Osler), to a perispondylitis affecting the periosteal structures (Gibney), associated with inflammation of the nerve roots (Wilson). M'Crae[15] showed by radiograms that in his case new bone had been deposited in and round the vertebral column; he regards the condition as an infective spondylitis. Suppuration has never been observed.

Abdominal Reflex in Typhoid.—From an investigation of the abdominal reflex in 45 cases, Rolleston[16] found that it was affected in 93 per cent., and absent in 68 per cent. It reappears as convalescence begins, and again disappears if relapse occurs. For practical purposes he divides the reflex into supra- and infra-umbilical; the latter is the first to go and the last to return. Rolleston concludes that abolition of the abdominal reflex in a patient under 50 is confined to nervous diseases and certain acute abdominal affections, especially typhoid and appendicitis; it may therefore be of diagnostic importance in cases of chronic pyrexia.

Diagnosis of Typhoid.—The Widal reaction still holds the first place in everyday work. For the macroscopic agglutination test a dead culture may be used. Ficker's "typhus diagnosticum" is a dead culture sold for this purpose; other similar preparations are in the market. Agglutination tests, however, cannot be relied upon to differentiate between the various typho-colon infections. Among other diagnostic methods are:—(1) *Blood cultures.*—These have been alluded to. Cultures made from the rose spots also yield a positive result in most cases, but as by the time the rose spots appear the diagnosis is usually established, the method is not of practical value. The isolation of the bacilli from the stools is difficult. The Drigalski-Conradi method (for details of which a special text-book must be referred to) is regarded as the most satisfactory. (2) The method of *complement deviation* has also been applied to the diagnosis of typhoid fever (*see* IMMUNITY, DIAGNOSIS). (3) *Oculo-reaction.*—Chantemesse[17] introduced the method of instilling into the conjunctival sac an extract made from dead typhoid bacilli. Patients suffering from typhoid, and bacilli carriers, are said to react. Kraus, Lusenberger, and Russ[18] have confirmed his observations to this extent, that they get a reaction in typhoid fever, but they also found that a good many patients suffering from other diseases (tuberculosis, etc.) reacted. Healthy persons did not react. The test has not been much employed; its value, if any, is negative—*i.e.* absence of a reaction probably excludes typhoid. A corresponding cutaneous test is even less trustworthy (Orszag[19]).

Treatment—Prophylaxis.—Apart from the steps which should be taken to combat such sources of infection as flies, dust, and bacilli carriers, a method of antityphoid inoculation has been elaborated by A. E. Wright, and was extensively employed during the South African War. A vaccine consisting of dead bacteria is used; two injections, with a fortnight's interval between them, are given. Inoculation is followed by some constitutional disturbance (fever, etc.) and enlargement of the adjacent glands. There is a temporary lowering of the resistance to infection, followed by a period of increased immunity lasting for about 2 years. Wright believes that the incidence of typhoid in the army was diminished by about half in the inoculated, and that the death-rate among them was about half what it was in uninoculated troops. "Among 19,069 inoculated soldiers there were only 226 cases of typhoid fever, a proportion of 1 to 84·4, and of these 39 died, which equals 17 per cent. Among 150,231 uninoculated soldiers there were 3739 cases of typhoid fever, that is 1 in every 40 took the disease, and the death-rate in this class was 25 per cent." (quoted by M'Crae[20]). Leishman[21] has more recently stated that the mortality among the uninoculated is 20 times as great as among the inoculated. Antityphoid serums have also been prepared, and used in prophylaxis, by Bassenger and Mayer,[22] Meyer and Bergell,[23] and others.

Serum Treatment.—This is as yet in the experimental stage. Antitoxic serums have been used by Chantemesse[24] and Jez; antibacterial serums by others. Chantemesse

states that the mortality with his serum has been only 4·3 per cent., as opposed to a mortality in the other Paris hospitals of 177.

Diuresis.—Cushing and Clarke,[25] and other American physicians lay great stress on giving large quantities of water to typhoid-fever patients. They urge the patients to drink 4 ozs. of water every quarter of an hour, and try to give from 8 to 14 pints in the course of twenty-four hours. Marked polyuria is established as a result of this copious drinking. Both the severity and the mortality of the disease are said to be diminished under this treatment.

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Tyramine. — A vaso-constrictor substance, having the formula C_2H_7NO, found in the watery extract of ergot; it is also a decomposition product of tyrosin $C_3H_7NO_3$; its action resembles that of adrenin but is slower and weaker; the dose hypodermically is $\frac{1}{12}$ grain. *See* Fortescue-Brickdale, *Newer Remedies*, p. 130, 1910.

Tyrosinase.—*See* Ochronosis.

Ultramicroscopy. — A method of examining minute bodies in which no light reaches the eye of the observer except the rays which are reflected from the object looked at; there are various plans for carrying out this principle, such as the dark-ground condenser with a central stop, the Siedentopf ultramicroscope in which the direct rays transmitted through the object are cut off in the objective, etc. *See* Paul Gastou's work, *L'Ultramicroscope*, Paris, 1910.

Unna-Tänzer Stain. — An orcein stain for elastic tissue, *e.g.* in sputum.

Uramine.—A trade name for urotropin.

Ur-a-sol.—A formaldehyde derivative, which acts as an intestinal antiseptic.

Ureometer.—An instrument used for the estimation of urea in urine, *e.g.* the Doremus ureometer or its modification by Hinds; the hypobromite of soda solution is used, and the amount of nitrogen evolved when it comes in contact with the urine is measured, and the urea estimated in accordance therewith. *See* Webster, *Diagnostic Methods*, pp. 210-212. 1909.

Ureters, Surgery of.—The surgery of the ureters is of comparatively recent development. Experience has shown that the ureteral tissues unite well when sutured, and, in consequence, a number of surgical procedures—suture, anastomosis, and implantation of the ureters into other viscera have come into vogue.

Ureterotomy.—When an impacted calculus is present, it may be removed by incision and subsequent suture of the ureter. Brewer (*Amer. Journ. Med. Sci.*, May 1908) recommends an 8-inch incision parallel to Poupart's ligament, splitting of the aponeurosis of the external oblique, and division of the internal oblique and transversalis. The peritoneum is then separated from the iliac fascia and side of the pelvis. The wound in the ureter is sutured with chromic catgut. As some leakage of urine may occur, it is advisable to drain. Woolsey (*Annals of Surgery*, 1909, xlix. p. 674), in dealing with calculi in the pelvic ureter, thinks it is advisable first to localise them exactly by opening the peritoneum and palpating the ureter. The peritoneum is closed before proceeding further with the operation. In considering the question of operation in ureteral calculi, the calculus should be given a chance of being passed, provided it is not too large, has not been long impacted, and that there is no infection. The size and progress of the calculus are determined by X-rays. Rubber drainage tubes are dangerous on account of the possibility of their eroding large vessels; cigarette or rubber tissue drains are preferable.

Suture of Ureters.—Wounds of the ureters may be unavoidable in pelvic operations, especially when it is bound to its sheath by inflammatory adhesions, or infiltration of new growth. When it is completely divided, and a channel for the escape of urine remains, a fistula, which has little or no tendency to cure, develops. On the other hand, as the result of division, the ureter may be occluded, which causes dilatation above the block, and consecutive injury to the kidney substance. The urine from a cut ureter is liable to infiltrate the planes of cellular tissue in the pelvis, or to escape into the peritoneal cavity, according to circumstances. When the ureteral canal is pervious, longitudinal incisions heal readily, with little escape of urine into the tissues. Apart from actual division at the time of operation, the ureter may be injured by the

temporary application of a clamp with subsequent necrosis of a part of the wall, or its blood supply may be interfered with, or a too free dissection of it from its sheath with rough handling may lead to the same result. When a fistula is present after an operation, it is important to decide whether it is due to complete or partial division of the ureter, as in the former case there is little prospect of spontaneous cure, while in the latter case cure is probable. The matter is decided by cystoscopic examination, or the use of the separator (*q.v.*, p. 60).

When a ureter is divided during an operation, several procedures may be adopted according to the nature and locality of the lesion. When the wound lies within an inch or an inch and a quarter of the bladder, the upper end can be drawn down and implanted into the bladder. When the injury is higher up we may have to do either with simple division and no loss of substance, or division with loss of substance. In the former case an end-to-end anastomosis, an end-to-side anastomosis, or a lateral anastomosis may be performed. Where there is loss of substance sufficient to prevent coaptation of the cut ends a lateral anastomosis into the other ureter, or an implantation of the ureter into the bowel may be performed. Lateral anastomosis into the opposite ureter—uretero-ureteral anastomosis—is advocated by Bernasconi and Columbini, on the basis of their experiments on animals and on the cadaver. The injured ureter is carefully separated from its peritoneal covering and carried across the median line to a position parallel to the opposite ureter. The divided end is closed by a ligature, and the two ureters are united by two stitches. The anterior surface of each is then incised longitudinally, and the edges of the wounds are united first posteriorly, then anteriorly. The procedure is said to be easier than uretero-enterostomy. In an operation in which end-to-end anastomosis of a divided ureter was performed over a sound introduced from the bladder and kept in position for twelve days Boasi got complete cure. The sound is said to have caused no discomfort while *in situ*.

When a fistula has developed, Sampson advises uretero-vesical implantation, nephrectomy, or uretero-ureteral anastomosis. When uretero-vesical implantation is possible, he prefers to establish a fistula by fixing the divided end of the ureter to the wound and performing a nephrectomy subsequently (Bernasconi and Columbini, *Annales des maladies des organes génito-urinaires*, 1905, 15th Sept.; Boasi, *ibid.*, 1908, ii. p. 1761; Sampson, *Surgery, Gynecology, and Obstetrics*, 1909, p. 479; Alksen (experimental work), *Folia Urologica*, Bd. iii., Heft, 2).

