REPORT AND COMMENTARY

ON

FIVE CASES

SUBMITTED FOR THE

PATTINSON PRIZE IN CLINICAL SURGERY

BY

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Cases taken at
Western General Hospital.
FIVE CASES ILLUSTRATING

SURGICAL CONDITIONS OF THE PROSTATE GLAND.

(Shakespeare, King Henry IV, part II.
Act I, Scene II.)
During three months resident at the Western General Hospital, a number of patients suffering from various types of prostatic obstruction were encountered. The five cases illustrative reported here were chosen, as illustrating some of the different pathological conditions which may be present in the prostate, and not especially as a typical case of prostatic abnormality.

Have you not a moist eye, a dry hand, a yellow cheek, a white beard, a decreasing leg, an increasing belly.

(Shakespeare, King Henry IV, part II. Act I, Scene II.)
During three months residence at the Western General Hospital, a number of patients suffering from various types of prostatic obstruction were encountered. The five cases histories reported here were chosen, as illustrating some of the different pathological conditions which may be present in the prostate, and not especially as a typical series of cases.

An attempt has been made to describe the normal anatomy and physiology of the urinary system, and to superimpose upon this description the pathology and surgery of the prostate gland, using the reported cases as a basis for this discussion.
According to Loweley the glandular portion of the prostate develops by the outgrowth of five buds from the prostatic urethra, which first appear about the twelfth week of intra-uterine life, and grow back towards the bladder. These buds grow to form five distinct lobes, which coalesce at a later stage to form a single mass.

A downward process of the prostatic cavity exists during fetal life between the prostate and the rectum. In the adult female this is represented by the Poupart'sligament. In the male the anterior and posterior walls of the space are approximated and the cavity obliterated. The posterior wall of this terminal cavity is the so-called base of the vesica of Denonvilliers which has an important place in the anatomy of the gland.

The gland is similar to a chestnut in shape, with the apex pointing downwards and forwards, and its base adjacent to the neck of the bladder. The posterior surface of the base is divided by a median longitudinal groove and lies in close position to the walls of the rectum, but separated from the roof by two layers of the fascia of Denonvilliers.

The gland is pierced from apex to base by the prostatic urethra. The channel is not central, but that posterior to the axis of the prostate. When fully distended the prostatic urethra is roughly fusiform in outline, but when empty it loses
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A downward process of the peritoneal cavity exists during early foetal life between the prostate and the rectum. In the adult female this is represented by the Pouch of Douglas. In the male the anterior and posterior walls of the pouch are approximated and the cavity is obliterated. The fascial walls of this obliterated cavity constitute the aponeurosis known as the fascia of Denonvilliers, which has an important place in the surgery of the gland.

The gland is similar to a chestnut in shape, with its apex pointing downwards and forwards, and its base applied to the neck of the bladder. The posterior surface of the gland is flattened, is divided by a median longitudinal groove, and lies in close apposition to the walls of the rectum, but separated from the bowel by two layers of the fascia of Denonvilliers.

The gland is pierced from apex to base by the prostatic urethra. The channel is not central, but lies anterior to the axis of the prostate. When fully distended the prostatic urethra is roughly fusiform in outline, but when empty the lumen is /
The anatomy of the Prostate.

(after Cunningham).

Bladder.
Seminal vesicles.
Prostate.
Ejaculatory ducts.
External sphincter.
Bulb of urethra.
Anal canal.

Fascia of Denonvilliers in Red.
Peritoneum.
Prostate. Transverse section.

(after Cunningham).

Venous plexus.

Urethral crest.

Utricle.

Ejaculatory ducts.

At a level just above the prostatic utricle.

Venous plexus.

Urethra.

At a lower level.
is effaced by the aposition of its anterior and posterior walls. The shape of the lumen is further complicated by the urethral crest or verumontanum, which runs down the posterior wall as a narrow longitudinal elevation about the centre of which is the prostatic utricle (the only persistent relic of the Mullerian ducts in the male), and the openings of the ejaculatory ducts on either side of the utricle. The openings of the prostatic ducts are situated in the sinus on either side of the verumontanum.

For descriptive purposes the prostate is divided into five lobes. That part of the gland posterior to the ejaculatory ducts is described as the posterior lobe, that part between these ducts and the urethra as the middle lobe, and the anterior lobe and the two lateral lobes lying anterior to, and on either side of the urethra respectively. This division is purely artificial in the normal gland, but is extremely convenient and useful for descriptive purposes in the pathological gland. Authorities differ as to whether this division has any embryological basis.

Histologically the prostate is a compound tubular gland made up of acini embedded in a stroma of involuntary muscle and fibrous tissue. The stroma is probably derived from the mesoblastic tissue surrounding the urogenital sinus, and the gland elements from the outgrowth of solid epithelial buds from the urogenital sinus itself.

A sheath of fibrous tissue encloses the prostate adhering intimately /
intimately to the glandular substance, and blending with the muscle and fibrous tissue of the bladder and the internal sphincter muscle. This sheath is not to be confused with the false capsule of the gland formed by compression of normal elements of the gland by the enlargement of another portion of the gland. The fascia of Denonvilliers is closely adherent to the sheath of the prostate, and is of considerable importance in the perineal approach to the gland.

The prostate receives its blood supply from many small branches of the internal pudendal, middle haemorrhoidal, and inferior vesical arteries. Its veins drain into the plexus of Santorini which lies chiefly on the anterior and lateral aspects of the gland. The lymphatic system is of importance in the spread of infection after operation on the prostate. Deep lymphatics arise in the gland acini, and superficial lymphatics in the venous plexus between the fascial sheath and the gland. This network drains into the obturator nodes on the pelvic wall and into the iliac glands and is connected with the lymphatics of the bladder which in turn are connected with those of the ureter. The periuretral lymphatics have been found to be swarming with organisms in patients who have died a few days after the removal of the prostate, and these organisms are similar to those found in the prostatic bed of such patients.

The nerve supply to the bladder is via the pre-sacral nerves (hypogastric plexus) and the hypogastric nerves. These fibres /
fibres arise from S2.3 and 4 and, in addition to containing motor fibres for the internal sphincter, are believed to contain sensory fibres from the entire bladder.

The prostate may be considered functionally as a secretory gland and as a muscular organ. Much work has been done on the glandular function of the prostate but it is as yet too early to make any statement as to its exact nature. As a muscular organ the prostate plays an important part in the act of micturition and it is with this aspect that we are chiefly concerned, for a lesion of the prostate is almost always reflected in the act of micturition. It is for this change in micturition rather than for any glandular disturbance that the patient seeks advice from his doctor.

Normally urine is retained in the bladder by the action of the internal sphincter, a circular band of unstriped muscle fibres, continuous with the circular muscular coat of the urethra, but lying above the prostate. This muscle may become displaced upwards by prostatic hypertrophy and come to encircle the gland, dividing the gland into an intra-vesical and an extravesical part. Cystograms of the distended bladder show that it is globular rather than pyriform in shape, and that therefore the internal sphincter remains in tonic contraction and the urethra is closed. In long standing obstruction of the membranous urethra from stricture of this part, the prostatic urethra may become distended and the internal sphincter be incapable of preventing /
preventing escape of urine.

In addition to the internal sphincter, there are the accessory muscles, chief of which are the extrinsic muscles of the urethra, especially the compressor urethrae, which lies between the layers of the urogenital diaphragm, its fibres encircling the urethra and being to a certain extent under voluntary control. It has been proved by urethrograms that in patients whose internal sphincter has been damaged in prostatectomy, the compressor urethrae is responsible for the retention of urine within the bladder, but that more often the internal sphincter is sufficiently intact to retain its place as chief factor in bladder control. The external sphincter, which may be part of the compressor urethrae, lies between the compressor and the apex of the gland, and may be voluntarily forced into strong contraction, and may therefore be regarded as a second adjuvant to the internal sphincter.

The bladder and posterior urethra receive spinal and sympathetic innervation. The spinal nerves arise in the lumbo-sacral region and reach the organs via the hypogastric nerves. The sympathetic fibres accompany the vessels and end in minute ganglia in the muscles and sub-mucosa of the trigone and neck.

The centres governing micturition are situated in the lumber part of the spinal cord and are connected with the higher centres in the cerebral cortex. The micturition centres, acting through the hypogastric nerves, maintain the internal /
internal sphincter in tonic contraction. As the bladder becomes more distended, the muscle coats are stretched and rhythmic contractions occur in it, as a result of which an impulse is transmitted to the higher centres and is there translated as a desire to void urine. The higher centres inhibit the lumbar micturition centres, causing relaxation of the internal sphincter, and stimulation of the muscle of the walls to greater contractions. Voluntary contractions of the abdominal wall aid in the expulsion of urine by compressing the bladder upon the bladder.

The prostate has a purely passive function in normal micturition, voiding being a function of the bladder and the urethra.

PATHOLOGICAL ANATOMY AND PHYSIOLOGY.

The changes produced in the urinary system by an obstructing prostate are well known; the mechanism of obstruction is still rather obscure. Various theories have been put forward to explain the manner of obstruction, but all have the weakness of explaining only one particular type. It is possible that there is no single explanation.

The original idea that the prostate causes obstruction by encroaching on the lumen of the urethra has now been abandoned. Frequently we find less resistance than normal in passing a catheter through the posterior urethra because the enlargement of the prostate holds the walls of the urethra apart. It is often
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The effect of an Intra-vesical Enlargement.

Resolution of the Forces

Intermittent Micturition.

Pressure within bladder tending to occlude urethra.
often possible to look right into the posterior urethra on opening the bladder as a result of stretching of the internal sphincter.

Swift-Joly's hydrostatic theory aims at explaining retention produced by enlargement of the prostate according to the laws of hydrostatics. It depends upon two necessary conditions:

1. The presence of an intravesical projection of the growth raising the meatus above the level of the bladder floor, and
2. That the tissues be sufficiently soft and free from infiltration to allow them to be moulded by slight variations in intra-vesical pressure.

The increase of fluid pressure caused by contraction of the bladder is exerted at right angles to its walls, and is, therefore, directed downwards and inwards towards the urethra and can be resolved mathematically into two components, a horizontal and a vertical acting respectively at right angles to and parallel to the urethra. The horizontal acts from all sides and tends to close the urethra. The amount of compression sustained by the urethra is directly proportional to the intensity of the intra-vesical pressure and to the size of the intra-vesical projection, and inversely proportional to the resistance of the tissue to distortion.

It is more common to find an intra-vesical prostate with the urethra opening into the hollow of a truncated cone like the crater of a volcano, than to find the urethra opening onto /
Cystograms of the bladder-neck.

(after Alesio).

At rest.

<table>
<thead>
<tr>
<th>Horizontal axis of the Bladder-neck.</th>
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<tr>
<td>90°</td>
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<td>Long axis of the urethra.</td>
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During micturition.

<table>
<thead>
<tr>
<th>Horizontal axis of the bladder-neck.</th>
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<tr>
<td>Less than 90°</td>
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<tr>
<td>Long axis of the urethra.</td>
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onto the apex of a cone. The crater-like opening introduces the complication of the horizontal component acting outwards on the inner surface of the crater walls, this might be tending to balance the constricting force. It is therefore only the closed urethra below the level of the crater that is subjected to the full constricting force, the effectiveness of which depends on the height of the closed portion of the urethra.

This theory helps us to understand why the size of the prostate is of so little importance in this form of obstruction, as compared with its form and consistence.

The trigonal muscle of the bladder is believed to have an important function in micturition. Young and Wesson showed that its fibres passed down the posterior margin of the internal meatus and prostatic urethra to be inserted into the upper part of the verumontanum, and claimed that in micturition the contraction of the muscle flattened out the angle formed by the junction of the plane of the trigone with the plane of the floor of the urethra, forming a gutter, and supported this by the observation of the hypertrophy of the trigonal muscle in prostatic obstruction. The anterior muscle bundle of the neck may have a similar action and the opening of the internal meatus will not be merely passive relaxation, but relaxation associated with active dilatation. The formation of a posterior gutter by the contraction of the trigonal muscle has /
has been confirmed by cysto-urethrograms, but the anterior margin remains stationary.

Thus difficult in micturition will be produced by any factor impeding the backward movement of the posterior margin of the orifice, including diminished elasticity of the structures in the neck (sclerotic median bar, new growth fibrous prostatitis).

The dynamical explanation depends on the association of enlargement of the gland with a tendency to reflex spasm. Acute inflammatory conditions produce spasm, and chronic inflammation may have the same effect.

No one theory is self sufficient, and it is more reasonable to combine the factors and admit both spasm and mechanical difficulty as factors in the causeation. The spasm theory is strongly supported by the changes in severity so often noticed. East winds, worry, fatigue, changes in temperature all affect the ease with which micturition is carried out and, possibly due to congestion, are more likely to be effective through reflex spasm.

There is the rare, though well known, variety of obstruction which is due to the hypertrophy of the glands of Albarran lying in the sub-mucous layer of the trigone which enlarge to form a pedunculated tumour which, acting as a true ball valve, drops over the internal meatus and occludes it. The patient may be unable to pass water in the upright position but can do /
do so perfectly well while leaning against a wall or lying on
his back.

Enlargement of the prostate is commonest in men above the
age of fifty. About eighty per cent of men in this country
are said to show enlargement of the gland at death, but only
eight per cent of these have symptoms during life. These
symptoms when present are entirely due to the anatomical sit-
uation of the gland at the bladder neck.

Owing to the firm uro-genital diaphragm, on the upper layer
of which the apex of the gland rests, any enlargement of the
gland results in an upward displacement of the base of the
gland which carries with it the bladder floor, and increases
the length of the prostatic urethra (this latter point becomes
evident on passage of a catheter). Owing to the raising up of
the vesical half of the gland the upper half of the prostatic
urethra becomes vertical in direction and may meet the lower half
at right angles. This gives rise to difficulty in passing a
catheter. (This difficulty may be overcome by pressure for-
wards of a finger in the rectum lifting the tip of the catheter
round the angulation), and to some degree of difficulty in
micturition as a result of downward compression tending to com-
press the urethra in its upper half.

Enlargement of the lateral lobes results in a side to
side compression of the urethra, but is more than compensated
for by the increase in the sagittal diameter of the canal, the
ultimate result being an actual increase in the total capacity of/
of the urethra.

The changes in the gland leading to obstruction may be due to either:

1. Hypertrophy of the whole prostate, with either glandular or fibrous elements predominating.
2. Middle lobe enlargement.
3. Median bar.
4. Malignant neoplastic growth.
5. Calculus formation, single or multiple.

The cause of the normal hypertrophy of the gland occurring after the age of fifty is unknown, but is believed to be something of the same nature as the menopause in women, a form of abnormal involution; it is closely similar histologically to the appearances present in chronic mastitis. In both these conditions there is involution of a sex gland at the decrescent period characterised by irregular epithelial hyperplasia with an overgrowth of connective tissue. It is very likely that prostatic enlargement is nothing but an involutionary process, the results of which become very noticeable owing to the anatomical position of the organ.

