Manual of practical morbid anatomy : being a handbook for the post-mortem room / by H.D. Rolleston and A.A. Kanthack.

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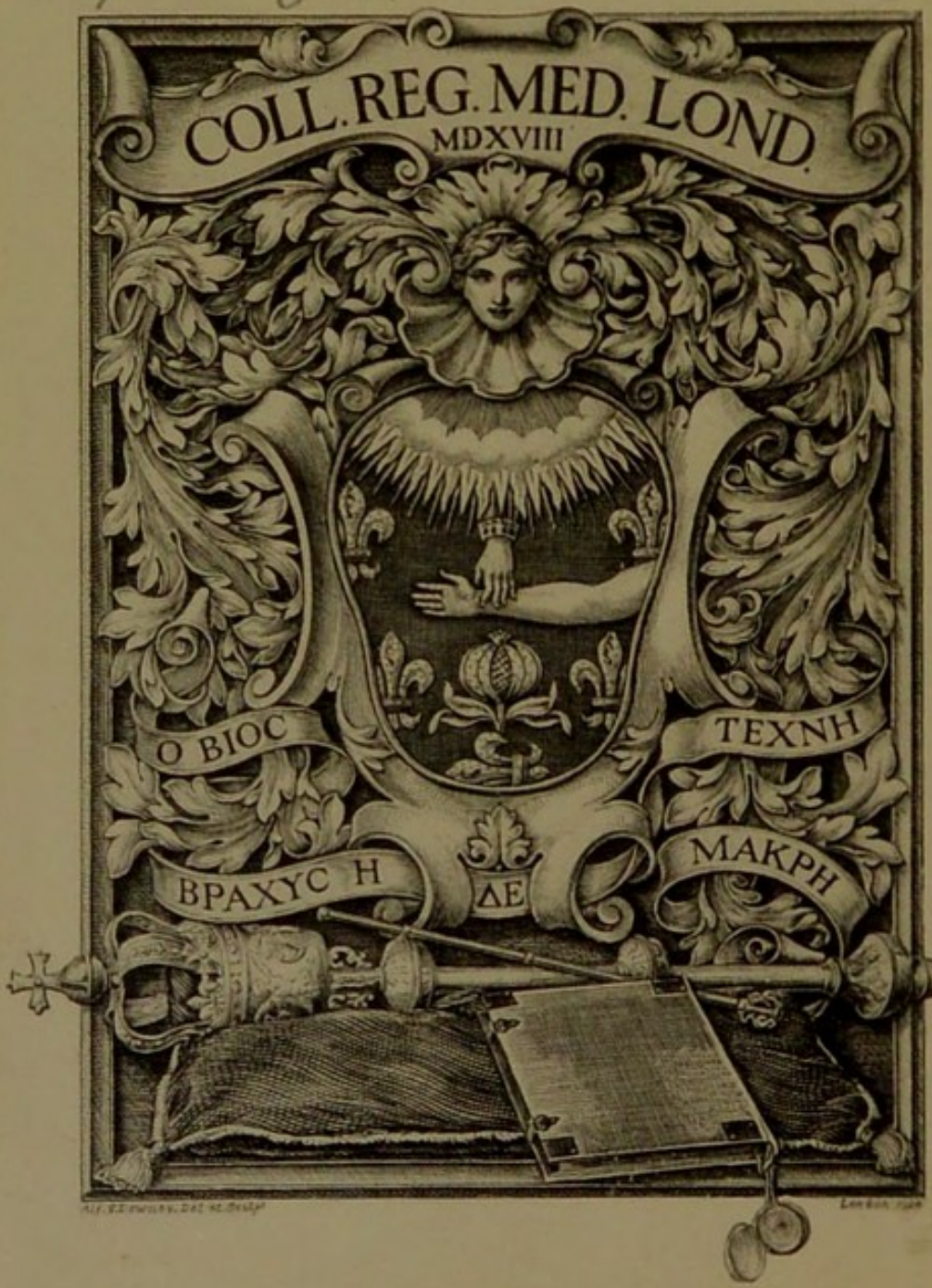
PRACTICAL MORBID ANATOMY



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MANUAL

OF

PRACTICAL MORBID ANATOMY

BEING

A HANDBOOK FOR THE POST-MORTEM ROOM

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INTRODUCTION.

THIS handbook is an attempt to supply a practical guide to the post-mortem room. Its object is two-fold, first to indicate the incisions and the most convenient way of examining the organs of the body, and secondly to point out what morbid changes to look for.

The organs should be examined, so that no part should be destroyed before its condition has been noted; in order to secure this, a systematic method of examination has been described which should be always followed. In special cases, however, this method must be modified. Some such modified dissections have been described.

The student, acquainted only with dissecting room anatomy, experiences considerable difficulty in recognising the physiological variations in organs at different times of life and the commoner abnormalities, and in discounting the various post-mortem changes which occur. Care has therefore been taken to point out the normal appearances

of organs, the common variations in them, and the effects of post-mortem change.

The morbid conditions, likely to be met with, have been pointed out under the heading of each organ, and have been briefly described, but no explanation of the pathological processes, leading to the morbid appearances, has been given.

A post-mortem examination has to fulfil more than one object or purpose, and it has to satisfy the wishes of more than one person. It is undertaken, generally to confirm or amend the diagnosis made during life, but occasionally it offers the first opportunity of finding the cause of death, where for special reasons it was impossible to do so before. In so far as it is able to do all this, it answers to the wishes of the physician or surgeon.

Pathology, however, has a far higher claim, and the requirements of pathology should always be considered before all others. Opportunities for observation are frequently lost in the post-mortem room, because this point is left out of sight. For the purpose of diagnosis often a few cuts only are necessary, yet specimens and organs are disturbed in their natural relations or hopelessly mutilated, so as to be of no further use for the museum or the laboratory. Parts requiring bacteriological investigation, as for instance the middle ear in otitis media, abscesses in the viscera, infective vegetations on the cardiac valves, inadvertently perhaps, are freely exposed

to air and dust, to contamination with blood from other parts of the body, and to the careless or rough touch of inquisitive hands.

These are points which require the fullest consideration and appreciation; they must be thought of before the autopsy is begun. It is impossible to lay down hard and fast rules, where circumspection and experience are the only guides. A post-mortem examination is a coarse dissection, and therefore it is well to remember, that a coarse method can reveal only coarse changes. These may be sufficient for the clinical observer, whose aim it is to trace the cause or effect of symptoms and signs, detected by him during life. The pathologist and the morbid histologist require more.

If a specimen is of such value that it ought to be kept as a record, or if it requires careful handling, because further histological observations are necessary, then if a single cut suffices for the purpose of diagnosis, a series of cuts should not be made. If a bacteriological investigation is desirable, the organs should not be touched, till the suspicious or suspected matter has been removed, whether by means of a platinum needle or a capillary pipette.

The microscope may often be used with advantage to assist hand and eye in doubtful cases. The nature of anaemia, for instance, may be decided in a few minutes by an examination of the heart's blood. Secretions, caseous masses or suspected tubercles may be readily stained for

the Bacillus tuberculosis. Again, the intestinal contents, under special conditions, may require an immediate, minute study. Sections may be cut of many tissues, without previous hardening, and a doubtful diagnosis may be cleared up in a short time and with little labour, while the interest is still keen and awake, and before the details of the case have slipped the memory. For the best methods to be employed in each case, whether for staining or cutting, reference must be made to special works.

A few words may be fittingly added, as to the best way of keeping morbid anatomy specimens, with the view to their temporary or permanent preservation. The following directions, as important as they are useful, are taken, almost literally, from a letter of Mr E. W. Willett, Curator of the Museum of St Bartholomew's Hospital, published in the *Lancet* of November 25, 1893, and here reprinted in part, with the writer's kind permission.

Unfortunately, no means are at present in use which will preserve the natural colour of specimens, removed during the autopsy, in a satisfactory manner. It is therefore necessary, to fall back on spirit, as the best preservative on the whole. Since it is impossible to retain the natural colour, the best thing to do, is to get rid of it as soon as possible. The following will be found the best means of doing this.

Thoroughly wash the specimens in cold water, as soon

as they are removed from the body, and leave them to soak in water for twenty-four hours; in very hot weather twelve hours will be long enough.

Livers and spleens, and organs which contain much blood, will require to be left rather longer in the water: for from thirty-six to forty-eight hours. In the case of the liver a stream of water sent through the portal vein, by means of a syringe or tube attached to a tap, will have the same effect as a prolonged soaking.

The specimens should then be placed in a mixture of equal parts of ordinary methylated spirit (usually about 65 over proof) and water; the amount should be about equal to two volumes of the specimen or rather less; this is easily calculated approximately.

If it is desired to preserve the specimen permanently, it will be necessary to change the dilute spirit at the end of a week; and again at the end of a month, if it is much discoloured, and perhaps a third or fourth time. Under any circumstances the spirit should be stirred every two or three days at first, in order to prevent the colouring matter of the blood from collecting at the bottom of the vessel and staining the lower part of the specimen.

When it is ready for permanent mounting, as shewn by the fact, that the spirit no longer changes colour, it should be finally placed in spirit (at proof, as ascertained by the alcoholometer). For this purpose freshly distilled spirit, diluted with distilled water, should be used.

There are a few other points to be noted. Brains

after being washed, by running a little water over them, should be placed at once in ordinary undiluted methylated spirit, or in Müller's fluid (vide p. 183, footnote). At the same time care must be taken, by means of cotton-wool placed under and at the sides of the brain, to maintain its proper conformation, since otherwise it will become hardened in a distorted manner.

Tumours which are soft when first removed, such as goîtres, sarcomatous or tuberculous testes, etc., are much better preserved, if they are placed at once in strong spirit, after carefully washing the outside, before they are cut into. This will harden them sufficiently in a week or ten days, to ensure their retaining their shape when cut into, and to allow also a subsequent, satisfactory microscopical examination of their structure to be made, should it be needed. If this is required in the case of ordinary specimens, which are to be treated by soaking in water and weak spirit, a small piece should be cut off from the most typical part and placed in an excess of Müller's fluid, when the specimen is quite fresh.

In conclusion, the authors wish to express their gratitude to their friend J. H. Drysdale, M.B., for much help and advice in correcting the proofs.

London,
October 31, 1894.

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CHAPTER I.

GENERAL EXAMINATION.

I. *Introduction.* II. *Signs of Death.* III. *Rigor Mortis.* IV. *Hypostatic Congestion.* V. *Examination of Skin.* VI. *Medico-Legal Examination.* VII. *Wounds.* VIII. *Stillborn Infants.*

I. CASES that have died after being under observation for some little time, and whose diseases and past history are fairly well known, do not require the same careful external examination as cases brought dead into a hospital where identity has to be determined and the cause of death found for a coroner's court.

The external examination will be described under two heads. The first will deal with points which should always be noted whether in an ordinary or in an inquest case, while under the second heading points requiring notice in medico-legal cases will be mentioned.

II. *Signs of Death.*

In any case where there is any possibility of trance simulating death a careful examination must be made before the autopsy is begun. The heart sounds and apex beat being absent a ligature should be placed round

a finger. This produces no effect on the dead, but if the circulation be still going on, even though feebly, the peripheral part will become congested from venous obstruction. If any doubt exist, an artery, such as the radial or the superficial temporal, should be cut down upon and opened; if empty, there is no doubt as to death.

Rigor mortis or post-mortem coagulation of the myosin of the muscular fibres which is abolished by forcibly bending the limb is a certain sign of death.

Dulling of the cornea and flaccidity of the sclerotic are also signs of death.

Ophthalmoscopic examination of the retinal arteries which in death are empty, is rather adapted for determining whether death has actually occurred or not, but is hardly convenient in the post-mortem room.

Height can be most conveniently measured by a stiff rod with feet and inches marked on it.

Weight may be taken in cases of emaciation or in cases of rapidly growing tumours where, in spite of cachexia, the patient has gained weight in the course of the fatal illness.

Note general state of nutrition: emaciation, obesity or fair state of nutrition.

III. *Rigor Mortis*: its presence or absence should always be noted. If absent in the arms it may be still present in the legs. It may be absent in the arms, not because it has passed off in the ordinary way as the result of advancing decomposition, but because the rigidity of the arm muscles has been broken down on lifting the body

out of the coffin on to the post-mortem table; the arms being rigidly crossed over the chest are extended in lifting the body and the rigid muscles broken down and rendered permanently flaccid.

Rigor mortis usually commences about 5 or 6 hours after death and lasts about 24 hours; as its disappearance is due to commencing putrefaction, it is influenced by whatever accelerates or postpones decomposition.

Dry cold air, as in winter, prolongs rigor mortis, while moist air shortens its duration.

Great muscular exertion, convulsions, spasms of tetanus or strychnia poisoning, and exhaustion from prolonged illness cause rigor mortis to come on rapidly and to pass away quickly.

Rigor mortis occurs, contrary to what is sometimes stated, in persons killed by lightning.

In very well-developed muscular persons rigor mortis develops slowly, but is strongly marked and lasts more than the average time.

Rigor mortis appears first in the muscles of the jaw, then in those of the neck and trunk, last in the arms and in the lower limbs; it disappears in the same order.

The dead body takes from 12 to 24 hours to cool down to the temperature of the atmosphere, the rate of cooling varying under different conditions, but it may be taken as being about 1° C. per hour for the first 12 hours. (T. Stevenson.)

IV. *Post-mortem lividity,* due to the blood serum transuding into the tissues from the vessels of a dependent

part, is usually found on the back: the parts of the body actually touching the table or bed do not shew this staining.

In septic cases, where the blood undergoes changes during life and remains liquid after death, post-mortem lividity is very marked, and the course of the subcutaneous veins is often marked out by branching greenish-black lines. This appearance may occur very soon after death.

Post-mortem staining must be distinguished from ecchymoses or extravasations into the skin. If there be any doubt, an incision into the skin will shew whether there is blood clot outside the vessel wall or not. Post-mortem lividity is merely due to staining by serum containing blood pigment, while in a bruise or ecchymosis the blood has left the vessels and is in the tissues.

In cases of death from convulsions or from great dyspnoea small extravasations of blood may be found in the skin over the neck and upper part of the chest.

V. The *skin* after death loses its elasticity and hence parts which have been exposed to pressure remain flattened.

Note the presence and distribution of oedema and the condition of the skin.

Note any abnormality of pigmentation. Scars of chronic ulcers often shew a surrounding zone of pigmentation.

The skin of the abdomen often shews lineae albicantes, silvery streaks due to rupture of the connective tissue fibres in the dermis from distension of the abdomen, pregnancy, ascites, intestinal obstruction at some former

time. The same appearance is seen on the mammae and thighs of fat women.

VI. *Medico-legal Cases.*

In the case of a person whose identity is unknown careful note should be made of the colour of the hair and eyes, of the presence of any scars, tattoo marks or any physical peculiarity. It may be advisable to examine and count the teeth and to note whether the ears have been punctured for ear-rings.

Examine the mouth, nostrils, ears, anus and vagina for any discharge or foreign body. If there is any discharge on or near the genitals, examine it microscopically for the presence of spermatozoa.

In cases of poisoning note any stains or discolouration of the skin around the mouth due to the action of corrosive fluids.

Examine the skin for bruises and extravasations. It should be remembered that violence sufficient to rupture the viscera may be applied to the body without leaving any trace on the skin.

VII. Carefully note the position, and measure the extent, of any wounds; note whether the edges are retracted, or united by blood clot, and whether there is any evidence of inflammation around it or of extravasations of blood into the surrounding tissues.

Note the beginning and ending of any incised wound, whether single or jagged.

Note the direction of the wound, from left to right, as in most suicidal wounds, or from right to left.

The following are the distinctive characters of wounds made some time before and some time after death.

Wound made during life.	*Wound made after death.*
(i) Eversion of edges due to elasticity of skin.	(i) Edges of wound are in contact.
(ii) Free haemorrhage from vessels with effusion of blood into the tissues around.	(ii) Little or no haemorrhage and no infiltration of the surrounding parts.
(iii) Clots in the vessels cut across or in the wound.	(iii) No coagulum in the wound.
(iv) Signs of inflammation, healing or gangrene.	

There is, however, little difference between a wound made shortly before death and one made soon after, and in any doubtful case very exact notes of the appearances should be made at the time and a very cautious opinion expressed.

If a dead body be struck within two hours after death, the resulting contusion cannot be distinguished from one due to a blow inflicted shortly before death.

Note any marks or indentations on the skin due to pressure of hands, cords, etc., especially about the necks of children.

In cases of bullet wounds note whether there is any blackening of the skin or burning of the hair around the wound. The orifice of entrance is much smaller than that of exit. At the orifice of entrance the skin is drawn in, while it is everted at the orifice of exit.

Note whether any pieces of clothing have been carried into the wound.

In cases of suspected suicidal pistol or revolver wounds carefully examine the hands.

When a corrosive poison has been taken, stains and burns should be looked for on the lips, tongue, face and hands.

VIII. In still-born or very young children measure the height and weight. The condition and colour of skin, nails and hair should be noted. Examine the cord at the umbilicus and the umbilical vein and hypogastric arteries. The umbilicus may appear healthy and yet there may be phlebitis of the umbilical vein, accompanied by peritonitis and pylephlebitis or general pyaemia.

In a male note the position of the testes.

Examine the eyes and note the presence of a pupillary membrane which disappears at the seventh month of intra-uterine life.

In determining the maturity of a foetus note whether the lower epiphyses of the femora shew the centre of ossification which appears at the ninth month. Make a transverse incision across the patella so as to open the knee joint, disarticulate the bones and make a series of horizontal sections through the lower end of the femur.

For the tests to be applied in cases of suspected infanticide and for their limitations a text book on medico-legal medicine should be consulted.

CHAPTER II.

PRELIMINARY EXAMINATION OF ABDOMEN.

IX—XI. *Incision and General Examination.*

XII—XVIII. *Detailed Examination and Removal of Intestines.*

IX. An incision is made in the middle line of the neck, thorax and abdomen. The abdomen is first opened, the position of the diaphragm and the general arrangement of the viscera and any morbid conditions are noted.

The small and large intestines are removed.

After this it is most convenient to delay further examination of the abdominal viscera and to proceed to a detailed examination of the contents of the thorax.

In women who have borne children or are pregnant, and in cases where there has been much abdominal distension, white streaks are visible on the skin—lineae albicantes vel gravidarum. (See p. 4.)

Primary Incision.

The dissector stands on the right hand side of the body.

The knife is held in the palm of the hand and the handle firmly grasped by the fingers; the fore-finger may be placed on the dorsal surface of the blade.

The arm is held stiff and extended, and movement takes place chiefly from the shoulder joint, not at the wrist or elbow.

Extent of the Primary Incision.

In all cases the incision should extend from the pomum Adami to the symphysis pubis.

It is more satisfactory to make the incision from the symphysis menti to the symphysis pubis. But this produces disfigurement and in many cases therefore should be avoided.

The cut beginning at the cricoid cartilage is carried down in the middle line to the symphysis pubis, passing to one side of the umbilicus so as to save trouble in sewing up the body.

In the first incision the knife is carried through the fat and subcutaneous tissue, but not through the deep fascia and muscles.

When it is thought advisable not to cut above the cricoid cartilage the skin can be easily dissected away from the underlying thyroid cartilage, hyoid bone and muscles forming the floor of the mouth.

In doing so the cutting edge of the knife should be directed towards the deeper structures and the back towards the skin; in this way buttonholing the skin of the neck is avoided.

The superficial fascia having been divided by the first incision the next step is to lay open the peritoneal cavity.

The tissues of the linea alba just below the ensiform cartilage are cautiously cut through for about two inches,

and the convex surface of the liver close to the falciform ligament is then exposed[1].

The fore- and middle-fingers of the left hand are introduced into the peritoneal cavity with their dorsal surface towards the intestines.

By separating the fingers and lifting the abdominal wall up, the knife can be introduced into the abdominal cavity between the fingers with its cutting edge upwards.

The fingers of the left hand acting as a director the abdominal wall can be slit up from within outwards.

A pair of dissecting forceps can be introduced in the same way and the blade inserted between its two prongs.

The recti and oblique muscles are then dissected by rapid cuts off the costal arches and turned outwards, the body wall being pulled outwards by the left hand.

In order to facilitate the exposure of the abdominal viscera, the tendons of the recti should be cut across from within outwards, immediately above their insertion into the symphysis pubis and crest.

The blade of the knife is introduced with its surface parallel to the abdominal wall, and then turned so that its cutting edge is brought to play on the under surface of the muscle.

In infants, before cutting through the tendons of the recti, examine the condition of the umbilical arteries. In cases of peritonitis and pyaemia the umbilical vein in the

[1] On making this small incision if there is any free gas, it will be heard making its exit. In bodies much decomposed a large quantity of gas may be generated in the peritoneal cavity without there being any perforation of the intestines.

falciform ligament should be examined for inflammation and suppuration.

X. Note the height of the diaphragm: the thumb should be placed on the ribs externally and the rest of the hand inside the abdomen. The level to which the arch of the diaphragm ascends should be noted in the nipple line, by its relation to the ribs. Normally the diaphragm rises to the level of the fourth rib in the right nipple line and to that of the fifth rib in the left.

Note the colour and appearance of the peritoneum. It should be smooth and glistening. Vascular injection of the peritoneum is abnormal. The pyloric end of the stomach, the duodenum and the hepatic end of the colon will be found stained with bile, if the gall bladder is distended. This occurs normally after death.

Note the condition of the great omentum, adhesions, twists, thickenings, amount of fat, etc.

Examine the peritoneum and the peritoneal cavity for fluid, faeces, blood, pus and adhesions.

In commencing peritonitis longitudinal red lines running parallel to the mesenteric border are seen on the serous coat of the small intestine, due to the paralysed and therefore dilated coils of the intestines being in immediate contact except along these lines. Where they do not touch the vessels remain congested.

In exhausted old people when moribund there is often a low form of peritonitis.

The dependent parts of the intestines, such as the coils of the ileum in the pelvis, are generally engorged or con-

gested. This is due to hypostasis and must not be mistaken for inflammatory injection.

In cholera the peritoneum is described as being of a rose pink colour and having a peculiar sticky feel.

In acute peritonitis the serous coat is injected, dull and lustreless or covered by shreds of fibrin or false membranes with fibrinous bands stretching between neighbouring loops of intestines. The lymph or fibrin may be distributed in patches or cover larger areas.

In chronic peritonitis the serous membrane is opaque, greyish white in colour and often thickened, as may be well seen in cases of old standing ascites.

Slate-coloured patches may be found, evidence of old haemorrhages.

In chronic peritonitis of long standing, the mesentery and the whole length of the intestine become considerably shortened.

In chronic tubercular peritonitis the surface of the peritoneum (intestines, omentum, mesentery and diaphragm) is irregularly studded with small nodules of varying sizes.

The omentum may be much thickened and rolled up in these cases.

Similar small nodules may be seen in cases of malignant disease of the peritoneum and, as in the case of tubercle, a pigmented zone may be found around these disseminated growths, so that in older subjects in the absence of other signs a naked eye diagnosis is sometimes impossible.

In acute miliary tuberculosis the nodules are generally minute and the intestines are often but slightly studded with them.

As a result of past peritonitis there may be adhesions between neighbouring coils of intestines or between the latter and the abdominal wall or other viscera.

Bands should also be noted. Such bands may be formed by two adherent appendices epiploicae.

XI. Now proceed to the examination of the stomach and intestines.

Note the position, size and shape of stomach: it may be dilated or contracted or hourglass-shaped.

Look for perforations of the stomach and gut, especially in cases of acute peritonitis or where faeces or pus are found in the abdominal cavity. Note their position and relation to Peyer's patches.

Examine the position and condition of the caecum and vermiform appendix.

The latter may be free or bound down. It is often bound down from absence of a mesentery and not from past inflammation.

Note fossae and pouches round the caecum.

Examine the intestines for contractions or dilatations, diverticula, strictures and tumours.

Contraction of the large intestine is not very uncommon in persons who have died from various causes and is probably an "agony" phenomenon.

The gut may be collapsed or contracted below an obstruction or stricture. It is then generally found to be anaemic and empty.

The large intestine may be much distended with flatus. This often occurs in the caecum and ascending

colon and renders them more freely movable than in life. It may thus appear as if the first part of the ascending colon had an extensive meso-colon.

Considerable distension of the colon may suddenly pass into extreme contraction. This is an unimportant post-mortem or agony phenomenon.

Dilatation of the gut is found above the seat of obstruction. The wall of the distended bowel may be considerably thinned or hypertrophied.

Invagination or intussusception is commonest in children and as a rule occurs at the junction of the large with the small intestines.

Note the relations of the invaginated gut: adhesions, fibrin or lymph are generally present between the peritoneal surfaces of the entering and returning layers; the mesentery is drawn in and contorts the gut. This portion of the mesentery is generally discoloured by blood and is thickened and inflamed.

This true invagination must be distinguished from the agony intussusception which is often found in children. This always occurs in the small intestine and is often multiple, and while the true invaginations always take place from above downwards, in these cases the process may be reversed. There is no discolouration and they are never found at the junction of the caecum and ileum, the favourite seat of true intussusceptions. Again agony invaginations are easily reduced.

The attempt to reduce an invagination must not be made, until the parts have been carefully examined.

When volvulus is present the discoloured or gangren-

ous intestine may be seen to be looped on itself or twisted on the long diameter of the loop of the volvulus. Volvulus is commonest in the large intestine (caecum and sigmoid flexure). The upper end of the loop should be carefully examined in order to study the mechanism of the twist.

Strangulation of the large intestine is very rare. Where strangulation is suspected the parts should be delicately handled and the relations disturbed as little as possible. The obstruction may be due to kinking by adhesions or bands or to abnormal relations of the Fallopian tubes, Meckel's diverticulum or the mesentery or omentum.

In all these cases of acute obstruction gangrene of the gut is common. This condition is easily recognised by the characteristic discolouration of the intestine which is lustreless and of a dark blue or purple colour. The line of constriction at the beginning of the gangrenous area should be examined later for ulcers. In other cases the mesenteric arteries must be carefully inspected and dissected for thrombosis and embolism.

Tumours in the colon are easily recognised. They are usually malignant and their detailed examination is best deferred until the opening of the gut. The bowel is contracted, its walls puckered and hard and at times there is a marked raised ring around the gut.

Impactions and concretions are rare. In the large intestine scybala may be encysted in small pouches.

Meckel's diverticulum, when it exists, is generally found in the last three feet of the ileum. It is sometimes attached by a fibrous cord to the umbilicus.

XII. *Removal of the Small Intestine.*

The great omentum should be lifted up and spread over the costal arch. The small intestine with the mesentery is thus completely exposed.

The mesentery should be examined for any morbid condition such as enlarged or calcified glands, which if present should be cut into.

The third part of the duodenum is seen ascending to the attached border of the transverse mesocolon. Cut the duodenum across. A ligature need not be applied, except when there is any suspicion of poison, or in any case when it is desirable to preserve the contents of the intestine.

The knife is held like a fiddle bow and kept moving backwards and forwards while the small intestine is pulled over the edge by the left hand.

The mesentery must be cut through at its attachment to the bowel and none of it left, otherwise difficulty will be experienced in opening the intestine.

Removal of the Colon. When the caecum is reached draw it towards the middle line and cut through the peritoneum and fibrous adhesions on its right side, pull on the ascending colon separating its connections with the knife.

Take care not to open the second part of the duodenum which touches the ascending colon.

When the hepatic flexure is reached pull the omentum down, cut it off from the transverse colon; now separate carefully the transverse colon from the stomach. Make traction on the splenic flexure and free it from surrounding tissues.

Follow the colon down into the sigmoid flexure and rectum.

Before cutting through the rectum, pass the hand into the pelvis and squeeze any faeces up from the rectum into the sigmoid flexure above, then cut through the bowel. In this way soiling the hand is avoided when later on the contents of the pelvis are removed.

XIII. *Washing out and Opening the Intestines.*

The intestines are removed to a sink.

The cut end of the jejunum is held or tied on to a tap, the intestine being previously arranged in regular coils so that twisting and kinking of the bowel may be avoided when it becomes distended with water.

Run water through until it comes out clear. Care should be taken not to over-distend the intestine as it may thus be ruptured. In some cases where ulceration is suspected the intestines should be washed out very gently.

Opening the Intestines.

A pair of bowel scissors is employed, the blade introduced into the bowel being blunt. The intestine is then rapidly drawn over the blade. The small intestine is opened along the line of the attachment of the mesentery, in order that Peyer's patches which are situated opposite to this border may be left intact.

The vermiform appendix should be opened with a sharp-pointed pair of scissors. The size of its lumen and the presence of faeces, soft or hard, must be noted.

The lumen of the appendix may be partially or com-

pletely obliterated, in which case the distal portion may be distended with fluid or mucus.

Dilatation may also result from kinking or twisting of its caecal end.

True foreign bodies rarely occur, and faecal concretions must not be mistaken for such.

Faecal concretions are often moulded into an oval form and bear some resemblance to date-stones.

The colon should be opened in much the same manner as the small intestine.

XIV. The mucous membrane of the intestines is as a rule not stained with faeces when they have been well washed out, but such staining is generally observed at or around recent ulcerations, whether these be deep or superficial.

In the small intestine the valvulae conniventes diminish in size and number as the ileo-caecal valve is approached. The point in the ileum where they disappear varies within considerable limits.

In cases of starvation the gut is much thinned.

Observe the condition of the lymphoid elements. In children Peyer's patches and the solitary follicles are more marked than in adults, and in the former numerous follicles may be found in the colon which must not be mistaken for tubercles.

Later in life, on the other hand, the lymphoid tissue undergoes atrophy, and the presence of Peyer's patches is indicated merely by slightly darkened areas.

In scarlet fever and diphtheria they may often be

swollen, and so also in cases of diarrhoea, especially in children.

In lymphadenoma great enlargement of the lymphoid tissue of the whole of the intestine may occur, especially about the ileo-caecal valve. This condition is generally associated with considerable increase in size of the mesenteric glands.

Great swelling may also be found in the early stages of enteric fever, as will be described below.

In tubercular disease small caseous points may be seen in positions corresponding to the solitary follicles and Peyer's patches.

In consequence of long-standing irritation the lymphatic glands may become slate coloured.

Ulcerations will be described below.

In lardaceous disease the surface resembles wet wash-leather and is somewhat sodden. The iodine test should be applied. (See § XLII.)

In some cases of general dropsy the mucous coat is gelatinous in appearance and oedematous.

In heart disease and obstruction to the portal circulation the mucous membrane is engorged, the venules are dilated in many places, irrespective of position, and free blood may be found in the intestine.

True engorgement must be distinguished from post-mortem congestion due to gravitation of the blood in the coils of the ileum. The latter is sharply defined and limited to the dependent portions of the intestines.

It is often difficult to recognise inflammation of the intestines after death.

Injection of the vessels *per se* is valueless, but hyperaemia associated with the presence of tenacious mucus or adherent lymph may be regarded as a sign of inflammation.

Small areas of injected venules are often seen, but are of no importance, and by themselves no evidence of disease.

Occasionally varicosities occur in the veins of the submucous coat as large as a split-pea.

Small haemorrhages into the submucous coat are at times met with in chronic Bright's disease and ulcerative endocarditis, in which case they are probably due to embolism. Extensive submucous haemorrhages are rare, but may occur in connexion with Bright's disease and with embolism of the mesenteric vessels.

In some cases of enteritis the large intestine is acutely inflamed, while the small intestine wholly or in part escapes. A good example of this is poisoning by corrosive sublimate.

XV. *Examine the Surface of the Gut for Ulcerations.*

Ulcers similar to those found in the stomach may occur in the upper part of the duodenum where its contents are acid. These are situated most commonly on the anterior wall, and so close to the pylorus that it is often difficult in a case of perforation to be certain, before opening the parts, whether the ulcer is situated in the duodenum or at the pyloric end of the stomach. These duodenal ulcers are sharply punched out, and as a rule chronic, as shewn by their rounded and infiltrated edge. They resemble gastric ulcers (v. § XLIV.).

Tubercular ulceration is most commonly met with in

the lower part of the ileum and in the caecum, but also in the colon and rectum, and may begin in the solitary glands or in Peyer's patches. The earlier ulcers are round in shape, the result of the breaking-down of the small caseous points mentioned before.

They are essentially chronic, and like all chronic intestinal ulcers tend to spread round the circumference of the bowel.

In a typical chronic tubercular ulcer the edges are raised, hard and not undermined, the base is firm and rough from the presence of tubercles, and so infiltrated with inflammatory products as to be often thicker than the surrounding healthy intestine. Sloughs are absent, but there is local peritonitis. Small caseous tubercles under the peritoneum are perhaps the safest guide to the rapid recognition of tubercular ulcers. They hardly ever perforate during life, though owing to separation of adhesions during the removal of the intestines, post-mortem perforations are easily made.

Very chronic tubercular ulcers of quadrilateral shape with a pigmented base are sometimes met with in the colon.

When very chronic, ulcers encircle the intestine and tend to narrow its lumen by the contraction of the inflammatory products.

The ileo-caecal valve and the vermiform appendix should be examined for tubercular ulcerations.

In *enteric fever*, ulceration of Peyer's patches and the solitary follicles is found in the lower part of the ileum, and is not uncommonly localised within a few

inches of the ileo-caecal valve. The colon may be unaffected or may share in the changes occurring in the ileum. In some cases, though rarely, the colon may be almost exclusively affected.

It is usual to find the lymphatic glands shewing different stages of the disease. Thus the upper glands, perhaps, are swollen, while those near the caecum are ulcerated or sloughing. It will therefore be most convenient to give a summary of the dates at which the various changes occur in the glands.

