A text-book of genito-urinary diseases : including functional sexual disorders in man / by Doctor Leopold Casper ; tr. and ed. with additions by Charles W. Bonney.

Contributors

Casper, Leopold, 1859-1959.
Bonney, Charles W.
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Publication/Creation

Philadelphia : P. Blakiston's son, 1909, 1912.

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A TEXT-BOOK

OF

GENITO-URINARY DISEASES

CASPER

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"The name of Prof. Casper is sufficient in itself to guarantee the high quality of any work dealing with the branch of surgery with which his name is associated. The original German edition of this work is known all over the world as a standard treatise on genito-urinary affections.

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A TEXT-BOOK
OF
GENITO-URINARY DISEASES

Including Functional Sexual Disorders in Man

BY

DOCTOR LEOPOLD CASPER

Professor in the University of Berlin

Translated and Edited with Additions

BY

CHARLES W. BONNEY, B. L., M. D.

Assistant Demonstrator of Anatomy, Jefferson Medical College, Formerly Surgeon to the Southern Dispensary, Philadelphia, etc.

Second Edition, Revised and Enlarged

WITH 230 ILLUSTRATIONS AND 24 FULL-PAGE PLATES, OF WHICH 8 ARE IN COLORS

PHILADELPHIA
P. BLAKISTON'S SON & CO.
1012 WALNUT STREET
1912

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TO

FRANZ KONIG,

PROFESSOR OF SURGERY AND MEDICAL

PRIVY COUNSELLOR,

THIS VOLUME IS DEDICATED

AS A TOKEN OF ESTEEM.


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AUTHOR'S PREFACE TO THE TRANSLATION.

The cordial relations which have long existed between Germany and America, and which it has recently been endeavored to make more intimate, are better expressed by acts than by words. Accordingly it affords me great pleasure to see my Text-Book of Urology appear in American vesture.

An English-speaking surgeon first led me into the realm of genito-urinary diseases, and it is with a feeling of satisfaction and gratitude that I think of him, my honored teacher, Sir Henry Thompson, of London.

Although his profoundly scientific yet withal eminently practical publications were familiar to English-speaking nations, they were little known in Germany, and so, twenty years ago, I became his exponent, translating and publishing his "Stricture of the Urethra" and "Lectures on Diseases of the Urinary Organs."

I hope the following pages will prove to my American and English colleagues that Sir Henry's teaching fell upon fertile soil; and that they will show how urology has developed both as to scientific advancement and technical improvement.

I take this opportunity to thank my colleague, Dr. Bonney, for the diligence, comprehensive knowledge, and unremitting interest which he has manifested in the work of translating and editing the book.

LEOPOLD CASPER.

PREFACE TO THE SECOND EDITION

In preparing the second edition of this book I have endeavored to make a thorough revision, rearranging certain sections of the text, amplifying others and adding such new material as it seemed advisable to incorporate.

A number of American urethroscopes, cystoscopes and other instruments have been described; the treatment of acute posterior urethritis and chronic urethritis has been more thoroughly discussed; the operation of circumcision has been carefully described, chiefly for the benefit of the general practitioner, who is often called upon to perform it; an article on the anatomy of the kidneys has been written; syphilis of the kidneys has been elaborated, and a considerable number of new editorial notes have been made.

The revision of the article on the treatment of hypertrophy of the prostate has been done by Professor Casper. His views, based upon a further experience of two years with radical operations, are comprehensively stated.

A few new illustrations have been inserted, for some of which I am indebted to my student, Mr. M. L. Elsinger.

To the members of the profession who have received the book so cordially, and to the reviewers and correspondents who have expressed such favorable opinions of it, I hereby render sincere thanks.

CHARLES W. BONNEY.

320 SOUTH ELEVENTH STREET, PHILADELPHIA,
January 1, 1909.

EDITOR'S PREFACE TO FIRST EDITION.

This book is offered to English-speaking practitioners and students of medicine with the belief that it represents the best teaching of genito-urinary diseases which is at present available. I trust they will concur in my opinion, that it reflects the combined result of large clinical experience, modern methods of research, and conservative judgment.

Although the translation is by no means literal, yet some effort has been made to adhere as closely to the original text as clearness, precision, and the intrinsic idiomatic differences of the two languages would permit.