In the glandular type of simple hypertrophy there is a series of spongy nodules with well defined margins usually in the lateral or middle lobes which form, by compression, a false capsule of normal tissue around themselves, from which the nodules may be enucleated in part or as a whole (two cases of /
of this type are reported).

In the fibrous type of hypertrophy there is dense fibrosis throughout the gland with no nodules or false capsules. Enucleation is either impossible or rarely may be done on a small part of the gland. (One case of this type is reported).

Enlargement may occur solely in one or both lateral lobes of the gland. There may be formation of a middle lobe either by the hypertrophy of Albarran's glands or by the hypertrophy of the posterior commissure of the prostate lying beneath the internal sphincter and trigonal muscles. When one of these middle lobe enlargements occurs in the absence of lateral lobe change enlargement can only be diagnosed cystoscopically as usually nothing unusual can be felt on rectal examination. The posterior commissural type usually has a broad base, the other has a narrow flexible pedicle-like base. Learmonth and Watkins have described obstruction at the bladder neck due to valvular folds not arising from the prostate and occurring at any age and emphasise the importance of a cystoscopic examination in the diagnosis. Enlargement of the anterior part of the gland is very rare but Cran reported a case in 1934, and stated that others had been reported by Wade, Young and Walker. Riches and Muir give 1% as the incidence of this type. Owing to the enlargement of this type being in front of the urethra, no sign will be found rectally but the condition is readily diagnosed cystoscopically.

Carcinoma of the gland has the same age incidence as hypertrophy,
hypertrophy, but has no known aetiological relationship with any other condition in the gland. The prognosis in the disease is bad, since spread is rapid and has usually begun before the patient seeks advice. The growth starts in the posterior lobe and spreads up the ejaculatory ducts and can be felt as a hard stony irregular swelling by the finger in the rectum. It invades the floor of the bladder and surrounding structures, often occluding both ureters or their orifices, and rapidly reaches the pelvic and lumbar lymph nodes. It commonly gives rise to metastases in bone, easily recognised radiologically. In fact, carcinoma of the prostate is often first brought to notice by rectal examination after the discovery of a tumour of bone, or a pathological feature in an elderly man. The fascia of Denonvilliers is considered to be the means of preventing direct spread to the rectum. Obstruction may be due to alteration of consistence, enlargement, occlusion of ureters, and disorganisation of function due to actual infiltration of muscles.

Prostatic calculi may be single or multiple and may arise in three ways:

1. By enlargement and calcification of the corpora amylacea, which are concretions of mucus and broken-down epithelial cells found within the gland.
2. By the deposition of calcareous salts in infected crypts of the gland.
3. /
The effect of Enlargement upon emptying.

Normal.

Bladder full.

The effect of Enlargement.

Bladder full.

Bladder emptied as far as is possible.
3. By the impaction of a urinary calculus in the prostate.

When riddled with small stones (as in the case of this type reported) the gland may feel like a carcinoma, but an oblique X-ray will show shadows of the calculi. This type of obstruction is due almost entirely to an alteration in the consistence of the gland.

The shape and musculature of the bladder are markedly affected by prostatic obstruction. The vesical outlet, being raised, is no longer the most dependent part of the bladder which is now the trigone and the floor of the bladder behind the trigone, thus introducing another factor working against the complete emptying of the bladder. As obstruction increases the posterior wall sags more and more and gradually forms the retro-prostatic pouch so commonly found in this condition. At first partial compensation is obtained by hypertrophy of the muscle coats which stand out as a network of folds of mucosa raised up by the hypertrophied bands of muscle on the inner surface of the bladder. If relief is not obtained dilatation begins, first in the floor where the retro-prostatic pouch is further enlarged (and the amount of residual urine increased), soon affecting the whole of the bladder. Calculi are frequently found at this stage and may not give rise to symptoms if they are lying in the retro-prostatic pouch since they will not be pressed upon by the contracting walls. Herniation of mucosa may occur at various stages between /
between the hypertrophied muscle bundles, giving rise to extravesical pouches or diverticula. Infection may be superimposed upon the picture at any time and will result in acceleration of the decline.
RENAL ANATOMY AND PHYSIOLOGY.

Before a patient suffering from prostatic obstruction it is necessary to estimate the degree of damage sustained by, and the reserve power of, the kidneys. This is done by various excretion tests, which will be discussed. Before this is done a brief statement of the normal functions of the kidneys is necessary.

The nerve supply of the kidney deserves mention. Some fibres from the vagus probably pass to the kidney with the vessels, but no evidence has been obtained that they have any function. The sympathetic system sends different fibres to the kidney along the vessels running into the hilus. These fibres come from the renal ganglion and adjacent vertebral plexus, and ultimately
Renal Anatomy and Physiology.

The ureters and kidneys are bound to be affected by obstruction in the lower urinary tract, and the amount of renal damage is of paramount importance in the consideration of the condition of a patient before operation. The ureters and pelves of the kidneys first become congested and then dilated, even before the sphincters fail; their walls are thickened by hypertrophy of the muscle coats and by fibrosis, and again infection speeds up all the changes. In early aseptic cases the picture shown by the kidneys is that of an interstitial nephritis. Infection when added to this produces a purulent infiltration of the parenchyma, and may cause miliary abscess formation.

Before operative treatment is carried out on a patient suffering from prostatic obstruction it is necessary to estimate the degree of damage sustained by, and the reserve power, of the kidneys. This is done by various excretion tests which will be discussed. Before this is done a brief statement of the normal functions of the kidneys is necessary.

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ultimately from the region of D.6 to L.1 segments (and possibly also from D.4 and D.5) of the spinal cord. There is no experimental evidence of any secretory function due to these fibres and they are apparently vaso-motor in action. (The diuresis following sympathectomy is best explained as being vaso-motor in origin). (Woollard).

There are important and interesting points in the blood supply of the kidney. The arterioles from the vasarecta break up into a capillary plexus in the glomeruli. These capillaries then reunite into a second set of arterioles which break up into a second set of capillaries round the convoluted tubules. Their venous plexuses drain into the venous radicles. The glomerular capillaries therefore lie between two sets of arterioles each capable of contraction and relaxation and which have been shown experimentally to be affected differently by various drugs.

The kidney removes waste products from the blood by a process of active secretion, not merely by simple filtration. A filtrate, containing all the non-colloidal constituents of the plasma in exactly the same proportions as those in which they are found in the blood, is passed through the glomerular tuft into Bowman's capsule. As this filtrate passes down the tubules it is elaborated into urine, by reabsorption of water and the threshold substances (Cushny) and by active secretion of certain substances in addition (Starling).
Glomerular filtration is resisted by the osmotic pressure of the plasma colloids (about 30 m.m.Hg.) which tends to hold the water in the glomerular capillaries. The blood pressure in the glomerular tuft is about two thirds that of the arterial blood pressure (about 80 m.m.Hg.). There is therefore a positive filtration pressure in the glomerular capillaries of about 50 m.m.Hg. This is necessary for the normal secretion of urine. This positive filtration pressure may be reduced by any cause, which either lowers the blood pressure (glomerular), or raises the tubular blood pressure, thereby raising the counter pressure against filtration. It has been shown that the glomerular filtration ceases when the blood pressure falls to about 50 m.m.Hg., but that the addition of certain salts of a solution of urea will make the function possible at a lower blood pressure than 50 m.m.Hg. (Verney and Starling).

The function of the kidney briefly is as follows:

1. Maintenance of blood volume by secretion and retention of water.

2. Maintenance of the reaction of the blood at a reaction of p.H. of 7.4 by excretion or retention of buffer bodies.

3. Elimination of metabolic waste products, e.g., urea, uric acid, creatinine and ammonia. These substances are produced within the body, and are usually rapidly excreted from the blood by the kidney.
kidney and are usually highly concentrated by the kidney as it removes them, urea being concentrated 70 to over 100 times. Uric acid 25 times, creatinine 75 times. The concentrating power applies to all the functions of the kidney and is probably the earliest power to be disturbed when inefficiency appears.

4. The normal constituents of the blood are excreted or not in accordance with their threshold value, e.g., glycosuria in hyperglycaemia.

5. Abnormal entrants to the blood stream are rapidly excreted by the normal kidney, e.g., ketone bodies, bile, bacteria, dyes. Dyes are excreted by the kidney irrespective of their concentration in the blood.

6. The kidney is believed to manufacture certain substances, e.g., ammonia, hippuric acid, phosphate.

7. It is suggested that the kidney is controlled by a hormone secreted by itself. There is no definite evidence for this. The function is probably entirely dependent upon the composition and concentration of the blood circulating within the organ.

The mere routine examination of the urine is insufficient in arriving at an estimation of the functional ability of the kidneys. Further, no single test has yet been devised which gives
gives full information as to the functional ability.

The essentials of an ideal test are that it shall be:

1. Easily applied by the attendant.
2. Easily carried out by the patient.
3. Capable of estimation without the necessity of reference to a specialist laboratory.
4. Non-deleterious to the patient, however ill he may be.
5. Very delicate and capable of calling out the full functional power of the kidneys.
6. The test substance shall be one with which the kidney is regularly called upon to deal.
7. The test substance shall not be one which is influenced by any other organ in the body (Cameron, 1934).

Innumerable tests have at one time or another been proposed, the most useful and commonly used of those shall now be discussed.

Analysis of the blood chemistry will give an indication of renal damage and inefficiency by showing increased amounts present in the blood of substances normally excreted by the kidney - no such change is shown, however, until one half to three quarters of the kidney is affected. The blood urea is the usual substance chosen for estimation, its normal value being between twenty and forty m.g.\% (Samson Wright). The blood urea may be raised by renal failure, excessive loss of fluids, /
fluids, as by diarrhoea and vomiting, by high intestinal obstruction, or by a high protein diet.

Dye tests depending on the excretion of a dye introduced into a vein, e.g., indigo-carmine, are useful bedside tests in cases obviously not on the border line, but are time consuming and introduce a foreign substance into the kidney. They are more suitable for the testing of the functions of individual kidneys under cystoscopic observation of the ureteric orifices, than for cases of prostatic obstruction where both kidneys are likely to be damaged to equal degrees.

Uric acid and creatinine tests introduce technical difficulties in their estimation. The creatinine especially, since it is estimated colorimetrically.

The two remaining tests are, the urea concentration range test and the urea clearance test.

Cameron is of the opinion that urea is a non-deleterious substance and in adequate doses (e.g. 15 grams) will call forth the full reserve power of the kidney. It is a substance which is normally excreted by the kidney. He further considers that the estimation of urinary urae by the sodium hypobromide method compares favourably in accuracy with the urease method of estimation, and can moreover be carried out in any side room, whereas the urease method requires a fully equipped laboratory. Calvert's urea concentration test is carried our at night during sleep with the concentrating powers of the kidney are known to
be greater. It is therefore superior to Maclean's and de Wesselow's test which is done during waking hours and for which a concentration of 2 gms% is considered to be satisfactory. The normal daily urinary urea concentration is only 2 gms% when, according to Verney and others, only a very few glomeruli are active at a time. This concentration of 2 gms% in the Maclean test merely means that the kidney is equal to normal demands, when, by reason of the urea administered to the patient, the entire reserve power of the kidney should be called out. Cameron therefore fixed the lowest maximum concentration for the test carried out at night at 3.5 gms% because of the greater concentrating power at that time.

At the Western General Hospital the test is carried out as follows:

From noon onwards the fluid intake is restricted.

At 9 p.m. 15 gms of urea are given in 100ccs of water.

At 10 p.m. the bladder is emptied lest an initial urea diuresis upset the test. A specimen is kept and the total urine is measured.

10 p.m. - 6 a.m. Sleep.

6 a.m. the bladder is emptied, a specimen is kept, and the total amount is measured. After the bladder has been emptied, 2 pints of fluid are given, e.g., 2 cups of tea and 2 cups of water.

7 a.m. the bladder is emptied, a specimen is kept, and
I. Limit values in normal persons.

II. Average values in normal persons.
the total amount measured. 8 a.m. as at 7 a.m. 

The amount of urea in the specimens is then estimated in a ureometer, by reaction with sodium hypobromite. The sodium hypobromite must be prepared freshly for each estimation by the addition of one ampoule containing 5 c.c.s. of bromine, to 25 c.c.s. of 40% sodium hydroxide solution. Great care must be taken in the opening of the bromine ampoules, which is best done by pouring the soda into a large clean jam jar and dropping the ampoules onto the bottom, or by breaking the neck of the ampoule with a glass rod. (Bromine causes severe burns when in contact with the skin and is very irritating to the eyes and respiratory passages). The volume of gas in the tube is read off according to the graduations on the side of the tube, the graduations so arranged that this reading gives the urea content of the urine in grams per pitre. Fluid restriction before and during the test is very important in prevention of low maximum results in normal cases. Cameron's figures for the normal range at various degrees of impairment are given as tables and graphs.

Where the patient had residual urine the test was started at midnight, and he was catheterised at 8 a.m. instead of 6 a.m. It was noticed that with drainage by indwelling catheter the second morning specimen (7 a.m.) often showed a higher percentage of urea than the first morning specimen (6 a.m.) instead of /
of vice versa. This may be due to a diminution in the urine output subsequent to drainage resulting in distortion of the normal concentrating power or it may be due to unusual diuresis or to lack of fluid restriction. The high minimum value is probably due more to temporary damage from which recovery may occur if rest is given and the cause of the damage removed. The recovery is surprisingly complete in many cases.

Riches and Robertson consider that the urea concentration range, blood urea and dye tests lead to a feeling of false security and illustrate this with the urea clearance test.

They believe that the urea clearance test is a more reliable index of operability in cases of prostatic obstruction, that where the level is above 60% operation is safe, and where it is below this figure it is hazardous and the convalescence is liable to be more stormy and the complications are more frequent.

In the urea clearance test the kidney is observed working under normal physiological conditions and the action of the test does not depend on the excretion of any foreign substance, nor even of any artificial introduced normal substance.

No preparation is required for the test, which is done after lunch or breakfast. The only restriction is that coffee may not be taken at the previous meal. The patient is put at rest on a chair or couch, as activity affects the result. He should also be warned not to void urine for three hours before the test.
test because of the uncertainty of emptying the bladder if there
is only a little there. All prostatic patients should be
catheterised. The most important point in the test is the
timing of the intervals, one minute error making one per cent
error in the result.

The normal urea clearance is the number of c.c.s. of blood
that could be cleared per minute by the kidney if that organ
were completely to clear urea from the blood. There is a
normal maximum clearance (that occurring in the first hour) of
74 c.c.s. and a normal standard clearance (in the second hour)
of 54 c.c.s. Figures for the maximum and standard clearances
of the patient are obtained and expressed as percentages of the
normal.

The part played by infection in depressing function was es-
pecially well shown in the series of urea clearance tests re-
ported by Riches and Robertson.