Ureteral Transplantation.—This may be done into (*a*) the opposite ureter—uretero-ureteral implantation; (*b*) into the bladder—uretero-vesical implantation; (*c*) into some other viscus colon, sigmoid, vagina. These operations are performed either for fistula, or for extroversion of the bladder. *Uretero-ureteral anastomosis* has been referred to above. It is seldom possible in cases of fistula. *Uretero-vesical implantation* may be performed either by the intra-peritoneal or the extra-peritoneal—inguino-peritoneal—route. Sampson advocates the former as the simpler procedure. The abdomen is opened by a median incision, and the peritoneum is divided below and parallel to the pelvic brim. The ureter can then be lifted up in a peritoneal flap, which serves the double purpose of preserving its blood supply and being of use in fixing it to the bladder. The bladder is drawn up and fixed to the side of the pelvis, the ureter being united to the bladder by three or four stitches.

Ureteral Implantation into the Rectum for Extroversion of the Bladder.—Peters, of Toronto, devised a method, briefly as follows:—A rubber catheter is passed into the mouth of each ureter for about an inch, and fixed in position with a fine silk stitch. The mucous membrane round the ureteral opening is incised, and the coats of the bladder are divided until about an inch and a quarter of the ureter projects from the wound. The terminal portions of the ureters are then drawn through the anterior rectal wall. The operation was also independently originated by Bergenhein.

In 1892 Maydl introduced trigono-sigmoid anastomosis—the implantation of the intact ureters and trigone of the bladder into the sigmoid. In this operation the peritoneum is necessarily opened. A semilunar incision is made along the upper border of the wall of the extroverted bladder, the peritoneum is opened, the ureters (into which small catheters are passed) are freed, and a rhomboidal piece of the trigone is resected. This is then implanted into the sigmoid, which lies immediately behind the bladder to the left. Mucous and serous coats are separately sutured.

A great many instances of these operations are on record, and numerous modifications have been tried. For instance, the ureteral orifices have been implanted into the pelvic colon, being first freed, with a rosette of mucous membrane, from below, and then implanted by an abdominal incision above the level of the bladder. Dowden (*Edin. Med. Journ.*, Jan. 1909) implanted them into an excluded loop of colon (having previously made an anastomosis between the iliac and pelvic colon), with the idea of lessening the risk of ascending infection from the constant proximity of fæcal matter to the ureteral orifices. Diakonow dissects up a cuff of bladder wall, and makes from it a new urethra which passes within the sphincter ani and opens in front of the rectum.

As regards the results of these operations, two general statements may be made—(1) They give a great measure of, in some cases almost complete, relief from the misery which attends ectropia vesicæ; (2) they are all attended with more or less risk of ascending infection of the ureter. Patients who have their ureters implanted into the lower bowel generally acquire the power of retaining urine for several hours, and even nocturnal incontinence may not occur. A point of interest concerning this function of the rectum in acting as a urinary reservoir is that for the most part the urine is passed at intervals of several hours, clear and free from admixture of fæces, while in the morning there is a further evacuation of a normal motion without urine. Apparently one of the most important points in the prevention of ascending infection is to preserve the normal valvular opening at the ureteral papilla, and to avoid any cicatrisation of the outlet, which would lead to stagnation of the contents of the ureter. Buchanan also insists on the need for avoiding kinks or twists in the ureters as they are diverted into their new tracts. To avoid the risks of ascending infection Krönig (*Centralb. f. Gynäk.*, 18th May 1907) performed sigmoid-ostomy so as to give an artificial anus. He then implanted the ureters into the rectum. The case was one of ablation of uterus and bladder for pelvic sarcoma.

Statistical Results.—Maydl's operation has been performed on 80 patients, with a mortality of 28·7 per cent. Of 23 deaths, the cause is known in 20—peritonitis, 7; pyelo-nephritis and anuria, 11. Bergenhein-Peters' operation, 26 cases, with a mortality of 11·5 per cent. Of the 98 patients who survived one or other operation, 11 died subsequently of ascending infection. Of 64 cases known to be alive, 15 had survived the operation for from 6 to 12 years. In considering these figures it should be remembered that of 74 patients born with extroversion of the bladder and undergoing no operation only 23 attained the age of 20, the others dying of pyelo-nephritis (Buchanan).

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Uritone.—A synonym of urotropin (hexamethylene-tetramine $(CH_2)_6N_4$); an agreeable form for administration is the elixir.

Urodonal.—A uric acid solvent, being a mixture of lysidin, sidonal, and urotropin; it is in a granular effervescent form.

Urol.—A uric acid solvent, being "an addition product of quinic acid and two molecules of urea." *See* Fortescue-Brickdale, *Newer Remedies*, p. 105, 1910.

Uroleucic Acid.—An acid (aromatic substance) found in the urine in alkaptonuria, having the formula $C_9H_{10}O_5$.

Urorhodin.—*See* Urorubin.

Uroroseinogen.—A chromogen of the urine which is converted into the pigment urorosein, as urobilinogen is converted into urobilin.

Urorubin.—A red pigment of the urine, known also as indigo-red, skatoxyl-red, and urorhodin.

Urosin.—The lithium salt of quinic acid, acting as a uric acid solvent.

Urostealith.—A urinary concretion formed of fatty and soapy matter (Heller).

Urystamine.—A urinary antiseptic, being urotropin-lithium-benzoate.

Uterus, Malignant Tumours of.

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Since the *Encyclopedia and Dictionary of Medicine* was published two notable advances have been made in our knowledge of the malignant growths of the uterus, viz. a more correct estimate of the nature of the so-called Deciduoma Malignum (see Vol. VIII. p. 380; X. p. 372), and the introduction of more thorough methods of dealing with Malignant Tumours of the Uterus (Vol. X. p. 372). To each of these advances some paragraphs must be set apart.

Chorionepithelioma (*Deciduoma Malignum*).—*Pathology.*—The recognition of the true nature of this tumour was delayed for some years in Great Britain by the decision of the Committee of the Obstetrical Society of London in 1896, the decision being that the growth was only a sarcoma of the uterus. Yet S. Gottschalk (*Arch. f. Gynaek.*, xlvi. pp. 1-100, 1894), in a paper entitled "Das Sarcom der Chorionzotten," published in 1894, had stated his belief that the tumour was not (as Sänger had said) developed from the decidua but took origin primarily in the fœtal tissues and was indeed a sarcoma of the chorion arising from the cells of Langhans's layer and the stroma

of the villi. Further, a year later, L. Fraenkel (*Arch. f. Gynæk.*, xlix. pp. 481-507, 1895) described a case, and expressed the opinion that the tumour arose from the syncytium of the chorionic villi and not from decidua ("syncytioma malignum" or "carcinoma syncytiale"). But by far the most important contribution to the subject (since Sänger's paper of 1889) was contained in Marchand's articles of 1895, 1898, and 1901 (*Monatssch. f. Geburtsh. u. Gynäk.*, i. p. 513, 1895; *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxii. p. 405, 1895; *Berl. klin. Wochensch.*, xxxv. p. 249, 1898; *Zeitsch. f. Geburtsh. u. Gynäk.*, xxxix. p. 173, 1898; *Münch. med. Wochensch.*, xlviii. p. 1303, 1901; *Journ. Obstet. and Gynæc. Brit. Emp.*, iv. p. 74, 1903). This writer maintained that the tumour was neither a carcinoma nor a sarcoma, but a special and peculiar growth resembling both; that it was composed of cells from both layers of the epithelium covering the chorionic villi; and that it was, therefore (according to the conception then formed of the origin of the chorionic epithelium), of both maternal and fœtal origin. It had been noted that a hydatid mole often preceded the appearance of deciduoma malignum, and Marchand applied himself to the histological consideration of the former and came to the conclusion that its essential character was not found in myxomatous degeneration of the stroma of the villi, but in excessive growth of the epithelium covering these chorionic projections. He noted next that the cells of the hydatidiform mole and those of the deciduoma malignum were strikingly alike, and that they infiltrated the maternal tissues and invaded the blood-vessels in the same way; and he found that in certain hydatidiform moles (termed *malignant*) the histological appearances were exactly the same as those in deciduoma malignum (the tumour which, from 1898 onwards, he named *Chorionepithelioma*). It was easy to trace the connection between the epithelium of the hydatid mole and that which covered the villi in the normal placenta; and by-and-by connecting links were found joining together the three formations (chorionepithelioma, hydatid moles, simple and malignant, and normal placenta); and the connecting links were chorionepitheliomata containing villi (Apfelstedt and Aschoff, *Arch. f. Gynäk.*, l. pp. 511-547, 1896; Neumann, *Monatssch. f. Geburtsh. u. Gynäk.*, iii. p. 387, 1896; *Wien. klin. Wochensch.*, ix. p. 604, 1896; *Monatssch. f. Geburtsh. u. Gynäk.*, vi. p. 17, 1897). These conclusions and identifications were materially aided by the researches of Peters and others on early human ova; and so it came to be established that both the layers of epithelium covering the villi were of fœtal, or, better, ovular, origin, and that, therefore, the deciduoma malignum was not a maternal but a fœtal tumour. This change of view is most clearly shown in the terminology of the subject, in the substitution of chorionepithelioma for deciduoma malignum. But some years elapsed before these new ideas could make their way in England against the opinion which the Obstetrical Society of London had formulated in 1896, although, in Scotland, Teacher and Kelly (*Journ. Path. Bacteriol.*, v. p. 358, 1898) and Haultain (*Journ. Brit. Gynæc. Soc.*, xv. p. 190, 1899) had described cases showing that the tissue of the tumour was the same as the epithelium of the chorionic villi, and that the tumour actually had its origin in the villi. British opinion may be said to have been finally brought into line with the Continental and American view (as expressed by Marchand) only in 1903, when Teacher published his masterly monograph on the subject (*Journ. Obstet. and Gynæc. Brit. Emp.*, iv. pp. 1-64, 145-199, 1903). It is true that for a time Veit and his followers maintained that the tumour was a sarcoma of the uterus associated with a pregnancy, and that the latter fact accounted for the presence of fœtal elements, which were, therefore, not to be regarded as essential parts of the neoplasm; but Marchand's view has steadily gained ground whilst Veit's contention that disease of the mother cannot arise from the fœtus has not been strengthened.