From the third to the eleventh day there is marked swelling, so that the glands are prominent, pink and soft. This is followed by ulceration or by sloughing. When ulceration takes place, the gland has a worm-eaten appearance. When the whole or a large part of the gland necroses, a large soft ragged slough results, which is stained yellow by bile and stands out in marked contrast from the intestine. The slough may be partially separated, exposing an ulcerated surface. These changes occur from the twelfth to the twentieth day.

Separation of the sloughs follows during the next five days (twentieth to twenty-fifth day), and during the process the ulceration may spread to, and open up, an artery, giving rise to haemorrhage.

The ulcers which result from the process of separation have the following characteristics:

(*a*) In the ileum they occupy Peyer's patches, and therefore run in the long axis of the bowel.

(*b*) When in the colon they are circular, corresponding to the solitary glands.

(*c*) Their edges are thin and undermined, as may be well shewn by floating them out in water. The base is smooth, though often slightly ribbed on account of the muscular coat being exposed.

(*d*) These ulcers are acute and have a tendency to perforate. Apart from perforation there is no local peritonitis.

(*e*) In cases where healing is delayed the ulcers are shallow, slightly pigmented and tend to elongate in the transverse axis of the bowel.

Cicatrisation begins on or about the twenty-first day, and in an uncomplicated case should be near completion on the thirtieth day.

All these processes overlap and the dates are only approximate.

Differences between tubercular and typhoid ulcers.

Tubercular ulcers.	*Typhoid ulcers.*
Tend to spread around the circumference of bowel.	Tend to spread in long axis of bowel.
Edges raised and hard.	Edges thin and undermined.
Base thickened and rough.	Base smooth or slightly ribbed.
Local peritonitis with tubercles under the peritoneal coat.	No peritonitis.
Chronic.	Acute.
No tendency to perforate.	Tendency to perforate.

XVI. *Ulcers of the Colon.*

Acute Colitis: The mucous membrane is swollen, softened and injected, and often thrown into longitudinal folds which shew these changes to a more marked extent.

The surface is covered with tenacious mucus, or

more rarely with adherent lymph, and may shew various degrees of ulceration.

Ulcerative colitis may occur in two forms, which however may be combined:

(*a*) The mucous membrane presents an appearance, as if the surface were covered with multiple polypi, closely resembling a similar condition in dysentery. This is due to the presence of multiple serpiginous ulcers, destroying the mucous membrane down to the muscular coat and leaving islets of swollen, prominent and deeply inflamed and congested mucous membrane.

(*b*) The ulceration is more limited, and has a special tendency to perforate the mucous membrane in several places and to set up local or general peritonitis.

Ulcerative colitis is closely akin in its morbid changes to dysentery, and sporadic cases of the latter disease may therefore be easily mistaken for it.

In ulcerative colitis there is a total absence of cicatrisation. The ulceration spreads upwards from the rectum.

Dysenteric ulcerations are rare in England.

In *acute dysentery* the mucous membrane is often infiltrated with blood, much inflamed and covered with purulent mucus.

Ulceration is generally present, similar to that in colitis. The lesion may assume a diphtheritic type.

The solitary glands are ulcerated and the walls of the intestine much thickened.

The disease is limited to the rectum and colon.

In *chronic cases* the whole intestinal wall is much

thickened and the bowel may be much contracted. The mucous membrane is irregular and ragged, eaten away by ulcers and is often polypoid (colitis polyposa).

It is thrown into longitudinal folds, on the surface of which the changes are more marked.

Cicatrisation and contraction of the ulcers may lead to considerable narrowing of the lumen.

The intestine may be perforated by ulceration, setting up peritonitis. The mucous membrane and muscular coat may be thickened and hardened by the organisation of the inflammatory products.

Slate-coloured pigmentation of the mucous membrane is a marked feature of chronic dysentery.

In faecal accumulation and impaction ulcers may be found in the colon due to irritation by the retained masses of faeces (*stercoral ulcers*).

Scybala retained in sacculi, by pressure produce ulcers which may go on to perforation.

In cases of chronic or acute obstruction the mucous membrane of the bowel above the stricture may shew round so-called *distension ulcers*, which may also perforate.

In rare cases of Bright's disease ulceration associated with the presence of haemorrhage may be found. It occurs in the caecum and ileum and may give rise to perforation.

In infantile diarrhoea the intestines often present no morbid appearance.

Occasionally, however, in chronic cases pigmentation and follicular ulceration of the colon may be found.

Rarely in adults follicular ulceration is found throughout the intestinal tract.

In phthisis small follicular ulcers may be found which microscopically are not of a tubercular nature.

XVII. *Inflammation and Ulceration of the Vermiform Appendix.*

In catarrhal inflammation the appendix is swollen, thickened and rigid.

The peritoneum covering it may be inflamed.

Faecal concretions often lead to ulceration, and perforation may occur into the general peritoneal cavity or into a localised abscess.

Typhoid and tubercular ulcers may also occur.

XVIII. *New Growths.*

Polypi occur most commonly in the colon, and may be single or multiple.

They are usually small and soft, but may be large and firm.

They are often found in connexion with a stricture or ulcer of the sigmoid flexure or rectum.

Single polypoid growths are easily detected and recognised, and a difficulty will only arise in cases of multiple polypi. The condition of the mucous membrane in dysentery and colitis may be mistaken for multiple polypi and *vice versâ*.

Malignant growths in their order of frequency occur in the sigmoid flexure, rectum, caecum, splenic and hepatic flexures.

They are firm and white on section.

The growth spreads around the bowel, first occupying the loose submucous layer and subsequently infiltrating the muscular and peritoneal coats, and in this way produces an annular stricture.

When the growth has penetrated the peritoneum it often becomes adherent to adjacent structures and causes external puckering. The portion of the tumour projecting into the lumen of the intestine rapidly breaks down and a sloughing surface is produced.

Note any dilatation of the gut and hypertrophy of its muscular wall above the stricture, and the collapsed condition below (vide § LV).

CHAPTER III.

EXAMINATION OF THE THORAX.

XIX—XX. *Preliminary Examination and Opening of Thorax.* XXI—XXII. *Pleurae and Pericardium.* XXIII—XXV. *Heart and Large Vessels in situ.* XXVI—XXVII. *Oesophagus.* XXVIII. *Thoracic Aorta.* XXIX—XXX. *Larynx, Trachea and Bronchial Glands.* XXXI—XXXII. *Cavities and Valves of Heart.* XXXIII—XLI. *Lungs.*

XIX. *Preliminary.*

The contents of the thorax are first examined *in situ*, the tongue, pharynx, larynx, oesophagus and trachea are then reflected down from their attachments at the base of the skull and neck and are removed in continuity with the contents of the thorax for more detailed examination.

The skin and the great pectoral muscles are reflected outwards on each side by far-reaching cuts, the dissector standing to the right and facing the body when reflecting the tissues on the right side, and to the left and facing the feet for the left side. A cut may be made into the under

surface of the mamma in the female; the gland should be squeezed to see whether it contains milk. Note the presence of accessory mammae or nipples. (See § LXXXVI.)

If there is any suspicion of pneumothorax, a special method should be employed to test for the presence of air in the pleural cavity.

The reflected flaps of skin are separated and held out from the chest wall by an assistant so as to form a pouch which is filled with water. An incision with a knife is then made partially through the thoracic wall in one of the submerged intercostal spaces, a director or probe is then easily pushed into the pleural cavity; pressure is made on the abdominal surface of the corresponding leaflet of the diaphragm; if there is air in the pleural cavity, it is at once manifested by a stream of bubbles.

This test is very trustworthy; even in very advanced decomposition little if any gas is evolved in the pleural cavities.

XX. The bony cartilaginous front of the thorax is now exposed.

Examine the joint between the first and second pieces of the sternum; the line of union, "Angulus Ludovici," may be prominent in emphysema.

Examine the costal cartilages; they are often calcified, though not necessarily, in old age. The costal cartilage of the first rib may be calcified when the others are not. It is said that this is the case more often in phthisis.

Examine the junctions of the costal cartilages with the ribs; in rickety children there is a well-marked "bead"

which is more prominent on the inner surface; in healthy children there is normally a slight bulging which must not be regarded as an incipient rickety bead. In old subjects bony irregularities are sometimes visible on the upper surface of the calcified first costal cartilage.

If the costal cartilages are calcified, the ribs should be sawn through external to the point where they join the cartilages. The first rib should be cut through with bone forceps from below.

When the costal cartilages are normal, they should be cut through just internal to their junction with the ribs. The blade of the knife is placed so that its edge resting on the chest is directed obliquely outwards and backwards. The cartilages are therefore cut through obliquely. The whole length of the blade is employed and the cartilages are cut through not individually but together.

The reasons for cutting through the costal cartilages obliquely and not vertically are, that (i) it is easier, and that (ii) there is less danger of wounding the lung.

The costal cartilage of the first rib is to be cut through separately, by introducing the blade of the knife vertically into the first intercostal space and cutting upwards and outwards. Owing to the outward bulging of the first piece of the sternum the first costal cartilage does not begin in the same line as the others, but farther out, hence the necessity of directing the knife outwards.

It is advisable to open the sterno-clavicular joint after the costal cartilages have been dealt with, since if the innominate veins be wounded, less time is allowed for the escape of blood into the pleural cavity.

The sterno-clavicular joints should be opened from above with the point of the knife which is introduced at right angles to the surface of the body.

The situation of the sterno-clavicular joint can be felt between the two heads of the sternomastoid. The knife is passed in the direction of the joint downwards and outwards.

After separating the articular surfaces the knife is directed outwards and slightly upwards, parallel to the clavicle, so as to cut through the rhomboid ligament.

Removal of the Sternum and Costal Cartilages.

The sternum with the costal cartilages is lifted up by the ensiform cartilage and freed from its attachment to the diaphragm, the knife being kept close to the sternum so as to avoid opening the pericardium.

When the sternum has been freed up to the inter-clavicular notch, it is lifted up first at one sterno-clavicular joint and its connexion cut through, the knife being kept close to the bone. The sternum is tilted up to avoid cutting the innominate vein.

The same process is then repeated on the opposite side.

If the innominate veins are opened, blood rapidly escapes into the pleural cavities, and if the case be one of ruptured lung, fractured ribs, or effusion, it may be impossible to form an opinion as to what condition existed before death.

XXI. *Pleura.*

Examine at once for adhesions and for the presence of any effusion.

The adhesions may be the result of past, recent or chronic pleurisy. The results of a past acute pleurisy must be distinguished from those of chronic pleurisy.

If the surface of the pleura is dulled, there has been recent inflammation, if there is lymph sticking the surfaces together, there is fibrinous pleurisy: these are examples of dry pleurisy. Recent lymph is easily pulled off and leaves a surface often marked with dilated vessels.

There may be universal fibrous adhesions, the result of a past acute pleurisy. In these cases the inflammation will often be found to have passed through the diaphragm and to have set up a simultaneous inflammatory condition of the peritoneum around the spleen or liver, as shewn by adhesions between them and the diaphragm.

Old adhesions are often limited in extent; most often they are found at one or both apices and are associated with scars or puckers of the apex of the lung and are due to old phthisis.

Not uncommonly the adhesions are limited to the base, and they may result from a former pleurisy or attack of pneumonia.

In cases of chronic pulmonary tuberculosis the limited adhesions at the apex may be very firm, and in removing the lungs from the body vomicae under these adhesions are often torn open.

In some cases the visceral pleura at the apex is puckered or scarred or thickened so as to form a fibrous plaque without there being any adhesions.

In cases of chronic interstitial pneumonia, in empyema, and in some cases of chronic tubercular disease of the

lungs the two layers of the pleura are very extensively thickened, and so adherent that in order to remove the lungs the adhesions have to be cut through with a knife.

In some cases of this kind caseous masses, calcified plates or remains of localized abscesses may occur between the thickened and adherent layers of the pleura.

If as the result of a former pleurisy the anterior margin of the lung has become fixed to the pericardium, it may appear that the fat of the anterior mediastinum is adherent to the lung.

In cases where violent convulsions or struggles have preceded death, as in suffocation, small subpleural ecchymoses are often found.

Note the presence, and measure the amount, of any effusion into the pleural cavity.

In cases of general oedema both pleural cavities may contain serum without any evidence of inflammation (hydro-thorax).

Together with signs of pleurisy there may be a serous, sero-fibrinous, turbid, purulent or blood-stained effusion. A blood-stained effusion may occur in tubercular pleurisy, though this is somewhat exceptional, or in cases where there are malignant growths on the pleural surfaces.

In jaundice, pleural effusions will be stained by the bile. In septic cases where the blood remains generally fluid, and in advanced decomposition, any fluid in the pleural cavity becomes deeply stained by transudation of blood pigment.

In cases of scattered pleural adhesions localized effusions may occur; occasionally a localized effusion is found between the lobes of a lung.

Examine the parietal pleura. If there is blood under it, there may be fracture of the ribs. In order to determine whether the ribs are fractured or not, pass the knife down on each side of the ribs so as to divide the intercostal muscles: each rib can then be freely moved and examined for fracture.

If fracture is present, note displacement of fragments, presence of callus or of a wound of the parietal pleura.

In cases of carcinoma of the mamma examine the ribs and parietal pleura for new growth. If the ribs are involved, so-called spontaneous fracture may occur.

Method of Dealing with Pleural Adhesions.

The foregoing description has assumed that there are no pleural adhesions or none which cannot be easily broken down by the hand.

If the adhesions are dense and firm, the costal pleura must be dissected off from the thoracic wall with the help of the knife, and the lung together with both layers of the pleura separated from the wall of the thorax. If the adhesions are on one side only, this separation of the costal pleura from the ribs may be begun from the back by cutting through the posterior mediastinum.

XXII. *Pericardium.*

Note its position and size. In cases of pericarditis with extensive effusion the pericardial sac may quite hide the lungs when the sternum is removed.

Notice the presence, extent and character of any adhesions between the lungs and the pericardium.

Normally the pericardium is united to the sternum by delicate connective tissue.

As the result of a past severe inflammation of the pericardium, the latter may be firmly united to the chest wall over the whole area of the praecordium which may be bulged out.

A common situation for localized adhesions is between the pericardium over the apex of the heart and the chest wall.

Open the pericardium by two cuts which should meet below, (i) one vertically along its right border, (ii) the other along its lower border.

This is best done by picking the pericardium up with a pair of forceps and cutting it open with scissors.

Normally the internal surface of the pericardium is glistening and whitish blue in colour. Any injection of its vessels is pathological and signifies an early stage of pericarditis, which is often well seen in cases of pneumonia when the inflammation is beginning to spread by continuity to the pericardium. Small ecchymoses under the visceral layer, without any evidence of pericarditis, may occur.

Generally dulling is a sign of more advanced acute pericarditis. The lymph first forms a thin pellicle and very soon gets rubbed into small granular masses. As the amount of lymph increases, it forms shaggy or honeycombed projections. This lymph is easily peeled off and leaves the surface of the pericardium injected and slightly dull.

Notice whether the lymph is associated with any effusion.

Measure the amount of fluid. Pericardial effusions of inflammatory origin may be fibrino-serous, turbid, or purulent, but are commonly blood-stained. This is due to the constant movements of the heart breaking down any delicate newly formed vessels.

In pyaemia purulent pericardial effusions may be due to a small abscess on the heart-wall bursting into the pericardium, or may occur independently of any abscess in the heart-wall.

The presence of a little serous effusion in the pericardium is of no importance: this is frequently found in phthisis.

In cases of death from haemorrhage or cholera on the other hand the pericardium is dry.

In cases of general dropsy it may share in the oedema.

In jaundice the pericardial fluid is bile stained.

In septic cases where the blood remains fluid, and in advanced decomposition, transudation of blood pigment renders the pericardial fluid of a dark red colour.

In some cases the pericardium contains yellow serum and purple recent blood clot, or partially clotted blood. Weigh the clot. If an aneurysm bursts suddenly into the pericardium, ten ounces are quite enough to stop the heart at once, while if the leakage be gradual, the amount may be much larger.

"Milk spots" are commonly found on the pericardium and are due to local thickening. They are best seen on the visceral layer, but are also present on the opposite corresponding parietal surface. Most commonly situated on the anterior surface of the right ventricle, they occur

on the dilated auricles of mitral disease and elsewhere in large and hypertrophied hearts. On the uneven surface of dilated auricles, instead of milk spots, the visceral pericardium may shew localized nodular thickenings.

Adhesions may be local or universal, delicate or dense.

A common place for local adhesions between the two layers is at the apex of the left ventricle. This band is sometimes torn across and appears as a loose tag adherent only to the heart.

Irregular fibrous bands are often seen around the aorta and pulmonary artery without there being any other signs of past pericarditis. In some cases they are probably the result of an irregular reflexion of the visceral layer of the pericardium. They occasionally become oedematous and resemble small cysts.

Universal adhesions may be delicate, though organised, and are then fairly easily broken down. Or they may be dense, in which case the heart-wall may be invaded by offshoots from the thickened adherent pericardium.

In thick pericardial adhesions of old standing calcified plates occasionally occur.

In very stout persons the fat under the visceral pericardium, which normally collects in the auriculo-ventricular grooves and around the coronary vessels, may become very excessive. This is part of a general obesity and of little importance. It may, when excessive, pass into the fibrous tissue between the muscular bundles and produce fatty infiltration. It must be distinguished from fatty degeneration of the myocardium. (§ XXXII.)

In persons who have died from some wasting disease all the epicardial fat, i.e. the fat under the visceral layer of the pericardium, is absorbed and loose oedematous-looking tissue is left which allows the coronary arteries to be clearly seen. They are so prominent that they appear to be more tortuous than usual. This tortuosity may be partly due to an accompanying diminution in size of the heart while the length of the arteries remains the same. This condition is spoken of as serous atrophy.

XXIII. The *Heart* should be partially examined *in situ* at this stage, and the examination completed after removal from the body.

Notice the size and position of the heart. The relative size and distension of the right and left sides should be noted.

Open the right auricle, slit up the auricular appendix and examine the clots; cut from the right auricle up into the superior vena cava, and from it into the innominate veins;—if necessary the jugular and subclavian veins should now be opened.

The right auricle is found to be full of blood in cases where respiration has stopped before the heart; in death by suffocation the right side of the heart is greatly distended with blood.

XXIV. Examine the clots in the cavities of the heart and in the large vessels. It may be useful to tabulate here the differential characters of clots formed before and after death.

Distinctions between Clots formed Before and After Death.

(i) Clots formed before death are granular on section and decolourized, i.e. neither white nor red, the dirty hue being caused by changes occurring slowly in the haemoglobin.

In some cases the clot formed during life is laminated, especially in aneurysms.

Ante-mortem clots are firmly adherent to the wall of the heart or vessel.

In a large ante-mortem clot such as sometimes forms in a dilated auricular appendix, the central part may have softened and broken down and it resembles dirty pus.

Post-mortem clots are of uniform consistence and shew no central softening or lamination.

(ii) Clots formed after death are jelly-like on section; the superficial layers of the clot from which the heavier red blood corpuscles have sunk are white (the buffy coat), while the deeper layers are purple. The contrast between these two parts of the clot is striking. The colourless superficial part must not be confounded with a decolourized ante-mortem clot.

(iii) Clots formed post-mortem are easily detached and are not adherent to the enclosing walls. An apparent exception must be remembered. If a clot forms in connection with the musculi papillares, columnae carneae, chordae tendineae etc. it is not easily removed by traction and may therefore appear fixed to the heart-wall, while in reality it is only entangled.

(iv) Clots formed after death in the heart extend into

the aorta and pulmonary artery and often shew the impress of the semilunar valves.

By noticing the relation of the white and purple portions of post-mortem clots the position of the body after death can be ascertained.

When death occurs very slowly clots begin to form, "agony clots," which are leathery in consistence, somewhat adherent to the walls and of a pale yellow colour. In pneumonia clots formed during the agony or after death are found on the right side of the heart, and especially in the pulmonary arteries, while the aorta is empty. They often form distinct casts of the pulmonary arteries, extending some distance into the lung, and are tough and uniform on section.

XXV. *Examination of the Aorta and Pulmonary Artery in situ.*

Pick up the intra-pericardial part of the aorta and snip into it with scissors, continue the cut into the arch of the aorta, noticing the condition of the thymus gland or of its remains as it is cut through.

Continue the incision into the arteries arising from the arch of the aorta. Around and behind the innominate artery there is a considerable mass of lymphatic glands.

When it is desirable to follow the course of the recurrent laryngeal nerves, the arch of the aorta and its branches should not be opened until this has been carried out.

Pick up the intra-pericardial part of the pulmonary artery, cut into it, and remove the pericardium from the

base of the heart, so as easily to follow the left pulmonary artery into the root of the lung.

Now place one blade of the scissors in the right pulmonary artery and cut through it and the ascending part of the arch of the aorta.

The bifurcation of the pulmonary artery is thus exposed and the contained clot should be examined. At the commencement of the left pulmonary artery notice the depression for the ductus arteriosus, (vide § XXVIII).

Further dissection of the ramifications of the pulmonary artery must be delayed till after the bronchi have been examined.

XXVI. *Removal of the Tongue, Pharynx, Oesophagus, Larynx, Trachea, Lungs and Heart.*

The head should be allowed to hang over the end of the post-mortem table in order to put the tissues of the neck on the stretch and to enable the vault of the palate to be seen when the floor of the mouth has been removed.

The skin of the neck is to be dissected away from the underlying parts up to the symphysis of the jaw.

The knife is introduced vertically behind the symphysis menti through the floor of the mouth and should be carried round on both sides to the angle of the jaw in contact with the inner side of the bone. When introducing the blade, the handle should be depressed towards the spine, so that the point of the knife has a tendency to come out in front of the upper incisors. If this direction is not preserved, the tip of the tongue is often cut through and the muscles attaching it to the jaw are imperfectly divided.

When the structures of the floor of the mouth have been completely separated from the lower jaw, the tongue is seized in the left hand and drawn downwards.

The hard and soft palate and the fauces can now be seen.

The point of the knife is inserted into the soft palate at its junction with the hard, and carried outwards on both sides through the pillars of the fauces.

The posterior wall of the pharynx is now cut across transversely.

The forefinger of the left hand is introduced into the pharynx, and the loosened structures composing the neck are drawn forwards while the knife, kept behind the pharynx with its edge directed towards the backbone, frees the attachments to the vertebral column.

All the soft parts of the neck can thus be reflected downwards.

When the upper opening of the thorax is reached, the subclavian vessels must be divided by a cut directly behind the sternal ends of the clavicles.

The tongue, pharynx, and other structures being grasped in the left hand and drawn forwards, the contents of the thorax are also drawn forwards and the fibrous connections to the spine cut through with the knife.

The azygos veins, thoracic duct and sympathetic nerves are the only constituents of the posterior mediastinum left in the thorax.

The thoracic viscera are held up, and the oesophagus, aorta and inferior vena cava divided just above the diaphragm.

On cutting through the oesophagus a flow of liquid

food often takes place from the stomach which at first sight may suggest that an abscess has been opened.

In cases where a corrosive poison has been taken, it is well to leave the oesophagus in continuity with the stomach. This can be done by turning the left lung over to the right side and dissecting and separating the oesophagus from the other structures in the posterior mediastinum. A ligature may be placed around the oesophagus below the cricoid cartilage and the oesophagus divided above it. (vide § XLIII.)

When a non-corrosive poison has been taken, a ligature should be applied to the oesophagus just above the diaphragm, after separating it from the neighbouring structures, and the oesophagus may then be divided above the ligature.

XXVII. *Examination of the Oesophagus.*

Examine the hard palate: note elevation of the vault and look out for perforations. In early infancy in the middle line, at the junction of the hard and soft palate, a few grey miliary bodies are normally found which consist of included epithelium (Pearls).

The vault of the nasopharynx may be examined for adenoid vegetations.

The meatuses of the nose may be examined by chipping through the hard palate with bone forceps: this will expose the inferior meatus from below. (Vide § LXXVIII.)

The upper parts of the nasal fossae may be examined after the removal of the brain by cutting through the cribriform plate of the ethmoid bone.

The *parotid gland* can be exposed, if necessary, by continuing downwards the coronal incision for the reflection of the scalp. Suppuration of the parotid may occur in pyaemia, fevers and in cases of localized abscess in the abdomen. Notice the connections of any tumour in the parotid (vide § LXIV).

Soft Palate, Pharynx, Oesophagus and Larynx.

The removed organs are placed with their posterior surface uppermost on a small wooden table by means of which they are brought to a convenient height for dissection, the low elevation of ordinary post-mortem tables necessitating unpleasant stooping.

Tongue. The lymphatic glands at the base of the tongue, "lingual tonsil," vary much in size and development. The thick mucous membrane at the base of the tongue and in the sinus pyriformis, when detached by maceration, must not be mistaken for diphtheritic membrane. Note any changes on the surface of the tongue, ulcers, leucoplakia etc. The tongue is usually covered with fur and sordes.

Note the condition of the salivary and lymphatic glands in the floor of the mouth.

Tonsils. The orifices of the crypts are often very prominent. The follicles may be distended with caseous matter which if long retained, may become infiltrated with calcareous salts. Small white patches, composed of masses of leptothrix, "pharyngo-mycosis," may occur on the tonsils and soft palate: they are whiter and more firmly fixed than membrane.

Soft Palate and Uvula. Note the presence and extent of any membrane.

Cut through the uvula in the middle line, noting its length.

Occasionally it is bifid.

The posterior wall of the pharynx is to be cut through with a pair of scissors in the middle line and this incision continued throughout the whole length of the oesophagus. Small millet seed bodies, 'granulations,' may be seen in the pharyngeal mucosa.

The *oesophagus* is collapsed and its mucous membrane thrown into folds in the normal condition.

There is often post-mortem congestion of the pharynx which may end quite sharply at the beginning of the oesophagus (the result probably of post-mortem pressure exerted by the larynx).

The oesophagus may contain food which has run back from the stomach or which has been vomited at the time of death.

The lower end of the oesophagus may shew post-mortem digestion of the mucous coat.

The mucous coat sometimes has small wartlike elevations on its surface which do not extend into the submucosa: they are formed of thickened mucosa and may be compared to corns.

Notice any dilatation or prominence of the veins at the lower end of the oesophagus: this is a common appearance in cirrhosis of the liver.

Opposite the bifurcation of the trachea there is sometimes a dimple. In such cases the wall of the oesophagus will be found adherent to the bronchial glands which at some past time have been inflamed; evidence of this

in the presence of a calcareous mass is sometimes found. Note the position and character of any scars, strictures or diverticula of the oesophagus.

Malignant disease tends to produce an annular stricture. It first infiltrates the walls and later the surrounding tissues. The growth is white on section, ulcerated and ragged on the surface and has raised edges. It is usually a squamous celled carcinoma, and occurs at the beginning of the oesophagus or opposite the bifurcation of the trachea, or at the cardiac end.

XXVIII. Open up the *thoracic aorta* from its lower end along its dorsal aspect and carry the incision into the one made previously, (vide § XXV), along the arch of the aorta.

Look out for atheroma, especially around the orifices of the intercostal vessels. Just distal to the origin of the left subclavian artery there is a cicatrix which runs out transversely across the lumen of the aorta. This is the point of obliteration of the ductus arteriosus and is a common situation for atheroma. Small sacculated aneurysms pressing on the left recurrent laryngeal nerve are not uncommonly met with here.

Note the close connection of the aorta to the left bronchus.

Pick up the lower end of the thoracic aorta and reflect it upwards, freeing it with scissors from the underlying structures.

In fevers, cases of septic poisoning, pyaemia etc., the blood often remains uncoagulated, and the red blood

corpuscles breaking up, discharge their haemoglobin, by which the intima of the vessels and the endocardium become deeply stained. In jaundice the intima is bile stained.

The oesophagus is to be reflected from below by picking it up with a pair of forceps and dissecting it with a pair of blunt pointed scissors off the posterior surface of the pericardium which is left intact. In cases of pleurisy, pneumonia or pericarditis, note the presence of any lymph or adhesions around the oesophagus.

The oesophagus is so close to the pericardium that severe inflammation may pass from one to the other.

XXIX. Dissect the oesophagus off the bronchial glands.

Branches of the vagi are seen on the surface of the glands. Reflect the oesophagus off the trachea and remove it, cutting it across at the lower border of the cricoid cartilage.

In the groove between the oesophagus and trachea the recurrent laryngeal nerves are found as well as the tracheal lymphatic glands, which if enlarged or occupied by new growth, may exert pressure on the nerves.

The *bronchial glands* in children, like the lymphatic glands elsewhere, are well developed; they undergo atrophy as age advances.

In adults they are almost always deeply pigmented and may be uniformly black; their pigmentation varies roughly with that of the lungs (vide § XXXIII).

If enlarged and in places free from pigment, they are probably occupied by inflammatory or other new formation.

Examine them for caseous or calcareous changes. Sometimes the glands at the bifurcation may appear healthy, while glands lying on the bronchi in the root of the lung are caseous or calcareous. A caseous gland in this position may be very adherent to, and indent, the lung substance.

The caseous material may soften down and be quite diffluent.

In bronchopneumonia, pneumonia, pleurisy and diphtheria the bronchial glands are swollen and softened.

Mediastinal sarcoma most commonly begins in the bronchial glands and by continuity involves or compresses the surrounding structures. It may pass along the bronchi into the lung. It frequently narrows the bronchi and veins, and pulmonary arteries. It may surround, though it hardly ever narrows, the aorta.

It often presses on, and destroys, the nerves which pass through the mediastinum.

XXX. *Examination of the Larynx, Trachea and Thyroid Gland.*

The epiglottis in the child is thin and curled somewhat on itself, a condition which it may retain in adult life.

Notice any thickening, irregularity or ulcerations of the epiglottis: they are generally due either to syphilis or tubercle.

The aryteno-epiglottidean folds when acutely inflamed are swollen, red, slightly rough from adherent lymph and oedematous. In severe cases they may be infiltrated with pus.

The aryteno-epiglottidean folds may be swollen from

oedema: part of the general oedema of Bright's disease, or as the result of enlarged glands or tumours in the neck pressing on the veins.

It may be noted that "oedema of the glottis" seen during life may subside after death.

Swelling of the mucous membrane of the inter-arytenoid space and of the aryteno-epiglottidean folds occurs in tubercular disease of the larynx. This condition is accompanied by pallor of the laryngeal mucous membrane.

When laryngeal paralysis has existed or where an aneurysm is suspected, examine the position of the cords from above before opening the larynx.

Normally after death the cords are in the "cadaveric position" which is intermediate between the positions observed during phonation and inspiration.

With a pair of scissors divide the cricoid cartilage in the middle line posteriorly and carry the incision into the trachea and bronchi. By opening out the alae of the thyroid the inside of the larynx can be further exposed for examination.

In cases of oedema of the inter-arytenoid region, ulceration of the larynx or disease of the upper half of the oesophagus, the larynx and trachea should be opened in the anterior median line.

Note the presence and attachments of any membrane in the larynx and follow it into the trachea and bronchi.

Notice the presence of any foreign body or large pieces of food in the larynx.

Either as a result of vomiting at the time of death or

possibly of faulty manipulation during the removal of the organs, food may pass into the larynx and trachea.

If, however, particles of food are found in the small bronchi, they have almost certainly been sucked in during life, and may have been a factor in bringing about death, e.g. vomiting during the administration of an anaesthetic.

Normally the vocal cords are white and thin and have a sharp margin. Injection and localized haemorrhages are always pathological (acute laryngitis).

In septic cases, and in advanced decomposition, the mucous membrane may be diffusely stained by blood pigment.

If the cords are thickened, swollen or irregular, there has been chronic laryngitis.

Note the presence of local thickenings, papillomata, tumours or cysts on the vocal cords.

The mucous membrane of the ventricle of the larynx may become "prolapsed": it will then be prominent, and must not be mistaken for a new growth or for oedema.

As the result of chronic inflammation, the mucous membrane of the larynx may be granular, irregular and rough or thickened and opaque like the epidermis (pachydermia laryngis).

The mucous membrane below the posterior attachment of the true vocal cords (processus vocales) is at times considerably thickened and prominent. As a result of this the area of mucous membrane immediately above it appears as a depression or furrow, which must not be mistaken for an ulcer.

Ulceration of the mucous membrane may be found anywhere in the larynx, but is most frequent on the processus vocales: this is common in tubercular disease.

Notice whether the ulcers are superficial or whether they pass through the perichondrium and expose the underlying cartilages.

In cases of laryngeal paralysis and of tubercular disease notice the size and condition of the various muscles. The posterior crico-arytenoidei (abductors of the cords) especially should be carefully examined for fatty changes.

The cartilages of the larynx are to be examined next. The cricoid and the thyroid cartilages not uncommonly in adult life, and very frequently in old age, are found to be extensively calcified. This change occurs earlier in males.

Calcification does not seem to attack the elastic cartilages, the epiglottis etc.

The joints between the cricoid and arytenoid and between the cricoid and thyroid cartilages should be examined in any case where the immobility of the cords has been observed during life without other obvious cause, such as pressure on the recurrent laryngeal nerves.

If the perichondrium is found swollen and separated by exudation from the underlying cartilage, there has been perichondritis: this may produce necrosis of the cartilage.

When tracheotomy or laryngotomy has been performed, note the position and appearance of the wound; the presence of any membrane and the extent of any suppuration or sloughing. Surgical emphysema, if present, will have been noted in the preliminary examination of the body.

The mucous membrane of the larynx and trachea below the wound should be examined for any signs of ulceration due to the pressure of the tracheotomy tube.

In cases where tracheotomy has been done and recovery has followed, the scar of the wound should be examined and any evidence of contraction or deformity of the larynx noted.