No one test of function is sufficient in itself. The urea
clearance test is a combination as in it the blood urea has to
be estimated. The blood urea and urea concentration test are
used together in prostatic obstruction more than any others in
this country. The blood urea indicates whether or not there
is gross nitrogen retention and the concentration test indi-
cates the power of the kidneys to rise to an emergency. The
urea clearance test is obviously a more delicate test and re-
veals finer defects than the blood urea, and concentration
range /
range combination. It is further, for reasons stated, a more normal physiological test. Many clinicians consider that the finer defects revealed by the urea clearance test are more suited for the medical case than for the surgical case, where the ultimate criterion must always be the clinical condition of the patient. But the clearance test is a more exact method of diagnosis and involves no more specialist laboratory procedure than the other combination, while resulting in a saving of nursing labour, and should find a place in clinical surgery. The greatest objection to its general introduction is that every surgeon has his own interpretation of the blood urea and urea range tests, while few have any extensive experience of the urea clearance tests. This difficulty could be met by the application of both methods to all cases for a trial period, during which their respective values could be estimated and new criteria developed, and a decision reached as to which was to be discarded.
ANALYSIS OF THE CASES.

1. **Cysts**. Aged 65 years.
   - Simple hypertrophy, glandular type.
   - 2-stage operation:
     1. Supra-pubic cystostomy.
     2. Supra-pubic prostatectomy.
   - Function restored.
   - Result: cure.
   - Follow-up:
     - Died as a result of cardiac failure and bronchitis three months after discharge from surgery.

2. **Barb**. Aged 65 years.
   - Simple hypertrophy, glandular type.
   - Supra-pubic drainage six years.
   - Complicated by contracted bladder.
     - Cystitis.
     - Vesical calculus.
   - Operation:
     - Lithotomy.
   - Section of the prostate.
   - Complicated by leakage.
   - Function restored.
   - Result: cure.
   - Follow-up: nil.
Analysis of Cases.

Simple hypertrophy, glandular type.
2 stage operation;
1. Supra-pubic cystostomy.
2. Supra-pubic prostatectomy.
Function restored.
Result - cure.
Follow-up: -
died as a result of cardiac failure and bronchitis three months after discharge from surgical ward.

Simple hypertrophy, glandular type.
Supra-pubic drainage two years.
Complicated by contracted bladder,
Cystitis,
Vesical calculus.
Operation:
Lithotomy,
Enucleation of the prostate,
Complicated by anuria.
Function restored.
Result - cure.
Follow-up: - nil.
III. Baillie. Aged 69 years.

Simple hypertrophy, fibrous type.

Operation:

1. Supra-pubic cystostomy
2. Trans-urethral resection.

Complication - nil.

Function restored.

Result - cure.

Follow-up: - nil.

IV. McCafferty. Aged 59 years.

Prostatic calculi.

Stricture of urethra.

Operation:

1. Stricture dilated.

2. Calculi removed by perineal route.

Complications - anuria, rectal fistula.

Function restored.

Result - cure.

Follow-up: - fair.
V. Broothie. Aged 61 years.

Post-operative fibrous veil at bladder-neck.

Multiple vesical calculi.

Cystitis.

Operation:

1. Lithotomy.

2. Incision and suture of veil.

Complications - nil.

Function restored.

Result - cure.

Follow-up: - good.

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Simple Hypertrophy, Glandular type, 2 Cases.

Simple Hypertrophy, Fibrous type, 1 Case.

Prostatic Calculi, 1 Case.

Post-operative Veil, 1 Case.

Anuria, 2 Cases.
ALEXANDER CHALMERS.

Aged 83 years.

simple hypertrophy, glandular type.

2 stage operation:

1. Supra-pubic cystostomy.

2. Supra-pubic prostatectomy.

Function restored.

Result - Cure.

Follow-up:-

Died as a result of cardiac failure and bronchitis three months after discharge from ward.
ALEXANDER CHALMERS. Aged 83.
46, Cumberland Street, Stockbridge, Edinburgh.
Widower.
Flour-miller.
Recommended by Dr. Gibson.
Admitted 7.9.35.
Diagnosis: Simple prostatic hypertrophy.
Complaint: Inability to pass urine at various times during
the past two weeks.
History: Until two weeks ago the patient was passing his water
quite normally, and has never before had any difficulty with the
act. He occasionally rose once during the course of the night
to pass urine, but had noted no change in the character of the
stream and no increased frequency during the day. A fortnight
ago he went to a football match at Tynecastle, and became very
chilled during the game, after which he had a few drinks before
going home (two small whiskeys and a pint of beer). He tried
to pass his water at the public-house, but was unable to do so,
and he became rather alarmed. He then bought some gin and went
home, where he made himself a hot drink with the gin, and again
tried to pass water. After straining for some minutes he
passed a little in drops and felt a pain in the lower part of
the abdomen. He sat down by the fire, and after a while ex-
perienced an urgent desire to pass urine to which he yielded
and passed a large quantity.

Later /
Later the same evening he tried again to pass water but was quite unable to do so, and had to call in his doctor who passed an instrument and relieved him. During the last two weeks it has been necessary for him to have an instrument passed several times, and so his doctor sent him to the Royal Infirmary. An instrument was passed there and he was brought down to this hospital and admitted. He has no complaint of any other troubles and is otherwise perfectly healthy.

Previous illnesses: Gradually increasing breathlessness since he stopped work 12 years ago. Not very severe at present time.

Social history: Lives under good conditions with married daughter.

Family history: Wife died 45 years ago of cerebral haemorrhage. Children, 10. 6 alive, well. 4 died in childhood.

Examination: 11.9.35.

The patient was admitted in a somewhat exhausted and ill state. Today he has recovered and is a bright-eyed, cheerful, rather wizened-looking old man of average intelligence, but taking more than average interest in everything about him. He is already firm friends with his neighbours. He is thin but not emaciated.

Alimentary system: The tongue is white-coated but moist. He has only four teeth which are in the lower jaw and in a very foul condition.

Genito-urinary system: The abdominal wall is relaxed but there is /
is no tenderness. The contours are normal, there is no sign of oedema, the amount of fat present is normal. There are no areas of tenderness on light palpation. On deep palpation there is slight pain in both kidney regions but none over the ureters. The liver and spleen are not enlarged. The bowels are regular. There are no external piles. 

Rectal examination: The interior of the anal canal and rectum appear to have a normal contour. There are no signs of induration or oedema of the mucosa. The prostate is enlarged ++. The lateral lobes are affected, the enlargement is uniform in character, elastic in consistence, not fluctuant and not painful or warm on palpation.

Cardio-vascular system: There are no signs of cyanosis. Pulse regular in time and force well sustained. Wall slightly thickened and palpable. Rate 84 per minute. Blood pressure systolic 158 / diastolic 78. Heart - no abnormal pulsations. Apex beat fourth space in mid-clavicular line. The outline as estimated by percussion is within normal limits. The sounds are not well heard, but are closed and otherwise normal in all areas.

Respiratory system: A barrel-shaped type of chest, fairly well covered with fat, and muscles, which are in good condition. Does not move well in respiration which is of the mixed type. There are no unusual depressions. The lower part of the chest looks rather more full than it should. On palpation vocal fremitus /
fremitus is well felt. Percussion elicits a normal note in all areas. Auscultation - breath sounds are vesicular all over the chest. There are a few expiratory crepitations at both bases.

Central nervous system: The pupil reacts a little sluggishly to light and accommodation. The abdominal superficial reflex is doubtful. The knee and ankle reflexes are weak but present. Cutaneous sensation is diminished.

Other systems: Examination revealed no abnormal features.

Special examinations:

Urine: Amber colour.
Specific gravity 1012.
Acid to litmus.
No albumen.
Residual urine, three oz.

9.9.35. Urea concentration range. Maximum 2.5. Minimum 1.5.

Indigo-carmine excretion test: Dye appeared in urine in 22 minutes. Dye reached maximum concentration in 30 minutes.

Cystoscopy: 11.9.35.

Premedication morphine grains 1/6. Hyocine grains 1/150.
Rectal examination: Uniform enlargement of both postero-lateral lobes of the prostate.

Cystoscopy. 15F cystoscope was passed with ease.
The bladder was washed out. The bladder walls were congested and showed no trabeculation. There was enlargement of the middle /
middle lobe which projected up into the bladder and of both lateral lobes which were encroaching upon the urethra.

Blood: Urea nitrogen 18 mg%.

Provisional diagnosis:

Simple prostatic hypertrophy.

Treatment:

7.9.35. On admission the patient was put to bed and catheterised. He was put on a fairly full diet with abundant fluid, and impressed with the real need for him to drink as much as possible. A quart jug of fruit juice was always to be at his bedside, and it would be varied as far as possible to his taste.

8.9.35. A red rubber catheter was inserted to the bladder per urethra, and left in situ, being fixed in position by means of linen tapes and adhesive strapping after the part had been shaved.

12.9.35. Cystoscopy.

13.9.35. Operation. Mr. Band.

Premedication morphine grs ¼. Atropine grs 1/100.

Anaesthesia, local.

The skin was prepared in the usual way, by shaving and scrubbing with soap and water and then by painting with 1% tincture of iodine, the night before the operation, and being covered with a sterile towel until immediately before the operation began.

The indwelling catheter was withdrawn from the urethra and
and a fresh sterile red rubber catheter was inserted to the bladder per urethra and the bladder was filled with 4% solution of boric at a temperature of 100 degrees F., through this catheter which was then clamped.

Local anaesthetic (1% novocaine) was then injected over an area extending from half an inch above the symphisis pubis to one inch below the umbilicus, and to one inch either side of the middle line. A midline suprapubic incision was then made extending for one inch upwards, from a point one and a half inches above the symphisis pubis, this incision divided subficial fascia and fat. The linea alba was then split vertically. Blunt dissection carried the field onto the surface of the bladder, and the vesical veins were caught between forceps and divided. The bladder was opened by a vertical incision, into which the index finger was immediately thrust. The fluid within the bladder was allowed slowly to escape, and then the bladder was viewed. The enlarged prostate presented showing a middle lobe enlargement which was projecting onto the bladder, and slight upraising of the remainder of the gland. A lubricated Pezzer catheter on an introducer was inserted to the bladder via the wound, and the introducer was withdrawn. The vesical veins were ligated and the bladder wall closed around the catheter. The linea alba was sutured with catgut and the skin and superficial fascia approximated with interrupted silk-worm gut sutures. The bladder was then washed out in both directions /
CHALMERS. Urea range. I. 9.9.35.  
II. 8.10.35.
directions through the two catheters with 1/10000 silver nitrate solution and the urethral catheter was withdrawn.

Supra-pubic cystostomy.
First stage of prostatectomy.
14.9.35. There has been good drainage overnight and the patient is feeling well, apart from some soreness about the wound, and a little exhaustion. He is drinking freely.
15.9.35. The pulse is a little irregular. There are some extra systoles, also a slight cough.
17.9.35. Pulse regular, patient still coughing.
24.9.35. The patient is being given for his cough -
Mist Benzoate t.i.d.
Mist Expectorans t.i.d.
1.10.35. The general condition is good, apart from the cough.
6.10.35. It has been decided to do a bilateral vasectomy to eliminate as far as possible complications of the second stage. Therefore the patient is to have bladder washouts with 1/10000 silver nitrate sol. every second day.
8.10.35. Urea range.
11.10.35. Operation. Mr. Band.
Premedication morphine grs 

atropine grs 1/100.
Anaesthetic, local (1% novocaine).
The vas deferens was caught through the skin with an Allis' forceps on the right side about ⅛ inch distal to the external inguinal /
inguinal ring at the point where it is most easily palpable. Local anaesthetic was then injected into the skin ridge thus raised up and the skin incised on the summit of the ridge. The vas was secured and two ligatures were tied on to it, and it was divided between them. The skin was closed with a silk-worm gut suture. This was also done on the left side.

Bi-lateral vasectomy.

16.10.35. The vasectomy wounds have healed and the stitches have been removed. The patient's general condition is fair.

25.10.35. The patient's condition is much improved, he is drinking well and eliminating fluid quite adequately. Blood pressure, 158 systolic/90 diastolic.

1.11.35. Operation. Mr. Band.

Premedication morphine grs. 1/6, atropine grs. 1/100.

Anaesthesia, gas and oxygen.

The supra-pubic fistula was enlarged and the margins excised. The bladder was viewed. The prostate and the floor of the bladder were carefully examined. The plane of cleavage having been found, the prostate was enucleated digitally and the capsular tags were removed. A gauze pack rung out of saline was then firmly packed into the prostatic bed and a stout cotton ligature was firmly tied to the pack, and brought out of the wound. A large Freyer's tube drain was inserted and the bladder wall closed round this. The abdominal wall was then closed as described /
described above with cat-gut and interrupted silk-worm sutures. Enucleation of prostate. Second stage of prostatectomy.

**Pathological report:** Simple prostate hypertrophy with glandular hyperplasia.

The patient was returned to bed and the Freyer's tube was connected by a length of rubber tubing to a drainage bottle at the bedside.

2.11.35. The patient's temperature rose to 103 F. Pulse rate, 100.

3.11.35. The temperature fell to normal during the morning. Pulse rate, 100.

4.11.35. The Freyer's tube was removed and a Pezzer catheter inserted in its place.

6.11.35. The pack was removed by traction on the cotton ligature. The pack was offensive in smell but did not show signs of marked sepsis. There was slight haemorrhage from the prostatic bed after removal of the pack.

15.11.35. The patient today passed urine per urethram, but a great deal of discomfort is being caused by the oozing of urine which is occurring from the supra-pubic fistula round the sides of the catheter.

22.11.35. The patient is complaining of discomfort and pain in his penis. On examination it is found to be very red and oedematous, the roll of the prepuce especially being affected. He has been in the habit of keeping his urine bottle in the bed.
bed between his legs, and the constant irritation has been the cause of this severe balanitis. A cold ichthylol and glycerin dressing was applied and the patient was told to keep his bottle in his locker. It was impossible to reduce the prepuce.

23.11.35. The pain is worse this morning. There is some pus exuding from the meatus. The dressings were changed to magnesiu sulphate and glycerin.

26.11.35. The swelling in the penis has subsided greatly. The prepuce was reduced and cold cream smeared over the affected areas.

3.12.35. There has been a recurrence of the purulent urethral discharge. The urethra was irrigated with 1/10000 potassium permanganate solution.

7.12.35. The urethral irrigations have been stopped.

The patient has learned to control the flow of urine, and is holding it completely without any dribbling for as long as two hours at a time.

15.12.35. The patient was discharged today to his home with perfect bladder function and in good general condition.

Result: cure.

24.12.35. The patient was readmitted to a medical ward in this hospital complaining of severe cough, but having no urinary or bladder symptoms.

On examination he was full of spirit, but very breathless in spite /
spite of being propped up in bed. The chest was hyper-resonant in all areas on percussion. There were coarse crepitations at both sides.

Respiration rate, 35.