But it was not long till the occurrence of tumours closely resembling the chorionepithelioma outside the uterus, apart from pregnancy, and even in the male subject opened up a new field of inquiry. In the first place, typical chorionepitheliomata have been found as primary growths of the vagina. Hicks (*Journ. Obstet. and Gynæc. Brit. Emp.*, xii. pp. 119-129, 1907) reported such a case in 1907, and was able to gather together fourteen certain instances from literature, the earliest of which (Pick's and Schmorl's) were published in 1897. To explain these extra-uterine tumours it has been supposed that emboli containing the tissue of the chorionic villi migrate from the uterus and settle in more or less distant organs and tissues, and develop there into chorionepitheliomata. In the reported cases there was generally the history of a vesicular, mole, or, less often, of a simple abortion or of a full-term pregnancy; the growth apparently spread by the perivaginal veins, and there was some evidence that the infecting cells might lie latent for months. Again, in 1897, Kanthack and Eden (*Trans. Obstet. Soc. Lond.*, xxxviii. pp. 149, 171, 1897) reported cases of tumours (in the liver) histologically indistinguishable from chorionepitheliomata found apart altogether from pregnancy, and Lubarsch's specimen (*Arb. a. d. Posenen Instit.*, p. 230) of a growth arising from the uterus came from a girl of 13 years who had never menstruated. But, further, tumours apparently identical with the chorion-

epithelioma began to be discovered in the male. Schlagenhaufer (*Zentralb. f. Gynäk.*, xxvii. p. 82, 1903; *Wien. med. Wochensch.*, May 1902) recorded how a man, 43 years of age, suffered from a tumour of the left testicle of a friable nature; there was, also, a secondary growth in the lung; and the tumours from both organs showed, under the microscope, syncytium and the cells of Langhans's layer. Further, the testicular growth described by Breus in 1878 was re-examined by Schlagenhaufer and was found to be associated with secondary growths in the veins of the spermatic cord, and these could be traced through the inferior vena cava with the right auricle of the heart; the tumour itself contained syncytial masses. Here, then, were cases of deciduoma malignum in the male, and of hydatidiform mole in a man's heart! These occurrences bridged across the gulf between malignant tumours of the uterus and teratomata of the testicle, and at once brought what had been a purely local manifestation of disease into touch with the whole problem of cancer and of its possible origin of malignant growths in embryonic structures or "relics." Ritchie's discovery of a mediastinal tumour with the characters of a chorionepithelioma in a young man tended to draw attention more directly in this country to the occurrence of "deciduoma malignum" in the male. Other cases were reported by Wlassow (*Virchow's Arch.*, Bd. clxix. p. 220), and more recently by Emanuel (*Zentralb. f. Gynäk.*, xxviii. p. 143, 1904), by Fisch (*Interstate Med. Journ.*, xiii. p. 441, 1906), by Bernstein (*W. London Med. Journ.*, xii. p. 128, 1907) and by Emrys-Roberts (*Journ. Path. Bacteriol.*, xiv. p. 135, 1909). It must now be regarded as certain that chorionepithelioma occurs in both sexes, and in both has malignant characters, although it is more frequent in women, probably because of its well-known connection with pregnancy and the hydatidiform mole. In the male sex it would seem to be generally connected with a teratoma in which, it must be conceded, that there were embryonic relics corresponding to the stage of development in which the chorion and its villi are present (Eden, *Journ. Obstet. and Gynæc. Brit. Emp.*, xii. p. 433, 1907). This conclusion is supported by the fact that this malignant growth has been found to arise from ovarian teratomata in the female, when the presence of pregnancy could be excluded (*e.g.* in Pick's patient who was 8½ years old, *Berl. klin. Wochensch.*, xli. pp. 158, 195, 1904). We may summarise the progress of our knowledge of the pathology of the chorionepithelioma by saying that it is a malignant tumour consisting mainly of syncytium and of cells closely resembling those of Langhans's layer in the chorionic villi; that it most often occurs in the female and in the uterus, but may be met with in other organs (either secondarily or, very rarely, primarily), and even in the other sex (generally in association with teratomata of the testicle); and that it arises either from cells of the chorionic villi (especially in connection with a hydatidiform or cystic mole) or from some structure which has "the morphological value of an included matured and fertilised ovum." Since it arises either from the chorionic epithelium or from its forerunner, the trophoblast, it might be termed a trophoblastoma, but the term chorionepithelioma has been fairly well established in use and may be accepted as satisfactory. But it must be borne in mind that such a neoplasm is peculiar neither to the uterus nor to the female sex.

Little can be safely affirmed of the etiology of chorionepithelioma. When we know the cause of cancer, we may perhaps be within touch of that of the chorionepitheliomata; on the other hand, the investigation of the latter may throw a flood of light upon the former question and the wider one. The following facts have been established:—Chorionepithelioma occurs most often in individuals in adult life, and it is noteworthy that the age of predilection is actually thirty-three; its tendency to follow a molar pregnancy or an abortion is well known (but unfortunately the cause of the hydatidiform mole is itself a mystery, and it is not yet possible to say what form of mole is most likely to precede a chorionepithelioma); and it may be surmised that excessive trophoblastic activity has a causal influence, especially if combined with deficient resistance of the maternal tissues.

There is little to be added to the *clinical signs and symptomatology* of chorionepithelioma (vide *Encyclopedia and Dictionary of Medicine*, VIII. p. 380; X. 372). Its clinical connection with abortion has been fully borne out by reported cases, but it may follow on full time labour and even the birth of a living child (Hicks, *Journ. Obstet. and Gynæc. Brit. Emp.*, xvi. p. 179, 1909); it may also occur after the menopause, *e.g.* Krösing's patient was fifty-two years of age, and it was three years since her climacteric was reached (*Arch. f. Gynaek.*, lxxxviii. p. 469, 1909). In Fairbairn's case (*Journ. Obstet. and Gynæc. Brit. Emp.*, xvi. p. 1, 1909) there were almost no uterine symptoms, and operation revealed what was apparently a primary chorionepithelioma of the left ovary. *Diagnosis* founded upon curetting of the uterus is not always reliable, for the scrapings may not contain the distinctive cellular elements; the symptomatology, therefore, should not be lost sight of in coming to a conclusion. After removal the tumour can easily be recognised by its microscopical appearances. *Prognosis* is less grave than was at first thought; apparently the chances of recovery after operation are greater when the tumour has followed a hydatid mole than when it has

developed after a full time pregnancy. Out of 99 cases submitted to *radical treatment* (vaginal hysterectomy), Teacher's collected statistics showed 63 recoveries, of which 24 remained well for more than a year. The occurrence of metastatic deposits while lessening the chances of recovery does not necessarily preclude operation.

LITERATURE.—In addition to the articles already referred to, those of Risel (*Uber das maligne Chorion-epitheliom*, 1903; *Zeitsch. f. Geburtsh. u. Gynäk.*, lvi. p. 154, 1905), of Garkisch (*ibid.*, lx. p. 115, 1907), of Runge (*Zwei Beiträge* (Greifswald), 1907), of Green and Hunter (*Internat. Clinics*, 17 S. iv. p. 188, 1907), of W. Risel (*Ergeb. d. allg. Path. Anat.*, xi. p. 928, 1907), of Brenner (*Monatssch. f. Geburtsh. u. Gynäk.*, xxvii. pp. 574, 713, 1908), of Pazzi (*Ginecologia*, v. p. 504, 1908; *Clin. ostet.*, x. p. 314, 1908), of Lockhart (*Montreal Med. Journ.*, xxxvii. p. 784, 1908), of Hormann (*Monatssch. f. Geburtsh. u. Gynäk.*, xxix. p. 198, 1909), and of Labhardt (*Zentralb. f. Gynäk.*, xxxiii. p. 805, 1909) may all be consulted with profit. Napier Burnett's monograph, which appeared in the *Northumberland and Durham Medical Journal* for September 1908, is an admirable summary of the chorionepithelioma problem.

Cancer of the Cervix.—Two matters of considerable importance fall to be chronicled under progress in the subject of uterine cancer; one has to do with the earlier recognition of the disease, and the other relates to the choice of the plan of surgical procedure to be adopted.