The *trachea* and *bronchi* are frequently very deeply injected; this is of no importance by itself and is frequently found in bodies of persons who have been killed suddenly while in perfect health. In advanced decomposition there is marked blood staining. If, however, general congestion is associated with the presence of thick tenacious mucus, bronchitis has existed.

Small pit-like depressions of the mucous membrane without dulling or loss of substance are often seen in the trachea and are of no importance.

At times the mucous membrane appears covered with small whitish grey specks, they are composed of mucus and readily wash away: they must not be mistaken for tubercles.

Note the presence of membrane or blood in the trachea and trace them to their source.

Sharply punched-out tubercular ulcers may occur in the mucous membrane.

Cicatrices leading to stenosis of the trachea are very rare, and are syphilitic in origin.

The larynx should now be separated from the trachea by cutting across its upper rings.

Thyroid gland. With a pair of scissors the infrahyoid

muscles should be dissected off and the thyroid body exposed *in situ*. In cases where tracheotomy has been performed some weeks before death the tissues may be found somewhat matted to the thyroid gland.

Note the size of the thyroid gland, it is usually better developed in women than in men.

It undergoes slight atrophy in old age.

It may be uniformly enlarged and appear on section to be hypertrophied, or there may be a number of cysts containing colloid contents.

Cysts may be of large size and, if of old standing, their walls may become calcified.

Sometimes haemorrhage takes place into these colloid cysts.

When an enlarged thyroid gland compresses the trachea, the narrowing takes place from side to side and not from before backwards.

Notice whether the inferior laryngeal nerves are pressed upon by a goître or by cysts in the thyroid glands.

Notice the middle lobe running upwards at right angles from the isthmus towards the hyoid bone and often attached to it.

Small imperfectly separated pieces of the thyroid gland are sometimes seen. Small accessory thyroid glands may be found in the neighbourhood of the hyoid bone. They are redder on section than lymphatic glands which they resemble in shape and size; to distinguish them with certainty, however, a microscopic examination is necessary.

Sections should be made into the lobes and isthmus of the thyroid body.

In myxoedema the gland is replaced by a small mass of fibrous tissue.

XXXI. *Examination of the Heart.*

Before examining the lungs systematically the heart should be removed.

The superior vena cava, aorta and pulmonary artery have been already opened and examined and so may be divided close to the heart.

The heart is then picked up in the left hand and the pulmonary veins divided close to the root of the lungs: the left auricle is thus preserved intact.

If the left auricle be dilated, determine before this step whether it exerts any pressure on the left bronchus.

The superior vena cava, the aorta and pulmonary artery have been examined *in situ* (§ XXV).

The right auricle has already been opened. Slit up the auricular appendix, examine for adherent clots, cut into any that are present, and notice if they are uniform in consistence, or if they are granular or jelly-like on section.

On the septal wall of the auricle examine the fossa ovalis. There is often a communication of small size between the two auricles. It is usually valvular, and so long as it does not allow the admixture of venous and arterial blood it is unimportant.

Tricuspid Valve.

The competency of the auriculo-ventricular valves during life depends largely on the contraction of the muscular substance of the heart. Hence their competency can only be guessed at on post-mortem examination; the water

test, viz. distending the ventricle with water so as to float the valves up, is fallacious, as the heart muscle, which in life plays an important part in the closure, cannot be reckoned with.

The size of the tricuspid and mitral orifices can be roughly determined by the use of graduated cones or by estimating how many fingers can be passed through.

The circumference of a normal adult tricuspid orifice is $4\frac{1}{2}$ inches.

A rough measurement is made by passing fingers through the orifice: in a normal adult heart three fingers should pass through.

The tricuspid valve segments come in contact at their edges, and any thickening there may interfere with perfect closure.

Examine their upper surfaces for vegetations.

If the orifice of the valve is narrowed, there may be adhesions between the segments.

Notice the condition of the chordae tendineae: lengthening, shortening, thickening or rupture.

Opening the Right Ventricle.

If the tricuspid orifice is of normal size, the ring from which the valve segments arise need not be preserved.

The heart is placed with its posterior surface upwards,—this can be told by its being flatter,—and the base of the organ towards the dissector; one blade of the scissors is introduced into the cavity of the ventricle through the tricuspid orifice and placed against the septum, and the

thumb of the left hand is also introduced into the right ventricle to steady the organ.

The right ventricle is then opened up close to the septum posteriorly. When the apex is reached the heart is turned over, the apex now being towards the dissector, and the cut is continued quite close to the septum up to the infundibulum, from which the pulmonary artery arises. The competency of the pulmonary valves may be tested by allowing a stream of water to fall on them from above; they should come in contact and not allow any leakage to take place.

When performing this test be careful to see that there is no clot entangled between the segments, or they may appear to be incompetent.

To open the pulmonary artery continue the incision along the anterior septum keeping quite close to it. If this is done, the pulmonary artery will be opened between two of its semilunar valves.

The circumference of the pulmonary orifice is normally $3\frac{1}{2}$ inches.

Examination of the Right Ventricle.

Note whether it is in systole or diastole.

Hypertrophy of the right ventricle shews itself in increased thickness of the movable or right wall of the ventricle; this however is often not very noticeable. The best evidence of hypertrophy of the ventricle is increased firmness of its wall which becomes so hard that it cannot be indented by the finger.

In a hypertrophied right ventricle the musculi papil-

lares and columnae carneae stand out more prominently and are larger than normal.

Dilatation of the right ventricle is judged of best by looking at the movable wall. If on completely opening the cavity by the incisions described above, this wall appears flat like the extended hand, the cavity is normal; if however the movable wall appears bulged out and concave like the palm in a semi-flexed, cuplike condition, the cavity is dilated.

Adherent clots may be found in a dilated right ventricle near the apex.

Occasionally in cases of anaemia the musculi papillares and columnae carneae shew a transverse striation due to the presence of streaks of fatty degeneration: this has been called "tabby-cat" striation and is well marked in pernicious anaemia. [Vide p. 64.]

If there be any dilatation or any condition making it desirable to keep the ring of the tricuspid orifice intact, the right ventricle should be transfixed near the base, the knife being inserted on the posterior aspect close to the septum and brought out near the septum anteriorly, and then drawn towards the apex; the pulmonary artery can then be opened as described above with scissors.

Left Auricle.

With a pair of scissors connect together the orifices of the pulmonary veins, and prolong this incision up to the tip of the appendix.

Turn out the clots from the cavity of the auricle, noting whether there are any ante-mortem thrombi.

If the auricle is dilated, the contained clot may be weighed.

A normal adult auricle contains about three ounces.

Bear in mind that the endocardium lining the left auricle is normally thicker than that on the right side, a condition which is greatly exaggerated in mitral stenosis.

In mitral stenosis, and to a lesser degree in mitral regurgitation, the left auricle is dilated. Considerable hypertrophy of the auricular wall is seldom seen.

Mitral Orifice.

Normally it has a circumference of 4 inches and admits two fingers.

If it is narrowed, note whether the valvular curtains are depressed into the ventricle ("funnel shaped" mitral), or whether they form a more or less horizontal diaphragm.

Note the shape of the orifice of the mitral: normally it is slightly crescentic.

In some cases of mitral constriction this is exaggerated, and the mitral valve is said to be a "button hole" mitral, from its shape, and not from its size.

In all cases examine the cusps of the mitral valve for vegetations, which are to be found on the auricular surface of the free edge[1].

The segments may be thickened from old endocarditis. The edges, if thickened, will not meet and regurgitation may thus be produced.

[1] On the mitral valves of infants small nodules are formed, which are of no pathological importance and consist of connective tissue (so-called Albini's bodies). According to Bernays they are the remains of foetal valvular nodules and are normally present in infantile life.

Look out for any retraction of the valve segments due to past endocarditis: the valve segments then become crumpled, and will not be able to meet and close the orifice of the mitral valve.

In chronic inflammation of the valve segments, especially in mitral stenosis, the chordae tendineae become thickened and after a time contract and become shorter than natural. In this way the valve segments may be pulled down into the ventricle (as in a funnel shaped mitral valve) and be unable to meet.

Atheroma occurs so commonly in old people, without giving rise to symptoms, that a certain amount of it in the mitral valve must be considered as natural.

If the edges of the valve become thickened, regurgitation may follow; but if parts of the cusps away from the edge are atheromatous, no harm is done.

A very common site for atheroma is the middle of the anterior cusp of the mitral valve.

Opening the Left Ventricle.

If the ring of the mitral is to be kept intact, the left ventricle should be transfixed with a sharp knife just below the base of the heart. The heart lying with its posterior flatter surface upwards, the knife is introduced close to the septum on the posterior surface and taken through, so as to come out close to the septum on the anterior surface; the knife is then drawn towards the apex, and the cavity of the left ventricle opened.

If the mitral ring is not to be preserved, the left

ventricle should be opened by cutting downwards with a pair of scissors close to the septum posteriorly.

This incision is exactly like that described in opening the right ventricle.

When the apex is reached the heart is turned over and the incision continued half way up the anterior septum.

Examine the cavity of the left ventricle, and note if it is larger than natural, or if it contains adherent clots.

Note the condition of the muscular walls: they are thicker than normal in hypertrophy.

Look out for patches of fibrous tissue (fibroid disease).

Examine the columnae carneae and musculi papillares for the transverse striation (tabby-cat striation) of fatty degeneration. Notice the thinness of the muscular wall at the apex, this is normal. Clots are sometimes adherent here.

Examine the endocardium lining the ventricle: local patches of opacity are sometimes seen on the septal wall in cases of aortic disease, "water marks" or "ripples," possibly due to reflux stream.

Notice any thickening of the endocardium over the musculi papillares. This condition is often associated with fibroid changes in the underlying muscle and commonly occurs in old age to a slight degree and more markedly in cases of hypertrophied and dilated hearts.

Aortic Valves.

Before opening the aortic orifice test the competency of the semilunar valves.

The aorta is held open by two pairs of forceps by an assistant and the heart lifted up; the aorta is previously

to be slit downwards so that a good view of the valves can be obtained from above.

Remove any clot clinging to the valve segments. If it is adherent, it must however be left, as this is probably associated with endocarditis.

Allow a stream of water to trickle into the aorta and notice whether the valve segments meet and are competent.

The water may run away through the coronary arteries when the valves are quite healthy. Hence it is important to determine whether the valve segments come together properly and not to rely solely on the water being retained above them.

If there is stenosis, the aortic ring should be left intact, otherwise it is advisable to open the aorta at its origin, as the valve segments can then be further examined.

Opening the Aorta at its Origin.

The incision half way up the anterior septum is to be carried across the septum into the right ventricle, and then directly upwards through the infundibulum so that it passes exactly between the anterior and the right posterior valve segments of the pulmonary orifice[1].

If this is done, the aorta will be opened between the valves and they will be left intact. The procedure involves destruction of the pulmonary valves and must therefore not be pursued when it is desirable to keep the latter.

In this case the aortic orifice may be opened along the septum, care being taken to place the blade of the scissors

[1] These valves are named according to Macalister, Human Anatomy p. 326.

between the valves. This can be done by watching the position of the blade of the scissors from the aorta above.

Examine the aortic valve segments.

Normally the circumference of the aortic orifice is $3\frac{1}{8}$ inches. It may be enlarged in aneurysmal dilatation of the arch of the aorta.

The valves meet at the corpora Arantii in the middle of the free border of each and along a curved line running from this point to the lateral margin of each segment. There is thus an area of each segment between the free border and the line of contact, which is called the lunule and often shews fenestrations or holes. They are of no importance, for since they are above the line along which the valve segments mutually come in contact, no regurgitation can occur. These fenestrations must be distinguished from the perforations met with in ulcerative endocarditis, which shew signs of inflammation around them and may be almost hidden by vegetations.

Normally the lunule is much thinner than the rest of the valve. In cases of thickening where the segments are crumpled and retracted, this distinction disappears.

The same thing occurs when the valve segments are so distorted as to be inverted towards the ventricle.

Examine the contiguous margins of the segments: in the early stages of aortic stenosis they may be united to each other.

Notice any rigidity, thickening or calcification of the segments.

In recent endocarditis small vegetations are seen on the lines of contact on the ventricular surface.

Look out for aneurysm or perforations of the valves. Ulcerative or infective endocarditis produces destruction of the substance of the valves which being weakened thereby become bulged—aneurysm of a valve. If the ulceration proceeds, perforation results; if it attacks the margin of the valve or the chordae tendineae, rupture of the valve or of the chordae tendineae may be produced.

Note the condition of the sinuses of Valsalva and the orifices of the coronary arteries. There are very frequently two orifices, one small, the other fairly large, for the right coronary artery. Atheroma of the aorta may spread down to, and involve, the orifices of the coronary arteries.

If it is desirable to keep the orifices of the coronary arteries intact, a probe should be passed into the orifice and be cut down upon in the course of the vessel; a small pair of scissors is then used to slit the artery up.

Notice the size of the lumen: in old people patches of atheroma are often seen which are of no importance unless they obstruct or narrow the lumen of the vessel.

XXXII. *Examination of the Myocardium.*

Normally the myocardium is of a deep red colour.

In septic or febrile conditions it appears swollen, more opaque than natural and pale: this is the condition of cloudy swelling, and is described as looking as if it had been boiled.

In cases of anaemia the heart muscle looks pale and anaemic like the rest of the body.

In advanced anaemia, especially pernicious anaemia, the muscular tissue undergoes partial fatty degenera-

tion. This occurs first in the muscular fibres furthest removed from the blood supply of the coronary arteries, i.e. under the endocardium of the musculi papillares. Its occurrence in irregular areas under the endocardium gives rise to a striated appearance due to the contrast between the yellowish streaks where fatty degeneration has occurred and the darker areas of unaffected muscle. This is called "tabby-cat striation." It is much oftener seen in the musculi papillares of the left ventricle than of the right, and hardly ever in the auricles.

When fatty degeneration is very extensive, as in cases of phosphorus poisoning, there is no contrast produced, as all the muscular fibres under the endocardium have become degenerated and the heart is pale yellow and softened.

Fatty degeneration must be distinguished from the increase of fat which occurs in corpulent subjects on the outside of the heart under the visceral layer of the pericardium, especially in the auriculo-ventricular grooves, and around the coronary arteries. When excessive, this fat may infiltrate the interstitial tissue between the muscular bundle (vide § XXII).

In persons who have died of wasting diseases, especially carcinoma of the pylorus, the heart may appear of a darker colour than normal, almost brown. The muscular fibres are atrophied and the pigment they normally contain is increased in amount: this is brown atrophy or pigmentary atrophy.

In cases of cloudy swelling and fatty degeneration the heart muscle is softer than normal. In advanced decomposition the consistency is much diminished.

In fatal cases of acute pericarditis the muscular tissue under the inflamed pericardium appears, for a short distance, pale and swollen from the extension of the inflammation.

In cases of pyaemia small abscesses may be found in the heart-wall which may perforate the visceral layer of the pericardium and set up purulent pericarditis.

In ulcerative endocarditis a ruptured valve covered with vegetations, or a long infective thrombus, may by contact infect the endocardial surface of the ventricle, and give rise to deep ulceration of it, producing an acute aneurysm of the heart-wall.

After a severe attack of pericarditis, thickening and adhesion of the layers of the pericardium result. This is often accompanied by the formation of interstitial fibrous tissue between the underlying muscular bundles. They may be so much interfered with that dilatation of the ventricle may follow.

In rare cases localized patches of well-formed fibrous tissue are found replacing the muscular substance; this is called 'fibroid disease' of the heart. The fibroid areas may yield and lead to the formation of a cardiac aneurysm.

In dilated and hypertrophied hearts, and sometimes in old age, thickening of the chordae tendineae and endocardium spreads to the musculi papillares. This fibroid substitution should be distinguished from fibroid disease.

Occasionally in syphilis numerous small nodules (syphilomata) occur in the heart-wall, and may set up an extensive interstitial myocarditis around them.

Secondary new growths in the heart-wall are very rare.

The auricles are sometimes invaded by extension from a mediastinal sarcoma.

The weight of the normal adult heart varies with the development of the individual, but on an average in the male the heart weighs 10—11 oz. while in the female it is an ounce or so less (9—10 oz.).

In valvular disease generally, the heart is hypertrophied. This is best seen in the "bovine" hearts of aortic reflux. In mitral stenosis the left ventricle may be somewhat atrophied, but the hypertrophy of the right ventricle usually brings the weight of the whole heart up to the normal.

In cases of renal disease the heart is increased in weight. This is due to the greatly hypertrophied left ventricle. In some cases of chronic bronchitis and emphysema, and especially in congenital pulmonary stenosis, the right ventricle becomes markedly hypertrophied.

Hypertrophy may be associated with dilatation of the ventricular cavity, and is then called eccentric hypertrophy; or the hypertrophy may be simple, the cavity being of the normal size.

Simple hypertrophy is somewhat rare. Concentric hypertrophy, in which the cavity of the ventricle is smaller than natural, probably never occurs.

After death the cavity of the heart often appears smaller than it was during life on account of contraction due to rigor mortis. This accounts for apparent concentric hypertrophy.

Normally in old age the heart undergoes some atrophy.

In wasting diseases, where the patient is emaciated

and the quantity of blood diminished, the heart atrophies: this is seen in its most marked degree in some cases of carcinoma of the pylorus.

XXXIII. *External Examination of the Lungs.*

In a perfectly healthy body the lungs should collapse on removing the sternum. This however seldom occurs; the most frequent reason why the atmospheric pressure and elasticity of the lung tissue fail to drive the air out of the lungs is that there is an accumulation of mucus in the bronchi which retains the air in the vesicles.

Pleural adhesions necessarily prevent the lungs from collapsing.

In emphysema the elasticity of the lung tissue is diminished and the lungs do not collapse.

In pneumonic consolidation the lung remains in its expanded condition.

In bronchitis and broncho-pneumonia the air is imprisoned by mucus and inflammatory exudation as mentioned above.

The pleura has already been examined for dulling and the presence of recent lymph or organized adhesions. Small millet seed bodies, grey tubercles, may often be seen on the pleura.

Small petechial spots under the visceral pleura are often seen where death has been accompanied by violent respiratory movements as in croup or other forms of suffocation. In cases of death from haemoptysis the blood is aspirated into the small bronchi and shews through the visceral pleura, producing a delicate diffuse mottling.

Occasionally the visceral pleura may be locally thickened and opaque without there being any adhesions at the spot.

Examine the apices of the lungs for irregularities, scars or puckers. If present make a small cut with a knife to see whether there is any fibrous tissue or tubercle underneath.

Note the general colour of the lungs: in young children they are pale, in older persons there is always more pigment, especially in the inhabitants of towns, and most of all in those whose occupations have exposed them to the inhalation of particles of soot or other pigments.

If the lobular arrangement is prominent on the surface of the lung, there is (i) vesicular emphysema. Other indications of emphysema are:

(ii) a voluminous lung ("hypertrophic emphysema"); in old people however there is the opposite condition of "atrophic emphysema";

(iii) a swollen thick anterior margin to the lung, somewhat devoid of pigment;

(iv) an irregular outline at the margins, especially anteriorly, which may be due to the presence of emphysematous bullae;

(v) the loss of elasticity which as mentioned above prevents the emphysematous lungs from collapsing on opening the pleural cavity.

The lower lobes are frequently congested and of a dark purple colour. This is especially the case in patients who have lain helpless on their backs for some time before death (hypostatic congestion).

Notice any deeply congested area of lung tissue depressed below the level of the surrounding lung tissue, and squeeze it between the finger and thumb: if it does not crepitate but feels like a piece of wet dough, it is collapsed.

Areas of collapse and emphysema frequently alternate.

Considerable areas of collapse are most common in the lower lobes posteriorly.

In still-born children the lungs are unexpanded, unpigmented and congested (atelectasis).

Feel the lung all over; at the apex consolidated masses which are tubercles can often be detected. Wedge-shaped solid hard deeply congested areas with the base towards the pleura are pulmonary apoplexies. There is frequently recent pleurisy on the surface covering them.

If the patient died of haemoptysis, it is advisable before opening the lungs to introduce a syringe into the pulmonary artery at the root of the lung and to inject water, so that if there be a ruptured aneurysm of one of the branches of the pulmonary artery, the water will issue from a particular bronchus which can be followed up and the aneurysm found.

If there has been a pneumothorax and the orifice in the lung has not been found, a pair of bellows should be connected with the main bronchus and the lung inflated under water. The inflation should be cautiously performed, since if force is used a small emphysematous bulla may be artificially ruptured.

XXXIV. *Opening the Lungs.*

The lungs attached to the trachea should be placed

flat on the table with their posterior surfaces looking upwards.

The bronchi should be slit up first, and then a section of each lobe made with a long knife. If there be any suspicion of pulmonary embolism or thrombosis, or if pulmonary apoplexy be present, the branches of the pulmonary artery should be slit up before making sections of the lung. In order to do this the lungs must be turned over so that their anterior surface points upwards.

Bronchi.

With a sharp pair of scissors continue the incision on the posterior median line of the trachea into the bronchi; follow first of all the branch of the bronchus which descends near the posterior and median border of the lung, since by so doing but little of the lung tissue is destroyed. Follow up its branches.

Note the presence of mucus, muco-pus, blood and foreign substances such as food.

Note the colour of the bronchial mucous membrane. It is often stained uniformly by the blood, but this though striking is a post-mortem phenomenon and of no importance.

If however there is a marked congestion and tenacious mucus, there has been bronchitis.

In cases of broncho-pneumonia the mucous membrane of the terminal bronchi may be of a vivid red colour as if "bleeding," and at the same time the bronchioles may become dilated and filled with muco-pus (acute bronchiectasis).

When the bronchi are dilated, notice whether the

dilatation is local and saccular, or whether it extends along a considerable length of the tube (cylindrical bronchiectasis).

Notice the condition of the lung tissue around, whether collapsed, fibrosed or unaltered.

The other bronchi passing to the lower lobe may be opened but should not be followed deep into the lung substance, unless there be a special reason such as bronchiectasis, haemoptysis, membrane etc., or the lung will be too much cut up to shew properly on section.

The bronchi of the upper lobe are less easily followed since the bronchus breaks up into numerous offshoots which penetrate deeply into the lung. They should be traced to their termination in cases of haemoptysis.

The lungs should now be disconnected by cutting across the bronchi at the root of the lung, and should be weighed.

Normally the lungs of a healthy adult weigh

	Male.	Female.
R. lung =	24 oz.	17 oz.
L. lung =	21 oz.	15 oz.

Section of the Lungs.

The *left lung* is placed with the apex towards the dissector and its posterior surface upwards. It is steadied by pressing on it with the flat of the left hand or better with a sponge. Make a section from without inwards, parallel to the table. If the two lobes are adherent, they are both cut through by the same incision. The incision is to be carried through in one movement, but the two halves are to be left connected by the tissues at the root. After the first section others parallel to it are made in a similar manner.

If the two lobes are free and are not united by interlobar adhesions, they are to be incised separately though in a similar manner.

The *right lung* lying with its posterior surface upwards and its base towards the dissector is examined for any interlobar adhesions.

If the lobes are adherent to each other, they should be incised by a single cut of the large flat brain knife. The knife enters at the outer border of the lung and is drawn through, leaving the two halves united to one another at the root of the lung. Similar parallel cuts must afterwards be made.

If there are no adhesions, the upper and lower lobes should be separately incised, so as to divide them into anterior and posterior halves as before.

The middle lobe is best examined by making a cut into it from the front at right angles to the long axis of the lung.

It should be remembered that some of the bronchial glands pass into the root of the lungs, and on section, if enlarged and infiltrated with inflammatory products or with new growth, they may appear as if they were buried in the lung itself.

XXXV. *Colour of the Lungs.*

In a person suddenly killed while in perfect health the lungs like all the organs contain a large quantity of blood, and from comparison with the lungs of persons who have died after long illnesses might be thought to be morbidly congested. In such cases mere congestion is unimportant.

If intense congestion is associated with softening, as shewn by the lung being more easily lacerated than normally, this may be the first stage of pneumonia.

The test then of whether congestion is morbid or not, is its association with softening of the lung substance.

In cases of advanced decomposition the lung may be sodden, deeply stained with blood pigment, sometimes blackish green and somewhat softened. This softening cannot be considered evidence of any ante-mortem change.

In continued fevers and in cases where the patient has been lying on his back for some time before death the posterior parts of the lungs, especially the lower lobes, are full of stagnating blood (hypostatic congestion). There is less air in these parts of the lungs than normally, partly from collapse. If there be much softening, a low form of inflammatory hypostatic pneumonia has been present.

Deeply congested airless patches, depressed below the surrounding lung tissue, are due to collapse: they may be scattered about over the lung or form extensive tracts, usually in the lower lobes posteriorly. The lung tissue being collapsed, the bronchi retaining their normal size appear more prominent, and must not be thought to be dilated.

In emphysema the lung tissue is much paler than is usually the case. Emphysema and collapse are frequently found together, and the contrast between the dark or collapsed and the pale or emphysematous areas gives rise to a mottled appearance of the section.

After section the venous blood becomes bright from absorption of oxygen and the lung of a lighter colour.

The pigmentation of the lungs in old persons who have lived in towns or in an atmosphere impregnated with particles of soot, carbon etc. has already been referred to (§ XXXIII).

In very chronic inflammations, e.g. fibroid tubercle and chronic interstitial pneumonia, there is an increased amount of pigment in the affected parts.

Chronic venous congestion or brown induration of the lungs occurs in cases of mitral disease. The lung on section is of a brownish red colour and is firmer than naturally and contains little air, while on pressure brownish fluid stained by altered blood pigment wells up. This is evidence of oedema of the lungs.

Consistency of the Lungs, Pulmonary Apoplexies and Abscesses.

Normal lung tissue is like a delicate sponge work, and crepitates on pressure, which is due to the contained air. Though it readily yields, the lung is not easily broken down. When lacerable, the lung has been inflamed.

In the first stage of pneumonia as well as in red and in grey hepatization the lung is easily broken down, its resistance being greatly diminished.

In long continued venous congestion and as the result of any chronic inflammation the lung substance becomes much firmer.

The lungs may contain much serous fluid: oedematous lungs are often found in cases of renal disease and in some cases of cardiac failure. The consistency of the lungs however remains normal. But if softening is asso-

ciated with oedema the latter is due to, and part of, an inflammatory process.

Sometimes the lower lobes alone are oedematous: this is probably hypostatic. In other cases oedema is limited to the upper lobes, when it is probably a post-mortem phenomenon and of no importance.

"*Pulmonary apoplexies*" are hard dry wedge-shaped masses composed of blood clot, with sharp margins, and with their bases directed towards the pleural surface and their apices towards the centre of the lung. They are uniformly dark red in colour.

They may be due to rupture of a small branch of the pulmonary artery or to embolism (infarct). The pulmonary artery going to the affected area should be slit up with a fine pointed pair of scissors and an embolus looked for. Sometimes a thrombus is found but no embolus. The thrombus may appear to be more recent than the pulmonary apoplexy, and the effect rather than the cause of it.

It may be mentioned here that extensive thrombosis may occur in the pulmonary arteries without any pulmonary apoplexies.

Pulmonary apoplexies often occur in chronic venous congestion from mitral disease, and sometimes in cases of granular kidneys.

On the pleural surface of the pulmonary apoplexy inflammation is often seen. Sometimes a pleural effusion follows which by producing collapse of the surrounding lung tissue causes the affected area to stand out in greater prominence.

Pulmonary apoplexies hardly ever leave scars, as infarcts do elsewhere, for owing to the free blood supply the lung recovers and the blood is partially re-absorbed.

Pyaemic Abscesses.

Embolism of the branches of the pulmonary artery in cases of right-sided ulcerative endocarditis or in pyaemia gives rise to a condition at first somewhat resembling a pulmonary apoplexy. It is succeeded, however, by suppuration, and an abscess results which may burst into the pleural cavity and set up an empyema or a pyo-pneumothorax.

Pyaemic abscesses are nearly always multiple, and each is surrounded by a zone of consolidated lung tissue.

A single abscess in the lung may be the result of pneumonia in a weakened subject. Its walls are ragged and formed by breaking down lung substance, while the tissue around is consolidated. The contents are usually very offensive, and there is often a combination of pulmonary gangrene and abscess.

Care must be taken not to mistake the cross section of a dilated bronchus full of muco-pus for an abscess. This is best avoided by following and slitting up the bronchi passing to the affected area.

In gangrene of the lung there is a ragged cavity with no definite walls which contains sloughs and offensive green fluid. Gangrene may follow perforation of a growth in the oesophagus, or it may be a sequela of lobar pneumonia and a complication of diabetes. Numerous small gangrenous abscesses may occur in septic broncho-pneumonia or in some cases of croupous pneumonia.

XXXVI. *Lobar or fibrinous pneumonia* is often spoken of as croupous, because the exudation coagulates in the air vesicles just as the exudation does in the larynx in some cases of laryngeal dyspnoea or croup.

At times the upper lobe is attacked alone, but generally the lower lobe is the one affected.

The first stage of pneumonia is that of congestion: the lung is actively injected, but it still contains air and therefore floats in water and crepitates on pressure.

On squeezing it the lung tissue is found to be more lacerable than normally and blood-stained serum pours out, but there is no consolidation.

In the second stage the lung is solid and drier, and deep red in colour—red hepatization. It is granular on section, an appearance which is due to the alveoli being filled with plugs of fibrin. It is of full size and often indented by the ribs, doubled or even trebled in weight, quite airless and sinks in water. Its resistance is much diminished, being friable and easily broken down by the pressure of the finger. Solid casts of fibrin may be found filling up both the blood vessels and the bronchi.

In the third stage, that of grey hepatization, the section is grey, and somewhat less granular but more friable than in red hepatization.

Very often the transition from red hepatization to grey is seen, the part first attacked having passed into the further stage, while the rest is still in a condition of red hepatization.

Purulent infiltration is a later stage, in which the surface is bathed in pus, and in places this change may have advanced so far as to produce small abscesses.

A little recent pleurisy is nearly always found, but sometimes there is a considerable quantity of lymph, when the condition is called pleuro-pneumonia.

Occasionally in pneumonia the lung substance undergoes gangrene. Dark sloughs bathed in very offensive sanious fluid are found lying in a cavity lined by the ragged breaking down lung substance.

In the irregular pneumonia of diabetes caseous patches softening into abscess cavities or becoming gangrenous may occur. The lung affection in diabetes is a low form of pneumonia with a tendency to caseation and softening, and not a tubercular process, though phthisis may complicate diabetes.

XXXVII. *Broncho-pneumonia* may be (i) catarrhal, as met with in young children, (ii) tubercular (vide § XL), (iii) influenzal, or (iv) it may be due to inhalation of irritating or septic particles.

When the inflammation spreads from the small bronchi to the surrounding lung substance, so that numerous small areas or patches of lung tissue around the bronchioles become involved, the condition is known as broncho-pneumonia, lobular or catarrhal pneumonia.

Besides these small nodules of consolidation, collapsed and emphysematous vesicles are found in broncho-pneumonia.

The appearances in broncho-pneumonia differ according to the stage and the degree of the disease.

In the early stages before the small areas of consolidated lung tissue become striking, the affection may

be suspected from the marbled or mottled appearance of the section of the lung associated with the presence of mucus in the tubes. This mottling is chiefly due to the contrast produced by patches of collapse alternating with patches of compensatory emphysema.

In children, especially after measles, typical broncho-pneumonia may occur.

Both lungs are found to be occupied by small discrete areas of consolidation around small bronchi, which are usually rather smaller than split peas and are of a whitish yellow colour. On squeezing the lung, muco-pus exudes from the tubes in the centre of these areas.

This form of broncho-pneumonia often very closely resembles general pulmonary tuberculosis. The fact that muco-pus can be squeezed out of the bronchiole in the case of broncho-pneumonia distinguishes this affection from tuberculosis.

The bronchi, if opened up, are found to contain much mucus or muco-pus, the mucous membrane is deeply injected and may have an appearance like granulation tissue.

The inflammation of the walls of the bronchi may weaken them to such an extent that the mucus in them leads to dilatation of the tubes. This acute bronchiectasis when present is most often seen in the lower lobes, and is associated with collapse.

The small patches of consolidated lung may, as the disease goes on, become bigger and by fusion form large confluent areas.

When this occurs evidence of acute pleurisy will be usually found in recent lymph on the surface of the lung.

In influenza a special form of broncho-pneumonia is met with. In addition to the inflammation and acute dilatation of the bronchial tubes comparatively large areas of lung may be found to be solid. These may even be as large as half-a-crown pieces. They project above the level of the surrounding tissue, are of a greyish colour and have an appearance suggesting oedema, which however is not present. These areas by coalescing may lead to consolidation of a whole lobe. This condition may resemble grey hepatization, but is not so uniform.

In cases where irritating or septic material has been inhaled, scattered patches of consolidated lung broncho-pneumonic in distribution may be found. At first they are usually red in colour and later greyish yellow.

XXXVIII. *General tuberculosis.*

Both lungs are affected, often though not invariably to an equal extent.

They may be densely packed with tubercles so that the lung is almost solid. In other cases the tubercles are few in number.

The lungs may be otherwise healthy or there may be old tubercle or a vomica at the apex.

On the surface of the pleura miliary tubercles can usually be seen.

The tubercles may be grey and translucent, or if older they may have undergone caseation and be yellow, in which case they are larger. These two conditions may be found in the same lung, those in the upper lobe being yellow while the lower lobes contain grey miliary tubercles

In general tuberculosis search should always be made for a primary focus of tubercular infection, such as a caseous mass or vomica in the lung, a caseous bronchial gland or tubercular disease of some other part of the body, e.g. tubercular osteitis.

XXXIX. *Chronic Tuberculosis.*

This heading includes most of the conditions found in phthisis.