Pulse was irregular but apart from extra-systoles there appeared to be nothing abnormal present.

Pulse rate, 95 per minute.

He was given mist expectorants t.i.d. from admission.

26.12.35. Ephedrine grs. l.b.i.d. for asthmatic attacks.

28.12.35. Mist lobelia aetheris t.i.d.

15.1.36. The pulse and respiration rates have risen steadily since admission and are now 120 and 42 respectively.

3.2.36. Blood pressure 120 systolic/80 diastolic.

Temperature 97.2 degrees F.

Pulse rate 100 per min.

Respiration 50.

7.2.36. The pulse rate has begun to fall again.

10.2.36. Pulse rate 84 per min.

14.2.36. The patient has gone gradually downhill. His pulse has been falling steadily during the last week, and he died early this morning.
ALEXANDER ROSS.

Aged 65 years.

Simple hypertrophy, glandular type.

Supra-pubic drainage two years ago.

Complicated by:

- Contracted bladder.
- Cystitis.
- Vesical calculus.

Operation:

- Lithotomy.
- Enucleation of the prostate.

Complicated by Anuria.

Function restored.

Result: Cure.

Follow-up: Nil.
ALEXANDER ROSS. Aged 75 years.
No fixed abode. Last address, Eastern General Hospital.
Single.
Horse-driver.
Recommended by Mr. Band from Eastern General Hospital.
Admitted 7.11.35. Ward D IV.

Diagnosis: Simple prostatic hypertrophy. Vesical calculus.

Complaint: Pain in the bladder. Difficulty and frequency in passing water.

History: The patient first began to experience difficulty in starting to pass water nearly three years ago. He was not working at this time. The difficulty was increased if he became cold. The condition became worse, and a year and ten months ago, he was admitted to the Royal Infirmary where he underwent an operation for "drainage of the bladder", and was discharged with a permanent catheter in the bladder. He reported to have this changed regularly at first, but later was forgetful about it.

About nine months ago he began to feel pain when "the water tried to force its way down the penis". The pain was severe and sharp, like jabs with a needle at the tip of the penis. It was irregular in occurrence, sometimes being experienced as often as six or seven times a day, and three or four times at night, while at times he was free of pain for several days at a time. He was passing some urine still in the /
the usual way and the pain was then only felt after the thin dribbling stream had stopped.

About three months ago he had a few sharp stabs of pain in the loin on the left side, but apart from this had nothing to worry him anywhere. He was admitted to the Eastern General Hospital to await a bed in this hospital.

**Previous illness:** None.

**Social history:** The patient's surroundings are none too good. He usually lives in a lodging house. He is not intemperate, but likes "his pint and a dram", and admits that at times they make the pain worse. His diet is all that could be expected—chiefly tea and carbohydrates ("jammy pieces and an occasional pie or piece of meat").

**Family history:** Parents died of old age. Healthy during life-time.

**Examination:**

**Genito-urinary system:** The abdomen is sparsely clad and muscular, moves well on respiration and is of normal contour. There is a supra-pubic fistula two inches above the symphysis pubis, there is a hard indurated margin of the consistence of cartilage to the fistula, with the operation scar extending out above and below. There is wrinkling of the skin by scar tissue and some redening and excoriation of the skin round and especially below the fistula. There is some white crusting on the fistula and on the Pezzer catheter into the bladder.
The liver dullness is increased on percussion to about two fingers breadths below the costal margin but is not palpable nor is the dullness upwards on percussion.

The spleen and kidneys are impalpable and there is no tenderness in the loins.

Rectal examination: There are no external piles, the contour and consistency of the rectal walls are normal. There is a large bi-lobed enlargement of the prostate projecting into the rectum and encroaching upon its lumen. There is a well defined groove between the lobes. The gland is firm, inelastic and contains a few firmer nodules.

Respiratory system: The chest is broad, well-made, and of a large capacity. It moves well on respiration, which is thoracic in type. Vocal fremitus is slightly diminished. Percussion elicits a slight degree of hyper-resonance. On auscultation the breath sounds are vesicular but there are rhonchi and some coarse crepitations at both bases. Vocal resonance is slightly diminished.

Cardio-vascular system: Pulse rate, 64 per minute, of good volume and fairly well sustained. Vessel wall palpable, rather inelastic but not hard. Apex beat 5th left intercostal space in the mid-clavicular line. Heart not enlarged. Sounds closed and clear in all areas. Blood pressure 165 systolic/90 diastolic.

Digestive system: Appetite good, but not a hearty eater. Tongue furred
furred but moist. Teeth all dirty, several carious. He is constipated unless he takes medicine regularly.

Central nervous system: Pupils react to light and accommodation. Superficial and deep reflexes present and normal.

Special examinations:

8.11.35. Urine cloudy and deep yellow in colour.
   Specific gravity 1018.
   Alkaline to litmus.
   Pus cells present.
   Paratyphoid B. bacilli isolated from specimen from bladder.
   Residual urine, a few c.c.s.

9.11.35. Stool paratyphoid B. bacilli isolated.

Urea nitrogen, 8.11.35. 36 mg%.
   15.11.35. 26 mg%.

9.11.35. Urea range.

9.11.35. Indigo-carmine excretion test. The dye appeared in the urine in 26 minutes. It reached a maximum concentration in 35 minutes. The amount excreted was small.

15.11.35. Cystoscopy. Mr. Band.

Premedication morphine grs ½.

Rectal examination. Prostate enlarged +.

Cystoscopy: A 15 F. cystoscope was passed and bladder washed. The bladder capacity was 30 c.c.s. Under continual lavage a stone about the size of a marble was seen in the dependent part /
ROSS. Urea Range.

I. 9  II. 35.

II.16   II. 35.
part of the bladder.

**Provisional diagnosis:**

Simple prostatic hypertrophy.

**Treatment:**

7.11.35. The patient was put to bed, well propped up with pillows. He was put on a full diet and encouraged to drink as much fluid as he could possibly take. His bladder was washed out twice daily during the first week, warm silver nitrate 1/10000 being used. The Pezzer catheter was changed on admission, the old one which was removed being caked and partly blocked with a whitish crust of phosphates and having a very offensive smell.

14.11.35. The patient has developed a troublesome cough with sputum. Mist. expectorans has been prescribed.

15.11.35. Urea range.

15.11.35. Cystoscopy.

17.11.35. He complains of severe spasmodic pain in the abdomen round the umbilicus and in the bladder region, which comes on suddenly.

19.11.35. **Operation.** Mr. Band.

Premedication morphine grs ¼. Atropine grs 1/100. Anaesthesia, gas and oxygen.

The supra-pubic fistula was enlarged upwards and downwards and the indurated margins of the fistula were excised from skin to bladder mucosa. A greatly thickened and trabeculated bladder /
bladder wall was then palpated. The calculus noted at cystoscopy was then removed from the base of the bladder with lithotomy forceps. The marked intravesical projection of the enlarged middle lobe of the prostate was then felt, and a plane of cleavage searched for, this being found at the posterior margin of the middle lobe. Enucleation of the middle and right lateral lobes of the prostate was then carried out, the deep part of the manipulation being assisted by a finger in the rectum pushing up the gland to meet the intra-vesical finger. A smooth prostatic bed remained with no tags of mucosa or gland. The prostatic cavity was firmly packed with a narrow strip of gauze to which a stout cotton thread was tied to facilitate removal of the pack. A large Freyer's drainage tube was inserted to the bladder which was closed about the tube and the abdominal wound was closed in layers about the tube with cat-gut and silk-worm gut sutures. A silk-worm gut stitch was inserted to the skin, tied, and then tied to the Freyer's tube to retain it. The bladder was washed out gently with warm silver nitrate 1/5000 solution through the Freyer's tube.

Supra-pubic lithotomy.

Second stage supra-pubic prostatectomy.

Pathological report; Simple prostatic hypertrophy with considerable fibrosis.

The patient was returned to bed and the Freyer's tube was connected to a length of rubber tube draining into a bottle at the
the bedside. The urine secreted by the patient was at first deeply blood-stained; this passed off and the urine became normal in colour.

20.11.35. The patient is very sleepy and complains of some pain in the bladder region. Morphine grs 1/6 was given at 11 p.m.

21.11.35. The patient has become confused in his mind and is complaining of severe pain in the bladder. The urine secretion has been falling off, and at 4 p.m., as almost none had been secreted since 8 a.m. this morning, and since there was no fault with the drainage system, it was decided to carry out a continuous intra-venous infusion of 4.82% sodium sulphate. This was done, the rate of injection being about 30 drops per minute. Urine began to appear about 45 minutes after the infusion had been begun. This urine was of a deep brown colour and contained 1.9% urea. The blood urea nitrogen at this time was 40 mg%. Urine was secreted well after this time. There was a rigor at 5.5 p.m. which was treated promptly and the infusion was continued until approximately 600 c.c.s. of the solution had been given.

22.11.35. The patient is secreting urine quite well and the initial diuresis is passing off.

24.11.35. The Freyer's tube and the pack were removed. There was slight bleeding when the pack was removed. A Pezzer catheter was well lubricated and inserted to the bladder and connected /
connected to the drainage tube.

11.12.35. The patient got up today for an hour.
512.35. He has today passed urine per urethram and in a reasonable quantity.
23.12.35. Supra-pubic fistula has closed.

Urine is being voided well per urethram.

The bladder capacity is still small, giving rise to frequency, but the patient thinks that this too is improving. He is learning to hold his water again.

30.12.35. Progress maintained.

The patient was discharged to the Eastern General Hospital.

Aged 80 years.

Simple hypertrophy, fibrous type.

Operation:

1. Supra-pubic cystostomy.
2. Trans-urethral resection.

Complications - nil.

Function restored.

Result - Cured.

Follow-up: Nil.
ROBERT BAILLIE.

Aged 69 years.

Simple hypertrophy, fibrous type.

Operation:

1. Supra-pubic cystostomy.

2. Trans-urethral resection.

Complications - nil.

Function restored.

Result - Cure.

Follow-up: Nil.
ROBERT BAILLIE. Aged 69 years.
12, Wardlaw Terrace, Gorgie, Edinburgh.
Married.
Storeman.
Recommended by Dr. S. Hudson.
Admitted 25.9.35.
Discharged 14.12.35.
Diagnosis: Simple prostatic hypertrophy of fibrous type.
Complaint: 1. Hoarseness and pain in the chest for 2 - 3 months.
2. Difficulty and pain on trying to pass water.
History: Two or three months ago the patient first began to be troubled with hoarseness, which was of a variable character, sometimes dry and burning and sometimes wet. Later he began to experience pains behind the breast-bone which became progressively worse, were stabbing in character, slow in onset, and spread down to the left arm, to the fingers, then passed up on to the left side. The pains were accompanied by palpitations, slight breathlessness, severe sweating and a feeling of compression of the chest. The pain was made worse by hard work, and he was forced to stop whatever he was doing, when the pain was present.

For about two weeks before admission, he had had difficulty in starting his water, and has experienced pain during, and dribbling after, the act of passing the water. He has never been /
been totally unable to pass water at any time. He has been rising twice at night for several months to pass water. Occasionally he feels a sudden very great desire to pass water; if he does so everything is well. If he is forced to postpone the act the pain in the lower abdomen has at times been severe. 

**Previous illnesses:** Pleurisy in right side, many years ago.

**Family history:** Mother bed-ridden for many years as a result of heart trouble, of which she eventually died. Father, dead: cause of death unknown. Wife, asthma. Two sons, both alive and well.

**Social history:** Conditions good.

**Examination:**

The patient is well nourished, pale but not anaemic, and of average stature and development. He speaks quietly and with assurance and cannot be shaken in any of his statements by cross questioning.

**Cardio-vascular system:** The patient is not cyanosed or breathless, but he is pale. Pulse rate 100 per minute, regular and well sustained, the arterial walls are impalpable. There is slight capillary pulsation in the lips and nails. There is no carotid pulsation. The blood pressure is 118 systolic/75 diastolic. The apex beat is in the fifth left intercostal space in the mid-clavicular line. There is no thrill palpable. On percussion the outline of the heart is normal. On auscultation the first sound is closed in the mitral area. In the aortic /
aortic area there was a soft systolic murmur and a faint diastolic murmur; these were not markedly propagated. Similar sounds were audible in the pulmonary area but they were best heard in the aortic area. In the tricuspid area both sounds were closed. The second sound in the mitral area carried with it a suspicion of the diastolic murmur heard at the base of the heart.

Respiratory system: The chest is barrel-shaped, but no abnormal signs were elicited on examination.

Urogenital system: The patient has a good appetite and enjoys his food, but does not eat a great deal. He has no digestive troubles as a rule, but at the moment is troubled badly by flatulence. Usually he is not constipated.

Teeth, all false, no septic foci in mouth.

Tongue clean and moist.

The abdomen is well covered but rather distended. This distention does not prevent or limit movement on respiration. Borborygmi is heard. On palpation the swelling is felt to be tense but not hard, and to fluctuate beneath the hand. It is markedly tympanitic on percussion. There is no increased bladder dullness.

There are two small, but very painful, external piles. The rectum is of normal contour; there is no thickening or induration. The prostate is enlarged and tender but not fluctuant or unduly warm. The enlargement is uniform and smooth; the gland is firm and of an even texture.
Central nervous system: The pupils react well to accommodation and light. The superficial and deep reflexes are present and normal.

Special examinations:

26.9.35. Urine specific gravity 1014.

Pale yellow.

Acid to litmus.

No casts. No pus cells.

Bacteriological examination negative.


7.10.35. Urea nitrogen (Urease) 28 mg.%.  
Creatinine (Folin) 2.7 mg. %.

CO2 combining power (van Slyke) 57.3 vols %.

14.10.35. Urea range.

Indigo-carmine excretion test. Dye appeared in eight minutes. It was not concentrated to any further degree.

Residual urine, four oozs.

16.10.35. Cystoscopy. Mr. Band.

Premedication morphine grs 1/6, rectal examination, prostate uniformly enlarged, simple hypertrophy.

Cystoscopy: 15 F. cystoscope passed, limpid urine withdrawn. Bladder filled, capacity 200 c.c.s. There is a purulent deposit /
deposit on the bladder base, and oedema of the bladder neck. There is slight encroachment on the internal orifice by the lateral lobes of the hypertrophy. There is more marked hypertrophy in the posterior commissure.

**Provisional diagnosis:**

Fibrous type of simple prostatic hypertrophy.

**Treatment:**

6.10.35. The patient was unable to pass water all day, and was catheterised in the evening. A red rubber catheter was passed with little difficulty and 28 ozs. urine withdrawn at 6 p.m.

7.10.35. Catheterised.

1. 10 ozs. withdrawn at 2 p.m.

2. 12 ozs. withdrawn at 8.30 p.m.

Blood pressure 125/75.

8.10.35. Catheterised. 26 ozs. withdrawn at 6 p.m.

9.10.35. Catheterised.

1. 16 ozs. at 2 p.m.

2. 8 ozs. at 9 p.m.