The discussion of radical operations for hypertrophy of the prostate has been rewritten conjointly by the author and myself. My own annotations and additions have been placed in brackets. The technic of a few operative procedures not given in the German edition has been described, and many new illustrations have been added.

I desire in this place to express my deep appreciation of the willing assistance which Professor Casper has given me in the preparation of this edition, and also to render acknowledgment to the numerous gentlemen who have loaned pathological specimens or drawings. I am particularly indebted to Professors Keen and Coplin, of Philadelphia; Young, of Baltimore; and Bransford Lewis, of St. Louis. I also wish to thank the publishers for many helpful suggestions.

CHAS. W. BONNEY.

320 SOUTH ELEVENTH STREET, PHILADELPHIA,
August 1, 1906.

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GENITO-URINARY DISEASES.

GENERAL SECTION.

To the physician who has studied the diseases of the urinary organs carefully a most satisfactory field is offered. Among these diseases, as among all others, there are incurable afflictions which baffle human skill, but yet a large number of cases are curable, while in others the experienced and resourceful physician is able to bring about improvement and assuage the agonizing pain to which the patients are so frequently subject. Oftentimes by some simple, though exactly appropriate procedure, he will be able to confer almost instantaneous freedom from suffering. On the other hand, the inexperienced, through improper treatment, may do great harm, which perhaps it will not be possible to remedy.

Therefore, if consciousness of being able to relieve suffering lend increase to the physician's sum of happiness, and interest in the study of the diseases in question incite him to keep on the alert, so likewise should the realization that deficient knowledge may lead to the infliction of injury awake in him the desire thoroughly to master this branch of medicine and surgery.

It scarcely need be said that training in general medicine is necessary for the accomplishment of such a purpose. Only those who have directed their vision upon the entire organism, those who have dealt not with a "part of the whole", but with "the whole in all its parts" can expect to obtain results; but he who adds to his general knowledge that special skill without which urology cannot be successfully pursued will come little short of attaining the object desired. The acquisitions made to this branch of medicine during the last decade, acquisitions as gratifying as they are great, enable us in the majority of instances to make a quick and exact diagnosis. The whole subject is summarized in the sentence: "qui bene diagnoscit, bene curat."

The diagnostic expedients at our command are:—

I. Interrogation of the patient.

II. Physical methods of examination.

III. Chemical, physical, and microscopic examination of secretions and excretions.

I. INTERROGATION OF THE PATIENT.

The interrogation of the patient is begun by taking an accurate anamnesis. It must be learned what diseases have occurred in the patient's family and of what maladies his near relatives died. Special attention must be given to tuberculosis, rheumatic or gouty affections, and lithiasis, because they are diseases in which heredity plays an indisputable rôle. As to other incidents of family history the rules of general medicine are applicable.

Concerning the patient himself, we must endeavor to ascertain whether he has ever had gonorrhœa, syphilis, scarlet fever, or other significant diseases.

After having obtained information concerning the beginning of his present illness, its mode of onset, its course and duration, the special interrogation of the patient should be begun.

This **special interrogation** relates to a series of symptoms which are present in one form or another in a large number of diseases of the genito-urinary tract. Certain ones are pathognomonic of certain diseases. The special interrogation, by directing our attention along definite lines, makes diagnosis more easy, although we must not be led into making a diagnosis solely upon the statements of the patient without resorting to the other methods of investigation appropriate to his case. To do so would be only to fall into error. The object of questioning the patient is to arrive at a diagnosis, and we should avoid asking questions which are unnecessary and perhaps distasteful to him. We are not justified, however, even though only the slightest doubt exists, in basing our diagnosis entirely upon this examination.

The questions to be asked relate to:

1. **The frequency of micturition.**
2. **Changes in the urinary stream.**
3. **The presence or absence of pain.**
4. **The admixture of blood with the urine.**

I. FREQUENCY OF MICTURITION.

A healthy person urinates about five times in twenty-four hours. As the normal quantity of urine voided in twenty-four hours is about 1500 cubic centimeters (50 ounces), the average capacity of the bladder may be given as 300 cubic centimeters (10 ounces).