What has been called the "crusade against cancer of the uterus" may be said to have commenced in 1890 when Clement Godson wrote a paper on the importance of the earlier recognition of the disease by paying attention to the symptom of bleeding occurring at, after, or near to the menopause. He showed that in 600 cases of cancer of the cervix bleeding had been the first symptom in 461 (76·6 per cent.), and the only symptom in 225 (37·5 per cent.); pain and discharge usually came on later (*vide* Godson's letter in the *Brit. Med. Journ.*, ii. for 1907, p. 854). Winter approached the subject in 1891 (*Berl. klin. Wochensch.*, xxviii. p. 809, 1891), and returned to it again in 1904 (*Die Bekämpfung des Uterus Krebses* (Stuttgart), 1904; *Zentralb. f. Gynäk.*, xxviii. p. 441, 1904), when he was able to report that wonderful progress had been made in securing earlier recognition of the disease in East Prussia. It is interesting to note that Winter found to be the causes which prevented patients consulting their doctors early: in 30 out of 69 patients the delay was due to ignorance of the symptoms of uterine cancer, in 19 it was ascribed to laziness, in 4 to modesty, in 14 to fear of doctors, and in 2 to lack of money. W. Anstruther Milligan summarises in a useful fashion the progress of the movement in the various countries of Europe up to the end of 1906 (*Journ. Obstet. and Gynæc. Brit. Emp.*, xi. pp. 45-63, 1907). The literature of the subject is already considerable (*vide* Milligan's article, p. 57); but little had been done of a practical nature in this country till the late Dr. Cullingworth wrote to the *British Medical Journal* (14th Sept. 1907), and the Council of the British Medical Association appointed a Committee to consider the best means of promoting the early recognition of uterine cancer. H. R. Spencer's paper and the discussion which followed the reading of it (*Brit. Med. Journ.*, ii. for 1907, p. 431 ff.) were instrumental in arousing the attention of the medical profession. Since then more systematic efforts have been made to disseminate a knowledge of the first symptoms of cancer of the womb: an appeal has been made to medical men to investigate at once (by a physical examination) all cases showing these symptoms; the significance of bleeding at the menopause is being insisted on in the lectures and text-books given to and prepared for nurse pupils in hospitals; and pamphlets setting forth the advantages and means of early recognition of the disease are being circulated among midwives, nurses, and health visitors. The British Medical Association, for instance, in its circular appeal to midwives and nurses, points out that "cancer of the womb is a very common and fatal disease in women, but it can be cured by operation when it is recognised early. A woman sometimes tells a nurse or midwife her ailments before she speaks to a doctor, and the nurse or midwife has then an opportunity of aiding our crusade against this terrible disease. Cancer may occur at any age, and in a woman who looks quite well, and who may have no pain, no wasting, no foul discharge, and no profuse bleeding. To wait for pain, foul discharge, or profuse bleeding, is to throw away the chance of successful treatment. The early signs of cancer of the womb are—1. *Bleeding*, which occurs after the change of life. 2. *Bleeding* after sexual intercourse, or after a vaginal douche. 3. *Bleeding*, slight or abundant, even in young women, if occurring between the usual monthly periods, and especially when accompanied by a bad-smelling or watery blood-tinged discharge. 4. *Thin watery discharge* occurring at any age. The nurse or midwife who is told by a patient that she has any of these symptoms should insist upon her seeing a medical practitioner in order that an examination may be made without delay. By doing so she will often help to save a valuable life, and will bring credit to herself and to her calling." Information such as is contained in the above circular will doubtless lead to the earlier recognition of cancer and therefore to operation at a time when there is some reasonable hope of cure. Already there are signs that women are beginning to understand the possible significance of metrorrhagia and even of menorrhagia at, after, or near the menopause (Meyer-Ruegg, *Zentralb. f. Gynäk.*, xxxi. p. 629, 1907). Even extreme old age does not seem to interfere with the rule that a red

vaginal discharge after the menopause is suspicious, for Findley (*Amer. Journ. Obstet.*, Oct. 1902) has reported a case of cancer of the cervix in a woman aged 93, whose daughter had died of the same disease at the age of 48; the old lady thought it was a "return of the period." Further, medical men are recognising more clearly the variability of the early signs of cancer, and are resorting more to microscopic examination of scrapings from curettings, or of pieces of tissue removed by excision.

While this "crusade" has been starting, gynecologists have been endeavouring to decide what form of *operative interference* promises the best results in uterine cancer. At first, the introduction of vaginal hysterectomy marked a distinct advance: there was a great reduction of the operative mortality, and the operation itself was shorter and less difficult of performance. Yet it was not long before it began to be found that the after-results were not so satisfactory. Halliday Croom (*Trans. Edin. Obstet. Soc.*, xxiv. p. 6, 1898) picked 14 out of 260 cases of cancer of the cervix as suitable for the operation of vaginal hysterectomy; in all of them the operation was quickly recovered from, but all of them were dead within a year from the recurrence of the disease. Six years later Duret and Besson (*Rev. de gynéc. et de chir. abd.*, viii. p. 395, 1904) reported 40 cases in which the vaginal operation was performed, and 23 in which the abdominal route was followed; among the former cases there were six deaths (15 per cent.), and among the latter 10 (43·4 per cent.); further, of the 9 cases of the latter group which recovered from the operation, all died within one year, while of the vaginal cases 13 were free from a return of the disease at the end of two years. Still there was a strong tendency among operators, notwithstanding these unfortunate statistics, to develop the abdominal operation, and to seek for a means of dissecting out affected glands in a systematic and complete fashion (Ries, *Surg., Gynec., and Obstet.*, Sept. 1905). When, therefore, Wertheim (*Brit. Med. Journ.*, ii. for 1905, p. 689) in 1905 announced that "since the autumn of 1895, he had, with a few exceptions, operated on all cases of carcinoma affecting the cervix and portio vaginalis by the abdominal route," he found the profession ready to give him a sympathetic hearing. He further stated that he was able, by freeing the ureters and separating the bladder and rectum, to remove the cancerous uterus with a great deal of the surrounding cellular tissue and lymphatic glands. The Wertheim operation, thus introduced, gave 60 to 70 per cent. of patients free from recurrence of the disease after four or five years' observation, a result which no other method had yielded. It was recognised at once that its performance vastly increased the number of cases of cancer of the cervix and vaginal vault that should be considered as operable; but it was also evident that it was a long and somewhat difficult operation to perform, and entailed great anatomical knowledge and operative skill, dexterity, and care. Berkeley and Bonney (*Brit. Med. Journ.*, ii. for 1908, p. 961), however, were able to report 18 cases of carcinoma of the cervix operated on by the Wertheim method; 3 of these died from the operation, and of the 15 who survived, 14 were alive at the time of writing and showed no signs of recurrence, but, as the authors pointed out, the time had been too short to afford any certainty of permanent cure. Berkeley and Bonney thought that the operation, notwithstanding its technical difficulties (which were much greater in advanced cases than in early ones), would be in a few years the only one carried out for the cure of carcinoma of the cervix. They have modified certain steps in the procedure, such as the separation of the bladder, the clamping of the vagina to prevent infection of the operation area, and the stitching of sterile linen to the edges of the incision. Cuthbert Lockyer (*Brit. Med. Journ.*, ii. for 1907, p. 443) regarded Wertheim's method as "*the* operation of the future, and the only scientific operation for carcinoma cervicis at the present time." The stages of the operation may be enumerated. First, the cancer is disinfected as far as possible by the vagina (scraping, cauterising, etc.). Then, with the patient in the Trendelenburg position, the abdomen is opened. The posterior layer of the broad ligament is divided and the ureters exposed; the bladder is separated from the supravaginal cervix of the uterus and rolled back by digital pressure effected through a swab; the infundibulo-pelvic, round, and broad ligaments are ligatured and divided; the uterine vessels, with the surrounding cellular tissue, are next ligatured and divided, and then the vesical portions of the ureters can be completely separated; next, the posterior layer of the peritoneum is divided and the rectum separated from the vagina; the vagina is again cleansed at this stage, clamped in its upper part, and then cut across; the cancerous organ is now removed, and the dissection of the lymphatic glands proceeded with, every one that is at all enlarged being extirpated. The cavity of the wound is then lightly packed with gauze which extends to the vulva, and the peritoneum is closed by sewing together the anterior and posterior flaps above the operation area which is being drained by the gauze. Finally, the abdominal wound is closed. Berkeley (*Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 145, 1909) has published, during the present year, an able summary of results

and a fair estimate of the advantages possessed by the Wertheim operation over simple vaginal hysterectomy and paravaginal section. Over the former operation (vaginal hysterectomy) Wertheim's panhysterectomy has the advantage of a far greater range of operability, and much larger number of permanent cures; but the primary mortality is higher. In other words, the patient runs a greater risk but has a better chance of permanent cure. The advantage would seem to be largely due to the removal of the parametrium in the Wertheim procedure, and to the thorough way in which the vagina is dealt with. Schauta's paravaginal section (*Monatssch. f. Geburtsh. u. Gynäk.*, xix. p. 475, 1904), the operation devised in 1893 by Schuchardt, enables hysterectomy to be performed by the vaginal route, and at the same time secures free access to the parametrium which is to be removed. The paravaginal incision is "begun in the left vaginal vault, at about the level of the cervix, and is carried forward through the left paravaginal and pararectal tissues, the left labium, the left levator ani and coccygeus muscles, the cellular tissue of the left ischio-rectal fossa, and the skin of the perineum and of the lateral anal region back to the sacrum." Bleeding from the incision is dealt with by fine catgut ligatures. "The next step in the operation is to circumcise the vaginal wall at the junction of the upper with the middle third of the vagina, and dissect it off from the rectum and bladder. This cuff of vagina is then sewed over the cervix so as to shut off the cancerous area from the operative field. The ends of the ligatures employed for this purpose are left long and are used as tractors to control the position of the cervix. The cervix is now separated entirely from the bladder and ureters, and the vesico-uterine pouch is entered. Douglas's pouch is opened, and the dissection of the parametrium from the ureter and pelvic wall, the isolation and ligature of the uterine artery, etc., is begun. After the uterus and parametrium have been removed, the anterior and posterior leaflets of the peritoneum are united by suture, and the paravaginal incision is closed. Vaginal drainage is used" (Henrotin in Kelly and Noble's *Gynecology and Abdominal Surgery*, i. p. 789, 1907). There would seem to be, according to Berkeley (*loc. cit.*, p. 156), a general opinion that Schauta's paravaginal section is more difficult than Wertheim's operation, that its primary mortality is as great, that the percentage of operability is less, and that the percentage of cures is also less; at the same time Sir W. J. Sinclair (*Journ. Obstet. and Gynæc. Brit. Emp.*, ix. p. 241, 1906) is strongly in favour of it. Both Wertheim's panhysterectomy and the Schuchardt-Schauta paravaginal section are long and complicated operative procedures, but they are directed towards the complete removal of cancer of the uterus, and as the end is a great one, so the means by which it is to be reached may be expected to be arduous. The fact that Polosson had 36 consecutive cases of Wertheim's operation without a death does much to remove the dread of a high operative mortality (Berkeley, *loc. cit.*, p. 168). Until some way of preventing cancer or of dealing with it by non-surgical means be found, the gynecologist must be prepared to use the methods which surgery provides.