There are some pus cells in the urine containing gram-negative bacilli and bacilli. The following were therefore prescribed -

- Ammon. chlor. grs 15.
- Hexamine grs 10.
- Morphine grs ¼.

14.10.35. /
14.10.35. The patient developed incontinence.
16.10.35. Cystoscopy.
18.10.35. Daily bladder washouts with 1/10000 silver nitrate solution instituted in preparation for supra-pubic cystostomy to be done in four days time.
22.10.35. Operation. Mr. Band.
Premedication: morphine grs $\frac{1}{4}$, 
hyocine grs 1/100, anaesthesia local 1% novocaine.

A red rubber catheter was passed into the bladder per urethram and the bladder filled with 4% boric lotion at 100 degrees F. and the catheter bent upon itself and clipped. The skin in the supra-pubic region was infiltrated with local anaesthesia. A mid-line supra-pubic incision one and a half inches in length was made, dividing skin and superficial fascia. The linea alba was split and retracted laterally exposing the anterior aspect of the distended bladder which was opened by a short incision. A finger was passed into the bladder and examination made. The prostate felt fibrous and the internal orifice was much sclerosed. There was no intra-vesical herniation. A Pezzer catheter was introduced into the bladder which was closed about the catheter and the wound was closed in layers with cat-gut and silk-worm gut. The bladder was washed out with 1/10000 silver nitrate in both directions, and the patient was returned to bed where the catheter was connected to a drainage jar at the /
Tissue removed at operation.

Weight: 0.7 grams.
BAILLIE. Urea Range. I. I4. I0. 35.

II. 4. II. 35.

grams %.

2.8

2

1.5

1

0.5

0

1 2 3 4 5
the bedside.
4.11.35. Supra-pubic cystostomy.
Urea range. Blood urea 23 mg % urease.
8.11.35. Daily bladder washouts were instituted as the patient is to have a trans-urethral operation in a week's time.
15.11.35. Operation. Mr. Band.
premedication morphine grs $\frac{1}{4}$, atropine grs. $\frac{1}{100}$, anaesthesia, low spinal, novocaine.
The patient was put up in the lithotomy position. Bougies were passed. Then the McCarthy electrotome was passed with the obturator in position. The obturator was withdrawn and the bladder was washed out with sterile water. The loop electrode and telescope were introduced, and the inlet tube was connected to a reservoir of sterile water. 14 cuts were made with the loop, which, with the carrier, was removed from the sheath after each cut and the tissue removed from the loop. A few small points of haemorrhage were coagulated by a bead electrode and the bladder, having been washed out, the sheath was removed. Transurethral resection.
Pathological report: Fibrous prostate with no glandular elements in tissue excised. Weight of tissue removed, 7 grams.
(Photograph).
There was some haemorrhage post-operatively but it soon stopped.
The bladder was washed out every four hours with $\frac{1}{5000}$ silver nitrate /
nitrate for the first two days after the operation. Both
temperature and pulse rate rose on the night after the opera-
tion and did not settle until the third morning.
22.11.35. The Pezzer catheter was removed.
some urine was passed per urethram today, to the great delight
of the patient.
24.11.35. The patient complains of pain over the bladder and
at the tip of the penis every time he passes water.
27.11.35. Up for an hour.
29.11.35. Bougies were passed with ease and without pain up
to 16 / 19. The passage is much improved. There is still
considerable leakage from the supra-pubic fistula which is
causing much discomfort, and the patient's bed is continually
wet.
7.12.35. The supra-pubic fistula has now closed; the patient
has recovered control of his urine almost prefectly, and is in
a sounder general condition.
14.12.35. The patient was discharged today, to his home. The
bladder function is now perfect. He has been warned to go
quietly for a few months owing to the condition present in his
heart.
JOHN BROTHIE.

Aged 61 years.

Post-operative fibrous veil at bladder-neck.
Multiple vesical calculi.
Cystitis.

Operation:

1. Lithotomy.
2. Incision and suture of veil.

Complications Nil.

Function restored.

Result Cure.

Follow-up Good.
JOHN BROTCHIE. Aged 61 years.
5, Livingstone Place, Edinburgh.
Married.
Housepainter.
Recommended by Dr. Lamont.
Admitted 25.11.35. D.I.

Diagnosis: Post operative stenosis at bladder neck.
Multiple vesical calculi.

Complaint: Pain in penis on passing water for 15 months.

History: The patient had his prostate removed in August 1934, in Chalmers Hospital. Since then he has had pain on passing his water. The pain is situated all along the penis while the water is passing, but at the point at the end of the act. For a short while after his operation he was passing small stones. He has passed none recently. He finds it difficult to pass his water at times, and at these times the urine is thick and yellow in colour. He thinks the stream is of normal size. There is some dribbling of urine at the end of the act, but none before or between times.

He has twice been unable to pass his water at all, and has called in his doctor, who has not been able to pass an instrument because of the pain it caused. The spasm, as the patient calls the attack, has passed off later and the water has come away.

He has to rise every two hours during the night to pass urine, and during the day the call comes more often than this.
The urine is usually whitish in colour but has at times been reddish.

Extract from doctor's letter:- "the operation was for malignant prostate and he subsequently had X-ray therapy in the Royal Infirmary. Pain has been almost constant since the operation. He uses about 1 drachm of tinct. opii a day. Retention has occurred twice, but has passed off. I was unable to pass a catheter on account of the extreme pain induced."

Previous illnesses: None, except for operation mentioned.

Social History: The patient lives under good conditions.

Family history: Father died 40 years of age, bad chest.

Mother died 65 years of age, old age.

Children alive and well.

Examination:
The patient has a worried, drawn expression. His face is deeply lined. His completion is pale, sallow, and he is washed-out looking. He is of average muscular development and nutrition.

Genito-urinary system: The abdomen is protuberant and firm. The umbilicus is below the level of the surrounding skin. There is a scar of the previous operation which has healed well, and shows no sign of weakness. Nothing abnormal is found on examination. The liver is not palpable and the area of dullness within normal limits of percussion. The kidneys are not palpable.
palpable or tender.

Rectal examination: There are no pile masses. The rectum and anal canal are of normal contour. There is no induration, oedema or fixing down of the mucosa. There are no signs of recurrence of the disease in the prostate, which is enlarged and firm, not nodular or fluctuant.

Circulatory system: The pulse is slow, regular, of good volume and well sustained.
Rate, 80 per minute.
The heart apex beat is in the 5th space in the mid-clavicular line.
The heart is not enlarged.
The sounds are closed in all areas, but not well heard.
Respiratory system: The chest is rather barrel-shaped.
Respiration is thoracic in type.
Expansion is diminished a little at the right base. Vocal fremitus is slightly reduced. There is some increased resonance on percussion, but there is slight dullness at the right base. The breath sounds are diminished, vocal resonance is normal. There is a slight friction rib in the right axilla.

Digestive system: Appetite good, also digestion.
Tongue furred but moist.
Teeth comparatively good.
Bowels fairly regular.
Central nervous system: Pupils react to light and accommodation.
Superficial /
Diagnosis: Multiple vesical calculi.
superficial and deep reflexes are present and normal.

special examinations:

26.11.35. Urine, specific gravity 1019.
   Amber colour with white deposit.
   Some albumen and phosphates.
   Alkaline to litmus.
   Gram negative diplococci.
   Staphylococci and few bacilli coli isolated on culture from specimen from the bladder.
   Residual urine could not be measured.

27.11.35. Blood, urea nitrogen 17 mg%.

27.11.35. X-ray, no evidence of bone metastases.
   Multiple bladder calculi.
   Normal pyelogram. Renal function satisfactory.

Cystoscopy: Mr. Band.

Premedication morphine grs ½.

Rectal examination, simple prostatic hypertrophy.

Cystoscopy: Cystoscope held at entrance to bladder. Prostatic urethra felt to be dilated.

Provisional diagnosis:

   Multiple vesical calculi.
   Post operative stenosis of bladder neck.

Treatment: On admission the patient was put to bed and a full diet ordered. It was impossible to pass a catheter, so bladder lavage had to be dispensed with.

Operation: /
Fibrous veil at the bladder-neck.

Appearance on opening the bladder.

Appearance after suture of the flaps.

Fibrous Veil.

Prostatic cavity.

Urethra.

Diagram of veil and cavity.
Operation: Mr. Band.

Premedication, morphine grs ½,
atropine grs 1/100.

Anesthesia, spinal - novocaine.

A midline supra-pubic incision was made down to the bladder. Owing to it being impossible to fill the bladder before operation, that organ was exposed at a lower level than usual, and its anterior wall was incised in the bloodless area. Seven vesical calculi were removed with the lithotomy forceps, varying in size from one inch in diameter downwards. The stenosed vesical orifice was viewed. Its opening just admitted the tip of a Miller's bougie. The opening to the prostatic urethra was dilated and it became evident that the scar of the previous operation had formed a complete fibrous veil across the bladder outlet. This veil was divided in the midline as far back as the inter-ureteric line, thus throwing the entrance to the prostatic urethra widely open. The prostatic urethra was dilated. The edges of the flap formed by incision of the veil were secured by a fine catgut suture in each side to prevent reformation of the obstruction. The prostatic urethra was then packed with gauze in the usual way. A Freyer's drainage tube was then inserted to the bladder and the bladder wall and wound closed in layers in the usual way with catgut and silk-worm gut sutures. The bladder was then washed out with 1/5000 silver nitrate solution.

Supra-pubic /
Supra-pubic lithotomy.
Division of post operative cicatricial veil.
Suture of flaps of veil.

The patient was returned to bed and put into a position with
the head low until the effects of the spinal anaesthetic had
worn off, when he was propped up.

28.11.35. Pains in penis continued as usual.
1.12.35. Pain still present; drainage is occurring well by
tune.
5.1.35. Freyer's tube removed from prostatic urethra.
Pezzer catheter introduced.
Pain in penis has gone. Patient feels very much better.
11.12.35. Pezzer catheter removed from supra-pubic fistula.
13.12.35. Bougies passed per urethram to bladder up to largest
size.
Bladder washed out with 1/5000 silver nitrate.
18.12.35. Up for an hour today.
Bougies passed with ease.
Bladder washed out with 1/5000 silver nitrate solution.
Urine passing well by urethra.

Supra-pubic wound is healing but is still fairly wide
open and this is causing discomfort, as, in spite of
pads placed over the fistula and fixed tightly with
binders, the patient becomes very wet and uncomfortable.

8.1.36. Supra-pubic wound almost completely healed. Patient
was dry all day.

14.1.36. Bougies passed up to largest size.
    Slight bleeding at night.


Owing to the evident tendency to fibrosis and contraction the
patient was urged to report regularly every month to have boug-
ies passed to keep the vesical orifice dilated.

15.4.36. Reported. Passing urine normally, everything satis-
factory. Bougies passed to full range with ease.

15.10.36. Reported. The patient complained of pain in the
penis and of passing thick urine for three months.

Bougies were passed to full range; slight difficulty
was experienced, probably due to some spasm of the external
sphincters.

Cystoscopy: A 15 F. cystoscope was passed and clear urine with-
drawn. The bladder was filled; the capacity was normal.
The bladder walls were healthy.
The prostatic bed and the outlet of the bladder were normal.
PETER MCCAFFERTY.  

Prostatic calculi.  

Stricture of urethra.  

Operation.  

1. Stricture dilated.  

2. Calculi removed by perineal route.  

Complications:—  

Anuria.  

Rectal fistula.  

Function restored.  

Result cure.  

Follow-up Fair.
PETER McCAFFERTY. Aged 59 years.
0/o Smith, 332, Lawnmarket, Edinburgh.
Single.
Labourer.
Recommended by Mr. Band from Eastern General Hospital.
Diagnosis: Multiple prostate calculi.
Admitted, 6.13.35.
Complaint: Pain in the back passage on passing motions, which is becoming worse.

History: The patient contracted a gonorrhoeal infection during 1916, after which he underwent an operation for stricture. He has since been well until about five years ago when he began to be troubled with pain in the back passage every time the bowels worked; it was burning in character, only lasted while he was at stool. There was no pain on passing water until about a year ago when it first occurred, but it was slight. It has since become more severe and is situated at the tip of the penis. Four months ago the pain became very much worse and the patient was admitted to the Eastern General Hospital. The pain has been present continually during the last three months, prior to which he was free from it for periods extending up to one month. His bowels move regularly once a day.

He has noticed no alteration in the strength of the stream of urine on micturition, and has never experienced difficulty in starting the act, but there has occasionally been definitely abnormal /
abnormal dribbling at the end of the act. He has also noticed that the colour of the urine has varied from a clear amber to a thick muddy brown.

The patient has no other complaint such as breathlessness or palpitation and considers himself to be a healthy man, but thinks he has lost weight recently but has not weighed himself. **Previous illnesses:** Jaundice, 1910. Gonorrhoea, and Stricture, 1916. France. Orchitis R. side, 1932. E.G.H. Stricture, and Slight retention, 1933. W.G.H. **Examination, 7.12.35.**

The patient is a fairly typical example of an undernourished but otherwise fairly healthy ex-service man, of middle height, with sparse fair hair and a rather muddy skin. He is sitting up in bed and taking an interest in the happenings around him. He has been talking agreeably to his neighbours on either side. **Genito-urinary system:** The anterior abdominal wall is poorly covered with fat, but moves well on respiration, and there is no abnormality of contour. Nothing abnormal is felt on superficial palpation, nor was any pain or tenderness experienced by the patient. The regions of the kidneys are apparently normal and nothing is elicited on deep palpation along the line of the ureters or over the bladder. The penis and scrotum appear /
appear normal; testicular sensation is present. There is a small scar in the mid line in the perineum. There are no external piles.

Rectal examination:
The rectal mucosa is felt to be healthy and of normal consistence, not fixed or indurated except slightly so in the mid line anteriorly below and over the prostate. The prostate is felt as a hard, stony, bilobed swelling, somewhat larger than would be expected. The right lobe is larger than the left, and is pyriform on shape, the apex being directed downwards. There is a definite groove felt between the lobes. There is a slight crepitus on hard palpation, giving rise to pain which is complained of in the rectum and at the tip of the penis.

Cardio-vascular system: Pulse rate, 80 per minute. Volume good, wave well sustained.
Temperature, 98.2 degrees F.
Blood pressure, systolic 142 / diastolic 83.
There is no precordial pulsation. The apex beat is in the 4th intercostal space in the mid clavicular line.
On percussion the heart is of normal contour.
The sounds are closed in all areas.
Respiratory system: The chest is of normal contour and moves well on respiration, which is of the costal type. There are no bulgings of the inter spaces. Nothing abnormal is observed on palpation, percussion or auscultation.
Diagnosis: Multiple prostatic calculi.
Central nervous system: The pupils react to accommodation and light. The knee and ankle reflexes are present and normal. The superficial abdominal reflexes are present and normal, as are the skin sensations.

Other systems: On examination revealed no abnormal features.