Caseous masses in the lung are formed partly by the coalescence of tubercles and partly by the caseous pneumonia or broncho-pneumonia they set up.

These caseous nodules soften down and the escape of their contents into the bronchi leads to the formation of a cavity.

The tubercular process in the apex if slow gives rise to the formation of fibrous tissue around.

Tubercular pleurisy is usually concomitant and gives rise to adhesions around the affected part of the lung.

The apex of the lung is the part first diseased and from that focus the process spreads by continuity downwards, but the apex of the lower lobe is very early affected, so that a vomica with caseous matter around it at the apex of the upper lobe may be accompanied by a caseous nodule or a small cavity in the apex of the lower lobe, without the lower part of the upper lobe being much altered. The tubercular process however spreads from the apex to the base of the lung.

Cavities may be small or large, circumscribed or irregular, forming cavernous passages.

Note the relation of the cavity to the pleura and see

whether there are adhesions and thickenings of that membrane, or whether, as in a recent vomica, the pleura is thinned and in danger of perforation.

A large cavity in the upper lobe may pass through interlobar adhesions and communicate with a cavity in the lower lobe.

Examine the wall of the cavity, whether it is smooth or ragged, whether it is surrounded by fibrous tissue or caseous material.

Running across a cavity there are often trabeculae. These are the remains of the fibrous septa of the lung and frequently contain blood vessels which as a rule however are impervious. The trabeculae may be ulcerated through, so as to hang loose like tags in the vomica. If the vessel is not obliterated, the erosion may lead first to the production of an aneurysm and subsequently to rupture of this aneurysm into the vomica.

The differences between recent cavities and those of old standing may be best shewn in a tabular form.

Recent cavities.	*Old cavities.*
Small size.	May be very large; very old cavities however may be quite small due to cicatricial contraction.
The walls are rough and ragged and often formed of softening caseous material.	The walls are smooth.
Surrounded by caseous material which may be softening down. Not surrounded by fibrous tissue.	Encapsuled more or less by fibrous tissue.
Often contain caseous matter.	May be empty or may contain pus.

Obsolete tubercle is often found in the lungs of persons who have died from accidents, &c.

Associated with the presence of old localized pleural adhesions the apices may contain hard tubercles, surrounded by old pigmented fibrous tissue, or encapsuled masses of caseous material which may have undergone calcification, or small cavities, surrounded by dense fibrous tissue, which are contracting.

The walls of these obsolete cavities are smooth; sometimes they contain dried-up or even calcified caseous material.

In cases of obsolete tubercle the bronchial glands should always be examined for the presence of caseous or calcified masses of tubercle.

XL. *Caseous Pneumonic Tuberculosis.*

The lung may be occupied by greyish white caseous products which rapidly soften down with the production of recent vomicae.

The process is so rapid that, although there may be some pleurisy, firm adhesions are not formed and the rapid destruction of lung tissue may, by perforating into the pleural cavity, give rise to pneumo-thorax.

The distribution of these caseous areas may be broncho-pneumonic and in both lungs, though it is then usually more marked in one than in the other, or lobar, being almost limited to one lobe.

XLI. *Fibrosis of the Lung.*

In cases of obsolete tubercle the apices of the lungs

contain dense old pigmented fibrous tissue often enclosing caseous or calcareous masses.

In cases of greatly thickened pleura, strands of thick fibrous tissue may be seen passing into the lung.

In the subjects of syphilis, fibrous areas may be found in the neighbourhood of the root of the lung or elsewhere, without there being any evidence of tubercle at the apices. These fibrous areas may contain caseous material and may resemble gummata elsewhere, both to the naked eye and microscopically.

As the result of the inhalation of irritating particles a chronic inflammatory process may start from the bronchioles and give rise to a general increase of fibrous tissue throughout both lungs. When this is due to the inhalation of particles of stone it is called stone-mason's phthisis or silicosis; when due to particles of steel, knife-grinder's phthisis or siderosis—a similar change may result from inhaling particles of flax. The foreign particles may produce much pigmentation as well as fibrosis of the lung tissue as in potter's lung, or in anthracosis, coal-miner's phthisis, but increased pigmentation often exists without any fibrous increase.

Tubercular disease may be engrafted on the already damaged lung, and it may be difficult to decide which is the older lesion.

The bronchial glands will be found to be undergoing the same changes as the lungs.

As the result of long-standing pleural effusion or empyema, the lung may be small in bulk, compressed, hard and firm in consistence.

Chronic Interstitial Pneumonia.

One lobe or the whole of the lung may be almost entirely transformed into dense fibrous tissue which is pigmented and of a steel grey colour.

The lung is shrunken and covered by the thickened pleura which is firmly adherent to the chest wall.

This change which is limited to one lung begins in and is often limited to the lower lobe.

The bronchial tubes are usually greatly dilated, their mucous membrane is rough and they contain varying amounts of mucus which may be very offensive.

This condition may follow broncho-pneumonia in childhood or lobar pneumonia, and is not due to tuberculosis though that condition may subsequently develop.

The other lung will be found to be greatly emphysematous.

CHAPTER IV.

DETAILED EXAMINATION OF THE ABDOMINAL VISCERA.

XLII. *The Spleen.* XLIII—XLVI. *Duodenum, Stomach and Bile Ducts.* XLVII. *Pancreas.* XLVIII. *Suprarenal Bodies.* XLIX and L. *Liver.* LI. *Structures on Posterior Wall of Abdomen.*

After the intestines have been removed (§ XII) and examined, the remaining abdominal viscera should be examined in a routine order which should only be varied when some special condition necessitates some modification. Thus in the case of a subdiaphragmatic abscess, the contents of the thorax and abdomen may with advantage be taken out as a whole and the parts dissected from the back; or in the case of pylephlebitis, where the entire course of the portal vein should be exposed and opened *in situ*, and therefore be examined before the removal of the intestines.

XLII. *The Spleen.*

The spleen should be drawn forwards by the left hand and with a few touches of the knife freed from the tail of

the pancreas: this entails cutting across the splenic vessels.

When rupture is suspected the spleen must be carefully examined before removal.

The spleen if softened, as in enteric fever, pyaemia, septicaemia or other infective fevers, may be so diffluent as to break up into a soft pulp in the attempt to remove it, so that in these cases particular care should be taken.

Any adhesions to the diaphragm should be noted, and if present their association with pleural adhesions on the left side should be kept in mind, since left pleurisy, by extension, often gives rise to local peritonitis around the spleen.

After removal the spleen should be weighed at once. In the adult its average weight is 6 to 7 oz., though there are considerable variations within physiological limits.

External Examination of the Spleen.

In old people the spleen normally atrophies and the capsule is wrinkled, loose and slightly opaque: a similar wrinkled condition is seen in cases where the spleen has been enlarged and has subsequently shrunk.

The capsule sometimes shews hard, raised, almost cartilaginous projections; when cut into they are seen not to encroach upon the splenic substance but to be elevations. They are very dense and are composed of well formed fibrous tissue. They are termed lamellar fibromata and are probably, like milk spots in the pericardium, the result of friction.

Notice any depressions on the capsule; when these are

cut into, fibrous tissue is seen invading the substance of the spleen—these are the scars left by old infarcts.

Small tags of organized adhesions around these scars are the remains of local peritonitis set up at the time of infarction.

Recent infarcts appear either as deeply congested patches or as anaemic areas surrounded by a zone of congestion—in either case there is no depression of the surface. There may be a little local recent peritonitis.

The capsule may be uniformly thickened in chronic peritonitis and may shew a few sharply punched out holes due to the contraction of this inflammatory membrane.

The capsule may have numerous small fibrous tags on its surface, the organized remains of a past attack of acute inflammation of the peritoneum.

In acute peritonitis there may be a thick layer of lymph covering the spleen.

In general tuberculosis small translucent tubercles frequently project from the capsule and somewhat resemble small flakes of organizing lymph, they are however more firmly attached.

Miliary tuberculosis of the spleen is as a rule more easily detected on the capsule than on section of the organ.

When the stomach or colon is distended with flatus the part of the spleen in contact with them is often stained of a dark black to purple-green colour. This discoloration is limited to the areas of contact and so can be at once distinguished from cases of pigmentation, as in melanaemia, in which the whole surface and substance

of the organ are affected. On section this post-mortem discoloration is seen to be quite superficial.

This discoloration of the spleen is due to gases, among which is sulphuretted hydrogen, diffusing through the walls of the stomach and intestines after death and meeting in the spleen with traces of iron, as a result of which sulphide of iron is produced. A similar change is often seen in the liver. Vide § XLIX.

As in the liver, so in the spleen, with advanced decomposition gas may be formed in its substance and produce a honey-combed appearance.

The spleen may be greatly enlarged in leukaemia, ague and occasionally in rickets.

Accessory Spleens.

Small miniature spleens are often present; they occur in the hilum, in the gastro-splenic omentum, and towards the left end of the great omentum; they resemble the spleen and share in its morbid conditions.

Examination of the Spleen on Section.

The best way is to make a number of incisions not quite through the thickness of the organ, transversely to its long axis; the several slices should be left attached by the capsule.

Attention should be paid to the following points—

Colour.

Normally a dark dull red which however becomes lighter, from oxidation, on exposure to the air.

In cases of anaemia the spleen is pale and often mottled.

The whole of the splenic pulp may be of a dark black hue as in cases of melanaemia.

Consistency.

Normally the substance of the spleen is soft so that it readily breaks down on pressure, but it is sufficiently coherent to retain its shape on section.

In fevers (especially enteric) the spleen is much softened.

In chronic venous obstruction the spleen is hard, of a deep purple colour and but slightly increased in size.

In lardaceous disease the consistency is firmer than natural.

In ague the spleen is enlarged and hard from increase of the fibrous elements.

Condition of the Malpighian bodies.

Often they appear unduly prominent, this is probably explained by digestion being in progress at the time of death and is not a morbid condition.

In chronic lymphadenoma they become fibrous and much enlarged.

Lardaceous disease may attack the pulp (diffuse waxy) in contradistinction to the malpighian bodies, but most commonly the malpighian bodies are affected. They become enlarged and translucent, and this variety of lardaceous spleen is called the "sago" spleen. Sometimes in lardaceous disease the malpighian bodies do not shew up prominently until treated with iodine.

Iodine test. First wash away oozing blood, as the contact of blood with iodine may give rise to a fallacious appearance, then pour over the washed surface the iodine solution. It is often best to leave a thin section in the

iodine solution in a watch glass, as the reaction takes some little time to become well marked.

A solution of iodine and iodide of potassium in water should be employed; if the tincture of iodine is used the proteids of the spleen by becoming coagulated may interfere with the reaction.

This test should be applied oftener than is usually done in cases of anaemia, chlorosis, renal disease etc.

Tubercles.

In general tuberculosis there may be a large number of miliary tubercles so that the organ appears stuffed with them and there is no difficulty in recognizing them. In cases where they are less numerous they resemble the malpighian bodies: it is stated (Wilks) that if a stream of water is allowed to play on the spleen the malpighian bodies are washed away first, while the tubercles cling and remain after the pulp has been removed.

In some cases in adults and more commonly in children caseous tubercles of various sizes occur. When softened in the middle no doubt exists as to their tubercular nature, but if firm and white they, to the naked eye, resemble chronic lymphadenoma and a microscopic examination is necessary to determine their nature.

Infarcts.

On section the cicatrices of old infarcts appear as fibrous masses roughly triangular in shape with the base towards the pucker on the capsule and the apex towards the blocked vessel.

Recent infarcts are either pale or haemorrhagic triangular wedges, the former are surrounded by a zone of

congestion. In pyaemia and ulcerative endocarditis the infarcts suppurate and soften down so as to form abscesses. Infarcts when pale and recent can be distinguished by their position at the surface of the organ from the firm white patches of fibrous tissue met with in chronic lymphadenoma which are situated in any part of the organ and not specially under the capsule.

XLIII. *Examination of the Duodenum and Stomach.*

After the removal of the small intestine and colon the mesentery which is left crossing the third part of the duodenum should be removed.

The mesentery is picked up in the left hand and cut across with a knife just above its root so as completely to expose the horse-shoe curve of the duodenum. The mesentery should be examined by dissecting off one layer of the peritoneum and so exposing the vessels and lymphatic glands. It should be remembered that in children the mesenteric glands are relatively much larger than in adults.

Removal of the Stomach and Duodenum intact in cases of poisoning.

When a corrosive poison has been taken, the oesophagus, stomach and duodenum may with advantage be removed in one piece, since in this way the damage done to this part of the alimentary tract can be better estimated than if the oesophagus be divided in the ordinary way just above the diaphragm, a procedure suitable for cases of non-corrosive poisoning where all that is necessary is to collect the contents of the stomach (cf. § XXVI).

Ligatures have previously been placed on the termination of the duodenum and at the upper or at the lower end of the oesophagus; the stomach and duodenum, and in cases of corrosive poisoning the oesophagus, are freed from all the surrounding structures and removed intact.

In cutting through the diaphragm care must be taken not to cut into the oesophagus or stomach between the ligatures. In removing the duodenum the head of the pancreas had better be taken with it and not dissected off from the bowel, as their close connection renders this somewhat difficult.

In poisoning cases the detailed examination of the bile ducts cannot be completely carried out.

Before moving the stomach note the position of any adhesions, tumours or any perforation of its walls.

Note the size of the stomach and whether there is any dilatation which cannot be explained by the post-mortem formation of gas.

Opening of the Duodenum and Stomach in situ.

Introduce one blade of a blunt pointed pair of scissors into the cut end of the duodenum and open it up, keeping along the convexity of the horse-shoe curve. Before cutting through the pylorus, examine it by passing a finger into it. If there be thought to be any stricture it should be left intact and the stomach opened separately by snipping a hole on the other side of the pylorus and then opening the stomach along its greater curvature. If the pylorus be normal the incision for opening the duodenum is continued through the pylorus and along

the greater curvature of the stomach up to the oesophagus.

The reasons for opening the stomach along the greater curvature are (*a*) that a much better view is thus obtained of the condition of its walls and (*b*) that ulcers when present most commonly occur on the lesser curvature and so escape being damaged by this method of opening the organ.

The contents of the stomach and duodenum should be gently removed by allowing a stream of water to play on them or by sponging. In so doing the surface should be dabbed and not scraped, so as not to remove tenacious mucus until its presence has been noted. Notice the presence or absence of rugae, when present they shew that the stomach has been contracted and empty.

Notice the character of the contents of the stomach with especial reference to the presence of blood.

In advanced decomposition bubbles of gas may be found under the mucous membrane.

After death, food, when present, is found in the cardiac end of the stomach, and hence this is the part where post-mortem digestion of the stomach occurs.

For the same reason the veins at the cardiac end of the stomach are more often brought into prominence as black branching channels—the blood in the veins having been acted upon by the acid contents of the stomach.

Post-mortem digestion of the stomach is distinguished from chronic ulcer of the stomach (*a*) by its being extensive and diffuse (*b*) by the loss of substance being gradual (*c*) by the absence of any thickening or induration along

its edges and (*d*) by the absence of any adhesions or signs of chronic peritonitis on the outside.

In cases of portal congestion, from cirrhosis of liver or from heart disease, the stomach is often very deeply injected and small ecchymoses may be seen. But generally speaking congestion of the stomach and intestines is valueless as a sign of inflammation by itself. If associated with the congestion there is thick tenacious mucus on the stomach wall gastritis has probably existed during life. In chronic gastritis the mucous membrane may be atrophied or the submucous layer thickened. In long standing cases there may be pigmentation of the mucous membrane near the pylorus. In cases of lardaceous disease apply the iodine test (vide spleen § XLII).

XLIV. *Ulceration.*

Sometimes small shallow (follicular) ulcers of the mucosa surrounded by congestion are present, they are multiple—they, like the sharply punched out single ulcers, are more often met with near the pylorus.

Note carefully the position of any ulcer and whether it is adherent to any organ such as the pancreas or liver. Gastric ulcers may be single or more rarely multiple.

Gastric ulcers may be acute with no thickening of the edges of the ulcer, they are sharply punched out.

Chronic gastric ulcers occur most frequently on the posterior surface and near the lesser curvature towards the pylorus. Their edges are hard and somewhat prominent, the base is formed by the submucous or muscular coat or by some adherent organ such as the pancreas or

liver, the base may be somewhat irregular and formed of scar tissue but is more often smooth. Look carefully for any exposed artery or small aneurysm on the floor of the ulcer. When the ulcer is adherent to the pancreas the splenic artery may be eroded.

In a typical gastric ulcer the mucous membrane is more extensively destroyed than the submucosa and the muscular coat least of all, so that its form is described as being saucer-like or funnel-shaped.

The pylorus should be examined for stricture which may be due to cicatrization of ulcers, fibrous increase or new growth. It must be remembered that the walls of the stomach normally shew a marked thickening at the pylorus.

XLV. *Malignant disease.*

A squamous-celled epithelioma may spread from the lower end of the oesophagus to the cardiac end of the stomach.

A soft fungating carcinoma may be found growing from the cardiac end or from the body of the stomach. This form ulcerates rapidly, and microscopically is usually a spheroidal-celled carcinoma.

A firm slowly growing carcinoma surrounding and narrowing the pylorus and giving rise to hypertrophy of the muscular coat of the stomach is often seen. Ulceration of the mucous membrane may not occur, or only late in the course of the disease. It but rarely spreads past the pylorus into the duodenum. This is commonly a cylindrical-celled carcinoma.

Sometimes there is a very dense fibrous annular stricture at the pylorus; this may be a very chronic scirrhous carcinoma or may be composed only of dense fibrous tissue.

Carcinoma of the stomach may undergo colloid degeneration.

In some cases the whole of the stomach is greatly thickened and its cavity much diminished; the thickening is partly due to hypertrophy of its muscular coats and partly to a fibrous growth infiltrating its walls. In some of these cases the growth resembles a Sarcoma.

Sometimes on the peritoneal coat small nodules of carcinomatous deposits may be seen, apparently not directly continuous with the primary growth. They may give rise to general infection of the peritoneal cavity.

XLVI. *Duodenum.*

Notice the ridge of the pyloric sphincter; this forms a landmark which is useful in determining the position of ulcers. Gastric ulcers occur most frequently at the pyloric end of the stomach and duodenal ulcers which closely resemble gastric ulcers are almost limited to the first part of the duodenum.

Examine the mucous membrane for any ecchymoses or ulceration. Duodenal ulcers are sharply cut and "punched out," they occur more frequently on the anterior wall.

Examination of the Biliary Papilla and Bile Ducts.

The biliary papilla is situated at the lower part of the second portion of the duodenum on its inner side. It is a

fold of mucous membrane slightly funnel-shaped with its orifice directed downwards.

A probe is, as a rule, with difficulty introduced into it as the lax mucous membrane catches the point, the passage of a probe therefore is no guide as to the permeability of the duct during life.

To test the permeability of the bile ducts; cut through the diaphragm and pull the anterior margin of the liver upwards so that the liver falls back into the thoracic cavity, in this way the course of the bile ducts becomes easily visible.

Press on the fundus of the gall bladder so as to drive the bile through the cystic and common bile ducts, this tests their condition.

There is often apparent obstruction which is not due to any swelling of the wall of the ducts or to stenosis, as is proved by subsequently opening them, but to the cystic or common bile duct becoming kinked or twisted on itself when pressure is applied to the gall bladder.

Opening of the Bile Duct.

With a pair of scissors dissect the first and second parts of the duodenum over to the middle line so as to expose the common bile duct in its whole course. Notice whether any pressure is exerted upon it by the lymphatic glands in that position.

Snip it open with a finely pointed pair of scissors and follow the duct downwards into the duodenum and upwards to the entrance of the cystic duct. The hepatic ducts can then be followed and opened up into the portal

fissure. The cystic duct has a cork-screw like course and requires some little patience to follow it properly.

Notice any dilatation of the common bile duct which may be the result of the passage of biliary calculi. Impaction of gall stones occurs more frequently close to the papilla and may be associated with ulceration of the duct due to pressure, and with dilatation of the ducts and gall bladder, when, if of long standing, the fluid will be clear, not bile-stained. Note any stricture of the bile duct, which may be fibrous but is more commonly due to columnar-celled carcinoma.

Examination of the Portal Vein.

The cut end of the superior mesenteric vein can be examined as it passes behind the pancreas. By cutting it open the portal vein is reached and this together with the splenic vein can be laid open *in situ*. If the pancreatic duct is to be examined the opening of the superior mesenteric and portal veins should be postponed, as this procedure will entail cutting the duct across, since the pancreas is divided in exposing the superior mesenteric and portal veins.

XLVII. *Pancreas.*

At this stage of the dissection it is most convenient to remove the stomach, duodenum and pancreas together, and complete the examination of the pancreas out of the body.

Lift up the tail end of the pancreas and free it with a few strokes of the knife from the underlying organs; in doing so take care not to injure the left suprarenal

capsule which lies very close to it. Free the pancreas from the aorta by cutting across the branches of the coeliac axis and superior mesentery artery, and separate the duodenum and stomach from their connections.

The stomach, duodenum and pancreas are now removed from the body. The stomach and duodenum have been examined and, if normal, may be dissected off from the pancreas.

The weight of the pancreas averages about 3—4 oz. in adults.

Its consistency varies considerably with the cause of death; thus in fevers and septic diseases it is often soft and stained with blood pigment. In cases where decomposition has advanced rapidly after death it is in like manner much altered. In examining the consistency of the organ, calculi if present will be felt; their relation to the pancreatic duct should be determined.

Often, without there being any increase in the amount of interstitial fibrous tissue, it is extremely firm and hard, this is especially the case in the head, so that when feeling it, on first exposing the organ, an impression of malignant disease in the head of the pancreas is often given.

The tortuous splenic artery should be opened up with a finely pointed pair of scissors and the presence of atheroma noted.

If the splenic vein has not already been opened up, this should be done now.

The pancreatic duct need not be dissected as a matter of routine, but if there is any reason for examining it

(presence of calculi, cysts etc.), it can be done in the following way.

It runs embedded in the gland rather nearer its lower than its upper border.

Scrape away the pancreas at a point corresponding to the junction of the head with the rest of the organ, until a fine white tube is exposed; follow this back towards the tail and onwards towards the duodenum into the head of the pancreas where it curves downwards to the papilla. The reason for beginning the dissection at the junction of the head and body is that the duct is more readily found here than in the head of the pancreas.

The pancreas after being weighed should be cut into thin transverse sections.

The consistency and amount of fibrous tissue should be noted.

Not uncommonly small opaque white spots are seen; these are small masses of fat in the interstitial substance which have probably been acted upon by the secretion of the pancreas post-mortem and so become somewhat altered in appearance.

The pancreas is in close contact with the lymphatic glands around the aorta; these glands when tubercular or infiltrated with new growth may project into the substance of the organ and appear like growths in the pancreas.

If there appear to be any growth in the pancreas, it will probably be found to be a gland unless it be in the head when its relation to the common bile duct should be carefully noted. When present, malignant disease

occurs in the head and is scirrhous carcinoma; by compressing the bile duct it often leads to permanent jaundice.

If there be any haemorrhage in connection with the pancreas, it should be noted whether it is merely superficial, or whether it infiltrates the organ and in the latter case whether there is any softening or other evidence of inflammation (haemorrhagic pancreatitis).

Diffuse suppuration or gangrenous pancreatitis is rare.

Small multiple abscesses in the pancreas are sometimes found, they may be associated with impaction of gall stones in the common bile duct.

If there be diffuse suppuration around the pancreas examine the fat in the mesentery, omenta, etc. for opaque white spots—fat necrosis.

Pancreatic cysts may be due to blocking up of the duct by calculi or may follow on injury. They are rare. The contents of the cyst are brown or chocolate coloured.

In aneurysm of the aorta the pancreas may be expanded over the sac and shew atrophy.

XLVIII. *Suprarenal Bodies.*

After the removal of the stomach, duodenum and pancreas the suprarenal bodies can be easily and rapidly removed for examination.

The *left suprarenal* capsule should be removed first, it can be seen lying at the inner side and upper end of the kidney. The connective tissue covering it is pulled upon by the forceps and a few cuts of the knife or scissors easily free it from the kidney.

The left semilunar ganglion which lies close to its lower border can be examined at the same time.

The *right suprarenal* body should be taken out before the removal of the liver, with which it is in such close contact that if that organ be removed first the suprarenal will probably be partially removed with it.

The liver has already (duodenum § XLVI) been turned upwards and backwards into the cavity of the thorax; the whole course of the inferior vena cava is thus exposed. Open the inferior vena cava from below upwards as far as the liver. Note any distension with blood and the condition of its walls; in chronic heart disease its intima is often opaque.

The renal veins, and if necessary the spermatic or ovarian veins, should be examined and opened at the same time. Note the condition of the neighbouring lymphatic glands and whether, if enlarged, they press on, or infiltrate, the inferior vena cava.

Pick up the inferior vena cava with the forceps and dissect it off the spine, cutting it across quite close to the liver.

The right suprarenal, much more flattened than the left, can now be easily removed.

The right semilunar ganglion can be examined at the same time.

After removal the suprarenals can be cleaned by dissecting off the connective tissue with a pair of scissors. In this connective tissue small accessory suprarenal bodies may be found.

The examination of the suprarenals is most satis-

factorily performed out of the body, but if the post-mortem has to be done in a hurry they can be examined *in situ* by making a series of cuts into them. In cases of suspected Addison's disease the suprarenal bodies, semi-lunar ganglia and solar plexus should be dissected out *in situ* and removed *en masse*.

There are, not unfrequently, in the bodies of adults small white elevations on the surface of the suprarenals, like split peas, composed of suprarenal cells in an advanced stage of fatty infiltration. They are not tubercles to which they have a slight superficial resemblance. Tubercles almost always begin in the medulla of the organ.

When either kidney is displaced the corresponding suprarenal does not accompany it but is found in its normal position.

On section a marked contrast is seen between the buff coloured cortex and the purple medulla in health. When swollen from fever or decomposed this appearance is obscured.

When softened the medulla easily breaks and the organ appears to contain a cavity, this is a post-mortem production and is often developed in the process of removal. The presence of this cavity gave origin to the term "Capsule."

In foetuses the suprarenals are relatively of a much larger size than in adults, they are more than half the size of the kidney. In children they are also relatively large.

In adults the cortex of the suprarenal normally shews fatty infiltration.

If the organ appears normal from the outside it should be cut into thin sections; the suprarenal is held vertically and thin sections cut off successively with a sharp pair of scissors.

Note the presence of caseous tubercles or secondary nodules of new growth which grow from the medulla.

In cases of lardaceous disease place sections of the organ in iodine solution, if affected the cortex turns a dark brown, and produces an appearance which is the reverse of that normally seen, as the medulla now appears the paler.

In children dying during or shortly after birth recent haemorrhages are sometimes found in the medulla of the suprarenals. A similar condition sometimes follows severe accidents later in life.

XLIX. *Liver.*

The liver can now easily be removed by lifting it up and cutting through the ligaments connecting it to the diaphragm.

Weigh the liver, its average weight in the adult is 50 ozs.

In febrile conditions, as the result of cloudy swelling, it may be increased in weight to a very considerable extent. In fatty infiltration, in leukaemia, lardaceous disease and when occupied by new growths it is much heavier than normal. In fatty change the liver as a whole is usually increased in weight but its specific gravity is so far diminished that it may float in water.

In cirrhosis accompanied by fatty change its weight is greatly increased.

In atrophic cirrhosis ("hobnailed liver") the liver is smaller but its weight remains about the normal as its specific gravity is increased.

In some cases the size and weight are much increased without there being any morbid change to account for it. In lardaceous disease, leukaemia, fatty infiltration and in "biliary" cirrhosis the enlargement of the liver is uniform and its surface smooth, while in cirrhosis and when enlarged from the presence of tumours the surface is irregular.

In infants the liver is normally of a larger relative size than later in life, and the left lobe approaches very nearly to the size of the right.

A diminution in weight occurs normally in the aged. It is also met with in wasting diseases such as carcinoma of the pylorus.

In acute yellow atrophy the capsule is too big for the organ and readily wrinkles, this can be well shewn by allowing a stream of water to play on its surface.

Small abnormal lobes are not uncommonly met with, projecting like tongues from the under surface of the right or more rarely the left lobe.

The hinder aspect of the right lobe may be very deeply indented by the ribs, this may occur without there being any evidence of constriction of the lower part of the thorax by tight lacing or belts.

Examine the falciform and round ligaments. In cases of cirrhosis there may be large veins in the falciform ligament.

In cases of malignant disease there may be nodules of

growth in the falciform ligament; one may not uncommonly be felt near the umbilicus.

Open up the piece of inferior vena cava left in connection with the liver.

Examination of the Surface of the Liver.

The capsule may shew local thickenings; occasionally there is some thickening on the upper surface of the left lobe near the falciform ligament, probably due to the friction of a hypertrophied right ventricle of the heart, this may be associated with an indentation of the liver so that it is partially saddle shaped.

Local thickenings of the capsule may be due to pressure and may be seen near the anterior margin.

In cases of tight lacing where there is a line of atrophy of liver substance, corresponding to a woman's waist or to the belt of a man, the capsule is usually thickened.

As a result of past peritonitis there may be organized adhesions uniting the liver to surrounding organs. Adhesions between the liver and diaphragm are often due to a past pleurisy which has spread through the diaphragm. (Cf. Spleen, § XLII.)

In chronic peritonitis or in perihepatitis the capsule may be greatly thickened and almost cartilaginous; notice small holes in this thickened capsule produced by the contracting tissue rupturing. A thick layer can often be peeled off from the liver leaving the original serous covering of the liver in its position.

Notice any irregularities on the surface due to

cirrhosis, miliary tubercles, gummata, syphilitic cicatrices or new growths. Nodules of new growth are usually depressed or umbilicated in the centre.

In recent peritonitis the surface of the liver may present small masses of lymph.

In cases of long standing obstruction of the bile duct from impacted gall stone or new growth the bile ducts on the surface of the liver can be seen to be dilated with fluid which may be quite clear.

Irregular anaemic areas form a striking and common appearance on the surface of the liver. They occur on the anterior surface of the liver and are due to pressure exerted through the abdominal walls after death, probably in laying out the body.

Another striking and equally unimportant appearance is that of dark purple stains on the surface of the liver. They are found where the liver has been in contact with the distended stomach and colon and are due to the gases, among which is sulphuretted hydrogen, generated in those viscera, diffusing after death through their walls and meeting in the liver with particles of iron; as the result of this some compound like sulphide of iron is produced and discolouration follows.

Turn the liver over and examine the gall bladder and structures in the portal fissure.

Any adhesions between the gall bladder and other viscera should have been previously noted.

Snip open the fundus of the gall bladder and open it up to the neck.

Note the colour and consistency of the bile. On the

reticulated mucous membrane of the gall bladder a muddy deposit of bile may sometimes occur.

Examine any calculi in the gall bladder and note whether the mucous membrane is healthy. When from long standing obstruction the gall bladder is dilated its contents are often devoid of bile.

Open up the portal vein and follow its bifurcations into the liver.

Note the condition of the glands in the portal fissure, comparatively small secondary growths in the portal fissure may, by pressure on the bile ducts and portal vein, give rise both to jaundice and ascites.

In cases of congenital cystic disease of the liver—a rare condition—the liver may with advantage be injected from the bile duct; it is difficult to detect this affection before making sections of the organ, but if any minute cysts are seen on the surface it may be suspected.

In any case of icterus neonatorum the bile ducts may with advantage be injected before cutting into the liver.

L. *Examination of Substance of the Liver.*

In an ordinary case the liver should be cut into slices with a big knife, the sections being first parallel to the falciform ligament and then at right angles to it. In making them the sections should begin from the anterior surface and not extend quite through the thickness of the organ, so as to preserve the several pieces in position.

If there is any abnormal condition this procedure should be modified.

Colour.

Normally the liver is of a uniform deep red colour, in cases of sudden death it contains a large quantity of blood and this must not be considered as evidence of any morbid process.

In the cloudy swelling met with in febrile diseases the liver is pale, dull, and looks as if it had been boiled.

In jaundice the liver like other parts of the body is stained yellow, in long standing cases it may be green. In cases of anaemia the liver is very pale, partly from fatty degeneration, partly from absence of blood.

In fatty degeneration and infiltration it is of a whitish yellow colour; in slight fatty infiltration the pale periphery of each lobule contrasts with the central part of the lobule, which retains the normal colour, and a speckled appearance results which must not be confounded with the "nutmeg" liver of chronic venous congestion nor with lardaceous disease.

In acute yellow atrophy it is yellow with red areas often irregularly mixed.

In old people the colour of the liver is often deepened.

In cases of well marked cirrhosis the liver is usually yellow in colour; in some cases lobules undergoing fatty degeneration may be a uniform bright yellow, a condition which gave rise to the term cirrhosis.

In chronic venous congestion of the liver due to obstructive heart or lung disease, such as mitral reflux and obstruction or chronic bronchitis and emphysema, the liver presents an appearance which is compared to the section of a nutmeg.

In a typical case there are deep purple spots which correspond to the distended sublobular and intralobular veins. These spots, which are darker than normal, are surrounded by areas stained with bile and infiltrated with fat, the intermediate zone of the lobule is stained from the stagnation of bile and the outer zone infiltrated with fat.

Sometimes there are large areas of a dark purple colour alternating with large pale fatty areas.

In lardaceous disease the liver is anaemic, slightly yellow and somewhat translucent. On applying the iodine test the intermediate part of the lobule, viz. that between the area of fatty infiltration externally and that of chronic venous congestion internally, becomes stained a dark brown while the rest of the organ is stained yellow. In a lardaceous liver thus treated the affected areas appear as dark brown rings.

Consistency.

Normally the liver is firm and resists any ordinary pressure from the finger.