Uterus, Non-Malignant Tumours of.

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DURING the past few years the chief advances that have been made in connection with fibroid tumours or fibro-myomata of the uterus have been an extension of their operative treatment by abdominal sub-total hysterectomy and a clearer realisation of the dangers which may arise if they are left alone (as used to be done) until the menopause.

Etiology.—Whilst it cannot be said that the causation of fibroids of the uterus is yet discovered, there is a general tendency to regard them as associated in some way or other with irregularities in the performance of the reproductive functions. Pinard (*Ann. de gynéc. et d'obstét.*, 2 S. ii. p. 1, 1905) believes they are connected with disuse rather than with use or abuse of the genital organs, and he thinks that the most evident predisposing cause is failure to permit the process of reproduction to pass through its usual stages on to its legitimate and proper conclusion. In other words, impregnation should be followed by pregnancy and a full-time labour, and labour should be succeeded by lactation. Further, late marriage (opsigamy) and secondary sterility have something to do with the development of uterine fibroids, as is shown by the fact that out of 171 cases in which these growths complicated labour, no less than 94 were primiparæ, and of them 80 were thirty years old or more; of the total number 85 per cent. had married late in life. Pinard puts his conclusion into an easily remembered phrase when he says, when you have to do with a primipara of thirty years or more in the labour room, *cherchez le fibrome*, and he adds that it is sterility that causes fibroids rather than fibroids that cause sterility. Alongside these facts one must put the records of uterine fibroids in two or more of the same family, suggesting family prevalence, if not heredity. Doran, for instance, operated by

hysterectomy upon three sisters for fibroids of the uterus (*Brit. Med. Journ.*, ii. for 1905, p. 924), and Macpherson Lawrie (*ibid.*, i. for 1904, p. 357; ii. for 1907, p. 1342) operated upon four sisters, while a fifth was similarly treated in a hospital. But when we come to consider the question of heredity we must take into account the frequency of this neoplasm, for it is so common that the fact of its occurring in two or more of a family is by no means inexplicable, quite apart from family predisposition. Further, Doran's three patients were all above thirty years of age and were all unmarried, so that even in this case Pinard's generalisation is of value.

The *prognosis* of uterine fibroids is now held to be graver than it was thought to be some five or ten years ago. This is the result of the greater knowledge which has been obtained of the life-history of these tumours, made possible through more frequent operations. Doubtless in the past death was often ascribed to complications (pulmonary, renal, and cardiac) when it was really due to the uterine myoma. As far back as 1902 the late Dr. Cullingworth (*Journ. Obstet. and Gynæc. Brit. Emp.*, i. pp. 3-28, 1902) published an analysis of 100 cases of uterine fibro-myomata in which the condition of the tumours and the complications to which they had given rise were verified by operation. Of the 100 cases 89 had been operated on by abdominal hysterectomy and 9 by myomectomy. Forty-six of the tumours were, so to say, healthy and typical, 2 were unusually vascular and had no capsule, and *fifty-two* had some form of secondary degenerative change. Among the last-named were 27 which showed œdematous and myxomatous change, 18 showing necrotic changes (either necrobiotic or infected), and 5 showing cystic and fibro-cystic degeneration; 1 was myxo-sarcomatous, and 1 was calcareous. Twenty-two cases had complications due directly to the tumour; there were serious peritonitic adhesions in 12, hydrosalpinx in 5, a twisted pedicle in 2, dilated ureters and hydronephrosis in 1, etc. The tendency to take a graver view of fibroids of the uterus was much strengthened by these statistics, and more recent articles further bear this out. Piquand (*Ann. de gynéc. et d'obstét.*, 2 S. ii. p. 335, 1905) has investigated 175 cases of calcified fibroids; in a considerable number of these cases (111) no surgical interference took place, and many of the patients died from the fibroid; 64 patients were operated upon and 12 died (18 per cent. mortality). Obviously, calcification of the fibroid, which was at one time the result hoped for, by no means saves the patient's life; indeed, the operation for its removal would seem to be a specially dangerous one. The "red degeneration" of fibroids has been shown to be due to thrombosis of the blood-vessels, and its occurrence predisposes to infection with septic organisms (Lorrain Smith and Shaw, *Journ. Obstet. and Gynæc. Brit. Emp.*, xv. p. 225, 1909). C. P. Noble (*Journ. Obstet. and Gynæc. Brit. Emp.*, x. p. 436, 1906) pleads for earlier operation, and bases his plea on the fact that degenerations or complications existed in 1550 out of the 2274 cases (68 per cent.), and that cancer and sarcoma of the uterus occur more frequently than is supposed as complications of fibroids. Piquand (*Ann. de gynéc. et d'obstét.*, 2 S. ii. pp. 393, 485, 565, 1905; *Rev. de gynéc. et de chir. abd.*, ix. p. 579, 1905) had also noted this association of malignant growths with fibroids, and had drawn the same conclusion from it; and Winter (*Monatssch. f. Geburtsh. u. Gynäk.*, lvii. pp. 8-66, 1906) thought that there was a direct relation between cancer and uterine myomata. All gynecologists, however, are by no means at one on this subject, and Haultain (*Trans. Edin. Obstet. Soc.*, xxix. p. 173, 1904), for instance, was of opinion that malignant disease was but slightly predisposed to by fibro-myomata, and might be looked upon merely as a coincidence; at the same time, the volume of evidence in favour of the frequency of the association of the two morbid states is considerable. Another risk run by the woman who has a fibroid growth of the uterus is *axial rotation* of the tumour or (what is still more dangerous) of the whole uterus. Haultain (*Trans. Edin. Obstet. Soc.*, xxx. p. 197, 1905) has recorded two such cases, and others have been reported by Boursier (*Sem. gynéc.*, x. p. 329, 1905), Bland-Sutton (*Trans. Obstet. Soc. Lond.*, xlvi. p. 149, 1905), Lacouture (*Journ. de méd. de Bordeaux*, xxxvi. p. 364, 1906), Cameron (*Brit. Med. Journ.*, ii. for 1905, p. 714), Pichevin (*Sem. gynéc.*, xi. p. 209, 1906), Schultze (*Samml. klin. Vortr.*, N. F., No. 410, 505, 1906), Gayet (*Lyon méd.*, cix. p. 272, 1907), Bérard (*ibid.*, cx. p. 374, 1908), Grosse (*Gaz. méd. de Nantes*, 2 S. xxvi. pp. 241, 261, 1908), Pellet (*Normandie méd.*, xxiv. p. 255, 1908), Schulte (*Gynaek. Rundschau*, ii. p. 729, 1908), and Connell (*Journ. Obstet. and Gynæc. Brit. Emp.*, xvi. p. 184, 1909). When all these risks are borne in mind, it is not wonderful that gynecologists, instead of being afraid to remove the myomatous uterus (as they were some fifteen years ago), are now afraid to leave it unoperated upon.

The *treatment* has varied little during the past few years. The sub-total or supravaginal form of hysterectomy is still the operation of choice, although conservative gynecology demands the performance of simple myomectomy (hystero-myomectomy) as often as it is possible to get the neoplasm away without too great a risk. It is becoming customary, also, to try to save one or both ovaries unless these are markedly pathological. It is true that ovarian cysts have sometimes developed after

the removal of the fibroid uterus, and Broun (*Amer. Journ. Obstet.*, lix. p. 307, 1909) has ascribed these tumours to the disturbance of the circulation following hysterectomy; but it is not generally felt that the danger is a great one. Frequent performance of the sub-total hysterectomy has led to a simplification of the procedure, and a lessening of the mortality directly due to the operation. In 1903 Haultain (*Trans. Edin. Obstet. Soc.*, xxviii. p. 128, 1903) reported 42 cases of uterine myoma treated by myomectomy or by hysterectomy (panhysterectomy in 3 cases, supravaginal in 28) with 1 death (in one of the panhysterectomies); in 1905 his list contained 120 hysterectomies with 3 deaths (*ibid.*, xxx. p. 105, 1905), and in 1906, 203 supravaginal operations with 2 deaths (*Brit. Med. Journ.*, i. for 1906, p. 233); and he has recently (*Trans. Edin. Obstet. Soc.*, xxxii. p. 121, 1907) put on record 30 cases of cervical fibroids removed by abdominal hysterectomy with 3 deaths. Other operators have been able to report similarly good results, and Noble (Kelly and Noble's *Gynecology and Abdominal Surgery*, i. p. 711, 1907) has gathered together statistics which show that supravaginal hysteromyomectomy has a mortality, in uncomplicated cases, of 1 per cent., in average cases of from 2 to 4 per cent, and in seriously complicated cases of 10, 20, or 30 per cent.; that myomectomy in strictly selected cases has a mortality of about 3 per cent., and of about 5 per cent. when the selection is not so strict; and that total hysterectomy may be said roughly to be nearly twice as dangerous as the supravaginal operation. Thus, in Kelly's clinic there were 306 myomectomies with 14 deaths (4·5 per cent.), and 691 hysteromyomectomies with 22 deaths (3·1 per cent.). Werder (*Amer. Journ. Obstet.*, liv. p. 736, 1906) had 118 operations with 1 death, Webster 100 with 3 deaths, Bland-Sutton 100 consecutive hysterectomies for fibroids with no death (*Journ. Obstet. and Gynæc. Brit. Emp.*, xiii. p. 328, 1908), and Noble 115 with no death at all (the 115 operations consisting of 104 abdominal sections and 11 vaginal myomectomies). This is a marvellous achievement of gynecology: it is not much more than twenty years ago since Keith abandoned hysterectomy for Apostoli's electrical method of treatment on account of the mortality of the former procedure, and now hysteromyomectomy has a mortality as small or smaller than Keith himself obtained in his wonderful ovariotomy lists. In this relation Vanderveer's article on evolution in the history and treatment of uterine fibroids (*Amer. Journ. Obstet.*, lix. p. 169, 1909) may be studied with interest. So much has the attitude of the profession altered in respect to uterine fibroids that C. H. L. Reed (*Brit. Med. Journ.*, ii. for 1906, p. 1197) has made the general statement that the menopause is a poor surgeon, and that the only safe place for a fibroid of the uterus, however small or large, however soft or hard, however recent or old, is outside the patient's body. The only cases in which operation may be postponed or omitted are those in which the tumour does not cause bleeding, or exert pressure, or exhibit signs of infection or malignancy, or which has ceased to grow. Of course, the presence of a complication which would make operation as dangerous as the tumour would also be a cause for consideration, delay, or abandonment of operative interference. There are still unsettled questions, *e.g.* the advisability of early rising after operation for fibroid tumours (see Brothers's article in the *Medical Record* of New York, lxxi. p. 476, 1907; and C. Hartog's in the *Zentralb. f. Gynäk.*, xxxi. p. 1610, 1907), the method of closing the abdominal incision (through and through sutures, or by layers), the direction (vertical, transverse, curvilinear) of the abdominal incision (see Maylard, *Brit. Med. Journ.*, ii. for 1907, p. 895), and the fate and value of belated ovaries (Bland-Sutton, *ibid.*, ii. for 1908, p. 10; Doléris, *Ann. de gynéc. et d'obstét.*, 2 S. iv. p. 641, 1907); but the broad principles of the operation are all well established, with the result that what was a dangerous procedure in 1896 has now a mortality (in the hands of practised gynecologists) of less than 2 per cent.