Special examinations:
- Urine, reaction acid to litmus.
  - Specific gravity, 1014.
  - Colour, deep yellow brown.
  - Deposit, greyish-yellow.
- Microscopical examination of centrifugal deposit revealed. Large number of pus cells.

Blood: Wasserman reaction negative.

X-ray examination of the pelvis: The plate showed a circumscribed area corresponding to the position of the prostate in the pelvis in which were mottled shadows of no very definite shape, which were diagnosed as multiple prostatic calculi.

Cystoscopy, 11.12.35. Mr. Band.

Premedication, morphine grs. \( \frac{3}{4} \).

Rectal examination: Prostate hard and irregular. Prostatic calculi present.

A stricture was present at the level of the membraneous urethra. This was dilated from a Miller's bougie up to cystoscopy 14/17 Lister bougie. A 15 F. cystoscope was passed and clear urine was
was withdrawn from the bladder. The bladder was filled – its capacity being within normal limits. The bladder walls were healthy, apart from slight congestion. There was oedema of the bladder neck without any encroachment upon the lumen of the urethra of the prostate. No urine was sent for bacteriological examination. The patient experienced a good deal of pain during this examination. His temperature rose to 102 degrees F. during the ensuing night, but fell again to normal by noon.

**Diagnosis:** Urethral stricture.<br>Prostatic calculi.

12.12.35. In view of the patient's good general condition it was decided to remove the calculi from the prostate by the perineal route.

**Operation, 17.12.35.** Mr. Band.

Premedication, morphine grs 1/6,<br>hyoscymus grs 1/100.<br><br>**Anaesthesia,** low spinal with neocain.

Considerable difficulty was experienced in passing bougies. Miller's bougie eventually was passed and then Lister's up to 14 / 17. The patient was put up into the exaggerated lithotomy position and the parts painted with spirit. The scar of a previous external urethrotomy wound was seen just posterior to the root of the scrotum.

A horseshoe incision was made anterior to the anus and the /
The Perineal Operation.

- Line of incision.
- Exaggerated Lithotomy Position.
- Young's retractor in position.
- Section showing approach to prostate.
the skin-flap was dissected off and drawn back. The dissection was deepened behind the transverse perineal muscles in front and on either side of the central tendon, which was then divided and the rectum mobilised and retracted. There were dense adhesions present which made identification of the rectourethralis muscle difficult, and in dividing that muscle the anterior wall of the rectum was accidentally opened. This wound was at once repaired with a purse string suture, which was further reinforced with a second similar suture. The posterior layer of Denonvillier's fascia was exposed and divided, and the posterior aspect of the prostate was viewed. An inverted V-shaped incision was made in the prostate and a catheter previously inserted to the bladder per urethram was exposed in the prostatic urethra. This catheter was removed. The multiple calculi were removed from both posterior lateral lobes of the prostate by digital compression and by curettage. The internal commissure was slightly fibrosed.

A Pezzer catheter was inserted to the bladder by the prostatic incision and this opening was then closed round the catheter with three interrupted catgut sutures. The wound in the rectum was further repaired with a Lembert's invagination suture and the skin incision was closed with interrupted silk-worm gut sutures, the Pezzer catheter draining from one corner. A dressed flatus tube was inserted to the rectum. The bladder was washed out with a 1/10000 solution of silver nitrate and the
the patient was returned to bed and placed on his left side with the buttocks drawn to the edge of the bed. The Pezzer catheter was connected to a drainage bottle at the bedside.

**Progress:** In the first 24 hours after the operation the patient only passed four ounces of urine which was very dark brown in colour and contained 1.6 grams urea per 100 c.c.s. The Pezzer catheter was frequently syringed to ensure that there was no obstruction to the flow of urine from the bladder. It was realised that this was a case of post-operative reflex anuria. At 2.15 p.m., 18.12.35, a continuous intra-venous infusion of a 4.82% solution (isotonic) of sodium sulphate was begun, the rate of infusion being 20 drops per minute. The bladder had previously been emptied and the Pezzer catheter had been arranged to drain into a test tube at the bedside. Between 2.15 p.m. and 6 p.m. four ounces of urine were secreted. At 6.30 p.m. the rate of infusion was increased to 160 drops per minute. About 8 minutes later urine began to drip out of the Pezzer catheter at a rate of 5 drops per minute and continued to do so at gradually increasing rate. The rate of infusion was reduced at 7 p.m. to 20 drops a minute. At 7.40 p.m. there was a slight rigor. The urine became gradually less concentrated and dark in colour during the night. Samples of urine were preserved and sent for analysis. Unfortunately it was not possible to obtain a complete series. 1000 c.c.s. of sodium sulphate were run into the vein of the patient's right arm.
arm and the drip apparatus was dismantled. During the infusion the patient's pulse rate rose from 110 at 6 o'clock to 130 at midnight, but fell rapidly after the cessation of the infusion to 100. The patient suffered considerable pain in the rectum and bladder during the night for which he was given grains 1/6 omnopon.

20.12.35. Daily bladder lavage was instituted as examination of the urine had revealed some pus cells. Lavage was carried out with 1/10000 silver nitrate solution warmed to body temperature and instilled via the Pezzer catheter, only very slight positive pressure being used. This treatment gave rise to considerable pain.

26.12.35. The diet up to date has been chiefly fluid, with the addition of milk pudding, bread and butter and vegetables. Liquid paraffin was given yesterday and again today. This morning the flatus tube was removed from the rectum. This evening there was noticed some oozing of faeces on to the dressing.

28.12.35. Fluid faeces are being passed by the wound which has broken down and opened. Nothing is being passed by the anus.

20.12.35. A high colour lavage was carried out with good result.

Operation: Mr. Band.

1.1.36.

Premedication, omnopon grs. 1/6.

Anaesthesia /
Anaesthesia, gas oxygen.
The Pezzer catheter was removed from the bladder by the perineal wound after the bladder had been washed out. The urethra was then dilated with bougies up to 14/17 Lister's. A soft red rubber catheter was inserted to the bladder via the urethra and tied in. The bladder was again washed out until the washing returned clear. The perineal wound is gaping and showing signs of sepsis; fluid faeces having been passing out by the fistula since the second day.

7.1.36. Drainage is occurring satisfactorily by the urethral catheter - faeces are still passing by the fistula. The patient's general condition remains surprisingly good. Urethral catheter changed.

14.1.36. The perineal wound has closed slightly and is looking much more healthy. The urethral catheter was changed.

18.1.36. A large flatus tube was inserted to the rectum this morning. This afternoon the patient passed the first motion by the flatus tube.

21.1.36. The patient is feeling much more comfortable in every way. He complains less of pain and is now satisfied and convinced that he is making good progress. The urethral catheter was changed.

23.1.36. The temperature rose to 100.2 degrees F. and the pulse rate to 120. The penis was swollen and reddened and some pus was exuding round the catheter which was freed and removed.
removed. Four hourly fomentations were applied to the penis, hot boric soaks being laid on and surrounded by jaconet, cotton-wool, and a light bandage, care being taken that there was no constriction and no obstruction to the flow of pus which was slight.

24.1.36. The patient is much easier and is proud of having passed some urine in the normal way per urethram. An abscess which had formed in Colle's fascia was opened by a stab wound and drained to the exterior.

25.1.36. Abscess draining well.
Faeces and urine both being passed normally.
Temperature 99 degrees F. Pulse 100.

29.1.36. The fomentations and the bladder lavage were stopped.

7.2.36. The patient continues to improve. The perineal fistula is showing well marked signs of healing in its deeper parts.

21.2.36. The patient's general condition is much improved.
Temperature 98.2. Pulse 84 per minute.
The bowels move regularly at least once a day, the motions are kept soft with liquid paraffin, and are being passed normally and are causing no pain. The fistula is slowly closing. The urine is being passed normally per urethram without causing pain.

28.2.36. The patient has been up for a short while in a chair.
14.3.36. All wounds are healed. The patient is still rather shaky on his feet and is not fit for discharge.

14.4.36. /
1.4.36. The patient was discharged today.

Result — cure.

4.11.36. The patient was encountered in the street today. He has not reported at the hospital since discharge. He says he has no symptoms or trouble except slight pain on passing water; the stream is good, there is no frequency or urgency and dribbling before or after the act. He is taking especial care to keep his bowels regular.

DISCUSSION

d. History, examination and investigation.

d. Treatment.
DISCUSSION.

a. History, examination and investigation.

b. Treatment.
Discussion. a. History Examination and Investigation.

The importance of the history in any case of prostatic obstruction cannot be over-emphasised. It must give an accurate account of the onset of the condition, the nature of the symptoms and the order of their appearance.

The cases of Chalmers and Baillie are best suited as a basis for a discussion of the history of prostatic obstruction. In both these men nothing was amiss until about two weeks before admission. Changes must have been taking place for a considerable time, probably years, in the prostate before this, but without producing symptoms of such a degree as to attract their attention. Baillie had, for some months, to rise twice during the night to pass water; Chalmers had occasionally to rise once. Neither could state exactly when this started.

Nocturnal frequency is especially characteristic of prostatism. It is not a true nocturnal frequency, but is only noticed because of the inconvenience of having to rise up out of bed to pass water. By careful questioning it is often possible to elicit a history of increased frequency of a greater degree occurring during the daytime. This was done in the case of Brodie.

Associated with increased frequency of micturition there is usually noticed an increased difficulty in starting the stream. This was present in the case of Baillie who also complained of pain during the act, dribbling afterwards, and occasionally /
occasionally of an urgent desire to pass water. None of these symptoms were complained of by Chalmers. The increased difficulty was probably due to the mechanical factor of the fibrous gland interfering with the dilatation of the internal meatus. There may also be some weakening of the musculature in the region of the bladder neck, or of the bladder musculature as a whole. Straining is due to the impatience of the patient, because the initiation of the act takes longer than he has come to expect, causing him to use the muscles of the abdominal wall and perineum, consciously, if without understanding. Urgency is probably due partly to impaired action of the sphincter and partly to hypertrophy of the bladder wall. Dribbling at the end of the act is due to interruption of the normal muscle wave and to the impaired action of the bladder muscle, which fails to project a sufficient quantity of urine into the urethra for the voluntary muscles of the perineum to get a purchase on the column of fluid and expel it as such.

Difficulty in starting the act was complained of by Ross; here there was the prostatic condition acting as above. In the case of Brotchie the difficulty was caused by the minute orifice in the fibrous veil over the prostatic bed. This opening was the only way available for the passage of urine, which was at the times of difficulty of a thicker consistency than normal. This thickening of the urine, and its yellow colour, probably indicated a cystitis with pus and phosphate in.
in the urine. The frequency of which he complained was much more severe than in the case of Baillie, and was a sign of a bladder of lessened capacity and great irritability.

Retention of urine is the complete inability on the part of the individual to pass any urine, and so empty his bladder. It may be the last of a long train of symptoms, or it may be the first indication to the patient that all is not well in his urinary system, e.g., Chalmers. Retention is usually caused by changes in the prostate superimposed upon a pathological condition which has been present for some time, and which may or may not have given rise to symptoms. The prostatic man is very similar to the menstruating woman in that any excess or over-indulgence reacts promptly on his sexual organs. Too much exercise, over-indulgence in rich spicy foods, sauces or alcohol, sudden changes of temperature, and especially exposure to chill and cold east winds are liable to precipitate a crisis in the prostatic man. In the case of Chalmers, a certain amount of excitement, the strain of standing to watch a football match, a cold wind and a chill, and alcohol, were sufficient to cause acute retention of urine. The obstruction was almost certainly due to these factors, especially to the chill, for, after resting before the fire, he was seized with a great desire to pass water, and was able to do so. The repetition of the retention is not uncommon, and it is liable to become more frequent, especially after instrumentation. On the other hand /
hand it may never occur again.

Brotchie twice suffered from retention but in his case there were the fibrous veil with an exceedingly small orifice, and the calculi in the bladder. He described the attack as a spasm. At operation the obstructing veil at the bladder neck was shown to be fibrous and it would be incapable of contraction, having no muscle fibres. It is more likely that the retention was due to a calculus coming to rest upon the orifice of the veil and causing pain of a spasmodic character, and obstruction to the flow of urine. There was probably not a true urethral spasm. The pain on passage of the catheter was caused by the tip of the catheter stretching the fibrous veil (this was the case in hospital where the catheter was passed the usual distance to the internal meatus without resistance, but at that level was felt to meet obstruction, and caused pain).

Nocturnal erections may occur, perhaps as a result of the erectile tissue of the penis being supplied by sympathetic fibres which pass through the prostatic nerve plexus. There was a notable absence of history of such erections in these patients.

Pain is not usually a prominent symptom in histories of prostatism. Four of these five men, however, had pain; in three of their cases it was the major complaint. Pain at the tip of the penis, or along the shaft of the penis, is referred /
referred pain from a stimulus in the bladder. The bladder is supplied from the vesical plexus which gets fibres from the upper lumbar roots and from the second and third or the third and fourth sacral roots. The penis is supplied from branches of the pudendal nerve which arises from the second, third and fourth sacral nerves. There is therefore a nerve pathway for impulses from the bladder to the skin over the penis.

The causes of such pain are three in number:

1. Urethral spasm, associated with a desire for micturition. This was the probable reason in the case of Baillie, as no evidence of the other two causes was found, and the pain was experienced during the passage of urine.

2. Vesical calculus, which was present in the cases of Ross and Brotchie. Ross exhibits the typical pain due to calculus, present only when the flow of urine has stopped, due to the bladder contracting down on the stone. Brotchie exhibited this terminal pain, but, in addition, complained of pain during the passage of urine, which possibly was due to the stenosis of the internal meatus. There was in Ross' case pain due to the Pezzer catheter impinging on the posterior wall of the bladder.

3. Infection present in the bladder. This was present in both Brotchie and Ross, and may have caused pain in addition to that due to the stone.

McCafferty complained of "pain in the back passage" on defaecation /
defaecation due to the impact of the faecal mass on the prostate which contained calculi. He suffered later from pain on micturition referred to the tip of the penis, probably due to the spasm induced by the dilatation of the prostate filled with calculi.

The pain in the loin experienced by Ross may have been caused by distention of the ureters and renal pelvis on that side, as a result of backward pressure from the bladder, or by a short-lived infection of the upper urinary passages.

Previous illness is important in that it may have a bearing upon the present condition, as in McCafferty who had urethritis and stricture, for which he was operated upon, and which were important in the aetiology of his present condition. The family history may be of assistance.

The next step in the investigation is the physical examination of the patient. It is important that this investigation should be thorough and complete in every case, for there is in every prostatic case the possibility of an operation becoming imperative at some time.

In assessing the condition of the patient, his appearance is of value. It is often found that the prostatic man has a sallow or muddy skin, and is emaciated or thin. He has often a worried look, especially if suffering from acute retention or continual pain. The systems are examined in the order of importance, the one to which the primary complaint refers being examined /
examined first. In Baillie this was the cardio-vascular system, which presented a fairly typical picture of a well compensated aortic dilatation. In the other four cases the genito-urinary system was examined first. Particular attention should be paid to the tongue for signs of oral sepsis, to any indication of vesical distention, and to the kidneys and ureters which must be carefully palpated, any tenderness being noted.