In cases of advanced decomposition gases may be formed in the liver substance so that it becomes spongy and appears to contain multitudes of small cysts. The gas can be heard issuing from the liver on section and these cavities can be distinguished from cysts by the presence of gas, instead of fluid, inside them. This can be shewn by squeezing the liver under water.

In cases of decomposition the liver is softened.

In cirrhosis the liver is firm and hard; in cases of cirrhosis and fatty change combined the substance of the liver is also firmer than normal.

In lardaceous disease the liver is much firmer than in health.

In acute yellow atrophy the liver is soft and easily bent on itself.

In fatty liver there is as a rule marked softening, but in some cases it is more compact than usual and this without there being any cirrhosis.

Morbid conditions.

In cirrhosis there may be either, a granular appearance on section due to small masses of liver substance being surrounded by fibrous tissue, or the cirrhosis may be coarse, comparatively large areas of liver substance being enclosed in new fibrous tissue. The second appearance is found in cases of so-called "hobnailed liver."

In syphilis there may be a fine uniform cirrhosis which spreads into the lobules of the liver and passes between the cells, this occurs in congenital syphilis. The organ is bright yellow in colour.

In acquired syphilis gummata occur, when young they are areas of pinkish fibrous tissue, they are however rarely seen in this early stage. When fully developed, gummata are masses of caseous material surrounded by fibrous tissue, the contraction of which may shew itself on the capsule by scars.

General tuberculosis frequently attacks the liver. The miliary tubercles are best seen on the capsule, but if fairly large (size of pin's head), and especially if they are beginning to turn yellow from caseation, they become easily visible to the naked eye in the liver substance.

Often the microscopical examination of the liver shews

it to be full of tubercles when no definite opinion could be given from naked eye examination.

Occasionally in children and very rarely in adults large caseous tubercular masses (size of nut or walnut) are seen in the liver; when broken down in the centre they may be bile-stained.

Before softening has occurred they resemble the white fibrous masses met with in hard or chronic lymphadenoma, to be certain a microscopic examination is necessary.

Actinomycosis is a rare disease; when met with in internal organs it most commonly occurs in the liver and produces a honeycombed branching abscess cavity, the contents being pultaceous but not caseous. Sometimes it resembles an ordinary abscess, but differs in having no limiting walls, as it infiltrates the surrounding liver substance.

In suppurative thrombosis of the portal vein (pylephlebitis) the suppuration may spread in a branching manner throughout the liver, the section being studded with small abscesses. Suppuration spreading along the bile ducts (cholangitis) may produce much the same appearance.

Hydatid cysts occur more commonly in the liver than elsewhere, the thickness of their walls and the character of their contents should be noted.

Simple cysts are sometimes found in the liver, generally on the surface.

In rare cases the liver is affected by cystic disease, the whole organ being occupied by cavities of various sizes containing clear fluid; this condition may be associated with cystic disease of kidneys and the brain.

Small tumours composed of blood vessels are occasionally seen.

Biliary calculi of considerable size are sometimes found embedded in the liver substance.

When there is a single abscess in the liver, the connection with dysentery should be remembered; when multiple, pylephlebitis and pyaemia should be borne in mind.

Secondary nodules of new growth—carcinoma or more rarely sarcoma—may be found scattered throughout the liver, they are commoner on the surface of the organ.

They tend to break down in the centre.

Primary new growth may start in the bile ducts or gall bladder, and grow by continuity into the liver.

Primary new growth of the liver is more often sarcomatous and is often pigmented; it tends to infiltrate the liver very extensively and greatly increases its weight.

When a large melanotic growth occurs in the liver the eyes and the skin should be carefully examined for any suspicion of a primary growth, as the primary growth may be comparatively small while the secondary tumours are large and prominent.

Pernicious Anaemia.

The section of the liver should be tested both macroscopically and microscopically for the presence of free iron. A solution of ferrocyanide of potassium is allowed to flow over the surface, after this a dilute solution of hydrochloric acid is poured over, if free iron is present a speckled blue tint is developed.

This is however not an absolute test for pernicious anaemia.

Sulphide of ammonium gives a dark green colour even if no free iron is present and is therefore of no diagnostic value in pernicious anaemia.

LI. *Structures on the Posterior Wall of the Abdomen.*

Any fluid in the abdominal cavity should be soaked up with a sponge and got rid of.

All the viscera have now been removed. The inferior vena cava was opened up and removed in the examination of the suprarenal bodies (vide § XLVIII).

The condition of the lymphatic glands around the aorta should be noted. They may be enlarged in cases of lymphadenoma when the individual glands will remain distinct, in sarcoma (especially of the testis) or carcinoma secondary to disease in the viscera, when the growth will not be limited to individual glands, but will be found to spread out of one to others and into neighbouring tissues.

The glands may surround the vessels and often compress and infiltrate the thin walled veins, but the aorta is almost always unaffected though it may be deeply embedded in the growth.

The lymphatic glands in front of the spine may be much enlarged in tuberculosis; those in contact with the pancreas are commonly attacked and, by indenting it, may simulate tubercle of pancreas, which is however extremely rare.

Occasionally the lymphatic glands are found pigmented.

In enteric fever the glands may be seen to be swollen and soft like those in the mesentery.

The semilunar ganglia were examined at the time that the suprarenal bodies were removed. The solar plexus and sympathetic cords should now be examined and if necessary dissected.

The *aorta* should be opened up with a pair of scissors in the anterior median line and the incision carried into the iliac arteries. Care must be taken in cases of thrombosis of the iliac veins not to cut them across; in such cases the veins should be carefully opened first.

While cutting open the aorta note the condition of its walls; in young anaemic girls its walls are very thin and the vessel is small; in old people there is nearly always some atheroma.

There may be extensive calcification in the internal coat and the calcareous plates may be exposed to the blood stream; note the rarity of any clotting occurring on these exposed plaques. These calcareous plaques may be stained black.

A frequent site for atheroma and calcification is just above the bifurcation of the aorta, which often shews raised patches of chronic endarteritis around the origin of its branches.

When atheromatous the aorta may be tortuous; this is more frequently seen however in the iliac arteries.

In febrile or septic cases the intima may be stained by blood pigment; this is a post-mortem phenomenon (cf. § XXVIII).

If it is desirable to examine the thoracic duct this

should be done before removing the aorta; it should be looked for under the right renal artery, the right crus of the diaphragm should be drawn outwards and cut across and the thoracic duct followed into the thorax.

Dissect the aorta off the front of the spine so as to expose the vertebral bodies.

In old people the anterior common ligament may be ossified, or there may be small bony masses projecting from the front or sides of the vertebral bodies.

In aneurysm of the aorta the condition of the vertebra should be noted; if there is any erosion the relation of the sac to the spinal nerves should be made out.

In cases of new growth in any organ examine the vertebrae for secondary growths by testing the resistance of the bones to the point of the knife.

In fracture or caries of the spine the affected portion had better be sawn out intact and removed (vide Spine, § LXXXIII).

A cut should always be made into the psoas muscles in their long axes, so as to detect any suppuration recent or old.

If necessary dissect off the psoas muscles and examine the condition of the sacro-iliac joints. In cases of separation of the symphysis pubis without fracture of the pelvis, the sarco-iliac joint on one side will be found torn through.

CHAPTER V.

EXAMINATION OF THE KIDNEYS AND PELVIC VISCERA.

LII—LIII. *Kidneys and Ureters.* LIV. *Testes, Rectum, Bladder, Prostate.* LV. *Removal of the male pelvic Viscera.* LVI. *Removal of the male Urino-genital tract in continuity.* LVII—LXII. *Female pelvic organs and generative organs.*

LII. *Kidneys and Ureters.*

The kidneys and ureters are now the only viscera remaining in the abdominal cavity proper; the pelvic viscera however are still intact and will be examined later.

The ureters should first be exposed and examined. If they are dilated or thickened from inflammation it is best to remove the kidneys, ureters and pelvic viscera in continuity and examine them out of the body. A description of the method of removing the whole of the urino-genital tract will be found pp. 139—141.

Notice any twisting or tortuosity of the ureter. If the ureter arises from the anterior surface of the kidney, it will be found either that the kidney is displaced or that it is very freely movable.

If a floating kidney has been suspected during life, the mobility of the kidneys should be tested before the

removal of the colon, as after this has been done the peritoneal relations and connections are too disturbed to allow of an accurate opinion as to the existence of a floating kidney being arrived at; though normally the kidney will be found fixed after the removal of the colon and even of the liver.

Of the two kidneys the right is more often found to be movable than the left.

One of the kidneys may appear to be absent and may be represented by a small atrophied organ or no relic of it may be found; the other kidney will, if healthy, be found to be hypertrophied.

One of the kidneys may be displaced and found in the iliac fossa or on the brim of the pelvis or promontory of the sacrum.

The two kidneys may be united across the spine by a band of kidney substance from which a distinct ureter may arise: in this horse-shoe condition the kidneys are always united by their lower ends.

If there be no disease of the ureters, the kidneys may be removed by pulling them forwards out of the fat which surrounds them, and cutting across the ureters and renal vessels at the hilum.

With regard to the vessels: the renal veins have been examined with the inferior vena cava. The renal artery in cases of unilateral atrophy should be opened up before removal of the kidney.

In removing the kidneys notice whether there is any matting together or firm adhesions between them and the peri-nephritic fat.

Peri-nephritic adhesions are found with "surgical kidney," tubercular disease of the kidney or renal calculi.

After removal from the body, dissect off any attached fat and weigh the kidney. The average weight of an adult's kidney is 6 oz., the left kidney usually weighs a little more than the right.

The kidneys should be examined at once after removal; if this is not convenient each kidney should be placed on the corresponding side of the body, so that no difficulty about right or left may arise subsequently.

Variations in weight.

In cases of fever, especially pneumonia, the kidneys, like the liver (§ XLIX), may be greatly increased in weight from cloudy swelling, without there being any old standing disease.

In cases of acute (scarlatinal and tubal) inflammation the weight remains practically normal.

In lardaceous disease, subacute and chronic parenchymatous nephritis, tubercular kidney, cystic disease and hydronephrosis, and in cases of new growth the weight of the organ is increased.

When there is only one actively functional kidney it hypertrophies and may weigh the same as two normal ones.

In old age the kidneys atrophy and lose weight considerably.

When both kidneys weigh less than normal, the common cause is chronic interstitial nephritis. If one kidney only is atrophied, it probably is due to its ureter

having been permanently blocked with a calculus. When the obstruction is intermittent hydro-nephrosis results.

In subacute and chronic parenchymatous nephritis the organ becomes more globular.

LIII. *Opening the Kidney.*

The kidney is held in the left hand with its convex border pointing upwards. The large flat brain knife is drawn through from heel to toe so as to divide the kidney substance in one cut down to the pelvis.

If the section is not made in one sweep irregularities are produced, which make it more difficult to judge of the appearance of the cut surface.

This cut generally exposes the pelvis of the kidney which can be further opened up with scissors. The inside of the pelvis should be smooth, shining, and shewing only a very few injected vessels. If the pelvis is much injected, roughened, covered with adherent lymph or if there be ulceration of its mucous membrane, there is pyelitis. The urine which is readily pressed out of the papillae of the pyramids is very often turbid and should not be mistaken for pus.

Removal of Capsule.

Pick up the capsule in a pair of forceps, or better with the fingers, and strip it off the surface of the kidney.

Normally veins pass, in one or two places, from the kidney into the surrounding fat, so that the capsule may appear to be adherent at one or more spots.

The capsule may be thickened and firmly adherent all over, so that, if an attempt be made to remove it, the

kidney substance comes away with it. This is the case where inflammation has spread from the kidney to the capsule, as in consecutive nephritis ("surgical kidney"), tubercular kidney and in chronic interstitial nephritis ("granular kidney"). It may be noted, however, that in many granular kidneys the capsule is not adherent.

In many cases the capsule splits; this may occur when it is adherent and thickened, but not uncommonly the fault is with the method of removing the capsule and not with the kidney.

In acute nephritis and in cases where the organ is swollen (febrile conditions) and the capsule has not had sufficient time to expand, it will be found to peel off more readily than is normally the case.

Examination of Surface of the Kidney.

Normally in children the kidney shews lobulation; this condition may persist into adult life and is often spoken of as foetal lobulation.

In old age the surface becomes slightly irregular so as to have a slightly 'granular' appearance.

In chronic interstitial nephritis the surface of the kidney is uniformly irregular from numerous depressions which leave the more healthy parts as small red elevations. Very frequently small cysts are found in considerable numbers in granular kidneys.

In contracting white kidney the elevations have the same arrangement but are white instead of being red.

In cases of old standing heart disease the kidneys frequently shew numbers of fairly large depressed scars—the cicatrices of old infarcts. Between these scars the

kidney substance stands up and simulates a granular condition, from which it should be easily told by the irregular distribution and comparatively large size of both the scars and the intervening elevations.

Recent infarcts appear as pale areas surrounded by a zone of congestion; pyaemic infarcts are small and may appear as deeply congested spots with or without a white softened centre where suppuration is beginning.

Pyaemic infarcts which have suppurated—pyaemic abscesses—may project from the surface of the kidney like small cysts; ordinary infarcts never appear above the rest of the surface of the organ.

Consistency.

In febrile diseases, in decomposition, in acute suppurative nephritis, in fatty degeneration and subacute and chronic parenchymatous nephritis, the kidney is softer than normal.

In chronic interstitial nephritis and in chronic cases of "surgical kidney" the increase of fibrous tissue renders them tough.

In chronic venous congestion the kidneys are slightly tougher.

Cysts.

A few small cysts are commonly found on the surface of kidneys which are otherwise normal: they project like small bullae and are often torn open on removing the capsule so that they then appear as small smooth walled depressions.

When there are a large number of cysts the kidney is most often in the condition of chronic interstitial nephritis.

In the condition of cystic disease the whole kidney may be a congeries of cysts. This may be an acquired condition, or may be congenital, in which case the liver and perhaps the brain will shew a similar change.

The contents of the cysts may be clear and watery, or from degeneration of their epithelial lining may come to contain syrupy or glue-like (colloid) contents. The colloid material may dry up and the cyst become solid with contents not unlike caseous material.

If the cysts are large their relation to the pelvis must be made out; if they communicate with it, they are not cysts but dilated parts of the calyces and the condition is one of hydro-nephrosis.

Small white spots are often seen on the surface of the kidney in cases of general tuberculosis; they are miliary tubercles, when they enlarge they look like minute abscesses, but differ from pyaemic abscesses in having no surrounding zone of congestion.

Colour of the Surface and of the Section of the Kidney.

Normally the surface of the kidney is a deep dull red. In persons who have suddenly been killed while in perfect health the kidney may contain so much blood as to suggest a morbid congestion.

In cases of decomposition it becomes darker and may, like the liver and spleen, be deeply stained from the post-mortem diffusion of gases from the colon (§§ XLIX, XLII).

In anaemia and fatty change the kidney appears uniformly pale.

In lardaceous disease and in the large white kidney of

subacute and chronic parenchymatous nephritis the surface is pale, but the pallor is not quite uniform, as the stellate veins give the organ a mottled appearance. In subacute cases the pyramids may be deeply congested and stand up in marked contrast to the pale swollen cortex.

In fatal cases of acute nephritis, or in cases of acute attacks on old nephritis, the outside of the organ may be very deeply congested. On section the kidney is deeply congested, of a dark chocolate colour, the pyramids shewing this even more than the cortex. The organ may be so congested that on section blood drips from it (dripping kidney).

In chronic venous engorgement the kidneys are often paler than in perfect health and hazy and dull.

Examination of the Cortex.

The size varies somewhat within normal limits so that much stress should not be laid on slight diminution. The cortex though healthy may appear diminished, if oblique or irregular sections are made.

When the kidney is swollen from fever or poisons, and in acute and chronic parenchymatous nephritis, the cortex is larger than normal.

In chronic interstitial nephritis, consecutive nephritis and in hydronephrosis the cortex is smaller than normal. In contracting white kidney the cortex is diminished, though not so markedly as in red granular kidney, and pale in colour.

With the naked eye the conditions of the malpighian bodies and of the tubules in the cortex can be partially examined.

In acute glomerulo-nephritis the malpighian bodies may stand up as prominent red dots.

In lardaceous disease the malpighian bodies appear somewhat translucent.

In applying the iodine test, wash the surface free from blood and pour on the iodine solution; allow it to remain for some little time as the reaction may not develop at once. The malpighian bodies appear as dark brown dots and the arteriae rectae, when affected, as streaks. The healthy parts are yellow.

When the convoluted tubes are dilated and distended with epithelial débris undergoing fatty degeneration, they may become visible as whitish opaque streaks.

The cysts, tubercles, infarcts, etc., seen on the surface will be better seen on section.

Recent infarcts appear as irregularly wedge-shaped pale patches with the base towards the cortex, surrounded by a zone of congestion.

Recent pyaemic infarcts may, when small, appear like small branching haemorrhages, the apex pointing towards the medulla. When large they are white triangular areas softening down in the centre and usually surrounded by a zone of congestion.

In suppurative nephritis, spreading along the fibrous framework from an inflamed pelvis, white spots and streaks of suppuration can be traced up from the medulla into the cortex.

The scars of old infarcts will be seen to have little tapering masses of fibrous tissue under them.

Examination of the Medulla.

Note the distinction between the cortex and medulla. In chronic interstitial nephritis it is very slight.

The pyramids in cases of hydro-nephrosis recede from the enlarged pelvis.

In chronic interstitial nephritis the atrophy of the medulla shews up the fat in the hilum which appears increased in amount.

On section the tips of the pyramids often appear pale; this is of no pathological significance; if however there are white streaks, this is due to the collecting tubes containing a deposit, probably urates or uric acid. In such cases the external ear should be examined for tophi and the first metatarso-phalangeal joints for uratic deposits.

Small hard nodules are sometimes found in the pyramids: they are fasciculated fibromata.

Small miliary tubercles may be scattered over the medulla; collections of caseating tubercles may run together and form abscesses in the medulla: this is an early stage of tubercular kidney.

In congenital cystic disease the cystic condition is most marked in the pyramids and spreads up towards the cortex; whereas the multiple cysts found in some cases of chronic interstitial nephritis occur in greatest numbers in the cortex.

LIV. *Examination of Testes.*

The testes are more conveniently removed from the body before the contents of the pelvis have been taken out, as the vas deferens is at this period of the examination still intact.

Examine the situation of the internal abdominal rings; a dimple is very frequently present there.

If the tunica vaginalis is patent or if there be an inguinal hernia, the tunica vaginalis or hernial sac should be removed together with the testis and cord in one piece. The peritoneum around the internal ring should be incised with the knife at some little distance from it and the tissues dissected away from the sac, which by gentle traction is gradually lifted out of the scrotum and freed from its connections.

In any case of herniotomy or radical cure the parts should be removed intact in a similar manner.

If the internal abdominal ring is normal the cord and testis should be removed in the following way.

The vas deferens as it comes out of the true pelvis should be picked up and followed to the internal ring. There is usually no difficulty in finding it at once, but if the contents of the pelvis have been removed it is not easy.

If for this or any other reason the vas deferens is not easily found, the spermatic veins can easily be traced down to the internal ring; they usually shew up plainly underneath the peritoneum.

At the internal ring the cord should be picked up with the forceps or in the hand and traction made on it. The testis is thus pulled up into the abdomen; as it passes through the inguinal canal the rings may require touching with the knife to allow of the passage of the testis. If the testis is not pulled through the canal easily and much force is employed, the cord is likely to

break, so it is well to use the knife if there is any difficulty at all.

If the cord has been broken, the testis can be removed by pushing it up from the scrotum into the abdomen and freeing any of the coverings of the inguinal canal which obstruct its passage. This is a clumsy method and should never be necessary.

On pulling the testis by the cord into the abdomen, the tunica vaginalis is seen to be united to the bottom of the scrotum by a varying amount of connective tissue (the remains of the gubernaculum testis): on traction this produces invagination of the scrotum.

The tissue connecting the tunica vaginalis to the scrotum is to be cut through quite close to the testis; if it be cut through at some distance the invaginated piece of the scrotum may be removed at the same time.

The tunica vaginalis may, however, be firmly adherent to the skin as in tubercular epididymitis and require more careful dissection.

After removal, the cord and testis should be examined on a small raised table.

The cord may be dissected with forceps and scissors.

The condition of the vas which lies behind the cord, and of the pampiniform plexus of veins is to be noticed. A varicose condition of these veins (varicocele) is commoner on the left side.

Thickening of the vas deferens occurs in tubercular disease of the epididymis.

Snip open the tunica vaginalis in the long axis of the testis anteriorly.

The surfaces should be quite smooth and glistening.

Adhesions may be universal and dense, or few and delicate.

The commonest cause of a few delicate organized adhesions is a past attack of epididymitis.

Note the character and amount of any fluid in the tunica vaginalis; it is generally small in amount and straw-coloured. The presence of blood (haematocele) in the tunica vaginalis is rare.

Occasionally small white bodies may be found loose in the tunica vaginalis; they are derived from the pedunculated hydatid of Morgagni and may be associated with a small hydrocele or with a granular appearance of the serous surfaces of the tunica vaginalis.

The Epididymis.

This body often has small cysts in connection with its head; they may project from its surface; their contents are usually clear but may be milky from the presence of spermatozoa (spermatoceles).

The epididymis is enlarged in cases of chronic or recurrent inflammation, the result of urethritis; the tubes in it may become distended with cells undergoing fatty degeneration, and the swollen epididymis may feel knobby.

Tubercular disease begins in the epididymis and produces great enlargement of it, from the epididymis softened caseous matter may pass outwards to the skin which becomes adherent to the affected part.

Between the globus major or head of the epididymis and the testis there are two bodies, the pedunculated and

the sessile hydatids of Morgagni, they vary much, sometimes one is absent; they may become cystic.

The pedunculated hydatid sometimes becomes detached and forms a loose body in the tunica vaginalis.

Section of Testis.

The testis should be tightly held with its anterior surface upwards and the epididymis directed backwards and opened by a single cut which should divide the globus major and the testis down to the hilum.

On section a healthy testis is of a white or slightly creamy colour and bulges out so that it appears to be a little too large for its capsule.

The surface is fluffy with a few slight depressions indicating the position of the septa, no fibrous tissue is seen unless the hilum is exposed.

The testis may shew a general fibrous increase or its substance may be entirely replaced by fibrous tissue, when this is the case the tunica vaginalis will probably be found adherent and thickened.

Small caseous masses surrounded by fibrous tissue are gummata.

Occasionally large caseous masses, without any fibrous tissue surrounding them, are found in cases where there is little or no tubercular disease of the epididymis; this is an exceptional form of tubercular testis.

In cases of tubercular epididymitis and orchitis the cord and vesiculae seminales must be carefully examined.

New growths begin in the testis and spread up the cord to the lumbar glands.

In sarcoma of the testis cartilage sometimes occurs; it is never present in carcinoma.

Cysts may occur in malignant disease.

Malignant growths of the testis are soft and often very vascular, they may be associated with haematocele.

Cystic disease of the testis is very rare.

LV. *Removal of the Male Pelvic Viscera.*

The method for removing the bladder, urethra, ureters, and kidneys in continuity will be found in § LVI.

In an ordinary examination the urethra is not examined.

Before removing the pelvic viscera examine them *in situ* for any evidence of inflammation recent or old.

In old people there is occasionally a very low form of peritonitis which has rather come on during the process of dying than been the cause of death; this like most other forms of peritonitis is most marked in the pelvis.

In cases of ascites some of the fluid may coagulate and may form a loose clot which is not uncommonly found in Douglas's pouch, but is not accompanied by evidence of any inflammatory process such as dulling or local injection of the peritoneum. The clotting has very probably occurred after death.

Note the condition of the bladder, if it is very much distended it will be safer to remove the urethra in continuity with it, as the dilatation may be due to a urethral stricture.

In cases where hypertrophy of the prostate is suspected

it is best to open the fundus of the bladder *in situ*, so as to be able to examine the relation of the urethra to the hypertrophied prostate. If the middle lobe is much enlarged the part it plays in causing obstruction can thus be easily observed. After this the bladder can be removed in the ordinary way.

In taking out the pelvic viscera it is very convenient to wear thick india-rubber gloves. The knife and the hand can then work safely together when out of sight.

With the left hand pull the bladder upwards and with the knife separate it from the anterior abdominal wall and from the back of the pubes and dissect a little under the pubic arch so as to free the prostate. Do not cut through the urethra yet, but carry the knife backwards around the brim of the true pelvis so as to free the bladder from its lateral connections. Pull the rectum forwards and with a few strokes of the knife separate it from the sacrum, follow it down the curve of the sacrum, cutting through any connective tissue between them.

Cut across the rectum close to the anus, and continue the dissection forwards on the floor of the perinaeum for a short distance.

Now lift the pelvic viscera upwards and pass the knife under the pubic arch and cut through the commencement of the urethra. A few touches more with the knife will free the pelvic contents completely.

Place the pelvic viscera on the table with the rectum upwards, pass the hand over the rectum so as to detect any growths or strictures. If the rectum is normal proceed with a pair of scissors to cut it up in the posterior median

line, if there be any cause to suspect stricture, this must of course be investigated before so doing.

Notice the size of the rectum.

Sponge the mucous membrane so as to clean it from faeces.

Examine the mucous membrane, note the presence of two transverse folds of the mucous membrane (Houston's folds).

Note the presence of any considerable injection, which is pathological, in the rectum; examine any ulcers and note whether there is any inflammatory condition spreading outwards from them or whether, if single, the ulcer is the opening of an ischio-rectal abscess.

Occasionally a flat ulcer is found on the posterior wall of the rectum with its surface caked with faecal matter. Ulceration of the rectum may also be due to syphilis. It is commoner in women and may lead to very extensive cicatrisation. Tubercular ulceration may be associated with an ischio-rectal abscess.

Notice the extent of any thickening of the wall of the bowel.

Note any piles. Varicose veins projecting under the mucous membrane form internal piles, external piles are covered with skin.

Notice any polypi, when small they are soft and composed of mucous membrane, when old and large they are much harder, and wart-like; microscopically however they are both formed of tubes like Lieberkühn's crypts.

Malignant disease of the rectum (columnar-celled carcinoma) spreads round the bowel, in the submucous layer,

and produces an annular stricture; the growth is white in colour and infiltrates the wall of the bowel. (Vide § XVIII for characters of malignant growths in colon.)

Pick up the rectum at its lower end and with a pair of scissors reflect it off the surface of the prostate and the base of the bladder.

Turn the bladder over so that one blade of a finely pointed pair of scissors can be introduced into the urethra. Open the prostatic part of the urethra and the bladder in the anterior median line.

Bladder.

In a normal bladder the mucous membrane is pale and smooth, shewing a few injected vessels in the trigone only.

Indications of muscular tissue under the mucous membrane can be normally seen; when greatly exaggerated in hypertrophy of the bladder, this condition is known as the fasciculated or columnar bladder.

When empty and contracted the mucous coat of the bladder is thrown into rugae and the muscular wall appears much thicker; this must not be confounded with hypertrophy.

Notice the character of the urine.

The urine is often turbid; unless it has an ammoniacal smell this is of no importance.

If there is decomposing urine there is probably cystitis.

Notice any admixture of blood, pus, mucus, or gravel with the urine.

Post-mortem urine does not necessarily contain albumin even when it has been in the bladder for a long time after death.

Mucous Membrane.

If it is swollen and deeply injected or if there is adherent lymph or ulceration, there has been acute cystitis during life.

In chronic cystitis the mucous membrane is thickened, corrugated into rugae and of a dark greyish purple colour; on its surface there will be tenacious mucus and in many cases a phosphatic deposit.

Inflammation of the pelvis of the kidney (pyelitis) may follow cystitis without the intervening tract of the ureter shewing any evidence of inflammation.

Occasionally, as the result of a past cystitis of some duration, the mucous coat shews pigmented areas of a slate colour.

In hypertrophy the muscular fibres shew up as fasciculi or columns under the mucous membrane; between the columns the mucous membrane may become pouched. These sacculi are very thin walled. They may contain encysted calculi.

When the bladder is hypertrophied the vesical orifices of the ureters should be investigated by passing a probe from the cut end of the ureter into the bladder. Their openings may become extremely valvular and obscured. The lower end of the ureters is the narrowest part and is a frequent place for the impaction of calculi. In tubercular disease there are ulcers at first small, afterwards larger. They are due to breaking down tubercles. This condition is accompanied by cystitis.

Mucous polypi of the bladder are very rare. Delicate branching villous tumours may be present, but are rare.

Malignant disease is most often squamous-celled carcinoma and slow growing; it infiltrates the whole thickness of the wall of the bladder and when ulcerated has some resemblance to a villous growth.

Examine the neck of the bladder; notice whether the prostate is prominent, if so whether any part of the base of the bladder is below the level of the urethra.

The prostate may be enlarged as a whole or the middle lobe may be chiefly affected and by being pedunculated may obstruct the urethral orifice.

Before making sections of the prostate the vesiculae seminales should be examined.

Vesiculae Seminales.

Turn the bladder over and with a pair of scissors clean the fascia off the base of the bladder just above the prostate.

The large convoluted vesiculae seminales are easily exposed.

On section they are thin-walled, honeycombed spaces containing a clear viscid slightly yellow fluid.

In children the vesiculae seminales are small and empty, in the aged they usually contain fluid.

Sometimes the fluid is turbid and brown in colour, probably from past inflammation.

The vesiculae seminales may be thickened from inflammation due to gonorrhoea or they may be occupied by caseous tubercle in cases of tubercular disease of the testis or bladder. In both cases the vesiculae seminales will be adherent to the surrounding tissues and their dissection will not be so easy as in health.

Prostate.

The prostatic plexus of veins is often prominent in old men, the veins may become varicose and the blood clotting in them may become organized and eventually become round hard white calcified masses—phleboliths.

Sections of the Prostate.

Cut a series of transverse sections from the posterior surface, leaving them attached by the mucous membrane of the urethra and bladder.

In these sections the common ejaculatory ducts are cut across and must not be mistaken for cysts.

Very commonly small blackish brown calculi are found embedded in the prostate of the old, they can sometimes be seen projecting under the mucous membrane of the prostatic portion of the urethra. They are composed chiefly of phosphate of lime.

Small abscesses may occur in the prostate. Occasionally the prostate shews excavations opening into the urethra, the remains probably of abscesses which at some former time discharged into the urethra.

In tubercular disease of the urino-genital tract soft caseous masses may occur in the prostate.

The prostate may be uniformly hypertrophied or there may be localized enlargements, these may be of various sizes and may be encapsuled so as to resemble fibro-myomata of the uterus.

LVI. *Removal of the Male Urino-genital tract on Continuity.*

In cases of stricture of the urethra or of hyper-

trophy of the prostate or in cases of obscure vesical disease the kidneys, ureters, bladder and part of the urethra should be removed from the body *en masse* and the urino-genital tract then opened up in its continuity.

In cases of phimosis, which have caused by backward pressure, hypertrophy of the bladder, dilatation of the ureters and pelvis of the kidneys, the foreskin, penis and the whole of the urinary tract may with advantage be removed in continuity. But as a rule it is advisable not to remove the foreskin and glans penis.

Removal of Kidneys, Ureters, Bladder and Urethra in continuity.

After the removal of the suprarenals the kidneys should, together with the ureters, be freed from their connections. Each kidney is held in the left hand, and the ureter is traced down to the bladder.

The kidneys and ureters are allowed to hang over the pubes while the rectum and bladder are freed from their connections in the pelvis (as described § LV).

The bladder is separated from the back of the pubic symphysis.

The original incision through the abdominal wall [§ IX] is continued downwards from the symphysis over the dorsum of the penis.

The skin is rapidly separated off the penis.

The penis is cut transversely across just behind the glans which is left attached to the foreskin.

The difficult part is the removal of the membranous and prostatic portions of the urethra without injury.

Two methods may be employed, in the first a piece of

the symphysis and pubic bones, with the urethra attached to its under surface, is sawn out. The bone and the urethra and bladder are removed together, the bone is then easily dissected off and can be replaced and firmly fixed with wire in its position in the body. This is the safer method; it is done as follows.

Method i.

Clean the upper surface of the symphysis pubis and adjacent part of the transverse rami of the pubes; clean the descending ramus of the pubes, removing the attachments of the adductor muscles.

Lift up the penis and dissect it away from the skin of the perinaeum. (The testes have been already removed.) The skin of the scrotum is left intact.

Cut through the attachments of the crura of the corpora cavernosa to the ischia.

Saw through the pubes on each side at a point about an inch from the symphysis.

Cut through the descending rami of the pubes where they join the ascending rami of the ischia with bone forceps. With the knife free any ligamentous bands uniting the bones.

Lift up the bladder and symphysis and carefully cut through with the knife the tissues under the prostate gland.

The bladder, urethra and symphysis should now be quite free, and together with the ureters and kidneys may be removed from the body.

The piece of symphysis can now be separated from the urethra, the knife being kept close to the bone. This can

be done quite safely out of the body, but the dissection of the urethra from under the pubic arch when in the body is dangerous, because, being necessarily rather out of sight, the urethra may easily be wounded or cut across.

The piece of bone should be replaced and a wire rivet put in to fix it.

Method ii.

The pubic arch is not sawn through but the penis with the contained urethra is dissected off from it, the blade of the knife being kept close to the bone. The crura of the penis are divided at their attachment to the rami of the ischia.

When quite freed from the under surface of the symphysis the penis is pushed through the opening thus made into the cavity of the pelvis.

The penis and bladder are grasped in the left hand and drawn upwards while the prostate is freed from its connections until the bladder and urethra are quite free and can be removed from the body.

The urethra, bladder, ureters and kidneys are placed on a table.