Uterus, Prolapsus and Retrodeviations of.—No very marked advances in the treatment of uterine displacements fall to be recorded as having been made during the past five or six years since the articles in the *Encyclopedia and Dictionary of Medicine* (VII. p. 384; X. p. 327) appeared.

In 1904 Bantock (*Trans. Edin. Obstet. Soc.*, xxx. p. 34, 1904-5) wrote in defence of the pessary as a means of treating uterine displacements; and challenged the statements made by Macnaughton Jones and Giles (*Med. Press and Circ.*, N. S. lxxvii. p. 439; lxxviii. p. 1, 1904) as to the dangers of such supports, and the allegation that they were necessary evils. He spoke in strong terms of the "mania for surgical interference which characterises the present-day gynecology," and was of opinion that "for a case of uncomplicated retroversion in which the uterus is perfectly mobile and capable of being raised into its normal position, either bimanually or by means of the sound . . . the only legitimate treatment is that by a properly adapted pessary." He thought, also, there was a prospect of *cure* in a large majority of the cases; and he preferred Britannia or white metal as the material out of which the pessary should be made, for the shape could be easily altered and retained, the presence of an irritating muco-purulent discharge was indicated by blackening of the metal, and it was easily

cleaned. Several of those who took part in the discussion which followed the reading of Dr. Bantock's paper held views resembling those laid down therein; and there can be no doubt that in the profession generally a great many practitioners make use of temporary measures (pessaries and supports) for the treatment of uterine displacements in patients who are averse to operation, or who cannot, for various reasons, undergo such interference. It is to be hoped that these practitioners are as careful as Dr. Bantock in the choice of the supports employed, and in the way in which the treatment is carried through. B. C. Hirst also (*Therap. Gaz.*, 3 S. xxi. p. 289, 1905), and Hofmeier (*Münch. med. Wochensch.*, liii. p. 1649, 1906), have written in a somewhat similar way about the pessary treatment of displacements. At the same time, there can be no doubt that the trend of theory and practice in gynecology is still strongly in the direction of operative interference, and that the abdomen is being frequently opened in order to carry out this interference.

Alexander's operation of shortening the round ligaments of the uterus is extensively practised, but there is still considerable difference of opinion as to the best method of performing it. It may be done, as Alexander proposed, by the extraperitoneal operation; this method has practically no mortality, and, in the case of women who may reasonably expect to bear children, it is to be preferred, for it does not interfere with the changes incident to pregnancy and labour; but difficulty is occasionally experienced in finding the ligaments externally, and the results of the shortening are not so certain or so permanent as when the procedure adopted is the intraperitoneal one. In 1903 Baldy (*New York Med. Journ.*, lxxviii. p. 167) proposed, as had been done previously by Webster, to shorten the round ligament by passing it through an opening in the broad ligament (under the Fallopian tube) and suturing it to the posterior surface of the uterus; but Noble (Kelly and Noble's *Gynecology*, i. p. 539, 1907) condemned this method on theoretical grounds, and advocated *Gilliam's operation* in which the proximal end of the round ligament is sutured to the anterior abdominal wall, the aponeurotic sheath, rectus muscle, and peritoneum being perforated, and the ligament fixed to the aponeurosis of the external oblique. Gilliam's operation is really a round-ligament ventro-suspension of the uterus, and, as modified in F. Simpson's retroperitoneal shortening (*Trans. South. Surg. and Gynec. Assoc.*, xv. p. 223, 1903), would seem to possess obvious advantages. J. W. Taylor (*Journ. Obstet. and Gynec. Brit. Emp.*, xii. p. 415, 1907), however, is impressed with the safety and value of the extraperitoneal operation, and uses it save in cases where adhesions exist; in 170 operations there was no mortality, and the results as to the position of the uterus were very satisfactory, for in three only of the number was there a relapse. Before shortening the ligaments Taylor dilated and curetted the uterus, and put it in a position of complete anteversion, with a pessary to retain it.

It is difficult to speak decisively regarding the value of shortening of the *utero-sacral* ligaments in prolapsus and retro-displacements. It may be done either by vaginal section (the posterior vaginal fornix being incised without opening into the peritoneum, and the two ends of each ligament being sewed together) or by opening the abdomen and suturing together the two ends of each ligament on their peritoneal aspect.

The operation of *ventral suspension*, known also as hysterorrhaphy, ventrofixation, and hysteropexy, was introduced more than twenty years ago by Kelly and Olshausen; but there is still a lack of uniformity regarding its advantages, its dangers and inconveniences (immediate and remote), and the best method of performing it (see Giles, *Brit. Med. Journ.*, ii. for 1906, p. 1188, and Herman, *ibid.*, ii. for 1908, p. 790). It would seem that, if the abdomen is to be opened, some combination of plication of the broad and round ligaments with attachment of the uterus to the anterior abdominal wall will best achieve the end in view, viz., retention of the uterus in an anteverted position at its normal level *quâ* the pelvis with sufficient mobility not to interfere with the normal progress of a future pregnancy and with the safe accomplishment of a future labour.

Utriculoplasty.—An operation on the uterus introduced by Howard Kelly, consisting in the reduction of the size of that organ by means of excision of a wedge-shaped piece of the whole thickness of the uterine wall, having its base at the fundus and its apex at or near the internal os; the two halves of what remains are then sutured together with catgut stitches in the middle line; thus a utriculus or miniature uterus is produced, capable of maintaining the function of menstruation, but not likely to allow of menorrhagia or metrorrhagia. The operation, therefore, is really a vertical resection of the organ, and the result is a uterus as long as before, but only half its size as measured from side to side. The indications are subinvolution, small fibroid tumours causing bleeding, and prolapsus uteri when it is usefully associated with ventrofixation (H. Kelly, *Trans. Amer. Gynec. Soc.*, xxxiv. pp. 536-549, 1909). Victor Bonney has devised for this operative procedure the term "utriculoplasty," as defining clearly its nature and scope, but it is not free from ambiguity, as there are other utricles in the body besides that artificially produced by Kelly's operation. Bonney has

described five cases in which utriculoplasty was employed (*Lancet*, i. for 1911, pp. 1266-1268); and he is of opinion that it is a legitimate alternative to hysterectomy in the treatment of intractable uterine hæmorrhage due to "hæmorrhagic metritis" or "chronic fibrotic metritis," and that it is also feasible to deal in this way with a uterus the seat of small fibroid tumours. It is preferable to hysterectomy when the cervix is healthy, and when the patient desires the menstrual function to be maintained. It has yet to be discovered how a future pregnancy and labour will be borne by such a reduced uterus.

Uviol Glass.—A contracted form of ultra-violet glass, *i.e.* a filter which allows ultra-violet radiations much shorter than the glass to pass.

Valerobromine (Lagrand).—A proprietary preparation, being an organic combination of the valerianates and the bromides, for which it is claimed that it is not unpleasant to take, and does not produce bromism; it is a sodium salt or bromovalerianate; and it is recommended in neurasthenia, epilepsy, and other nervous disorders. See *Lancet*, i. for 1910, p. 653.

Validol.—A synthetic valerian derivative, being the menthol ester of valerianic acid; it constitutes a fluid which is pleasant to take, containing 30 per cent. free menthol; the dose is from 10 to 15 drops, in conditions for which valerian itself is prescribed. *See* Fortescue-Brickdale, *Newer Remedies*, p. 264, 1910.

Valisan.—A synthetic valerian derivative, being the bromo-isovalerianic ester of borneol, an almost tasteless fluid, insoluble in water. *See* Fortescue-Brickdale, *Newer Remedies*, p. 264, 1910.

Valyl.—The diethylamide of valerianic acid, which has been recommended (in capsules) in the maladies for which valerian itself is prescribed.

Vanadic Acid. — The pentoxide of vanadium (V_2O_5) has been used in medicine in solution, and also as the metavanadate of sodium ($2Na_2O.V_2O_5$), the former in doses of $\frac{1}{60}$ to $\frac{1}{40}$ grain daily, the latter in doses of $\frac{1}{80}$ to $\frac{1}{12}$ grain daily; hypodermically the former is given in doses of $\frac{1}{120}$ grain and the latter of $\frac{1}{60}$ grain; these drugs have been used in phthisis (early) as oxygen carriers. *See* Fortescue-Brickdale, *Newer Remedies*, pp. 245-247, 1910.