A rectal examination should be made after the lower bowel has been emptied. Much practice is needed before the information obtained is of any great accuracy or value. It is important that the examination should be systematic. The patient should be in the left lateral position with the knees drawn up to the chin, and he should be told to relax himself as far as possible. Any straining increases the pain and difficulty of the examination. Visual inspection of the perineum and anus is important. In McCafferty it revealed a scar, and in the others external piles or mucosal tags were found. There is always a certain amount of discomfort and even pain during this examination but this can be reduced to an absolute minimum by using plenty of vaseline, and allowing little more than the weight of the finger to rest against the sphincters, when they will dilate quite readily and easily. The contour and texture of the rectal wall must be estimated and any induration and areas of tenderness noted. Size, consistence, mobility, surface-contour, definition of outline, and presence or absence of median /
median sulcus are estimated in order. Ross had a large, firm bilobed enlargement with a few firmer nodules, which is fairly typical of the simple hypertrophy. Chalmers too had a bilobed enlargement of the lateral parts of the gland of the simple hypertrophic type. Baillie had a smaller gland than these two and it was of a firmer and more even texture. McCafferty had a slight degree of asymmetrical enlargement, but the gland was hard and stony, and slight crepitus was elicited; this crepitus caused pain. The sensation imparted was not quite that described as typical, being more like coarse sand felt through a piece of rubber. In Brotchie's case the examination was of the utmost importance, as having been operated upon for a malignant prostate it seemed highly probable from his history that the condition had been progressing in spite of operation. No induration, oedema or fixation of the rectal wall was found, and no signs of spread in any other regions, (liver, sub-umbilical gland, etc.). The prostate was firm and enlarged but not nodular; this was interesting in view of enucleation having been performed.

The residual urine should be estimated in all cases. The patient emptying his bladder standing up, a catheter then being passed and any remaining urine being withdrawn. This passage of a catheter also provides information about the urethra, e.g., length and point at which obstruction is met. Baillie had four ounces of residual urine. The bladder in the normal state
when contracting to empty its cavity assumes an erect form, contracting on to and about a vertical axis passing through an internal meatus. The muscle coats all arise from the small fixed area above the base of the prostate and are thus able to obliterate the cavity completely in the normal viscus. Any enlargement of the prostate enlarges the origin of these fibres and disturbs their normal action and the cavity is not completely obliterated. Any intravesical projection of the gland will increase the amount of residual urine produced as above, and tends to the formation of a pouch posterior to the trigone.

Oedema of the legs, harsh skin or sallow complexion, a dry coated tongue, may all be signs of renal impairment. Examination of the reflexes is important in the exclusion of nervous causes of urinary obstruction.

The special examinations in a case of prostatic obstruction include cystoscopy and estimation of the degree of impairment of renal function. Renal efficiency tests should be done at the earliest possible moment on the lines indicated. In all cases the daily fluid intake and output was charted, and gave an indication of the water-excretion power of the kidney. Improvement in the patient’s condition is demonstrated by the reduction of discrepancy in output and intake. An Examples of these charts are given. Adequate reserve powers of the kidneys is shown by their ability to respond to the greatly increased fluid intake induced in the patient after admission.

Indigo-carmine /
Indigo-carmine tests were carried out on three patients. The patients were catheterised, five c.c.s. of dye were injected intravenously, and the urine was collected in small test-tubes at two minute intervals. The samples were then compared for concentration. There is a two minute lag in excretion time by this method due to the column of urine within the catheter. Baillie exhibited good excretion but loss of power to concentrate. Chalmers and Ross had poor excretion but good concentration power.

The blood-urea nitrogen was estimated in four cases, three to five c.c.s. of blood being withdrawn and sent for examination. Ross showed the highest level and this was compatible with his longer illness and the more severe changes present in his prostate and bladder, the urinary infection and calculus, and the reduction in bladder capacity. The raised figure in Baillie's case may have been due to obstruction present for a longer time than the history suggested. The response to treatment here was poor, due no doubt to the cardiac lesion. Ross responded much more readily and satisfactorily to treatment; Chalmers and Brotchie were both within normal limits.

The urea concentration range was carried out on Baillie, Ross and Chalmers. Chalmers responded well to treatment; the minimum figures fell but were still well above normal, while the maximum figures rose almost to normal. There was still very definite renal impairment, but the improvement was such as to justify /
justify operation when correlated to his general condition, and
illustrates the importance and great benefit from adequate and
prolonged pre-operative treatment. Ross showed a gross impair-
ment of function, with almost no range at all. The test
repeated after a week showed some improvement, but there was
still severe impairment of function. The response under the
circumstances is good when the more severe initial condition
and the fact that only one week of treatment had been received
are considered. Baillie showed a less marked impairment than
Ross but the improvement in function after three weeks' treat-
ment was not as good as was hoped for, nevertheless it showed
some increase in range with a general lowering of the minimum
and raising of the maximum values. These tests all demonstrate
the importance of pre-operative treatment. They also show that
the impairment of renal function present in a prostatic patient
is not all permanent, but can be relieved to a varying degree by
removing the causes, and by improving the general condition of
the patient. Although this test may not be an absolute indica-
tion of renal function, it is a very accurate index of improve-
ment in function.

Only cystoscopy furnishes exact information regarding the
changes in the bladder neck and within the bladder, and al-
though a diagnosis may be arrived at without this procedure,
it is usually necessary to view these areas before arriving at
a decision as to the type of enlargement, and the operation which /
which is therefore indicated. Cystoscopy is not a minor procedure, and should not be carried out until some idea of renal function has been obtained, and until the patient's condition permits the instrumentation. It is never without danger. Some degree of trauma is bound to occur, thereby increasing the risk of sepsis. In all cases morphine was given by hypodermic injection before cystoscopy as severe pain is often caused. Two cups of warm weak tea are drunk before leaving the ward to promote diuresis, and a hot drink is given after examination. Rectal examination is carried out on the table as a routine.

Cystoscopy was carried out on all the cases. A 15 F. cystoscope was used, any difficulty in passage was noticed as was the residual urine, if any was present. The bladder was filled to capacity with boric solution at 100 degrees F., the amount required being noted, and the structures inspected systematically. It was impossible to pass the instrument beyond the neck of Brotchie's bladder; the prostatic urethra was felt to be dilated by the freer movement of the instrument, the dilatation being the prostatic bed left by the enucleation of the gland. The obstruction was later found to be due to a fibrous veil formed by the adhesion of mucosal tags left round the edges of the prostatic bed at the previous operation.

The length of the urethra is estimated by the distance to which the instrument may be passed. The condition of the walls /
walls of the distended bladder is noted. In Ross the bladder capacity was only 30 c.c.s., this being the result of the presence of the permanent Pezzer catheter which, by allowing continual drainage, reduced the necessity for capacity, and by causing unceasing irritation, stimulated a condition of permanent systole. Hypertrophy of the muscle occurs in this condition, resulting in the trabeculation which was seen in this bladder.

The condition of the prostate is next examined. Chalmers had enlargement of the middle and both lateral lobes. The middle lobe was projecting up into the bladder and was similar in appearance to that in the case of Ross, which also projected into the bladder. Baillie had some oedema of the bladder neck, with slight encroachment on the internal orifice by both lateral lobes and even more markedly by the posterior commissure. McCafferty exhibited oedema of the bladder neck, but there was no encroachment upon the urethra by the prostate. Ross had a small stone in the dependent part of this bladder, and, in addition, his urine was thick and lavage had to be carried out for some minutes before anything could be seen.

As a result of the findings at cystoscopy it was possible to state more exactly what pathological condition was present. Brotchie's condition was still doubtful, but there was an almost complete obstruction somewhere in the upper prostatic urethra, which might be a valvular false passage, or a fibrous adhesion /
adhesion at the neck; there was no evidence of recurrence of his former malignant condition. Ross and Chalmers were almost certainly simple glandular hypertrophies of a type suitable for enucleation by the supra-pubic root; Ross in addition had a vesical calculus. Baillie was considered to have a simple hypertrophy of the fibrous type, and to be unsuitable for enucleation. In the case of McCafferty there was no evidence of any change at the bladder neck, and his symptoms must therefore have been due to some cause within the gland which was not giving rise to any change in contour, and only to the gritty sensation on palpation, and crepitus. It could therefore be either carcinoma or multiple calculi. Of these two, calculi were the more likely as there was no evidence of lymphatic spread or of local induration. He was therefore referred for X-ray examination of the pelvis. This showed the presence of a shadow corresponding to the position of the gland and confirmed the diagnosis of calculi.
b. Treatment.

The general treatment of these patients was directed especially towards improving their physical condition, to the removal of infection where present, by the provision of adequate drainage, bladder lavage and the forcing of fluids, and, at a later stage, supra-pubic cystostomy was performed to improve the urinary condition still further. The third principle in treatment, which was served by these two, was the improvement of renal function by the removal of sepsis and obstruction. A fairly full diet was given. The bowels were moved at least once a day, cascara and enemata being given where necessary. The patients co-operated excellently in every case.

The individual pre-operative treatment varied in certain details. Chalmers, having had an attack of retention, was put on to continual drainage via a tied-in catheter per urethram. The catheter was joined by a glass connecting piece to a rubber drainage tube which dipped below the surface of dilute lysol in a bottle at the bedside; the idea of the lysol being the prevention of sepsis ascending the tube and as a deodorant to the urine. Cystoscopic examination was made five days after admission, and on the next day supra-pubic cystostomy was carried out under local anaesthesia as the first stage of prostatectomy. The patient stood this operation well in spite of his years, but showed slight cardiac upset and had a persistent cough for some weeks. Drainage was much improved.

Vasectomy /
Vasectomy was considered to be advisable on account of the age of the patient to eliminate all possibilities of an epididymitis, which is not uncommon, and often fatal, in men of such advanced age. Bladder lavage was instituted as an additional precaution against sepsis.

There was a very strong and characteristic smell about the patient Ross on admission, due to the foul state of his catheter, which was coated with inspissated pus and phosphates. There was much urinary infection and so bladder lavage twice daily was at once started. The irrigation fluid used in all these cases was 1/10,000 silver nitrate solution warmed to a little above body temperature. This was made up by putting two ounces of 1/500 stock solution in a sterilised jug and adding water to two pints, cold sterile water was added first, and then nearly boiling water added to warm the whole. No assistance being available on most occasions, everything was prepared at the bedside, and the hands were then sterilised. The catheter was passed where this was necessary and the bladder emptied of urine. The funnel was filled, one end of the rubber tubing being kinked and the funnel was given to the patient to hold. The left hand was kept aseptic and all manipulations done with the right hand, e.g., filling funnel. The bladder was filled, this being indicated by the patient, and by a cessation of flow from the funnel. The catheter and the irrigation tube were both kinked, and the glass tube disconnected.
disconnected and the bladder emptied; the fluid passing into a bowl, at the patient's side of draining from a supra-pubic catheter, or between his legs if from a urethral catheter. Where possible lavage was carried out alternatively per urethram and supra-pubically. The funnel, tubing and catheter were boiled for fifteen minutes before use, sterile lubricant was used, and careful cleansing of the parts practiced.

Baillie was admitted to a medical ward where he had to be catheterised daily as he was unable to pass any urine. After four days pus cells and organisms were found in the urine, and he was given hexamine and ammonium chloride.Five days later he developed incontinence and was transferred to a surgical ward. Cystoscopy was carried out and daily lavage with 1/10,000 silver nitrate was instituted in preparation for a supra-pubic cystostomy. Drainage was satisfactory after operation. The renal function tests were repeated. For a week before transurethral operation lavage was again carried out.

It was impossible to carry out any local treatment on Brotchie as no catheter could be passed. McCafferty was not given any local treatment; attention was concentrated on improving his general condition by moving his bowels regularly and forcing fluids.

The stone in Ross' bladder may be described as a pre-operative complication, being the result of the neglect of the supra-pubic drainage. It was a phosphate stone, whitish and crumbling.
when dry, typical of the type found in decomposing urine. The calculi in Brotchie's case were multiple and faceted and also phosphatic, but were not so crumbling or white in colour and were due to urinary stasis and infection. Ross was a good example of the undesirability and disadvantages of the "catheter life" in patients of the hospital class.

Operation in prostatic obstruction is indicated only in the presence of, and to remedy, two groups of symptoms:

1. Those of obstruction, either residual urine which is increasing in amount, or several attacks of retention requiring catheterisation.

2. Those of irritation, the commonest being frequency of micturition of such a degree as seriously to disturb sleep or daily routine. Sepsis and calculi may cause irritation and are therefore indications for operation. Sepsis is often intractable until the prostate is removed; indeed, it is often irrational to treat it otherwise.

Operation is contra-indicated by extreme debility, grave disorders of the vital organs, and failure on the part of the patient to respond to pre-operative treatment. There are often temporary obstacles to operation which are, in the majority of cases, overcome by preliminary treatment.

The type of operation to be performed varies with certain factors, and it is highly important that the choice of operation should be preceded by a thorough investigation of the patient.
Supra-pubic prostatectomy is most generally used, at the present time, for those cases of simple hypertrophy in which the glandular tissue predominates and in which the hypertrophy can be shelled out from its false capsule. The operation may be done in one or two stages. Where patients are in very good condition preliminary drainage may be dispensed with and the operation done in one stage. In such an old man as Chalmers everything that would reduce the risk was considered to be advisable, and he therefore underwent prolonged supra-pubic drainage as a first stage. Preliminary cystostomy relieves distension and backward pressure upon the kidneys, thus removing factors producing impairment of their function and allowing recovery to take place; and, by improving drainage, aids the eradication of sepsis. The operation consists in opening the bladder and viewing the prostate and trigone. The hypertrophy is then enucleated digitally. The crucial point in the operation is the finding of the plane of cleavage between the false capsule and the nodule, after which the index finger breaks through the mucosa into this plane, and, by sweeping round, separates the nodule which is then removed from the cavity thus formed. Any tags of tissue are removed. Haemostatis of the prostatic bed was secured by packing with gauze for from three to five days. Drainage was by a Freyer's tube for three days, then by a Pezzer catheter. Provided that pre-operative treatment has been carried out the pack does not seem to increase sepsis.
sepsis and it is an efficient haemostatic agent. It may perhaps be the cause of pain after operation.