The portion of the penis removed should be firmly held by an assistant and the urethra opened along its dorsal aspect. One blade of a strong pair of scissors is placed in the urethra and the incision carried through the septum pectiniforme. The incision is carried on into the bladder along the anterior median line.

Examine the mucous membrane of the urethra for any ulceration or cicatrization. Note the presence and character of any stricture of the urethra.

If there is a stricture look carefully for false passages and compare the size of the urethra above and below the stricture. In the dilated part of the urethra above a stricture the mucous membrane may become ulcerated and a pouch, communicating with the urethra, may result.

Around such a pouch there will be condensation and inflammation of the connective tissue.

Examine the tissue around the stricture and the dilated proximal part of the urethra for thickening, the result of long-continued inflammation or for signs of recent inflammation such as diffuse suppuration or a localized abscess.

After examination of the bladder (vide § LV) the orifices of the ureters should be tested by passing a probe through them.

The ureters should be opened just above their entrance into the bladder and the probe passed downwards.

The ureters should be opened up with a pair of scissors and the pelvis of the kidneys laid open.

Cystitis may spread up the ureters to the pelvis of the kidneys by continuity, the ureters being inflamed, thickened and ulcerated, in other cases of cystitis the ureters may escape but pyelitis be found.

The ureters when much distended become somewhat tortuous. The distension of the pelvis of the kidneys or hydronephrosis is accompanied by diminution in the amount of the renal substance which is first shewn by a recession of the pyramids from the pelvis of the kidney.

LVII. *External Genitals. Female.*

Examination.

Note the presence of any swelling or laceration of the labia majora.

Warts, pendulous growths or ulcers should be looked for.

Note the condition of the fourchette and the perinaeum.

Separate the thighs widely and pull the labia majora apart to expose the labia minora and vaginal orifice.

In children the labia minora not unfrequently project beyond the labia majora.

The labia minora may be fairly firmly united in young children.

Examine the vaginal orifice for any lacerations, blood or discharge.

If there is a purulent discharge, note whether it comes from the region of Cowper's glands or from the upper part of the vagina.

If there is a muco-purulent discharge or inflammation of the vulva place the index finger of the right hand in the vagina and make pressure with it on the urethra in the anterior wall of the vagina. If there is any urethritis muco-pus will be driven out of the urethra.

Gonorrhoea in women shews itself by a discharge from the urethra; the vagina is usually unaffected, though the inflammation often spreads to the cervix uteri and tubes.

Note the presence or absence of a hymen and its form if present.

The hymen may be imperforate. When destroyed its relics in the form of small projections on the vaginal wall, carunculae myrtiformes, should be noted.

The ovarian veins have been examined with the renal

veins. If thrombosed or inflamed they will already have been opened up and traced into the broad ligament.

In cases of recent delivery or of pregnancy the ovarian veins are much dilated.

If there is any reason to suspect thrombosis in the femoral veins, they are to be opened and any thrombus traced into the external and internal iliac veins before removing the contents of the pelvis.

Carefully examine the contents of the pelvis *in situ*.

Note any evidence of recent inflammation, any lymph or recent adhesions.

In cases of peritonitis the inflammation gravitates into the pelvis and is usually more advanced there. In cases where suppuration is most marked on the right side the condition of the vermiform appendix should have been already noted.

Not uncommonly a small patch of adherent lymph is found at the bottom of Douglas's pouch without there being any signs of more general peritonitis. In such cases the fallopian tubes must be opened up and the character of their contents examined, as such a local peritonitis might be due to leakage from the tubes.

Note any evidence of past inflammation such as adhesions around the uterus, ovaries or tubes. Adhesions are often found in Douglas's pouch.

In cases of past inflammation pigmentation of the peritoneum may be due to destructive changes in the blood which has been poured out, or it may be due to long-standing congestion.

In cases of chronic inflammation of the pelvic peri-

toneum the organs may all be bound together by dense fibrous tissue and their removal may be attended with some difficulty.

In any case of adhesions about the uterus and appendages note the position of the parts before removing them from the pelvis.

The uterus may be anteflexed, retroverted or retroflexed, or laterally displaced.

It may be prolapsed or procident; if so, its relation to the other pelvic viscera is much altered and should be noted, especially with reference to the bladder and ureters.

LVIII. *Removal of the Contents of the Pelvis in the Female.*

Separate the bladder from the pubes, to which it is rather more closely applied than in the male. Carry the incision round the brim of the pelvis on both sides, taking care not to damage the ovaries or broad ligaments, which may be pulled inwards by the left hand.

Rapidly reflect the rectum forward from the sacrum. The contents of the pelvis now remain attached by the orifices of the rectum, vagina and urethra.

In an ordinary case the rectum, vagina and urethra should be divided within the pelvis.

If, however, it is desirable to remove the whole of the vagina and the labia minora, the following plan should be adopted.

The vulvar orifice is widely opened, the legs of the subject being separated.

The blade of the knife is then inserted vertically just

above the urethra and carried upwards between the internal surface of the pubes and the bladder, the latter organ being pulled backwards by the left hand out of the way of the knife.

The incision is then carried downwards just external to the labia minora. The perinaeum is left intact, but the rectum is cut through inside the pelvis by elevating the handle of the knife, and so bringing the blade into a position parallel to the perinaeum.

The contents of the pelvis can now be lifted out, being freed from all their connections.

Examination.

The rectum and bladder should, in ordinary cases, be examined and removed before the uterus and appendages.

The viscera are to be placed on a small deal table with the rectum upwards.

The rectum is to be opened in the posterior median line. The points mentioned in the examination of the rectum in the male must be gone over (§ LV).

Syphilitic ulceration and stricture are much commoner in the female. If either is present, search should be made for evidence of spread of ulceration by continuity from the vagina.

Remove the rectum. Turn the viscera over and open up the short urethra and the bladder in the anterior median line.

Urethra.

Notice its direction, size and length: alterations are likely to be met with in prolapse and retroversion of the uterus.

Occasionally small vascular growths, caruncles, are seen

near the meatus. The mucous membrane may be very lax and, if prolapsed, may simulate a vascular caruncle.

In cases of gonorrhoea the mucous membrane may be covered with muco-pus and superficial ulcerations may be present.

Bladder.

The mucous membrane at the neck of the bladder in women is normally slightly injected.

The morbid conditions of the bladder met with in women are few.

Foreign bodies or cystitis may be found.

Women sometimes develop cystitis, when lying for some time on their backs.

The bladder may be invaded by malignant disease spreading from the cervix uteri or more rarely from the body of the uterus.

As the result of injury during labour the septum between the vagina and bladder may slough, and a vagino-vesical fistula may result.

If normal, the bladder should be dissected off from the vagina; otherwise it is left.

The vagina, uterus and appendages are now to be examined.

Vagina.

If the bladder has been left adherent to the anterior wall, the vagina is to be opened up in the posterior median line; but in ordinary cases the vagina is opened up in the anterior median line.

Note the presence of any laceration or ulceration of the vaginal walls.

If there is any discharge, note whether it seems to be coming from the os tenci.

The uterus projects downwards into the vagina, a condition which is more prominent in infants.

Examination of the External Os.

The nulliparous os is round, while that of a woman who has borne children is transverse. If a foetus has recently passed through the os, its margins will be thickened, somewhat ragged and everted, while the lateral extremities of the os will be torn.

The tears heal and can then be recognized by the white scars they leave.

The portio vaginalis of the cervix may be much elongated in cases of prolapsus and procidentia uteri.

There may be a red roughened condition of the mucous membrane around the external os: this is the so called "erosion," due to cervical catarrh.

In the neighbourhood of the os externum small cysts, Nabothian follicles, are not uncommon. They are often accompanied by cervical catarrh, but by themselves are not evidence of disease.

In the bodies of old women the external os uteri may be found to be much contracted, but complete obliteration is rare.

Malignant disease may start from the portio vaginalis of the cervix, when it is a squamous-celled carcinoma; or carcinoma may spread from the inside of the cervical canal to the vaginal surface of the cervix.

The surface of the cancerous mass is generally uneven, nodular or ulcerated, and may be warty, polypoid or

papillomatous. A special variety of the latter form is the so-called cauliflower growth which develops from the vaginal surface of the cervix.

The ulceration may be so extensive that the whole of the vaginal portion is destroyed and necrotic, and the cervix may be converted into a sloughing cavity with ragged walls. The carcinoma generally stops short at, or near, the internal os.

Mucous polypi growing from the cervical canal may protrude through the os externum into the vagina; they are small.

The mucous membrane of the cervix may protrude as a soft red mass through the os externum, forming a so-called "erosion." This may be smooth on the surface or papillomatous and spongy, and superficially ulcerated. "Erosions" are, at times, easily mistaken for malignant disease which macroscopically they often resemble.

Syphilitic ulceration of the cervix is extremely rare.

LIX. *Opening the Cervix and Uterus.*

The cervix and body of the uterus should be incised with a scalpel in the anterior median line, without quite opening their cavities; one blade of a pair of scissors is then introduced into the external os, and the cervix and body of the uterus are opened up. The preliminary incision with the knife is employed, because the substance of the uterus is so tough and resistent that it is not easily divided by scissors alone.

From the upper end of the incision a cut is made towards the entrance of each Fallopian tube.

On section of the uterine wall note its firmness: it is softened in cases of suppuration.

Examination of the Cervical Canal.

The cavity of the cervix is spindle-shaped or fusiform.

Normally the cervical canal contains glassy mucus and its walls shew a rugose condition, the arbor vitae, which disappears in great part after childbirth. In chronic catarrh its folds may be greatly swollen and polypoid in appearance.

Polypi may spring from the walls of the cervix; they may be soft, fibrous or cystic.

In cases of recent delivery there is no cervical canal.

The cervix may be considerably enlarged or elongated, and this hypertrophy is generally accompanied by prolapsus uteri.

Examination of the Uterus.

In adult nulliparae the uterus measures $2\frac{1}{2}$ in. in length. The cavity is small, triangular in outline and bounded by convex walls.

In old age the uterus atrophies.

If death has occurred during menstruation, the uterus and vagina contain a little grumous blood. The lining of the uterus is shreddy.

During pregnancy the uterus undergoes considerable changes which are easily recognised. The decidua of early pregnancy must not be mistaken for the membrane of membranous dysmenorrhoea.

The mucous membrane may be rough, sloughing or covered with pus.

It may be thickened and nodular (endometritis fungosa) or polypoid (endometritis polyposa).

Soft mucous polypi are sometimes present in the body of the uterus: they are usually attached to the fundus near the tubes, but are less frequent here than in the cervix. They may be multiple.

Fibromyomata starting in the wall of the uterus near the fundus may project under the mucous membrane and form submucous polypi. When such are present examine the endometrium for ulceration or sloughing. Fibroids vary much in shape, size and number and may undergo various forms of degeneration (fatty, calcareous, or necrotic). They may be inflamed or even sloughing and may suggest malignant disease.

Fibromyomata, in the form of encapsuled firm tumours, often occur in grown-up women in the wall of the uterus. When small they contain a large proportion of smooth muscular fibres and are softer.

They may project underneath the peritoneum and become pedunculated; when this occurs they may undergo calcareous infiltration.

When fibromyomata are present, the uterus may be enlarged from the presence of a submucous one filling up and enlarging its cavity, or it may be greatly deformed from interstitial or intramural fibromyomata producing irregularities in its shape; or again from the traction exerted by a pedunculated subperitoneal fibroid the shape of the organ may be much altered.

The section of a fibromyoma shews glistening bands of fibrous tissue surrounding muscular fibres.

Malignant disease may primarily attack the body of the uterus, but more often it spreads from the cervix. When occurring in the body the new growth is soft and white, infiltrates the tissues and breaks down rapidly; it is almost always a carcinoma. Sarcoma is very rare, and when it occurs, causes considerable enlargement of the walls of the uterus.

Changes in the Uterus after Delivery.

After delivery the uterus is enlarged, the fundus reaching above the symphysis pubis, and it is not until the tenth day or so that it again becomes a pelvic organ and then gradually still further diminishes in size. The top of the fundus is convex and rises above the line of the broad ligaments. This condition is permanent. The uterine walls remain thickened and on coronal section they are concave inwards instead of convex, and the cavity of the body of the uterus is distinctly enlarged.

The interior of the uterus is covered by the remains of the decidua, giving it a shreddy appearance, and is infiltrated with blood and covered by the lochial discharge, which changes in its constitution, according to the time which has elapsed since labour, being either blood-stained, serous or sero-purulent.

Two weeks after labour the internal surface of the uterus is cleaner and somewhat resembles granulation tissue and is covered by lighter, slightly viscid lochia. At the third week a pale thin new mucous membrane appears and the lochia are pale yellowish. The new membrane grows in thickness and by the fourth week is almost of normal appearance.

At the placental site, which is generally near the fundus on the anterior or posterior surface, the uterine wall is prominent, uneven and deeply blood-stained. The sinuses are either open or filled by thrombi.

During the second week after labour the placental site is smaller in area and becomes smoother and lighter in colour, the thrombi are cast off and the venous spaces are gradually obliterated by proliferation from their inner coats.

Gradually (from the third to fourth week) a thin pale mucous membrane appears covering the placental area; pigmentation, however, may be observed here for a long time after labour, and the venous spaces show markedly convoluted or folded margins.

The complete involution of the uterus occupies six to eight weeks.

Portions of the placenta and decidua may remain behind and, by the deposition of blood clot on their surface, lead to the formation of polypoid excrescences ("placental and decidual polypi"). Similar outgrowths may be developed from retained clots or thrombi ("fibrinous polypi").

The internal os of the cervix contracts immediately after labour, but remains sufficiently dilated to admit one or two fingers. After ten to fourteen days its involution is complete.

The cervix is loose and soft and increased in length, with irregular and lacerated edges, and remains enlarged for a long time, its involution occupying about six weeks. The external os is patulous and torn laterally and often everted. After seven weeks it resembles the normal os,

but remains a transverse cleft, instead of the round opening of the nulliparous cervix.

The vagina is rugose and gaping, and at its lower end often lacerated.

In puerperal fever the shreddy wall of the uterus is soft and covered by purulent, sanious and foul lochia and is often gangrenous in appearance. Small abscesses are at times seen in the muscular substance.

These changes are especially marked at the placental area, but similar processes may extend into the tubes. The thrombi are discoloured, broken down and soft, and pus may well out of the lumen of the vessels.

Sloughing and gangrenous ulcers also occur in the vagina, especially when the perinaeum is torn. (See also parametritis and perimetritis, § LXI.)

LX. *The Fallopian Tubes.*

The Fallopian tubes occupy the upper border of the broad ligaments. They vary greatly in length and one tube may be longer than the other.

A probe may be easily passed through their fimbriated ends into the ampulla, but is generally stopped in the narrowed inner part of the tube known as the isthmus.

One of the fimbriae attaches the tube to the ovary. A small cystic body, the hydatid of Morgagni, hangs from the fimbriated end of the Fallopian tube. It is often absent, and when present, varies both in size and in the length of its pedicle.

In cases of chronic salpingitis or peritonitis, the fimbriated end may become occluded and the tubes are then

often distended either with watery fluid ("hydrosalpinx") pus ("pyosalpinx"), or with blood "haematosalpinx").

Apart from these three conditions, enlargements of the tubes may be due to extra-uterine gestation, tuberculous infiltration and malignant disease, or to the rare condition known as parenchymatous salpingitis.

Adhesions, more or less firm, may be found between the tubes and the other pelvic organs, the result generally of pelvic peritonitis or salpingitis. All the parts may then be matted together in such a manner that dissection of the separate organs is impossible.

Examination of the Interior of the Fallopian Tubes.

The tubes should now be slit up from the abdominal end along their upper margins.

The mucous membrane is greatly folded near the fimbriated end and in the ampulla, but becomes smoother as the uterus is approached.

In acute inflammation the mucous membrane is swollen, deeply injected and often covered with pus. Simple congestion and hyperaemia of the fimbriated end is no evidence of pathological changes.

It is difficult to recognise chronic inflammation, unless the latter be associated with narrowing or dilatation of the lumen, or with the presence of blood or pus in the tubes. In some cases, however, the mucous membrane and muscular coat are thickened and small nodular masses project into the lumen of the tubes, while in others there is marked muscular atrophy.

True papillary and polypoid growths are extremely rare.

Tubercular salpingitis is generally secondary. Tubercular changes are most marked in the ampulla which is swollen, bent on itself, firmly united to the ovary or adjacent parts and contains caseous pus.

A rare condition somewhat resembling tubercular salpingitis is known as "parenchymatous salpingitis."

Carcinoma is generally secondary to disease in the uterus or more rarely in the ovary.

LXI. *Broad Ligaments.*

The broad ligaments extend from the uterus to the ovary and contain the Fallopian tubes, round ligaments and various foetal remains, viz. the epoopheron or parovarium between the ampulla of the tube and the ovary, and the paroopheron which is situated between the parovarium and the uterus, and also other tubular or cyst-like rudimentary structures in the neighbourhood of the parovarium.

The veins in the broad ligament may become varicose, and phleboliths may be found in them.

Haemorrhages (haematomata) may occur between the folds of the broad ligaments and attain considerable size. These, like para- and peri-metritis, may be unilateral or bilateral, and they may be encapsuled by newly formed fibrous tissue.

In parametritis the broad ligaments may be greatly swollen and oedematous or infiltrated with pus

These changes may occur on one or on both sides and may occupy only a part, or the whole area, of the ligaments. In cases of suppuration the ovarian veins should be

carefully traced up to their termination and examined for thrombosis and phlebitis, and the interior of the uterus should be minutely inspected.

Abscesses may occur or firm adhesions may be found, having led to a complete matting together of the pelvic organs or to dense fibrous induration ("parametritis chronica atrophicans").

Circumscribed collections of serous fluid or exudation are also described as occasional results of parametritis.

New growths are very rare and are as a rule carcinomatous in nature, having spread by extension from the cervix.

Cysts may develop in the broad ligaments and generally arise, it is stated, from the epoopheron or parovarium, rarely from the paroopheron. They are as a rule single and unilocular and situated between the ovary and the abdominal end of the tubes. Note carefully their relation to the tube, ovarian and round ligaments, and ovary. Their fluid contents are almost always clear and limpid, resembling hydatid or cerebro-spinal fluid.

Small cysts are occasionally found in the foetal remains in the neighbourhood of the parovarium, and somewhat larger cysts or small papillomatous nodules may be noticed superficially in the peritoneal covering of the broad ligaments.

LXII. *Examination of the Ovaries.*

In adults the ovary is a flattened oval-shaped body

with an anterior straight or tubal and a posterior convex or pelvic margin. It measures 1–2 in. in length, 1–1¼ in. in breadth.

It is situated on the posterior surface of the broad ligament and is connected with the uterus by means of the ovarian ligament.

In the living subject the ovary has an anterior and a posterior surface, but after death, on account of the falling back of the uterus, the direction of these surfaces may be altered or even reversed. In nulliparae the ovary lies in a peritoneal fossa which is sometimes exaggerated and shews some resemblance to the tunica vaginalis.

In infants the ovary is relatively larger and more elongated.

After puberty the surface of the ovary becomes scarred and irregular.

In advanced or old age the ovary is nodular, hard and greyish in colour. It is often diminished in size, being at times not larger than a hazelnut.

Abnormalities in position should be noted. Thus the ovary may be found in Douglas's pouch and in prolapse of the uterus its relations may be greatly altered.

Enlargement of the ovary is due to new growth or to inflammatory, tubercular or cystic affections.

Small cysts may be seen on the surface of the ovary, and are often of no pathological importance.

The various cystic formations will be considered subsequently (see page 161).

Acute inflammation, as seen in the post-mortem room is usually part of a general peritonitis.

When inflamed the ovary is slightly increased in size, soft and reddish in colour; occasionally however it may be more swollen and attain the size of a pigeon's or hen's egg, and it may be soft, with small collections of pus on its surface.

In chronic inflammation the ovary is hard and its surface may be puckered, and it may be fixed to the uterus or other pelvic viscera by adhesions.

In tuberculosis the whole ovary may be caseous and as large as a hen's egg, or several caseating nodules may be found in its substance. Both ovaries may be affected. The disease may be primary in the ovaries but is more commonly associated with tuberculosis of the tubes or uterus. Peritoneal tuberculosis and extensive adhesions around the tubes and ovaries are generally present at the same time.

New growths of the ovary are rare; fibroma as well as sarcoma and carcinoma may occur.

Fibromatous changes may cause a general enlargement of the ovary, so that the whole organ is converted into a large smooth tumour, or these changes may be more circumscribed, so that the surface of the ovary becomes irregular, nodular or polypoid. These conditions are best seen on section (page 160).

Carcinoma may be primary, but is often secondary to malignant disease in the abdominal cavity, and is frequently accompanied by cystic disease of the ovary.

Section of the Ovary.

The ovary should be divided with a knife, cutting from its hilum or the tubal margin.

The most superficial layer of the ovarian stroma is dense and homogeneous (tunica albuginea).

The innermost or medullary portion is fibrous and vascular, while the intermediate or cortical portion contains the Graafian follicles in various stages of development. The smallest follicles are superficial; larger ones are more deeply situated. The largest follicles form cysts which may cause a distinct prominence under the tunica albuginea. These large follicles are filled as a rule with clear fluid.

In the aged, the tunica albuginea is thick and hard and no follicles are seen, but often small greyish hard fibromatous bodies (corpora fibrosa), the altered remains of Graafian follicles or corpora lutea, are found. The arteries are thickened and in part occluded or even calcareous.

Small haemorrhages may be seen either under the surface, or in the stroma, on section of the ovary. These haemorrhages may be follicular and resemble corpora lutea. If bilateral, they are pathological.

When acutely inflamed the ovary is oedematous on section, and yellowish in colour, and occasionally small collections of pus or blood are seen in the stroma.

In chronic inflammation the stroma is hard and reduced in amount, and in some cases numerous small cysts may be seen in its substance.

Fibroma of the ovary may be general and diffuse or circumscribed. In the latter case small hard whitish masses (hypertrophied corpora fibrosa) are seen in the stroma. Corpora lutea may become fibromatous, in which case their wall still remains folded and wavy.

Corpora Lutea.

After rupture of a Graafian follicle, at the time of ovulation, a little dark brownish red coagulum of blood is found in the substance of the ovary (corpus rubrum).

Gradually organisation of the clot and fatty degeneration of the epithelium change the colour from red to yellow, and a corpus luteum is produced. The periphery or wall of these bodies is convoluted and thrown into folds.

Eventually cicatrisation and contraction take place, often leading to a slight puckering of the surface of the ovary. If the cicatricial tissue hypertrophies, a corpus fibrosum may result.

The corpus luteum of pregnancy is of considerable size up to the end of gestation and measures from $\frac{2}{5}$–$\frac{3}{5}$ in. (corpus luteum verum), while the corpus luteum of menstruation (corpus luteum spurium) is smaller and visible for a few months only.

Old corpora lutea may be recognised as small and minute collections of pigment.

Ovarian Cysts.

By no means all cysts in the ovaries are pathological.

Enlarged Graafian follicles and cystic degeneration of the corpora lutea must be distinguished from true cystic growths and also from the multicystic degeneration of chronic ovaritis.

In these cases the cysts are small. When they are as large as, or larger than, a walnut they must be considered pathological.

Cysts are not infrequently bilateral. They vary much in size and shape; their surface may be globose or nodular.

In the case of small cysts the remainder of the ovary is often unchanged; the cyst wall is thick, and intracystic growths are usually absent, and the fluid contents are limpid and serous, occasionally however mixed with blood (hydrops folliculi). Adhesions are generally absent.

In larger cysts adhesions are as a rule present; the wall is thin in parts and what remains of the ovary is much altered, being thinned and expanded or distorted; often apparently nothing is left of the ovary.

Remains of the ovary must always be looked for at the pedicle of the cyst near the broad ligament, and the relation of the tube to the cyst should also be carefully noted. The fimbriated end is often spread out over part of the cyst, but the tube as a whole is generally but loosely connected with the cyst.

The cyst is connected with the uterus by means of its pedicle, the parts of which should be carefully dissected. It consists of the broad and ovarian ligaments and often also of the tube and may be long or stumpy, twisted or strangulated.

At times the whole or part of the tumour may be enclosed between the layers of the broad ligament.

Commonly these cysts are multilocular, but they may be unilocular from fusion of the loculi.

The cyst should be laid open with a pair of scissors.

The fluid contents are as a rule sticky, viscid or even gelatinous.

The colour varies, but is mostly dark. The fluid may be clear or simply turbid, or it may be blood-stained and even purulent.

The inner surface of the cyst wall is either rugose like the mucous membrane of the stomach or it is covered with smaller secondary cysts.

At other times papillomatous outgrowths are found on the inner surface of the mother and daughter cysts. They occasionally appear also on the outer surface of the cyst wall.

Sand granules (psammomatous bodies) may be present, so that the inner wall feels gritty.

The cyst may be entirely filled up by its daughter cysts, or the contents as well as the cyst wall may become colloid. The colloid material may dry up and resemble caseous *débris*. In rare cases carcinoma may develop in the cysts, when it is generally colloid.

The ovaries are favourite seats for dermoids or teratomata. These are generally smaller than ordinary cysts.

They are either simple dermoids, the walls of which consist merely of skin and dermal elements, and are then filled with sebaceous and fatty, oily substance, often mixed with hairs, or they may be compound teratomata, containing bone, cartilage or teeth. The wall of these tumours may shew projections on its inner surface with hairs growing from them.

CHAPTER VI.

EXAMINATION OF THE HEAD.

LXIII. *Superficial Examination of the Head.* LXIV. *Opening of the Skull.* LXV—LXVI. *Examination of the Skull-Cap and Dura Mater.* LXVII—LXVIII. *Removal of the Brain and Examination of the Base of the Skull.* LXIX—LXXIII. *Examination of the Brain.* LXXIV—LXXV. *Tumours and Abscesses of the Brain.* LXXVI—LXXVIII. *Examination of the Ear, Eye and Nose.*

LXIII. *Superficial Examination of the Head.*

Note the presence or absence of rigor mortis in the muscles of the jaws and of the neck. It appears first and passes off soonest in these parts.

Congenital malformations, such as meningocele, encephalocele, hydrocephalus, microcephaly and premature synostosis, are readily recognised.

Eyes.

The eyes may be unusually small or asymmetrical, as the result of congenital malformation or disease (phthisis bulbi).

The eyes may be prominent (proptosis), as in cases of hydrocephalus, new growths and aneurysms of the orbit.

These various conditions will be recognised when the orbital contents are examined (vide § LXXVII).

Examine the eyelids for congenital malformations, inflammatory and ulcerative lesions.

The eyelids in fracture of the anterior fossa often shew extravasation of blood into their substance. In such fractures haemorrhage may track forward under the conjunctiva; sometimes there is a condition resembling chemosis, the conjunctiva being raised by an extensive effusion of blood, in other cases the blood passes under the conjunctiva at its point of reflection on to the sclerotic.

The cornea becomes opaque after death, but even twelve hours after death it may be still transparent; this is especially the case in poisoning by prussic acid, or cyanide of potassium, and in those who have died from suffocation by carbonic dioxide.

The pupils after death are nearly always of a uniform size, about midway between dilatation and contraction.

Examine the cornea for the presence of an arcus senilis, nebulae, leucomatous opacities and inflammatory lesions.

Note the presence of ulcers, phlyctenulae and staphylomata.

When the cornea is transparent the contents of the anterior chamber may readily be observed.

It may contain pus (hypopyon) or blood (hyphaema).

Opacities of the lens due to cataract can easily be recognised on looking into the eye through the cornea.

When inflamed the conjunctiva may be red and

injected or covered by pus and in rare cases by membranous exudation, as in diphtheria or smallpox.

Examine the conjunctiva for ulcers, phlyctenulae, pterygia or vascular thickenings.

Note the condition of the pupil and iris. There may be synechiae or signs of inflammation. In albinism the iris is devoid of pigment.

Any discharges of blood or other fluid from the mouth or nostrils should be noted.

The ears should be examined for the presence of blood or pus in the meatus, and note should be made of tophi and haematomata or other cysts in the pinna.

External Examination of the Nose.

Observe deformities due to injury or disease, especially syphilis.

Syphilis leads to a sinking in of the bridge of the nose or to total destruction of the nasal bones.

Note other abnormal changes, especially of an ulcerative nature.

Ulceration of the alae may be due to lupus, rodent ulcer or epithelioma.

Examine the scalp for any wounds, and note whether the bone is exposed.

LXIV. *Opening of the Skull.*

In women the hair, if long, should be unplaited and parted along a line leading from one mastoid process to the other so that as little damage as possible may be done to the hair.

The head should be somewhat raised from the table

by a block which is placed under the neck. A head-rest may also be employed for the same purpose, but is not so stable as a block.

Incision.

The head is turned over so as to look towards the left shoulder and the right ear is drawn forwards by the left hand.

The point of the knife is then introduced under the skin over the mastoid process, with the cutting edge directed towards the skin and the back towards the bone.

The blade of the knife is carried over the vertex to the mastoid process on the other side, the position of the head being altered as may be necessary.

In making this incision the tissues of the scalp are divided from within outwards. By this means much less hair is cut across than would be the case with an incision made from the surface.

The scalp is then dissected forwards as far as the superciliary ridges and backwards beyond the occipital protuberance. Any extravasations or bruises of the scalp should be noted. In new-born infants a sero-sanguineous effusion in the tissues of the scalp may be present (caput succedaneum), which must be distinguished from a cephal-haematoma, an effusion of blood under the pericranium which is limited to a single bone.

Before sawing through the skull, the temporal muscles are to be divided in the line of the saw-cut, so that the teeth of the saw may not be clogged by fragments of muscle.

If it be necessary, the parotid gland should be examined

at this stage by prolonging the coronal incision downwards (vide § XXVII).

The skull-cap is to be sawn through by making a horizontal cut just above the superciliary ridges which is continued backwards as far as the mastoid processes. The posterior extremities of this cut are then joined by two saw-cuts which meet at the occipital protuberance. Each of these meets the horizontal one at an obtuse angle.

The result is that a ∧-shaped piece of bone, with the apex at the occipital protuberance, is left projecting upwards above the horizontal part of the saw-cut.

The object of this is to prevent the skull-cap from slipping back, when it is replaced after the autopsy, and thereby producing displacement of the scalp and of the skin of the forehead. This can be further prevented by drilling holes through corresponding points of the calvaria and the frontal bone, and fixing a copper rivet in them, so that the bones are firmly held together.

The inner and outer tables should be sawn through all the way round, but the dura mater must be left intact.

The skull-cap is often imperfectly sawn through where the horizontal and oblique saw-cuts meet. In order to obviate this, the cuts should be made to cross each other.

If the horizontal incision be made too low in front, part of the orbital plate of the frontal bone will be left above the saw. If, therefore, after sawing deeply in this position bone is still encountered, this may be the cause, and the saw-cut must be taken at a slightly higher level.

While sawing the skull-cap the head should be fixed

by a towel, which is wrapped once round the left hand so as to protect it, should the saw slip.

When the skull-cap has been sawn through all the way round, gentle leverage applied in the middle line anteriorly will elevate it sufficiently to allow the hand or better the hook at the end of the handle of a post-mortem hammer to be introduced, with which the skull-cap can be wrenched off.

The hammer and chisel are not required, if the bone is sawn through all round, and their use is undesirable, as fractures are easily made. In any inquest case they must be strictly avoided.

In children, sometimes in old people, and occasionally in other cases it will be found that, although the bone is sawn through completely all round, the skull-cap cannot be removed. The cause of this is firm adhesions between the dura mater and the skull-cap. The bone must then be slightly raised and the dura mater divided all the way round the saw-cut with a pair of scissors.

The skull-cap with the dura mater adherent to it can then be removed.

In cases of simple posterior meningitis and in chronic hydrocephalus, it is advisable to examine *in situ* the membranes and the foramen of Majendie, in the roof of the fourth ventricle at its lower part, by which the cavity of the fourth ventricle communicates with the subarachnoid space. If the brain be removed in the ordinary way, their condition cannot be determined accurately. The skull-cap should be removed by a horizontal cut extending all the way round and the occipital bone sawn out by a V-shaped

incision, the apex of which is below at the foramen magnum. By gently elevating the cerebellum and brain any thickening and matting together of the membranes can be seen, while the roof of the fourth ventricle can be exposed by cutting through the arachnoid membrane where it passes from the cerebellum to the medulla. In cases of chronic hydrocephalus it is said that the foramen of Majendie is closed, and that this, by preventing the outflow of ventricular fluid into the subarachnoid space, produces the distension of the fourth and other ventricles. The method just described has the further advantage that the incision can be prolonged, and the cord taken out in continuity with the medulla, pons and brain.

LXV. *Examination of the Skull-Cap.*

The skull-cap, freed from the dura mater, should be carefully examined for fractures and defects, carious and necrotic changes.

The anterior fontanelle disappears early in infant life. It should be closed at the twentieth month, and if widely open after this date, the condition is pathological and due to rickets or hydrocephalus.

Wormian bones may also be present and should not be mistaken for fractures.

The cranium, especially the occipital and parietal bones, may be atrophied and thinned in some cases of rickets and congenital syphilis, a condition called craniotabes. The bones may become so delicate that they are not much thicker than a sheet of paper.

In other cases of congenital syphilis the bones

are softened, so that they may be readily cut with a knife.

Undue softening occurs also in osteitis deformans (vide *infra*).

Thinning with expansion of the skull-cap occurs also in hydrocephalus. General thinning without visible expansion of the cranium is met with in some cases of cerebral tumours.

Along the groove of the superior longitudinal sinus several depressions will be seen causing local atrophy of the skull. These are produced by the Pacchionian bodies (hypertrophied villi of the arachnoid membrane).