Vanadium.—*See* Vanadic Acid.

Vaporisation.—*See* Atmocausis.

Vaquez's Disease. — *See* Polycythæmia Vera; Osler's Disease. An autotoxic enterogenous cyanosis.

Varicose Veins. — Schede suggests that in operating for varicose veins it is advisable to make an incision down to the deep fascia completely or partially around the leg, below the knee, and to tie every vein which bleeds. This may be combined with multiple ligature or extirpation of the long saphenous. When a varicose ulcer is present it may be excised along with its indurated border, and the surface covered with Thiersch-grafts. Radical excision of the whole of the long saphenous vein by the open method involves a large incision, which may be slow in healing, and to obviate this several methods of subcutaneous enucleation of the vein have been devised.

Mayo (*Surg., Gynæc., and Obstet.*, April 1906) employs a ring vein-enucleator consisting of a quarter-inch steel ring set at an oblique angle on a long handle. The instrument is not unlike an ordinary uterine curette. After dividing the vein in the upper part of the thigh and tying the proximal end, the operator threads the lower end of the vessel through the ring, and while an assistant fixes the tissues on each side, he gently pushes the ring-enucleator under the skin down the vessel, making tension at the same time on the loose end. After separating six or eight inches of the vein in this way, the ring is made to project against the skin, and a second incision is made in it. The vein is then pulled through this incision, and the instrument having been withdrawn from the upper wound, is again threaded with the vein and used to enucleate another portion from the second incision. In enucleating a vein in this way the small lateral veins are of course divided, but they usually close of themselves without difficulty. In about 10 per cent. of cases the vessel walls are too friable to allow of the operation being successfully performed. The Mayos state that the subcutaneous removal of the internal saphenous vein from a point eight inches above the knee to a point four inches below it interrupts the superficial circulation as effectively as Schede's circumcision.

Keller has employed a somewhat analogous method. He divides the vein in two places some distance apart, and ties above and below. A strong suture is then attached to the distal portion of the vein in the upper incision, and a long wire is passed along the lumen from the lower incision. The suture is then threaded through a loop in the wire, and the wire, carrying the suture, withdrawn by the lower opening. By pulling on the suture the vein is then invaginated into its own lumen and removed by being turned outside in. Babcock

(*New York Med. Journ.*, 27th July 1907), finding that in Keller's operation the vein often gives way, operates with a special vein-extractor consisting of a flexible copper rod about two feet long with an acorn head at either end. He incises the upper part of the saphenous vein, and passes the extractor as far down the lumen as possible. The proximal end of the vein is then tied, and the distal end is firmly ligatured round the extractor, and a second incision is made on the lower end of the instrument. The vein is divided here, and its distal end tied. Firm downward traction is then made on the extractor, withdrawing it from the lower wound with the vein massed against the upper acorn head. The procedure may be repeated if a long enough piece of vein is not removed on the first occasion, or if there is more than one large varicose vein. If there are numerous varicose superficial veins as well as the large trunks, Schede's operation may also require to be performed.

Vasoconstrictine.—A trade name for adrenin or the active principle of the suprarenal capsule.

Vasotonin.—A compound consisting of urethane and yohimbine, which decreases blood pressure, and has been recommended in cases of hypertension due to arterio-sclerosis, etc.

Vaso-vesiculectomy.—Removal of the vas deferens and vesicula seminalis.

"Veda" Bread.—A proprietary food preparation, being a brown bread in which half the dry substance consists of soluble matter. *See* Report in *Brit. Med. Journ.*, ii. for 1910, p. 201.

Vein Anæsthesia (*see also* ANÆSTHESIA (*Venous*)).—A method of producing local anæsthesia introduced by Bier, in which the limb is first rendered quite anæmic by constricting Esmarch bandages; then 80 to 100 c.c. of a 0·5 per cent. solution of novocaine in physiological salt solution is injected towards the periphery into an empty vein in the area between the constricting bandages; after the operation the vein is washed out with normal saline. *See* Fortescue-Brickdale, *Newer Remedies*, p. 184, 1910; A. Bier, *Berl. klin. Wochnschr.*, xlvi. pp. 477-489, 1909; *Brit. Med. Journ.*, ii. for 1909, p. 810.

Venesection. — In the *Encyclopedia and Dictionary* (Vol. X. p. 432) the sentence occurs:—Venesection "is now comparatively rarely used, but there are good reasons for believing that it is a valuable therapeutic measure, and that its judicious use at the present day would be beneficial." The forecast here made has to some extent been fulfilled, and the procedure is certainly more commonly employed than it was twenty or even ten years ago, although *venesection* does not appear in the index to Treves and Hutchinson's *Manual of Operative Surgery*.

The *technique* of the operation has shared in the general change due to the introduction of the aseptic principle, and the preparation of the skin covering the vein should follow the lines laid down under the sterilisation of the operation area in the article on SURGERY, ASEPSIS (p. 350). The preparatory painting with tincture of iodine has been found satisfactory. Infection of a venesection wound is one of the rarest occurrences, but it is not unknown; care, therefore, must be taken that the knife used is sterile; if the abstraction of the blood is to be followed by transfusion of saline fluid directly into the vein, then the precautions must be all the more rigidly adhered to, and it will be well for the operator to dissect out and isolate the vein before he opens into it.

The *indications* for venesection given in the *Encyclopedia and Dictionary* (*loc. cit.*) have been confirmed of recent years; and its value in dilated right heart due to mitral disease or as a result of pneumonia or bronchitis, as well as in puerperal eclampsia (Ballantyne, *Journ. Obstet. and Gynæc. Brit. Emp.*, xviii. p. 378, 1910) and septicæmia has been established. Hall White (*Clin. Journ.*, xxxiii. pp. 385-391, 1909) has defined the circumstances specially requiring phlebotomy; in mitral disease when the breathing is difficult, hurried, distressful, when there is lividity of lips, ears, nose, and fingers, when the pulse is small (indicating that the blood is being retained in the veins), venesection not only relieves the symptoms but often enables digitalis which has so far been without effect to begin to act; when the same symptoms are due to bronchitis it may save a life, and in some (not all) cases of pneumonia; in a few instances of cerebral hæmorrhage where the patient is livid it may be used with care, and in epilepsy it often "acts like a charm"; in uræmia and puerperal eclampsia, especially if there be a high tension pulse and frequent convulsions, bleeding is a suitable measure, acting probably by diminishing the toxic material in the system; and the pain from thoracic aneurism, often agonising, may be temporarily relieved by it. O. Burwinkel (*Med. Klinik*, Jahrg., vi. p. 748, 1910) recommends the performance of venesection in yet other conditions, viz. acute articular rheumatism, migraine, gout, furunculosis, chlorosis, and migraine, and sees a possible sphere of usefulness in its repeated employment to prevent arterio-sclerosis and premature senility. Hale White (*loc. cit.*) is opposed to bleeding to reduce a high temperature, and it

certainly is contra-indicated in young children, in old people (especially the weak and debilitated), in hæmophilia, in grave anæmia, and in marked aortic regurgitation. Burwinkel, however, thinks it may be safely performed in children, the amount of blood withdrawn being 10 c.c. for each year of the child's age. In ordinary cases, in adults, the amount to be withdrawn varies from 6 to 10 or 12 oz., and may in exceptional instances be more.

A still wider field for blood-letting seems to be opened up by Dreyer's work, and by Knud Schroeder's researches on its effect upon patients suffering from enteric fever or paratyphoid fever, and upon animals immunised by injections of cultures of *Bacillus coli* and *Bacillus typhosus;* in both instances blood-letting (3 to 20 oz. being taken in the case of the patients) was followed by a rise in the specific agglutinating power of their serum. These results (clinical and experimental) may serve as the scientific explanation of the benefits which some physicians have seen following venesection in acute diseases.

LITERATURE.—In addition to the articles referred to in the text the following recent contributions may be named:—Kottmann, *Corr.-Bl. f. schweiz. Aerzte*, xxxviii. pp. 728, 755, 1908.—Holmes, *Lancet-Clinic*, ci. p. 434, 1909.—Power, *Practitioner*, lxxxii. p. 320, 1909.—Theilhaber, *Monatschr. f. phys.-diätet. Heilmeth.*, i. p. 221, 1909.—Lichtenstein, *Deutsche Aerzte-Ztg.*, p. 289, 1909.—Kottmann, *Repert. d. prakt. Med.*, vi. p. 285, 1909; and K. Schroeder's Researches in Editorial in *Brit. Med. Journ.*, i. for 1910, p. 104.

Verbigeration.—*See* Dementia Præcox (*Symptoms*).

Verruca Plana.—The skin disease characterised by the presence of flattened warts; the value of lime water in the treatment of this disease is emphasised by Kennard, Henderson, and Burdon Cooper (*Brit. Med. Journ.*, i. for 1910, pp. 81, 180, 240).

Viferral.—A mild hypnotic, existing as a bitter crystalline powder, a compound of pyridine with a polymer of chloral; it is best given in cachets (as its taste is unpleasant) in doses of from 15 to 45 grains, and it is stated to be free from the irritant action which chloral has on the mucous membrane of the stomach. *See* Fortescue-Brickdale, *Newer Remedies*, p. 149, 1910.

Vigoral.—A proprietary food tonic preparation, described as "extract of beef with the addition of other nourishing and muscle-forming constituents." *See* analysis in *Brit. Med. Journ.*, ii. for 1909, p. 563.

Vincent's Spirillum.—The spirillum found in Vincent's angina (ulcero-membranous angina and stomatitis), in association with a bacillus (Vincent's bacillus).

Vinsip.—A proprietary food preparation, recommended as a restorative and tonic food in convalescence, digestive impairment, etc.; it is also called "Liquor Hæmoglobin Co."; an analysis, showing 8·6 parts by measure of alcohol, is given in the *Brit. Med. Journ.*, ii. for 1909, p. 562.