The fibrous layer in the case of Brotchie was a complication of prostatectomy and may have been due to coalescence of flaps of mucosa left behind in the vesical outlet, or to shreds of prostatic tissue left in the prostatic bed. In addition, the anterior attachment of the internal sphincter may be left intact and this muscle may draw the margins of the orifice together. It may be prevented by packing, a haemostatic bag, a tied-in urethral catheter, or by suture of any flaps to the prostatic bed at the time of operation. (Harris 1932). It may be treated in three days:

1. Dilatation by bougies (the hole was so small that this method would have been extremely lengthy).

2. Excision by supra-pubic route or by resectoscope.

3. Division and stitching down of the flaps thus formed.

As there were calculi present which had to be removed, the supra-pubic route was chosen. The flaps were formed by an incision to the level of the interureteric bar. A boomerang needle greatly expedited the stitching in the confined space. The flaps were stitched down to the prostatic bed.

Where fibrous tissue predominates in the gland, enucleation is impossible as there is no false capsule formed, the gland being homogenous. This type of obstruction was formerly treated either by repeated catheterisation or by permanent supra-pubic /
supra-pubic drainage.

Per urethral operations are indicated:

1. Where the amount of enlargement is small but the amount of obstruction is great, e.g.,
   a. where the vesical part of the prostate is affected rather than the urethral part as in enlarged middle lobe;
   b. small fibrotic prostate;
   c. in cases of median prostatic bar.

2. In carcinoma as an alternative to cystostomy.

3. In patients in whom prostatectomy is contra-indicated because of poor general condition, or severe cardiac or pulmonary lesions.

The operations are of three types:

1. Fulguration with an electrode working through a cystoscope and leaving the coagulated tissue to slough away.

2. Diathermy with immediate removal of the coagulated tissue with a punch.

3. Resection with a wire loop activated by a cutting current, with immediate removal of coagulated tissue, general haemostasis being completed at the end of resection by the use of a coagulating bead electrode.

These operations are not minor procedures, but involve as much necessity for pre-operative investigation and care as prostatectomy. Where necessary a preliminary cystostomy should be made, as was done with Baillie. The danger of post-operative complications /
complications is no less, indeed in many cases it may be greater as the use of a cutting current kills or devitalises tissues at a relatively great distance from the loop, and these devitalised tissues form an ideal nidus for infection. In addition, many candidates for per-urethral operation may have been refused prostatectomy on account of poor general condition. Walker states that haemorrhage and sepsis are the commonest complications from urethral resection, and, of these two, sepsis is the more common, due, he thinks, to the use of a cutting current, and he states that there is a tendency to return to the cold punch and coagulating bead in the hope of reducing sepsis by reducing the amount of devitalised tissue left after operation. (Walker 1937).

McCafferty's prostatic calculi were treated by removal by the perineal route. Denonvillier's space was opened into and the dissection carried up to the posterior aspect of the gland. The operation follows the lines of the old perineal approach to the prostate used in the total excision of the gland. The operation is of interest in that it is rarely used now except in cases of calculi and carcinoma.

Anaesthesia is a matter for concern in these cases. The average age of these patients was 69.5 years. In a patient of such age, either it is not to be recommended as it causes serious respiratory complications. Gas and oxygen raises the blood pressure and so may increase haemorrhage. This was not
not marked in Chalmers who had gas and oxygen for his second stage operation. This was the open type of operation with a long incision and the rigidity of the abdominal wall was not a great handicap (though at times the operator's wrist may be gripped by the recti muscles). Pain tends to be more severe with gas and oxygen as the patient comes round soon after the operation is finished. Spinal anaesthesia alone or combined with gas and oxygen is very useful. A spinal was used for McCafferty, Baillie and Brotchie, and was satisfactory in all of them.

There are many risks in the post-operative treatment of prostatic patients, and good nursing is probably the most potent factor in combating these and in alleviating the many minor discomforts which beset the patient. The men who had spinal anaesthesia for their operation were placed flat in bed for the first few hours until the effects of the anaesthetic had worn off. They were later propped up on pillows. It was at times necessary to use an air cushion to ease the patient's buttocks. A waterproof sheet was placed under every patient until all leakage had ceased. Patients were encouraged to drink as much as possible. Supra-pubic drainage was by a Freyer's tube connected to a rubber tube running to a bottle at the side of the bed. In the case of McCafferty a Pezzer catheter was inserted through the perineal wound and prostate to the bladder. Here drainage by Bunsen's bottles was instituted. In this method a slight degree of vacuum is induced in the /
Bunsen's Bottles.

From catheter.  Air flow.

Collecting-jar.  Reservoir.
the collecting bottle by the slow loss of water from the reservoir. The Freyer's tube and pack were removed on the third day in the case of Chalmers and Ross, and on the fifth in the case of Brotchie, (the extra two days were given here because of the previous cicatrisation). A Pezzer catheter was inserted in place of the Freyer's tube. It is important that the Freyer's tube should be large in order that it may not be blocked by clots. The length of time that supra-pubic drainage is carried out depends upon the amount of sepsis present. In Baillie this was one week. Thereafter there was much leakage in all cases from the closing fistula, which caused the patients great discomfort and misery, and excoriation of the abdominal skin. To ease these conditions the dressings were changed more frequently and large pads of cotton-wool were applied to soak up the escaping urine; the skin was treated twice daily by smearing it with vaseline after it had been dried and cleaned.

Bladder lavage was not carried out after operation except in the case of McCafferty. The bowels were opened on the third or second day. The supra-pubic wound was healed in three weeks in the case of Baillie and in six weeks in Brotchie's case.

Baillie complained of severe pain on passing water one week after operation, this being due to the stretching of the scars in the bladder neck, the pain being referred to the tip of the penis. The pain passed off after a few days. Similar pain was felt by Brotchie, due perhaps to the tension of the stitches in /
in the flaps and prostatic bed. Bougies were passed on all these patients as part of the post-operative treatment to stretch scar tissue and mould the passage. Great gentleness is essential in this operation as well as scrupulous attention to asepsis. The bladder and urethra were washed out with 1/10,000 silver nitrate. There should be no blood in the washings or on the bougies after the first occasion. In Chalmers a certain amount of difficulty was experienced as there seemed to be a shelf in the lower prostatic urethra, over which it was difficult at times to lift the beak of the instrument.

Chalmers suffered from a severe balanitis with considerable oedema of the prepuce as a result of keeping his penis within his urine bottle, being unable to hold his urine for long. Infection spread up along the urethra and a purulent discharge came away. This was treated by irrigation with a 1/10,000 solution of potassium permanganate, injected with a urethral syringe with a Janet tip.

Ross and McCafferty suffered from the severe post-operative complication of anuria. Ross was the first case seen. Urine was at first produced satisfactorily. On the day after operation he complained of pain in the bladder which was put down to the pack in the prostatic cavity. Morphine grs. 1/6 was given. During the night the patient became very restless and confused in his mind and tried to leave his bed. Urine was still drain-
draining, but on the second day almost no urine was passed between 8 a.m. and 4 p.m. It was evident that no urine was being secreted as no fault or blockage could be found in the drainage system. Therefore, continuous intra-venous infusion of 4.82% (isotonic solution of sodium sulphate (Wade and Dick) was instituted. Deep brown urine began to drip from the catheter 45 minutes later. This urine contained 1.9 gramms urea per 100 c.c.s. as estimated by the sodium hypobromite method: the blood urea nitrogen was 40 mg% at this time. Unfortunately further specimens were not taken in this case. Urine was secreted at an increasing rate during the night and the diuresis lasted until the afternoon of the next day, about 24 hours in all. 600 c.c.s. of sodium sulphate solution were instilled.

McCafferty passed only four ounces of very dark brown urine in the first 24 hours after operation. This urine contained 1.6 gms of urea per 100 c.c.s. No fault could be found in the drainage system and it was realised that this was another case of post-operative anuria. Continuous intra-venous infusion of 4.82% sodium sulphate solution was started by the drip method at 2.15 p.m. at a rate of 20 drops per min. Only four ounces were passed in the next four hours, and, at 6.30 p.m., the rate of infusion was increased to 100 drops per minute. Urine began to come away in about 8 minutes at a much increased rate. The infusion rate was slowed after half an hour as it was /
McCafferty. Temperature and Pulse Chart.

Temperature

98°
97°

Pulse

130
120
110
100
90
80

Dec. 17 18 19 20 21

Operation

Sodium sulphate
was thought to be too rapid. A slight rigor occurred at 7.40 p.m., but it had been anticipated and was treated immediately with a heat cage and a little brandy. The urinary area was 1.95 at 7 p.m. and 1.6 at 9.30 p.m. 1000 c.c.s. of sulphate solution were instilled in all. The diuresis lasted about 30 hours; the temperature chart is appended, showing swinging of the temperature and marked rise in pulse rate, especially after the infusion started. A similar rise in pulse rate was noticed, however, in other patients in the ward who had intra-venous drip infusions at various times, and it was possibly due to some property of the saline.

The precise cause of anuria is not known. It has been debated since Chopart first described a case of calculous anuria in 1821. There probably is no single cause; there are certainly many predisposing factors. (Cubitt 1936).

Clinically cases of anuria are rare compared with the frequency of the apparent exciting causes, and are acute emergencies, and there is difficulty in investigating fully patients who are so ill. Much desirable information is lacking in the two cases reported as a result of the sudden onset of the conditions. The second case (McCafferty) was not more fully investigated because of technical difficulties associated with the collection of specimens and because the condition of the patient was very critical and interference was very aggravating to him. Blood pressures were not taken as their importance was not realised at
at the time; as no further cases have occurred it has not been possible to investigate this aspect of the condition.

For the secretion of urine three factors are necessary, and deficiency of any of these factors produces one of three kinds of anuria:

1. Adequate blood pressure - pre-renal anuria.
2. A kidney that will function - renal anuria.
3. An open outflow channel - post-renal anuria.

In both cases an open channel was present from the uretetic orifices; it is possible that congestion of the ureters may have played some part in the aetiology. For pre-renal anuria to occur, the blood pressure must have fallen below 50 mm Hg. unless urea and certain salts were present, in which case it would have been possible at a lower pressure. Urea was present in a concentration of about 80 mgm% in the case of Ross, but it is questionable whether this would be a high enough concentration to cause diuresis. After severe and prolonged operations the secretion of urine may be temporarily reduced or suspended, due to the low blood pressure of shock and collapse. This effect would be made more marked by disease of the kidneys. Normal function returns with the raising of the blood pressure. Surgical interference with the bladder or urethra may be followed by a reflex renal anuria, especially if the kidneys be diseases. Toxic anuria may occur after urethral operation where the kidneys are healthy and no ascending infection has occurred.
The anuria in the case of McCafferty was most probably due to the effects of the severe and prolonged operation under spinal anaesthesia (which also caused a fall in blood pressure) with perhaps an additional reflex factor from the region of the prostate due to trauma. In the case of Ross there was a certain degree of renal damage due to prolonged infection and backward pressure, and the operative manipulations at the bladder neck were severe as a result of the rather fibrous state of the gland; these were the most likely factors in the onset of anuria. That there was some vascular factor in the case of McCafferty is supported by the slower onset of diuresis in the early stages of infusion of sodium sulphate; it was not until about 600 c.c.s. of this solution had been given that diuresis really began.

Salts injected into the blood stream maintain water in the general circulation, and, by diluting the plasma proteins and reducing the resistance to glomerular filtration, produce diuresis. Dick (1934) has shown clinically that the diuresis produced by the intra-venous injection of sodium sulphate is greater in every case than that produced by sodium chloride in the same patients under similar conditions; and that whereas there is a rise in the sodium chloride secretion extending over more than one day, indicating storage of chloride in the body, there is no such rise in the excretion of sodium sulphate. The action of sodium sulphate in producing diuresis is due almost solely to its power to keep water in the tubules after water has been filtered /
McCafferty. Urine Output.

Fluid intake.  Urine output.

Sodium Sulphate excretion.  (Folin).

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Value</th>
<th>Amount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 19</td>
<td>8-30 a.m.</td>
<td>0.008</td>
<td>grams</td>
</tr>
<tr>
<td></td>
<td>11-30 a.m.</td>
<td>0.011</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>2-30 p.m.</td>
<td>2.856</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>5-30 p.m.</td>
<td>0.887</td>
<td>&quot;</td>
</tr>
<tr>
<td>Dec. 20</td>
<td>4-00 a.m.</td>
<td>0.216</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>2-30 p.m.</td>
<td>0.040</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
filtered through the glomerulus. Sodium sulphate exerts high osmotic pressure; it is difficult to force out of the glomerulus through the cell-membrane, but once it has been forced out it will not be reabsorbed since it is a non-threshold substance, and it will therefore retain water in the tubules to keep itself in solution, thus producing diuresis.

Dick recommended the intra-venous injecting of an isotonic solution of sodium sulphate (Glauber's salt, Na2SO4, 10H2O, 4.285 gms per 100 c.c.s.). This was given in the two cases quoted by the Farquharson type of continuous drip method.

The results of the analysis of the specimens obtained from McCafferty are given. The excretion curve of sodium sulphate is similar to that obtained by Dick and shows that none was stored in the body. The figures for the urea excretion show a slight fall at the time of the greatest concentration in sodium sulphate in the urine, which coincides with the maximum diuresis.

McCafferty developed a faecal fistula between the rectal and the perineal wound. This was due to the sutures inserted into the accidental operation wound in the rectum cutting through the rectal wall. The Pezzer catheter was removed from the perineal wound and drainage instituted via a urethral catheter. The urethral catheter was changed once a week. A flatus tube was inserted to the rectum in the hope that it would aid the closure of the fistula; this hope was realised. The patient was eventually discharged cured after a stormy convalescence lasting fourteen
fourteen weeks. He was seen seven months later and was in good health, with no recurrence of his symptoms and good urinary function.

Chalmers was readmitted to a medical ward nine days after his discharge, complaining of severe cough; he had no urinary symptoms. He was very breathless, and examination revealed severe bronchitis with some cardiac involvement. The pulse and respiration rates rose steadily in spite of treatment, and he died of cardiac failure seven weeks after readmission. During this time urinary function was perfect.

Ross was discharged for a further period of convalescence at the Eastern General Hospital. He did not report back as advised on discharge from that hospital, when his function was good, although there was still a certain degree of frequency as a result of the small capacity of his bladder.

Baillie was discharged in good health, with perfect function, after an uneventful convalescence. He did not report back for re-examination in spite of advice to this effect.

Brotchie was urged to report back on account of his evident tendency to fibrosis and contraction. On the first occasion, three months after discharge, his condition was excellent. Six months later he complained of three months pain on micturition and of passing thick urine. Bougies were passed with slight difficulty, due to spasm. On cystoscopy the prostatic bed and bladder outlet showed no signs of contraction and the bladder walls /
walls were healthy.
SUMMARY.

The normal anatomy and physiology of the prostate, bladder and kidney are discussed in relation to prostatic obstruction.

The changes in these organs subsequent to prostatic obstruction and the mechanisms concerned in the production of these changes are described.

Certain renal function tests are detailed and their application to the estimation of impairment of renal function in prostatic obstruction is considered.

Five cases illustrating surgical conditions of the prostate are reported, and their treatment is detailed and discussed.

Two cases of postoperative anuria are described and the probable mode of origin and treatment of both, and the investigation of one, are given.

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