Examine the pericranium. If there has been periostitis, local thickenings and nodes will probably be found.

More general thickening of the skull may be met with in cases of extensive chronic periostitis or osteitis, usually syphilitic in origin, and in osteitis deformans.

Such general thickening of periosteal origin is found in cases of congenital syphilis. Both parietal and frontal bones are increased in thickness and density on either side of the middle line around the anterior fontanelle (Parrot's nodes).

In ordinary osteitis the bones are generally thickened and sclerosed and the diploë is obliterated.

In osteitis deformans the skull is often enormously thickened, but instead of there being sclerosis the bone is so soft that it can be cut with a knife.

A certain amount of sclerosis is common in old age or may be a racial characteristic.

It may be well to tabulate the changes in the skull in acquired and congenital syphilis which have already been mentioned in part.

(*a*) Congenital syphilis:

(1) atrophic changes (craniotabes) with marked thinning of the bones, or

(2) softening without thinning of the bones, or

(3) osteophytic changes leading to the formation of symmetrical nodes over both parietal and frontal bones around the anterior fontanelle.

(*b*) Acquired syphilis:

(1) local thickenings due to periostitis (nodes);

(2) general sclerosis of the calvaria due to osteitis;

(3) carious and ulcerative changes. The bones become worm-eaten and pitted and at the same time new bone is formed by the periosteum, giving the surface a reticular or nodular appearance. Simultaneously, however, there is necrosis, and areas of dead bone may be seen.

LXVI. *Examination of the Dura Mater.*

The dura mater, which forms the internal periosteum of the skull, is rough on its outer surface and smooth and glistening on its cerebral surface.

As already mentioned, it is occasionally firmly adherent to the bone, and this in the young or aged is not necessarily a sign of morbid changes.

Adhesion may be caused by past inflammation, e.g. otitis media or injuries, or may be due to general morbid conditions, as syphilis or alcoholism.

Evidence of such causes should be carefully looked for.

Effusion of blood may have taken place between the bone and the dura mater. In such cases carefully examine the middle meningeal arteries and the lateral sinuses for rupture, and the bones for fractures.

If there is a collection of pus between the skull and the dura mater, the cause should be looked for, and it will usually be found to consist in otitis media or bone disease.

In such cases local thickening of the dura mater is generally present.

Tumours on the surface of the dura mater are rare; they are generally fibrous or fibro-sarcomatous in nature or may be small psammomata (sand tumours). Such tumours may cause depressions on the surface of the brain, or may even perforate the skull.

The superior longitudinal sinus should now be slit up and examined *in situ* for thrombosis or suppuration.

The subdural space should be exposed by cutting away the dura mater, leaving it attached posteriorly.

The inner or cerebral surface of the membrane can now be examined.

The dura mater may be greatly thickened (pachymeningitis) from the presence of membranous tissue on its surface, a condition which is very rare. The thickening thus produced may be firm and solid, or may be separated into layers by sacs or cysts containing altered blood, coagula or clear serous fluid. This condition is associated with general paralysis of the insane and chronic alcoholism.

In syphilis, also, there may be a general or local thickening of the dura mater.

Calcareous deposits may be found in the dura mater, especially in the falces or the tentorium.

The subdural space may be filled with pus or blood which may well out as soon as the dura mater is opened. In cases of haemorrhage evidence of injury to the head must be looked for.

The blood as a rule coagulates and becomes partly organised or encysted (arachnoid cysts).

Such cysts are generally adherent to the dura mater, but may be free in the subdural space.

The conditions leading to the collection of pus in the subdural space will be considered below.

The surface of the brain, as it lies in the skull, is now exposed, and should be examined *in situ* for atrophy or marked abnormalities, bruising or laceration, tumours or abscesses, or depressions caused by haemorrhage.

The more detailed examination of the brain must be deferred.

In the case of atrophy there is usually an excess of arachnoid fluid.

The *arachnoid membrane* may be thickened and opaque, especially in cases of chronic alcoholism or as the result of past meningitis and in cases of general paralysis of the insane or senile dementia.

Pacchionian bodies are usually found on each side of the longitudinal fissure nearer the posterior part of the brain: they must not be mistaken for tubercles, which they often resemble.

Examine the surface of the arachnoid membrane and the pia mater for the presence of meningitis, but defer the minute examination until the brain has been removed.

Mere fulness of the *cerebral veins*, with liquid blood, does not indicate ante-mortem congestion.

If in a case of sudden death the head has been opened first, these veins will probably be distended with blood, especially if the head has been in a dependent position after death. If, however, the head be examined after the jugular veins in the neck have been opened, the blood drains away from the cerebral sinuses and veins, shewing that the congestion is due merely to post-mortem stagnation.

The blood may coagulate post-mortem in the cerebral veins, and a loose coagulum, only half filling the lumen of the veins, will result. If, however, the veins are distended with clot adherent to the walls, thrombosis has taken place during life. Such thrombosis should be traced into the sinuses (vide *infra*).

Primary thrombosis of the cerebral veins and sinuses may occur in marantic infants and occasionally in anaemia, as in women after severe bleeding, but is comparatively rare.

LXVII. *Removal of the Brain.*

The left hand should be introduced under the frontal lobes and the brain lifted up from the base of the skull.

Divide the nerves and vessels in order as they appear at the base of the brain, as close as possible to the bone or dura mater.

After dividing the fifth nerves turn the brain over to one side. By so doing the tentorium is exposed on one side and should now be divided with a knife close to its attachment to the petrous bone. Then turn the brain over to the opposite side and separate the tentorium in a similar manner.

The seventh, eighth, ninth, tenth, eleventh and twelfth nerves must now be cut through.

Lift up the brain as high as possible, pass the knife down on each side of the medulla and divide the vertebral arteries, cut the spinal cord across as low down as possible, and while supporting the brain with the left hand, lever the medulla up with the fingers of the right hand.

The brain is now free and can be lifted out.

Weigh it: the average weight in males is 49–53 ozs., in females about 43 ozs.

LXVIII. *Base of the Skull.*

Place the brain aside for further examination.

Examine the base of the skull for manifest fracture or necrosis of the bone and inflammatory or suppurative lesions, especially over and around the petrous bones. In cases of necrosis of the bone the dura mater may be dull and lustreless or even black in colour.

The cranial nerves, both on the base of the skull and of the brain, should be examined for obvious morbid changes.

In insular sclerosis the first, second, third, fifth and seventh nerves may be grey and sclerosed.

Examination of the Cerebral Sinuses.

Open the cavernous sinus which consists of an in-

definite cavity. Thrombosis is much rarer in this sinus than in the superior longitudinal.

Examine at this stage the pituitary body or hypophysis cerebri, left behind in the sella Turcica. It may be enlarged, especially in cases of acromegaly. In myxoedema or other affections due to morbid changes of the thyroid gland it should always be carefully examined.

Trace the petrosal sinuses backwards from the cavernous sinus, the inferior and larger one to the jugular fossa, and the superior or smaller one to the lateral sinus.

Open up the lateral sinus. Loose jelly-like post-mortem clots are of no pathological importance.

Adherent granular clots are of ante-mortem origin.

If true adherent ante-mortem clots be found, they are almost always secondary and due to some inflammatory lesion elsewhere, especially disease of the middle or internal ear, injury to the bone or meningitis.

Examine the wall of the sinus carefully and see whether it is healthy.

In any case of thrombosis, however, the jugular vein in the neck, the superior petrosal sinus and the cerebral veins should be dissected out and examined. The clot in the lateral sinus may be pale, granular and friable and may be laminated, but at times it does not fill the lumen of the vessel. When it is secondary to some inflammatory condition, as is usually the case, it may be soft and puriform.

Examine the veins of Galen and the straight sinus in the tentorium for thrombosis.

The tentorium may be adherent to the cerebellum in cases of cerebellar tumours or abscesses. The latter may

have exerted pressure on the straight sinus and the veins of Galen. This is said to be a cause of hydrocephalus.

Notice the presence of blood, pus or lymph on the basal dura mater.

Now strip the dura mater off the inside of the skull. This is easily done with the handle of the forceps. The dura mater is much more adherent at the base than elsewhere. Examine the base of the skull for fractures and disease of the petrous bone.

Remember that the sutures in the orbital plate of the frontal bone resemble fissured fractures; they must not be mistaken for them.

The examination of the ear, eye and nose must be deferred till later (vide §§ lxxvi—lxxviii.).

LXIX. *Examination of the Surface of the Brain.*

Place the brain with its base upwards on the small table.

Examine the base first, and then turn the brain round and inspect the convex surface of the hemispheres.

Notice any marked atrophy, asymmetry or abnormality, local bulgings due to a tumour or an abscess, and depressions on the surface due to pressure exerted externally by tumours etc.

Note any blood clot or pus outside the arachnoid membrane or patches of softening on the cortical surface.

Meningitis.

(i) Examine the surface of the brain carefully for the presence or absence of meningitis. If present, it may

have been secondary to some diseased condition in the neighbourhood, the inflammation having spread by extension, e.g. from the ear, nose, eye, or it may have resulted from some external injury. It may have followed a cerebral tumour or abscess.

In these cases the surface of the brain is usually covered with pus or pyo-lymph. The exudation is generally external to the pia mater and easily washed off. The process often spreads all over the vertex; it may, however, be unilateral or local.

In such cases, if no palpable cause is at once visible, as e.g. fracture or injury, the ear, orbit and the various bony sinuses should be carefully examined.

(ii) In primary inflammation of the pia mater, of which infective or so-called epidemic cerebro-spinal meningitis is an example, the lymph and pus are as a rule, but by no means always, more intimately connected with the pia mater and not so easily removed by washing.

The process shows marked tendency to spread over the vertex, and may affect the vertex alone.

In all cases of meningitis the arachnoid membrane becomes opaque, and the opacity is well marked over the convexity of the hemispheres. At times there may be an oedematous infiltration, especially marked over the sulci. The surface of the brain is often reddened and softened or haemorrhagic in parts. Mere hyperaemia of the pia mater is of little significance, depending frequently on the position of the body after death.

(iii) In tubercular meningitis small miliary or submiliary tubercles are found in the pia mater, most marked

along the vessels at the base near the optic chiasma, over the anterior and posterior perforated spots, along the Sylvian arteries, on the under surface of the temporal lobes and on the upper surface of the vermis of the cerebellum.

Fragments of bone or bone-dust adherent to the pia mater must not be mistaken for tubercles. Tubercles hardly ever occur on the vertex alone. The resemblance of Pacchionian bodies to tubercles has been pointed out above (vide p. 174).

These small and minute tubercles are often difficult to see. If there be any doubt, a piece of the pia mater should be dissected off and held up against the light, or examined under water against a black surface.

There is often but little evidence of inflammation, and actual pus is generally absent. There may, however, be a considerable amount of gelatinous lymph, especially over the regions mentioned above.

The convex surface of the brain is generally flattened, dry and sticky.

(iv) Chronic meningitis, if general, as in cases of chronic alcoholism, causes opacity of the pia mater over the convex surface of the brain.

In children chronic changes may be found at the base in the posterior fossa, which may lead to firm adhesions between the pia mater and the cerebellum or pons.

Local patches of chronic meningitis may occur in syphilis.

Thrombosis of the cerebral veins is rare, but should be

looked for in cases of meningitis or infantile hemiplegia. It is generally a vein on the convexity of the brain which becomes affected (vide p. 175).

Vessels at the Base of the Brain.

Notice variations in the arrangement of the circle of Willis.

The posterior communicating arteries shew great variability in size.

Examine the arteries for atheroma and calcareous changes. They may be rigid, and either uniformly opaque, or opaque patches may be seen here and there through their outer coats.

On section they do not collapse, but their cut ends stand open like little pipes; the intima is thickened and, on opening the vessel with a pair of scissors, may separate from the middle coat, and then resemble a parietal clot.

Sometimes the arteries may be almost entirely occluded (endarteritis obliterans); this condition is usually syphilitic in origin, though closely allied to atheroma.

Slit up the arteries with finely pointed scissors and follow them up into the Sylvian fissures.

Examine them carefully for emboli, thrombi or small aneurysms. Being badly supported, aneurysms of the arteries on the base of the brain readily rupture and give rise to meningeal haemorrhage. They are commonest in the middle cerebral artery. Careful search should be made for calcareous emboli, derived from atheromatous and degenerated vessels, for they are said to be the primary cause of the aneurysmal lesion.

The emboli are commonly innocent, and consist of

small, pale red thrombus-masses. They are most frequently found at the origin of the Sylvian artery or its first branch, especially on the left side. Death being generally sudden when it is the result of an embolus, the latter is seldom adherent.

Now turn the brain over.

Cortex of the Brain.

In cases where there has been impairment of any special function, examine the cortical centres for softening, atrophy, pressure or the presence of a tumour.

It is advisable to make a diagram, at the time, of any morbid changes observed. Danielson's slates will be found of great use for this purpose. The diagram can subsequently be transferred to small charts, which may be pasted into the report of the autopsy, saving thereby much description.

Over softened areas in the cortex the pia mater is often adherent and cannot be peeled off, as it can over the healthy parts. In infants the brain has a greyish tint and is less opaque and less firm than in later life.

When decomposition has set in, the whole of the brain is softened, and when it is very advanced, gas develops in the cerebral substance and produces a number of cyst-like cavities, so that it may be aptly compared to Gruyère cheese.

Note any bruising over the frontal, temporo-sphenoidal or occipital lobes, and note also the relation of a fracture of the skull to any bruising.

The brain may be injured on the side of the fracture; in many cases, however, the greatest amount of bruising is

found at a point on the side opposite to the injury, when there is generally a slight depression in the cortex: in cases of an injury of the vertex most commonly near the apex of the temporal lobe. Bruising of the brain by "contre-coup" is fairly common, while it is doubtful whether fracture of the skull by "contre-coup" ever occurs.

LXX. *Dissection of the Brain*[1].

The cerebrum should be dissected before the cerebellum.

The cerebellum and pons may be first separated from the hemispheres by cutting through the crura, to be put aside for subsequent examination.

It is better, however, to leave the parts in continuity and examine them, one after the other, without disturbing their relation.

The brain is placed with its occipital lobes towards the dissector, and its convex surface upwards. Separate the hemispheres, thus widening the superior longitudinal fissure. Note any bulging of the corpus callosum due to haemorrhage or effusion into the ventricle.

With the left hand draw the left hemisphere outwards and at the same time gently upwards. Insert the blade of a short knife or scalpel into the superior longitudinal fissure, pass it under the gyrus fornicatus and cut outwards and downwards into the left hemisphere on a level with the

[1] At times it is advisable to remove the pia mater with the cerebral vessels, before beginning the dissection of the brain. Whenever a very careful examination is required, the brain should be hardened in Müller's fluid.

corpus callosum, through the roof of the lateral ventricle, so that the latter is laid open. The blade should be kept almost horizontal, and the cut should expose the whole length of the ventricle from before backwards.

The section should extend outwards for about $\frac{1}{2}$–1 inch.

Care must be taken not to cut deeply into the ventricle with this first incision, in order to avoid damaging the structures forming its floor; for the roof and floor of the ventricle lie close to each other.

Repeat the process on the opposite side, the knife being held in the left hand.

Both ventricles are now laid open.

Cerebral Hemispheres.

Replace the parts in position, and examine the hemispheres by means of serial sections.

With a brain knife make a horizontal cut $\frac{1}{2}$ in. above the level of the corpus callosum on each side, through the whole length of the hemisphere, extending outwards almost as far as the cortex, but leaving a rim of brain tissue with the pia mater over it—if it has been left—to form a kind of binding.

Turn the upper piece out, exposing thereby the centrum ovale minus.

Note any changes in the white substance of the latter, such as haemorrhages, lacerations, collections of pus, tumours or softening (vide pp. 188 and 189).

In disseminated sclerosis, small irregular, sharply defined, firm, reddish-grey patches will be seen in the centrum ovale.

Make a similar horizontal cut on each side below, and parallel to, the first, extending outwards nearly as far as the cortex.

Turn the slice of brain outwards, thus exposing the centrum ovale majus.

Observe any abnormal changes.

LXXI. *Examination of the Lateral Ventricles.*

The ventricles may be enlarged or distended with fluid or blood clots.

Note the character and amount of the contents, which may be clear serous fluid or stained with blood, or may be coagulated blood or even pus.

The ventricular fluid may be turbid with flakes of lymph in tubercular meningitis, when there may be a great excess of fluid, thus leading to "acute hydrocephalus" (vide p. 186).

Remove the fluid and examine the walls of the ventricles.

In tubercular meningitis the ependyma may be swollen and lustreless, granular or covered with a layer of lymph or granulation tissue.

The ependyma may be thickened also as the result of past inflammation (ventricular meningitis), and there may be adhesions obliterating the cavity of the posterior cornu in such cases.

Distension of the ventricles with serous effusion must be looked for in (*a*) chronic hydrocephalus, (*b*) acute hydrocephalus, (*c*) ventricular meningitis. Slight enlargement also occurs in general paralysis of the insane and in senile dementia.

In cases of ventricular haemorrhage, examine the choroid plexuses and the velum interpositum for miliary aneurysms (vide below). Primary ventricular haemorrhage may however be the result of congestion, as in cases of hanging, convulsions or concussion (Gowers).

Examine also the walls of the ventricle for lacerations, since the blood may have escaped from haemorrhages into the corpus striatum or optic thalamus. It should be remembered, however, that superficial lacerations may be secondary, due to the mechanical distension of the ventricles.

In ventricular haemorrhage, generally all four ventricles contain blood, which is usually coagulated and forms a distinct cast of their cavities.

In disseminated sclerosis, marked sclerotic changes may be seen beneath the ependyma, while in general paralysis of the insane the ependyma may be thickened and granular.

Dissection of the Brain (*continued*).

Now lift up the corpus callosum and fornix, introduce the blade of the small knife into the foramen of Monro, cut upwards through the anterior pillars of the fornix and the corpus callosum, and reflect the posterior portion backwards, exposing the velum interpositum and choroid plexuses.

Note the condition of the septum lucidum separating the two lateral ventricles anteriorly: it is thinned in hydrocephalus and much softened in tubercular meningitis.

Note also the condition of the foramen of Monro in

hydrocephalus, where it is either greatly dilated, if all the ventricles are distended, or occluded, if the lesion is limited to the lateral ventricles.

Velum Interpositum and Choroid Plexuses.

Examine the velum interpositum and choroid plexuses for tubercles in tubercular meningitis, for lymph or pus in septic meningitis, for miliary aneurysms in ventricular haemorrhage and for thrombosis of the veins.

In acute hydrocephalus (tubercular meningitis) there may be evidence of acute inflammation of the choroid plexuses and velum interpositum.

In chronic hydrocephalus the choroid plexuses may be thickened, and the veins of Galen are said at times to be obstructed.

In old people small, dark, reddish-grey tumours are often seen in the choroid plexuses near their free edges. They are hard and gritty and composed of brain sand (psammomata). In such persons small cysts of the size of a pea may also be found in the choroid plexuses.

Now divide the reflected portion of the corpus callosum and fornix in its whole length from before backwards by a vertical cut, and carefully remove the velum interpositum and choroid plexuses, exposing thereby the third ventricle with the soft grey commissure passing between the two optic thalami, and the pineal gland lying on the corpora quadrigemina.

Small psammomata and concretions and small cysts may occur in the pineal body.

Examine the remainder of the floor of the lateral ventricles.

The posterior cornua may be absent. This, however, is of no pathological importance.

Tumours may protrude, or haemorrhages may have burst, into the ventricle.

LXXII. *Examination of the Central Ganglia.*

Continue the examination of the brain by making vertical cuts through the caudate and lenticular nuclei and the optic thalami on both sides.

These cuts should not extend into the cortex on either side, the latter thus serving as a convenient frame or "binding," should any morbid lesion of the caudate and lenticular nuclei or optic thalami render it desirable to keep the parts in continuity. The cuts should be made with a large brain knife, straight across from left to right, dividing corresponding parts on the two sides, and should extend down to the base of the brain. Six or more parallel cuts should be made.

As each section is made, the exposed surfaces should be examined, and a careful comparison made between the two sides.

Remember the differences in appearance which normally exist between the component parts of the lenticular nucleus, so as to avoid mistaking the lighter coloured globus pallidus for yellow softening.

Note the position and extent of any haemorrhage in the central ganglia.

Cerebral Haemorrhage.

In the corpus striatum, haemorrhages are most commonly due to rupture of the lenticular branches of the middle cerebral artery in the area connecting the caudate and lenticular nuclei. These haemorrhages often extend upwards and outwards into the centrum ovale and may be considerable in size.

It may be mentioned here that large haemorrhages in the centrum ovale are generally due to an extension of blood from the corpus striatum. Primary haemorrhages in the centrum ovale are almost always small in size on account of the smallness of the vessels.

In cerebral haemorrhages the blood is clotted and the brain tissue lacerated, so that the walls of the irregular cavity containing the clot are shreddy. The surrounding tissue is blood stained and softened, and may contain smaller haemorrhages.

Having carefully examined the extent and relations of the haemorrhage, the portion of the brain affected should be placed under a gentle stream of water, until the brain substance is washed away. The small vessels with their minute ramifications, remaining behind, should be carefully picked out. Small red dots or points may be seen on the terminals and should be examined under a lens. They are miliary aneurysms.

Note the remains of any old haemorrhage.

There may be (1) a shrunken brownish mass, or (2) a yellowish fatty granular deposit, containing haematoidin crystals (which should be examined under a microscope), or (3) a haemorrhagic cyst, containing either clear fluid or

fluid tinted with blood pigment. The wall of such a cyst may be brownish yellow in colour from altered blood pigment.

Cerebral Softening.

Note the existence and extent of any softening.

Softening may be (*a*) red, (*b*) yellow, or (*c*) white.

(*a*) Red softening is either inflammatory, traumatic or embolic in origin, the tint being due to local hyperaemia or capillary haemorrhage. It occurs oftenest in the cortex and central ganglia.

(*b*) Yellow softening may be a primary change, but is generally the result of red softening, the lighter colour being due, in part, to the conversion into haematoidin of haematin.

(*c*) White softening is often but a post-mortem change. As a pathological condition, it occurs with arterial obstruction in the white substance or the central ganglia. Dilatations of the perivascular lymph-spaces, cyst-like in appearance, may be mistaken for multiple softening (*état criblé*).

In all cases of softening examine carefully the condition of the blood vessels.

Tumours are comparatively rare in the central ganglia, and for convenience' sake will be described separately.

Replace the cerebral hemispheres, hold the two sides together with the left hand, and with a large brain knife make a series of vertical transverse cuts through both sides, roughly corresponding to the sections through the basal ganglia.

Compare the corresponding sections on the two sides and note any morbid changes.

LXXIII. *Examination of the Cerebellum and Fourth Ventricle.*

Cut through the crura cerebri and remove the cerebellum with the corpora quadrigemina, pons and medulla.

Divide the superior vermiform process of the cerebellum by a vertical incision, extending from before backwards through the whole length of the process. This exposes the fourth ventricle. Turn the two halves of the cerebellum outwards.

Examine the cavity and floor of the fourth ventricle for clots, haemorrhages, tumours and other morbid changes.

Now insert the point of the knife into the lateral recess of the fourth ventricle, first on one side and then on the other, and cut outwards and downwards in the direction of the recess, dividing the entire substance of the cerebellum. Examine the cut surfaces of the cerebellar hemispheres, and starting again from the same point, make two further oblique cuts into each lateral lobe of the cerebellum, one in front and the other behind the first incision.

In this way the pieces of the cerebellum are all left in continuity, and if any morbid changes be found, the parts can be easily replaced.

Abscesses occur in the lateral lobes; they are generally secondary to ear disease.

Haemorrhages into the substance of the cerebellum are rare, and care must be taken not to mistake a vascular or haemorrhagic sarcoma or glioma for a simple haemorrhage. In cases where the fourth ventricle is distended with blood clot, the lateral recesses become occupied by blood, and if

a haphazard section be made into the cerebellar hemispheres, it might appear as if an independent haemorrhage had taken place into the substance of the cerebellum.

Tubercular tumours are more common in the cerebellum than in any other part of the brain, and may be found in the hemispheres or middle lobe. They vary in size from that of a pea to that of a hen's egg, and may be firm or caseous. They shell out easily, and may be single or multiple.

Gliomata, often cystic in this situation, may also be found; gummata are rare in the cerebellum.

Crura, Pons and Medulla.

Separate the cerebellum from the pons and medulla.

Make a series of vertical transverse sections through the corpora quadrigemina and crura, pons and medulla, starting from the dorsal surface, and leaving the sections connected on their ventral surface by the pia mater and basilar artery.

The pons may be enlarged or hypertrophied as the result of gliomatous infiltration or tubercular disease.

Note any abnormal conditions, such as tumours, haemorrhages, softenings, etc.

Haemorrhages may extend into the crura from the basal ganglia.

Diseases of the nuclei of the medulla and pons can practically only be recognised by means of the microscope.

LXXIV. *Brain Tumours.*

Tumours may often be recognised on inspection as local

swellings on the surface of the brain, or they may not be found until sections have been made.

They are most frequent in the cerebral hemispheres: more common, however, in the cortex and white substance than at the base of the brain.

Tumours may be circumscribed, and merely displace the brain substance (tubercular, syphilitic or sarcomatous growths), or they may infiltrate the tissues (glioma and carcinoma).

(1) Tubercular tumours, most frequently found in the cerebellum and the posterior cerebral lobes, are generally solid and firm, but may be cheesy and even softened; and as the surrounding tissue is also often softened, they may be easily shelled out. The pia mater over superficial tumours may be thickened and adherent to the dura mater. (Vide p. 192.)

These growths vary in size from that of a pea to that of a walnut or a hen's egg.

(2) Gummata are irregular and nodular in shape, and vary in size. They are firm on section, and contain cheesy nodules, irregularly distributed through their substance. The tissues around are not infrequently softened. These tumours are distinguished from tubercular masses by their irregular surface and irregular caseation; they may be hard and shrunken.

They are usually superficial and adherent to the pia mater and dura mater, and are most commonly situated in the hemispheres or the pons.

(3) Sarcomata are generally circumscribed tumours, displacing the tissues of the brain during their growth.

The surrounding structures may be softened, so that the tumour is readily shelled out. It may be hard or soft, and often is very vascular (angio-sarcoma).

(4) Carcinoma, whether primary or secondary, is rarely met with; it forms a soft tumour which may occupy any position in the cerebral hemispheres.

(5) Gliomata are infiltrating tumours. They are generally soft and myxomatous and pale grey in colour. They are liable to break down, or to become soft, cystic or haemorrhagic, so that they may be mistaken for cerebral haemorrhages. It is, therefore, of some importance to remember that haemorrhages in exceptional or unusual positions may be gliomata. These tumours most commonly occur in the cerebral hemispheres.

Rarer forms of tumours are melanotic sarcomata, fibromata, cholesteatomata, lipomata, and dermoids.

Cysts in the brain are generally due to haemorrhage or softening, or they develop in connection with sarcomata and gliomata.

In tumours of the pons, corpora quadrigemina, or middle lobe of the cerebellum, or in tumours, more or less in relation with the third ventricle, examine the latter, the aqueduct of Sylvius and the fourth ventricle, and also the veins of Galen.

LXXV. *Abscess of the Brain.*

Abscesses are commoner in the white, than in the grey substance of the brain, commoner in the cerebral and cerebellar hemispheres than in other parts of the brain. They are very rare in the pons and the medulla.

They are usually single, and if multiple are generally limited to one side. Multiple abscesses are almost always pyaemic in nature and due to some distant lesion.

Always examine the middle ear, disease here being the commonest cause of abscess. If no ear disease be found, search for evidence of bone injury or of disease of the orbit and nose, for caries of the skull or tumour of the brain. If no cranial lesions are present, distant causes, such as an empyema, bronchiectasis, or suppuration elsewhere in the body, must be looked for.

The abscess may be encapsuled, the presence of a capsule being somewhat of a guide as to the duration and age of the suppurative process.

The contents may be foetid, and may have in part escaped into the surrounding tissues or into one of the ventricles.

In size abscesses vary considerably: they may be as large as, or larger than, an orange, but generally they are smaller.

Ear disease oftener leads to abscess in the cerebrum than in the cerebellum; the temporo-sphenoidal lobe is perhaps oftenest affected. In children especially, it is rarer to find a cerebellar abscess after ear disease.

The abscess is generally in the substance of the brain and hidden from the surface by more or less normal substance; but it may be in direct continuity with the necrosed roof of the tympanum, and then considerable care must be taken in removing the brain, otherwise the abscess may be ruptured and the surrounding softened cerebral substance lacerated.

LXXVI. *Examination of the Middle Ear.*

The pinna and the outer ear have already been examined.

In cases of cerebral or cerebellar abscesses or of meningeal suppuration, the middle ear must always be opened. Otitis media, and its results, and cholesteatomata are the only conditions which the eye can easily detect.

The dura mater having already been stripped off the temporal bone, examine the thin roof of the tympanum on the anterior surface of the petrous bone.

The bone may be necrosed and the dura mater over it adherent and discoloured or covered by pus.

A cholesteatoma may have worked its way through from the middle ear and appear on the surface. It is a small glistening tumour whose origin is as doubtful, as the growth is rare.

Methods of Opening the Middle Ear.

Two methods, either of which can be employed, will be described.

(i) In the first method a wedge-shaped piece of bone is removed, and the cavity of the tympanum, thus exposed, is examined *in situ*.

With a sharp, broad chisel make a vertical sagittal cut through the petrous bone just outside the eminence corresponding to the superior vertical semicircular canal; and a second horizontal cut through, and at right angles to, the anterior surface of the petrous portion of the temporal bone, joining the former at an obtuse angle. On turning back the wedge-shaped piece of bone enclosed between these two cuts, with the chisel inserted from below and

held quite flat, the tympanum with the incus and malleus is freely exposed, the stapes being carried away on the reflected piece of bone.

(ii) In the second method the greater part of the petrous bone, including the internal ear and the inner wall of the tympanum, is removed, and the membrana tympani left *in situ*.

With a pair of bone forceps, or a sharp chisel, make two vertical cuts: (*a*) one at the junction of the squamous with the petrous portion of the temporal bone, which should pass through the tympanum just internal to the membrane; and (*b*) the other through the petrous bone at the level of the internal auditory meatus. By means of a horizontal cut connect the two vertical ones and carefully wrench up the enclosed piece of bone.

Remove the piece of the petrous bone, and examine the ossicles and inner wall of the tympanum.

In newborn children and young infants it suffices to cut away the tegmen tympani with a strong knife, inserted under it from the petro-squamous suture.

The membrane lining the middle ear normally should be pale, smooth and slightly moist. The cavity of the tympanum should not contain any fluid.

Notice any blood, pus or curdy caseous matter in the cavity of the tympanum.

The middle ear may contain mucus (comparable to gum-water), especially in young children. This exudative otitis may be concurrent with, or secondary to, meningitis and is not necessarily the primary condition, when the two are associated.

It should be remembered, that in stillborn children who have not breathed the whole tympanic cavity is filled up with a similar viscid fluid.

The lining membrane may be thickened, and granular or fleshy, as the result of chronic inflammation.

The cavity may be filled up by, and the ossicles embedded in, granulation tissue, or it may be distended with polypoid growths, or with retained secretion and shed epithelium which may become dried up, and thus lead to the development of a cholesteatoma, especially if the chronic otitis is accompanied by an epidermoid metaplasia of the lining membrane of the middle ear.

Notice the presence and extent of any necrosed bone, and of disease or absence of any of the ossicles.

Search for perforations of the membrane. These often occur in the upper segment near the notch of Rivini, where they easily escape detection.

In cases of otitis media, intracranial abscess or thrombosis of the lateral sinus, examine the mastoid cells and antrum.

When inflammation spreads to the roof of the tympanum, meningitis or abscess in the tempero-sphenoidal lobe is likely to follow; while inflammation in the mastoid cells or antrum may set up thrombosis of the lateral sinus or cerebellar abscess.

A naked eye examination of the internal ear reveals but little. If it be necessary to examine the latter, it should be carefully removed and prepared for microscopical investigation.

It may be stated, that whenever a minute examination

of the middle and inner ears is desirable, it is better to chisel out the petrous portion with the mastoid process as completely as possible, and to examine it subsequently by means of sections or with the microscope. The naked eye can only detect grosser lesions.

LXXVII. *Examination of the Eye and Orbit.*

To avoid disfigurement, the eye and orbit must be exposed from the base of the skull.

With a pair of bone forceps carefully chip away the roof of the orbit which is formed by the lesser wing of the sphenoid bone and the orbital plate of the frontal bone.

The contents of the orbit are thus exposed.

These may be oedematous and inflamed in retro-ocular inflammation, or there may be a collection of pus in the orbit.

Examine the veins for thrombosis, in cases of orbital inflammation or suppuration.

Tumours may occur in the orbit of which the commoner forms are exostoses, or other bony growths, and malignant tumours. The latter may infiltrate the whole orbit and are generally sarcomatous, and may have perforated the globe.

Notice the presence or absence of pigment, for these growths are often melanotic sarcomata.

Malignant tumours may have extended into the orbit from the superior maxilla and the base of the skull, or from the face and eyelids.

Examination of the Interior of the Eye.

Dissect away the muscles and fat of the orbit, so as to expose the optic nerve and the posterior half of the globe,

divide the optic nerve near the optic foramen, draw the globe backwards, and with a sharp scalpel make a small transverse incision into it a little behind its equator. Then introduce one blade of a pair of small, finely pointed scissors and continue the above transverse incision round the whole circumference of the globe.

Remove the optic nerve and the posterior part of the globe.