Vioform.—A quinoline derivative, forming a yellowish, odourless powder, insoluble in water, and used as an iodoform substitute.

Virogen.—A proprietary preparation described as a compound of soluble milk protein with the glycerophosphates of lime, manganese, etc.; it is recommended in general debility and nervous disorders. See *Lancet*, ii. for 1910, p. 468.

Virol.—A proprietary food preparation, being a combination of malt extract; it is described as a preparation of bone marrow; and, according to an analysis in the *British Medical Journal* (i. for 1910, p. 29), it contains 12·3 per cent. of fat, 59 per cent. of reducing sugars, calculated as maltose, 2·8 per cent. of protein, 1·6 per cent. of ash, and 21·1 per cent. of water.

Vitali's Test.—A test for pus in the urine: the urine is acidified with acetic test and filtered; then the material on the filter is treated with a few drops of tincture of guaiac, when, if pus be present, a deep blue colour appears. *See* Webster, *Diagnostic Methods*, p. 340, 1909.

Voit's Standard Diet.—*See* Diet (*Chittenden's Work*).

Vomiting, Cyclic.—*See* Acidosis (*Types*).

Von Pirquet's Reaction.—*See* Pirquet's Reaction.

Voorhees Bag.—*See* Accouchement Forcé.

Wang's Method.—A quantitative test for indican in urine, depending on the decomposition of indican and its oxidation to indigo-blue, which is then transformed into indigo-sulphuric acid, which can be directly titrated by means of potassium permanganate solution. *See* Webster, *Diagnostic Methods*, p. 244, 1909.

Wassermann's Reaction.—*See* Immunity; Syphilis.

Wassermann-Uhlenhuth Test for Blood.—When an animal is injected with the serum of a different species, its serum acquires the power of precipitating the albumin in the serum of the blood used for injection. By this means human blood serum can be distinguished from other blood. Uhlenhuth (*Berl. klin. Woch.*, 1901, p. 187) found that of 19 bloods tested human blood alone gave the reaction. The reaction is therefore to a great extent specific, but it seems that the serum of monkeys gives a similar reaction. The test is carried out thus:—A rabbit is injected with human blood serum at intervals of four or five days for a period of two or three weeks. It is then bled, and the serum pipetted off from the clot. The suspected blood is then diluted with normal saline and filtered. It is then added to twice its bulk of antiserum. Three controls are required: one of the filtered blood alone; one of filtered blood from some other mammal; one of antiserum with normal saline. If the blood tested is to be proved of human origin, the first tube alone must show precipitation, the three others remaining clear.

Wernicke's Aphasia.—*See* APHASIA (*Varieties*).

Wertheim's Operation.—An extensive operation for the removal of cancer of the uterus and neighbouring affected parts. *See* UTERUS, MALIGNANT TUMOURS OF.

White Line.—A white line following the drawing of the finger over the skin and lasting for two or three minutes has been noted in conditions resembling meningitis found by autopsy to be associated with disease (cheesy degeneration) of the suprarenal capsules. It is explained as due to reflex spasm of the capillaries during low arterial tension with more or less dilatation of the vessels; and it is said to disappear when adrenalin is given.

Winter's Prunus Perfect Food.—A proprietary food preparation, said to contain "about 23 per cent. of pure vegetable albumen, 50 per cent. of digested starch, 20 per cent. of nut fat in a perfect state of emulsion, and also valuable vegetable salts"; an analysis is given in the *British Medical Journal* (i. for 1910, p. 1241).

Winternitz Test.—A method of testing the motility of the stomach; iodipin (which is not acted on by the gastric juice, but only by the intestinal juice, setting iodine free in the intestine) is given immediately after a meal; defective motility of the stomach will delay the detection of the iodine in the saliva (tested by starch paste). *See* Webster, *Diagnostic Methods* p. 82, 1909).

Wire Filigree.—*See* FILIGREE IMPLANTATION; M'GAVIN'S OPERATION.

Word Blindness, Congenital.—The first case of congenital word blindness was reported by Morgan in 1896; Hinschelwood has lately recorded twelve instances of the condition. It is sometimes a hereditary, or at least a family, disease, for four of Hinschelwood's patients were children in one family of eleven. In congenital word blindness the incapacity may extend only to letters; figures are sometimes recognised without difficulty. In the diagnosis of the condition refractive and other ocular defects and mental deficiency must be excluded. Hinschelwood states that children afflicted with word blindness may nevertheless ultimately learn to read. They ought, however, to be withdrawn from an ordinary school, and specially taught.

REFERENCES.—HINSCHELWOOD, *Brit. Med. Journ.*, 2nd Nov. 1907.—JACKSON, *Amer. Journ. Med. Sci.*, May 1906.

Wormser Winemust.—A proprietary grape juice, analyses of which are given in the *Lancet*, i. for 1910, p. 1210.

Xanthine.—One of the purine bodies, being chemically dioxypurine.

Xaxa.—*See* DRUGS, RECENT (*Aspirin*).

X-Rays in Skin Diseases.—The X-ray treatment of tinea capitis, favus, tuberculosis, carcinoma, and lupus erythematosus is discussed under the various diseases.

SYCOSIS.—The epilating power of the rays has been made use of in the treatment of sycosis, but to get permanent results from this method doses sufficient to destroy the hairs and leave a permanent scar are necessary. Unless this is done, when the hairs regrow a recurrence is to be expected.

ACNE.—In acne small doses of X-rays are very beneficial in addition to ordinary local treatment. In this disease the production of a reaction with its subsequent atrophy of the skin is to be avoided.

ACNE KELOID.—In the condition on the back of the neck known as acne keloid, X-ray treatment gives very good results, causing a rapid disappearance of the keloid-like growths and a check to the spread of the disease.

KELOID AND HYPERTROPHIC SCARS.—Ordinary keloids also sometimes yield to X-rays, and the rays can be relied on to cause an improvement in the hypertrophic scars which are so often associated with scrofuloderma.

LICHEN PLANUS.—Many itchy eruptions are also benefited by X-rays, both as regards the eruption and the itching. This is especially the case in lichen planus. In the more chronic forms a few exposures to the rays often give wonderful relief from the itching which is so troublesome in such cases; but it requires repeated exposures to cause a disappearance of the eruption.

ECZEMA.—The only form of eczema in which X-rays are to be recommended is in the chronic patchy form where isolated spots resist all other forms of treatment. Here, too, in addition to having a good effect on the eruption it gives great relief from the itching. For such cases only small doses should be given.

PRURITUS ANI.—In pruritus ani X-rays also often give great relief, but care must be taken not to expose the genital organs.

WARTS, MOLLUSCUM CONTAGIOSUM.—Multiple warts and molluscum contagiosum, especially the latter, yield rapidly to a few applications of X-rays, and disappear in a surprisingly short time.

NÆVI.—In nævi varying results have been obtained. Some pigmented nævi yield to X-rays, but Finsen light or a combination of X-rays and Finsen light give better results. The angiomatous nævi are also susceptible to X-ray treatment. The superficial ones do better than the deeper ones. These nævi, of course, cannot be destroyed without giving sufficient doses to cause some atrophy of the overlying skin.

MYCOSIS FUNGOIDES.—Of the rarer skin diseases the one in which X-rays can be depended on to give valuable assistance is mycosis fungoides. The rapidity with which large tumour masses in this condition disappear after exposure to X-rays is very astonishing. Small doses should be given, as a too rapid breaking down of the tumours with a rapid absorption into the system of the broken-down products is apt to cause a sudden toxæmia with a fatal result.

REFERENCES. — MORRIS and DORE, *Light and X-ray Treatment of Skin Diseases*, 1907.—WETTERA, *Handbuch der Röntgen Therapie*, 1908.—JAMIESON, *Brit. Journ. Derm.*, Jan. 1903.

Zenker's Degeneration. — The waxy degeneration of muscle, *e.g.* in typhoid fever, in diphtheria, and as the result of blows.

Zenoni Test.—A test for mucin and albumin in the sputum; the sputum spread on a cover-glass is treated with alcohol for fifteen minutes, and then stained with a half-saturated aqueous solution of safranin; the albumin is shown as red and the mucin as yellow. *See* Webster, *Diagnostic Methods*, p. 5, 1909.

Zestocausis.—*See* ATMOCAUSIS.

Ziehl-Neelsen Method. — A method of testing for tubercle bacilli in sputum, in which the smear is first stained with carbol-fuchsin solution and then decolorised by, for example, a solution of sulphuric acid in 95 per cent. alcohol; then it is washed in water and counterstained with Löffler's methylene blue; the tubercle bacilli appear as bright red rods. *See* Webster, *Diagnostic Methods*, pp. 19-20, 1909.

Zomotherapy. — *See* TUBERCULOSIS (*Diet, Raw Meat*).

Zotal.—A proprietary disinfecting fluid preparation; bacteriological tests along with its chemical and physical characters are given in detail in the *Lancet*, ii. for 1909, p. 1522.

Zygote. — The result of the union of gametes, the impregnated ovum. Possibly, as Berry Hart suggests, there are two kinds of zygotes, male and female; then the union of a sex spermatozoon and a non-sex ovum will form a male zygote, and the union of a sex ovum and a non-sex spermatozoon will form a female zygote. In the terminology of Mendelism zygotic segregation means the sifting out or segregation of the unit characters in the zygote.

Zykloform.—The iso-butyl ester of para-amido-benzoic acid, only slightly soluble in water, but readily so in alcohol and ether; it is recommended as a "non-toxic, mildly drying, non-irritant, prompt, and strong local anæsthetic"; but see *Brit. Med. Journ.*, ii. for 1910, p. 1878, for critical discussion.

Zymophore.—*See* IMMUNITY (*Ehrlich's Theory*).

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