If it is desirable to obtain the whole length of the optic nerve, the bony ring of the optic foramen must be carefully chipped away, and the nerve traced back as far as the chiasma.

Note any swelling of the sheath of the optic nerve. It may be distended with serous fluid, or in cases of fractures of the base of the skull, with blood.

If the removal of the posterior part of the globe has been performed carefully, the retina will be but little disturbed and can be examined *in situ*.

Often the *retina* is detached from the choroid and cannot be satisfactorily examined, until it has been replaced. This is best done by holding the optic nerve, with the attached portion of the globe upwards, under water. Carefully evert the sclerotic and the choroid, and allow the retina to float out. On lifting the parts out of the water, the retina, now free from folds, falls smoothly over the choroid.

If the globe be divided in front of the equator, the sclerotic cannot be easily everted.

Be careful not to touch the choroid, otherwise its pigment will be removed, and an appearance resembling choroidal atrophy may result.

Examine the retina with a magnifying glass.

In retinitis there may be small grey or white patches on the surface. These are well marked in albuminuric retinitis, where they occur especially in the neighbourhood of the yellow spot.

Note the presence of any haemorrhages or pigmentation.

Detachments of the retina can hardly be satisfactorily studied at a post-mortem examination.

Examine the disc and the condition of its margin which is either sharply defined or obscured. In glaucoma the disc is cupshaped, a condition which is best demonstrated by making a longitudinal section through the globe and optic nerve.

Examine the retina for the presence of tumours which are either sarcomata or so-called gliomata. Fibroid tumours are rare.

Remove the retina, unless it be adherent to the choroid.

The *choroid* may contain plates of bone, tubercles or malignant growths. While searching for tubercles, which are always miliary, it is advisable first to brush away all the choroidal pigment.

The malignant growths are generally melanotic sarcomata.

In albinism the choroid is free from pigment.

The *vitreous humour* may be diffluent or solid; and may contain bloodclot, pus or even bone.

If it is natural or unduly softened, it will run out as the eye is divided, carrying the lens with it, and will thus escape observation. The lens, of course, may be easily picked up and examined for gross changes.

A detailed examination of the eye is only possible after complete removal and careful hardening.

LXXVIII. *Internal Examination of the Nose and Frontal Sinuses.*

(For External Examination of the Nose see § LXIII under Examination of the Head.)

The internal examination of the nose must always be incomplete, since a complete dissection leads to great disfigurement.

The condition of the dura mater over the cribriform plate of the ethmoid bone and over the vertical portions of the frontal bones has already been noted (vide §§ LXVI and LXVIII).

If the bones are necrosed, it may be discoloured, or adherent to the brain or covered with pus.

Empyemata of the frontal and ethmoidal sinuses may lead to suppurative meningitis or necrosis of the corresponding bones.

If it is desirable to examine the mucous membrane of the nose, carefully chisel through the suture between the cribriform plate and the frontal bone in front, and with a fine saw from above divide the septum nasi in front, and then extend the cut backwards on each side, passing through the inner and posterior third of the orbits, the middle fossae of the base of the skull and the inner fourth of the petrous bones. These lateral cuts should meet posteriorly just behind the sella Turcica. The saw must be pushed down deeply, so as to reach the cavity of the mouth and the hard palate which is divided at the same time.

Having completed the section all round with the saw,

the loosened piece is readily removed. It should include the turbinated bones, the greater part of the septum, part of the antrum of Highmore and the sphenoidal sinuses, the hard palate and sella Turcica.

With a small pair of bone forceps separate the hard palate from the septum nasi. The turbinated bones can now be readily inspected, while the antrum of Highmore may be examined *in situ*.

The inferior meatus of the nose can also be exposed—though imperfectly—by chipping through the hard palate from the mouth (vide § XXVII).

The mucous membrane should now be examined.

Note any hypertrophy or atrophy of the mucous membrane, especially over the inferior and middle turbinated bones at their posterior ends.

Examine the mucous membrane for polypoid growths, and the septum for crests or deflections. According to Zuckerkandl the septum nasi is usually deflected to the left.

The nasal passages may be narrowed by septal crests, deviations, polypi or other growths. Polypi may be innocent (mucous polypi) or malignant. The latter are vascular and generally sarcomata.

The ethmoidal cells may be filled with pus.

To open the frontal sinuses, carefully chip away with a chisel and a pair of bone forceps their posterior walls or the inner table of the frontal bone, and examine the contents of the sinuses for pus, or polypi and other growths.

The antrum of Highmore cannot be examined in a very satisfactory manner.

CHAPTER VII.

EXAMINATION OF THE SPINE AND SPINAL CORD.[1]

LXXIX. *External Examination.* LXXX. *Opening of the Spinal Canal.* LXXXI—LXXXII. *Removal and Examination of the Cord.* LXXXIII. *Examination of the Vertebrae.*

LXXIX. *External Examination.*

The body lying on its face, the head is allowed to hang over the edge of the table, so as to put the tissues of the back on the stretch and facilitate their dissection.

Examine the spine for congenital deformities, of which the commonest are spina bifida and sacral cysts.

In such cases the examination of the spine should be made before the abdomen and thorax are opened; in ordinary cases the thorax and abdomen should be examined and emptied first.

[1] The cavity of the spinal canal may be examined by two methods, (*a*) from the front by chiselling through the pedicles of the vertebrae on each side, and thus freeing the bodies of the vertebrae which are then removed; or (*b*) by turning the body on its face, dissecting down on the laminae, and sawing through the arches. This method is more convenient, allows of a more complete examination of the spinal column, and obviously does less damage.

Spina bifida is a congenital deformity which affects most commonly the lumbo-sacral region of the spine, and is always accompanied by a defect of the bony canal.

Examine the sac. The tumour may be sessile or pedunculated, and may shew a depression or "umbilicus" on its summit. It varies greatly in form and size, and the skin covering it is generally much thinned.

Open the sac and examine its structure and contents. Three chief varieties of spina bifida are generally described.

(*a*) The sac may be composed of dura mater and arachnoid membrane only, and not contain any nervous tissue, but merely clear cerebro-spinal fluid. (Meningocele.)

In cases where the cyst has been treated with iodine injections the fluid will be discoloured, and there may be signs of inflammation, adhesions and even suppuration.

(*b*) Oftener the cyst contains nervous tissue and nerves which may be spread over the wall of the sac, especially in lumbo-sacral spina bifida. (Meningomyelocele.)

Carefully examine the relation of the nerves and cord to the sac.

(*c*) Syringo-myelocele or distension of the central canal, with a defect in the spinal column, is very rare.

Occasionally the sac is hidden away by the soft parts and covered by healthy skin. In some of these cases a hairy patch may be noticed superficially (Spina bifida occulta).

Congenital sacral tumours occur in the sacral and coccygeal regions and are either dermoidal, lipomatous or cystic in nature.

They should be carefully dissected, and their relations to the vertebral column, cord and gut noted, and also the character of their contents.

Coccygeal cysts may cause intestinal obstruction and may protrude as tense swellings through the anal orifice. It is advisable to remove the parts *in toto* and defer dissection until they have been hardened in spirit.

Examine the spine for injuries and deformities, the result of disease.

The common deformities are angular and lateral curvatures.

Angular curvature is due to tubercular osteitis.

Look for suppuration in connection with angular curvature.

In lateral curvature note the position of the ribs and their relation to the iliac crests.

Injuries are commonly fractures or dislocations. These will be best recognised and described during the further stages of the examination.

LXXX. *Opening of the Spinal Canal.*

Incision. Make an incision from the external occipital protuberance along the whole length of the spine in the middle line.

Clean the spines and laminae, reflecting all the muscles outwards on both sides. It is advisable to divide the muscles passing from the occiput to the neck by means of two transverse subcutaneous incisions.

After the muscles around the cervical spine have been

reflected, the vertebrae from loss of support are so mobile, that it might be thought a fracture or dislocation were present, especially when either condition is suspected.

Note any effusions of blood, bruising or abscesses.

Fractures and Dislocations. Examine the laminae and spines for fractures.

The commonest seats of fracture are at the fifth or sixth cervical, and at the last dorsal and first lumbar vertebrae.

The laminae and spines may be intact and there may be no displacement, while at other times the arches may be driven in.

Examine the articular processes for dislocations. Both articulations, or only one, may be displaced, and fractures are common complications.

Exostoses and osteophytic deposits may be found on the arches or spines.

In cases of fractures, dislocations, or angular curvature the piece of the spine affected should be cut out intact by cutting through the heads of the ribs, externally to the laminae, and through the vertebral column above and below, for often fractures or dislocations can only be made out,—at any rate more readily,—from the front; and hence it is better to postpone the examination of the spine until the abdominal cavity has been cleared out (vide § LI).

The piece removed should be carefully dissected and examined, and if pressure on the cord is suspected, a longitudinal section to one side of the middle line through its whole length should be made. It is advisable to saw to one side of the middle line, so as not to destroy the cord.

Removal of the Laminae. To open the spinal canal the laminae, which previously have been thoroughly cleaned, are to be sawn through on either side. The edge of the saw should be inclined downwards and inwards, and not directly downwards, for if the cut is made directly downwards, it may pass altogether outside the spinal canal, which may result in the removal of the whole spinal column.

There may be some difficulty in sawing through the arches of the atlas and axis, which should therefore be divided separately with a pair of stout bone forceps.

When the laminae have been completely sawn through, they should be freed from the ligaments and other attachments by driving a spinal chisel (which is provided with a blunt guide) along the lines of the saw-cuts. Now the arches may be lifted off, any remaining tags of ligaments being cut through with a knife.

The *dura mater spinalis*, with fat irregularly distributed over it, is now exposed.

Note any extra-meningeal haemorrhages, tumours and signs of inflammation (various forms of pachymeningitis).

Post-mortem extravasation, produced by blood oozing from the engorged veins after cutting through the laminae, must not be mistaken for ante-mortem haemorrhage.

In external meningitis examine the condition of the bone. The dura mater may be covered by pus or may be thickened, opaque and nodular, and adherent to the bone.

The ganglia on the posterior roots can be exposed, if

necessary, by cutting through, and carefully removing, the pedicles of the vertebrae.

LXXXI. *Removal of the Spinal Cord.*

The cord is to be removed in its theca.

Pass the knife along each side of the dura mater, and divide the anterior and posterior roots.

Cut across the cauda equina and gently lift up the lower end of the cord, freeing it from any attachments to the posterior common ligaments, up to foramen magnum.

The dura mater of the spinal cord is attached to the skull, all round the foramen magnum, and must therefore be cut through at this spot. Great care must be taken, in lifting out the cord, not to squeeze or compress it.

Notice any thickenings and adhesions to the bodies of the vertebrae of the dura mater, any pus or caseous matter between it and the bone and, if such be present, look for caries of the spine.

Place the cord, in its theca, with its anterior surface upwards, on a plate, and with a pair of scissors open the dura mater in the anterior median line, thereby exposing the spinal "arachnoid cavity."

Note any haemorrhages. These are not common, and are generally associated with injuries.

Rapid Removal of the Spinal Cord.

For the rapid removal of the spinal cord Dr Savage's[1] method is especially useful.

The body lying on its face, with one long incision the

[1] The authors are indebted to Dr Savage for his kindness in supplying this account.

tissues are divided in the line of the spinous processes, from nape to sacrum, down to the bone.

Then with a stiff, short-bladed knife the arches of the vertebrae are rapidly cleaned, and beginning from above, with a specially constructed saw, which has the handle so set back, as not to interfere with the process of sawing, the arches are wholly, or nearly, cut through.

Now with a very powerful pair of bone forceps, introduced at the lower part of the dorsal region, between two arches, the laminae are quickly snipped through from below upwards on both sides.

Removing the laminae, the theca of the cord is fully exposed, and the process is now completed in the manner described above[1].

The *spinal membranes* may be acutely inflamed; then the pia mater may appear injected and even ecchymosed, or opaque, thickened and covered by serous, flaky or semi-purulent exudation. In many cases the distribution of the lymph is very irregular.

Thus in some cases of tubercular meningitis lymph may be found in the lumbar portion, while the membranes in the upper regions may appear normal. In cases of spinal meningitis, inflammatory exudation is usually found in larger quantity on the posterior than on the anterior surface.

The nerve roots may be swollen and reddened, and the cord may be reddened or soft and pale.

[1] The special instruments, required for this method, can be procured from Messrs Maw, Son and Thompson.

In chronic meningitis the membranes are thickened and opaque; the inner surface of the dura mater may be granular and adherent to the pia mater. The nerve roots are either swollen and congested, or much thickened by newly formed fibrous tissue.

Local patches of thickening may be found on the inner surface of the dura mater, especially in the cervical region, where they may resemble a tumour.

White hard "plates" may be seen on the arachnoid membrane, but are of no pathological importance.

Gummata or gummatous thickenings occasionally are found in the pia mater or arachnoid membrane. The membranes are greatly thickened, gelatinous or fibrous in appearance, and the newly-formed tissues shew a marked tendency towards caseation.

LXXXII. *Examination of the Cord.*

(*a*) *External Examination.*

The cord may be ruptured or bruised in dislocations and fractures, or it may be merely compressed and flattened.

In caries also the cord may be compressed, though in many cases it escapes.

Note any softening or reddening due to inflammation, or any discolouration due to haemorrhages.

It should be remembered that post-mortem softening is more likely to occur in the mid-dorsal region than elsewhere.

In acute myelitis the affected parts of the cord are softened, and may be almost diffluent. They may be white and creamy, or red, from extravasation of blood into the

softened mass. As in the case of the brain, the colour gradually changes with age from red to brown and yellow.

The cord may be locally enlarged in cases of tumours or syringo-myelia and hydromyelia.

(*b*) *Examination of the Cord by Serial Sections.*

A series of transverse sections should be made with a scalpel, almost completely dividing the cord from before backwards, but leaving a thin strand of nervous substance in continuity behind.

Carefully examine each section for degenerative and sclerotic changes, softening and haemorrhages, tumours and dilatation of the central canal.

Normally the grey matter should stand out clearly from the white substance, but in chronic myelitis the latter may be grey in tint.

Carefully examine the various tracts for degenerative changes which, however, are not easily seen, until the cord has been in Müller's fluid for a week or a fortnight.

The degenerated columns may be greyish in colour and less opaque than normally, but often are not recognised, until after the cord has been hardened.

In locomotor ataxia the posterior columns are affected, in spastic paraplegia the lateral columns, in ataxic paraplegia and hereditary ataxia both the posterior and lateral columns.

In chronic myelitis of some standing the arrangement of the degenerated tracts and areas varies greatly, and the cord should be examined for both descending and ascending lesions. Sclerotic patches may also be

disseminated through the cord, as in disseminated sclerosis.

Similarly, in compression the cord is often grey in appearance and hard at the seat of lesion, and is also degenerated above and below the same. Examine more distant parts of the cord for degenerations.

In acute myelitis there may be patches of softening which may be white, red, brown or yellow, in colour, or the section of the cord may be merely reddened in part or over its entire area.

In inflammation of the grey matter, as in anterior polio-myelitis, naked eye changes are but rarely observed, but occasionally softening, minute haemorrhages or a small cavity in the anterior grey cornu have been observed.

Haemorrhages into the substance of the cord are almost always secondary, as for instance in cases of acute myelitis. They then may occur at the onset of the disease when the eye is yet unable to detect the myelitis, and in such cases should not be mistaken for primary haemorrhages.

Careful hardening in Müller's fluid is absolutely necessary for a trustworthy topographical study of the morbid changes of the cord.

Tumours in the cord are generally easily detected. They are usually small and recognised by their colour or consistence.

Abnormal dilatation of the central canal or cavities in the substance of the cord, the result of secondary softening, which may or may not communicate with the

central canal, are rare conditions. (Hydromyelia and Syringomyelia.)

LXXXIII. *Bodies of the Vertebrae.*

Carefully examine the bodies of the vertebrae (vide p. 117).

These may be fractured, or even dislocated and displaced, or they may be destroyed by caries.

When death has resulted from an injury, or has been due to hanging, the atlas and axis must be carefully dissected. This is also necessary, where sudden death has followed upon what seemed to be a "concussion," especially when no cerebral lesion has been detected.

In these cases the transverse ligament may be ruptured and the odontoid process driven violently into the cord.

In caries of the cervical spine the ulceration may spread to, and destroy, the transverse ligament. The odontoid process, losing its support, is dislocated backwards, and by compression of the cord leads to sudden or instantaneous death.

Fractures of the bodies occur commonly in the lumbo-dorsal region; but they may be found also in the cervical region. There is generally some displacement, but the dura mater is rarely ruptured, though it may be bulged by haemorrhagic effusion between it and the bones.

In caries of the spine the bodies are spongy and porous, or broken down and eaten away.

Pus and inflammatory or caseous matter will be found in, and around, the diseased bone and also in the vertebral canal. The dura mater may be much thickened over the seat of the disease.

Note the condition of the intervertebral discs, which in caries are eroded and ulcerated, while in absorption by aneurysms of the bodies of the vertebrae they are but little affected and generally stand out prominently.

There may be considerable displacement, leading to an angular curvature, especially in the dorsal region.

Malignant growths, exostoses, and erosions of the bodies by aneurysms merely require passing mention.

In old people the anterior common ligament is often transformed into bone of irregular growth (vide p. 117).

The articulations of the vertebrae can now be more conveniently examined.

In chronic rheumatoid arthritis they may be anchylosed and nodular, and small osteophytic growths may be found around the foramina (vide p. 207).

CHAPTER VIII.

EXAMINATION OF JOINTS, BONES AND OF THE FEMALE BREAST.

LXXXIV. *Examination of Joints.* LXXXV. *Examination of Bones.* LXXXVI. *Examination of the Female Breast.*

LXXXIV. *Joints.*

Unless there is evident disease, the joints must not be opened, except when it is important to examine them for gouty (uratic) deposits.

If it is desirable to study the relations of the component parts of a joint, it should be excised, and the bones divided longitudinally by means of a sagittal or a coronal saw cut.

In chronic interstitial nephritis, lead-poisoning, or gout, the metatarso-phalangeal joint of the great toe should be opened by making an incision into it from within outwards, just in front of the ball of the toe. If no urate of sodium is found here, the knee joint may be examined. An incision is made into the joint, either by cutting into it, from the front through the ligamentum patellae, or from the inner side.

Deposits of urate of sodium are readily recognised in

the shape of white patches in the articular cartilage. Similar deposits may be found in the ligaments, synovial membranes, and even in the connective tissue around. In some cases the articular surfaces may be uniformly white. In doubtful cases, the help of the microscope is advisable.

Whenever a joint has to be opened, this should be done with due regard to external appearances. A single longitudinal incision should be practised wherever possible. If an excision is necessary, in most cases this also can be done through a longitudinal incision.

Only some of the more important changes can be described here.

Loose bodies may be found in the synovial cavity, sometimes in large numbers. The commonest source of these "mures articulares," as they are also called, is found in the villous synovial tufts and osteophytic growths of rheumatoid arthritis (vide infra).

In connection with these bodies, mention may also be made of a peculiar hypertrophy of the synovial tufts, appearing independently of disease, the so-called "lipoma arborescens."

(*a*) In *acute inflammation* the lining membrane may be swollen, vascular or oedematous, and the joint may be distended with fluid which may be clear, or flaky and turbid. Pus and even blood may be present. In other cases the synovial membrane may be covered by purulent granulations, and small haemorrhagic collections may be found in its substance. The cartilages and bones also may be

affected, the former being destroyed, and the latter superficially ulcerated.

In *chronic synovitis* the lining membrane is opaque and more or less thickened, and the cavity of the joint may be distended with clear fluid (hydrops articuli). The cartilages and the bones are rarely changed in this condition.

(*b*) In *tubercular disease* the appearance of the joint depends entirely on the stage of the affection. The joint is uniformly enlarged, the synovial membrane swollen, pulpy or oedematous in appearance, whitish or red in colour. The surface of the membrane may be covered by "fungous" granulations, or numerous submiliary grey tubercles may be seen under it. The synovial tufts become enlarged and expand over, or adhere to, the cartilage. The latter is often destroyed in part, and the bone may be ulcerated (carious). The synovial fluid may be muco-purulent or purulent.

Note the presence of abscesses and sinuses around the joint. The cancellous spaces of the bone may be filled with caseous matter, which is best seen on making a vertical section through the excised joint.

In later cases the synovial membrane is red, swollen and ulcerated, and generally contains caseous masses or collections of pus in its substance. There is also great destruction of the bones and ligaments.

Tubercular disease is apparently commoner in old people than is generally believed.

(*c*) In *chronic rheumatoid arthritis* the most striking change is the villous appearance of the synovial membrane.

The articular cartilages are rough and fibrous, or filamentous and nodular. They may be in part or wholly removed, the underlying bone being exposed. Then the latter will be found commonly to be hard and polished, and even porcellaneous or grooved in appearance. There is often marked loss of substance or absorption of the articular ends of the bones.

The intra-articular ligaments generally disappear, and osteophytic nodules are almost always found around the joint. The synovial fluid may be increased in quantity, but is generally scanty.

In rheumatoid arthritis of the hip joint the neck of the femur may become absorbed. The condition produced must not be mistaken for an ununited, or badly united, intra-capsular fracture. This error may be avoided by paying attention to the following points: (1) the polished appearance of the articular surface, (2) the absence of the round ligament, (3) the presence of osteophytic nodules and (4) the absence of a distinct line of union.

(*d*) *Charcot's disease* is a rare affection, resembling in its results rheumatoid arthritis. There is however greater absorption and destruction of bone.

(*e*) In so-called *gonorrhoeal arthritis*, as in pyaemic inflammation, acute or subacute destructive changes of the cartilages and the bones, often if not usually, accompanied by suppuration, are generally present. It is very doubtful, whether in the case of gonorrhoeal arthritis these lesions are due to true metastatic infection. Probably they are caused by an intercurrent infection with septic germs.

In all cases of dislocations, wounds, anchylosis, bursal cysts etc., the parts should be carefully dissected, without causing more mutilation than is absolutely necessary. Existing wounds or incisions should be utilised as much as possible.

Anchylosis may be fibrous or osseous: it is best studied after excision of the joint by means of a vertical section through the bones.

LXXXV. *Bones.*

There is no special difficulty in the examination and dissection of bones, which, as in the case of joints, should be done with due regard to outward appearances.

They should be examined only in cases of manifest or suspected disease or injury.

In cases of anaemia, especially if leukaemic or pernicious in nature, pieces of the ribs and sternum, and also portions of the long bones must be removed, and abnormal changes in the marrow carefully looked for.

In leukaemia, the marrow may be soft and puriform, or purplish in tint.

In pernicious anaemia, it is red and gelatinous, resembling red jelly, and there is some absorption of the bony trabeculae and more or less marked diminution of the fatty medulla of the shafts of the long bones.

An exhaustive account of the morbid naked eye appearances of the osseous structures cannot be given here.

In an examination of a bone note chiefly the following points:

(*a*) The condition of the overlying skin: it may be ulcerated or cancerous, and in either case the bone may be invaded.

(*b*) Carefully note the appearance of the periosteum: it may be vascular, thickened and oedematous, or suffused with pus; and a collection of pus may be found between it and the bone, which in some cases will be seen to be white and dry in appearance, being necrosed. Deposits of new bone may be found in, and under, the thickened periosteum.

(*c*) The bone under the periosteum may be irregularly thickened or stalactitic in appearance, the result of chronic periostitis.

(*d*) The whole or only parts of the bone may be necrosed. The so-called sequestra, or loose pieces of dead bone, are white and lustreless, brown or black in colour.

Sinuses or cloacae may be visible from the surface.

(*e*) The bone may be softened or broken down, and its surface ulcerated and covered by granulation tissue or pus (caries). The commonest causes of such destructive changes are tubercular, syphilitic and suppurating osteitis.

(*f*) In other cases it may be hard and thickened, irregular and nodular, as the result of sclerosis.

On removing the bone and making a longitudinal vertical section through it, the following changes may be noted.

(*a*) The consistence of the bone. It is often much

softened in rickets, osteitis deformans and osteomalacia, so that it can be cut with a knife; or it may be unduly brittle, or very hard and dense.

(*b*) The appearances and changes at the epiphysial line. It may be irregular and ill formed, as in rickets. The long bones in such cases are swollen where the diaphysis joins the epiphysis.

In congenital syphilis the epiphysial cartilage often atrophies, or becomes fibroid, while in "epiphysitis" the epiphysis may be separated from the shaft.

Abscesses may also be found in, and near, the epiphysis.

Tubercular masses or caseous deposits are occasionally seen near the epiphysial plate.

(*c*) Note carefully the condition of the shaft.

(1) The medulla and cancellous tissue may be uniformly inflamed and suppurating, as in osteomyelitis. At other times they are red and deeply injected, and in their substance there may be small haemorrhagic spots or collections of pus or portions of dead necrosed bone.

(2) In osteitis, the bone on section is reddish yellow in appearance, and the shaft thickened, but spongy, in the earlier stages. When sclerosis has taken place, it is thickened, the surface being at the same time irregular and nodular. The cancellous spaces are filled up by solid bone, and the medullary space is narrowed. In the skull in such cases there is complete obliteration of the diploë.

(3) In osteitis deformans, the bones are soft, so that they may be easily cut with the knife. They are also enlarged, curved and misshapen.

(4) In tubercular disease, the cancellous spaces are filled with caseous yellow matter, especially near the epiphysis (vide above).

(5) The changes of the marrow in leukaemia and pernicious anaemia have already been alluded to, but here a few words may be said on the changes which the medulla undergoes at various times of life. In the young all bones, long, short or flat, possess red marrow. At the age of puberty the medulla is yellow in the long bones, remaining red in the ribs, sternum and vertebrae. As age advances, it becomes light brown in colour, transparent and gelatinous.

Tumours of bone include exostoses, enchondromata, various forms of sarcoma, and carcinoma (always secondary deposits). Note the anatomical relations of these tumours.

In cases of fractures a minute examination should be made of the bone, of the amount and nature of union, of the displacement, of the callus etc.

LXXXVI. *The Female Breast.*

(*a*) *External Examination.*

The size of the breasts varies with age and with the physiological conditions during pregnancy and lactation. It may be hypertrophied or enlarged on account of either glandular or fatty hyperplasia.

Of congenital aberrations polymastia and polythelia (i.e. supernumerary nipples) require special attention (vide p. 29).

Note the firmness of the breasts, the colour of the areolae and the condition of the nipples. They may be retracted, or eczematous and ulcerated. In cases of mammary abscesses, fistulous openings may be found on the surface. The breasts may contain milk which will exude on pressure (vide § XIX).

(*b*) *Examination on Section.*

In cases where an operation has been performed during life, the incision may be opened up again and the breast-tissue exposed in this manner.

In other cases, it is necessary for appearance' sake to cut into the gland from its pectoral surface, i.e. from behind (vide § XIX).

Make a complete vertical section through the middle of the breast, being careful, however, not to pierce the skin.

Note the condition of the mamma with regard to lactation:

(*a*) In the resting stage, the breast is whitish on section, and shews chiefly hard fibrous tissue with a few, comparatively scanty, greyish red points, of the size of a pin's head, irregularly scattered through it. These are the inactive acini.

(*b*) During lactation, on the other hand, the mammary substance is greyish red on section and finely granular. On pressure either colostrum or milk oozes out. The former resembles pus, and in cases of doubt a microscopical examination must be made.

(*c*) In old age, it atrophies and becomes hard and irregular, on account of the contraction of the fibrous

tissue and the disappearance of the glandular substance. This condition must not be mistaken for scirrhus. The larger ducts, which generally remain, may become cystic, so that at times the atrophied breast is riddled with small cysts (involution cysts).

Inflammation and abscesses are easily recognised: the latter may be situated, (1) in the substance of the gland, when they are generally found at the lower and outer part of the mamma; or (2) they may occupy the retro-mammary region, between the gland and the pectoral muscle; or (3) they may occur in the superficial tissues, below the skin (intra-, retro- and ante-mammary abscesses). Occasionally the ducts are distended with pus.

Chronic interstitial mastitis may be general or partial. In the former case, small cysts may be found amongst the fibrous tissue which has taken the place of the gland-substance. If the process has been more partial, fibromatous, tumour-like nodules are found in, and between, the unaffected gland-tissue (vide infra).

Cysts are readily detected. They may contain altered milk, serous fluid, or even blood. In the case of serous cysts, pedunculated growths, papillary or polypoid in nature, may be found on the wall or lining membrane.

Solid tumours may be either so-called adeno-fibromata, sarcomata, adeno-sarcomata, or carcinomata, which are either hard or soft. The sarcomata often contain larger or smaller cysts, serous or haemorrhagic, with or without intracystic growths.

In the case of any tumour, note its situation, the absence or presence of a capsule, the consistency of the new growth, whether hard or soft, and also the external appearance of the breast and its nipple, as well as the condition of the structures underlying the breast.

It is often difficult to form a correct opinion without a microscopical examination, and for that reason no attempt is made here to give a detailed description of the various tumours.

In all cases of suspected, or undoubted, malignant disease, the axillary and clavicular lymphatic glands should be carefully dissected out and examined.

This may be done either by an external incision, extending from the breast into the axilla, or by reflecting the skin, as far as possible, into the axilla and beyond the clavicle. This latter method is preferable for obvious reasons.

In typical and well marked scirrhous carcinoma the new growth is hard, and often cuts, as it were, with a "creaking sensation." On section the surface is firm, pinkish or whitish in colour, and intersected by numerous bundles of white fibres which surround "wormlike" masses, composed of epithelial growth, undergoing fatty degeneration.

As the result of chronic interstitial mastitis, the breast-tissue may become so nodular and indurated, that in appearance it is not unlike the scirrhous condition just described. In such cases, however, the induration is more lobular in its arrangement, and the glands in the axilla are free from

disease. But errors in diagnosis easily occur without a microscopic examination.

No mention has been made of the male breasts, because pathological changes are extremely rare, and therefore unimportant. Hyperplasia is occasionally observed, when the rudimentary organ may resemble the female breast (gynecomastia).

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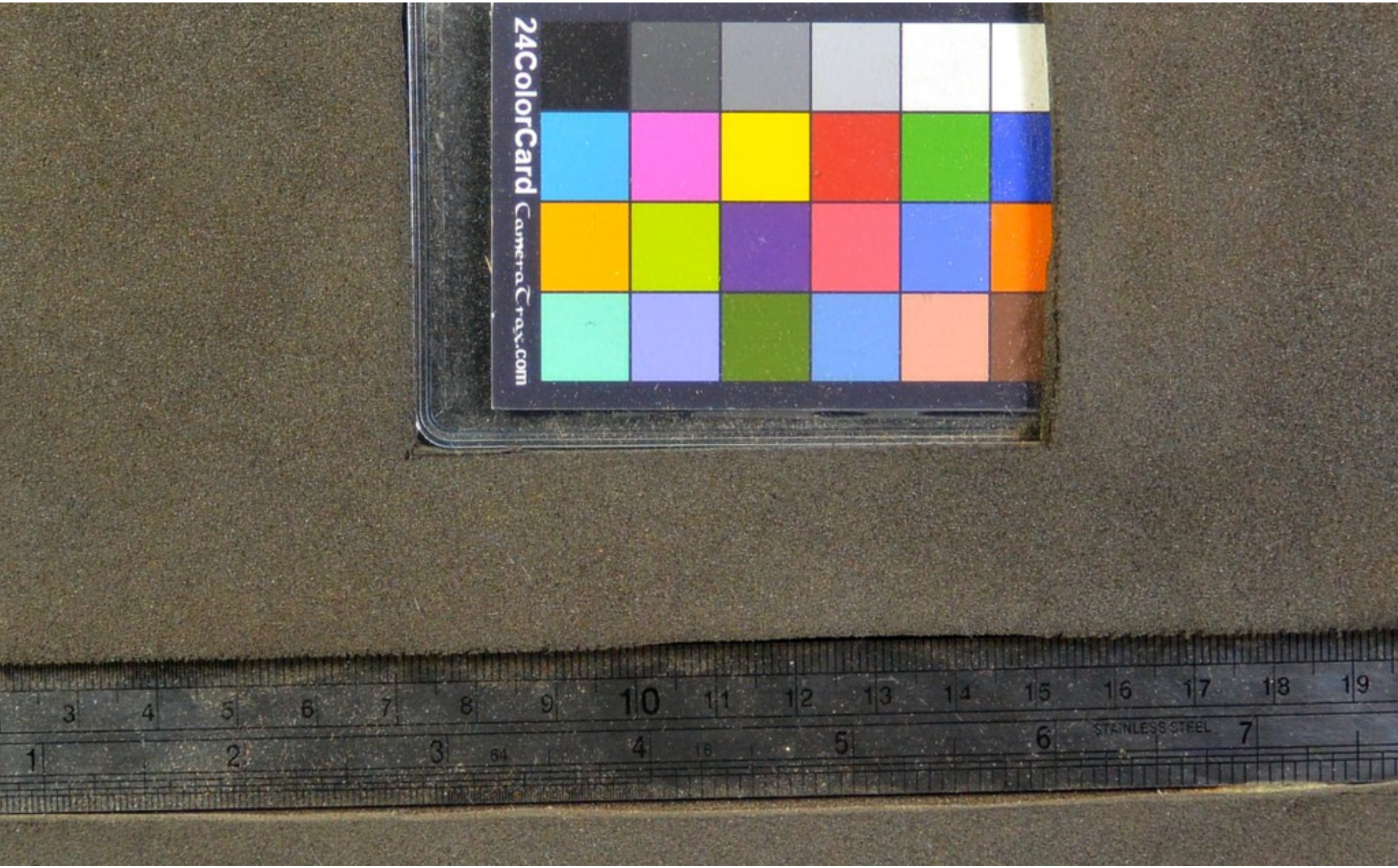
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