It has been observed that a large number of diseases of the genito-

urinary tract are associated with increased frequency of urination, although in this respect marked differences exist.

First of all, it is evident that a distinction must be made between those affections in which the quantity of urine is considerably increased, and those in which no increase occurs. If the capacity of the bladder has remained intact, patients having diseases of the first class will naturally urinate more frequently than healthy persons. Among such diseases may be mentioned diabetes mellitus, diabetes insipidus, chronic interstitial nephritis, and urina spastica.

In the second class, although the quantity of urine voided is normal, increased frequency of micturition is caused by **inflammatory conditions** of the urinary organs, as for example, acute posterior urethritis and cystitis. It is especially characteristic of this class of diseases that the urgency of urination is present both day and night.

In sharp contrast to these diseases are the neuroses of the bladder, which are peculiar in that they cause frequent micturition only during the day, the patients being able to hold their urine throughout the entire night.

In hypertrophy of the prostate and vesical calculus a decided difference exists between the number of urinations which occur during the day and the night. In the former they are much more frequent at night, while in the latter patients not uncommonly sleep the whole night through without having to pass their water once, although activity during the day increases the number of their urinations.

Mere suggestions should suffice to illustrate the importance of the interrogation. In our discussion of individual diseases we shall refer most frequently to this symptom. From what has already been said it will be seen that it is necessary to question the patient with the utmost precision on this subject. This may be done by asking him if he urinates oftener than a healthy person, or oftener than he formerly urinated. If an affirmative answer be received, then it must be ascertained whether the increased frequency exists both day and night, or only during the day; whether it is more manifest at one time than at another; and whether rest or exercise exerts any influence upon it.

2. CHANGES IN THE URINARY STREAM.

It is a constant symptom of every stricture of the urethra for the stream of urine to become smaller. This is so pathognomonic that it

may be said, the narrower the stricture, the smaller the circumference of the stream. In the worst cases there is no stream at all, the urine being voided drop by drop.

In contradistinction to this condition there is a symptom which is present when the bladder has lost its tonicity, or when an obstruction exists near its neck; this symptom consists in diminution of the projectile power of the urinary stream. The urine can no longer be forcibly expelled in an arched stream, but falls almost perpendicularly downwards. This symptom is observed in disturbance of the central nervous system affecting the vesical centers or paths of conduction, and especially in hypertrophy of the prostate.

In vesical calculus, when the stones are small and movable, urination may be suddenly arrested if a stone is carried toward the neck of the bladder in such a manner as to occlude its opening.

In conformity with our knowledge of the changes which occur in the stream, we should ask our patients whether they have noticed that the stream has become smaller, that it has lost force, or that it has been suddenly interrupted.

3. PAIN.

Pain is a symptom which is present in a large number of genito-urinary diseases, and yet it is one from which many conclusions can be drawn if its investigation be minutely conducted. In the first place, we must get information concerning the location of the pain, whether it be in the region of the kidneys, over the bladder, or in the urethra; if it be in the urethra we must find out whether it be near the end of the penis or in the deeper portions. It must also be learned whether the pain supervenes during urination or occurs independently thereof, and whether exercise increases and rest lessens it.

The value of this interrogation in enabling us to make a diagnosis will become apparent when we cite, for example, that the pain of renal colic occurs on the side corresponding to the diseased kidney and radiates along the ureter down into the groin; that in vesical calculus it is most pronounced at the end of the penis; that in stricture of the urethra it occurs at the site of the obstruction; and that in hypertrophy of the prostate and prostatitis a dull aching pain is often felt in the perineum and rectum. Vesical calculi often cause pain independently of micturition when the patient is moving about, and also at the end of micturition; in stricture the pain is generally felt only when the patient urinates, while

in affections of the neck of the bladder spasmodic pain follows the act and lasts for some time thereafter.

It is hardly necessary to state that there are many exceptions to these rules, concerning which we shall have something to say when discussing the individual diseases.

4. ADMIXTURE OF BLOOD WITH THE URINE.

The question whether the patient has ever passed bloody urine is one of great importance. It is unnecessary to ask the patient about the actual condition of his urine, because a thorough examination of it can be made; but as there are many genito-urinary diseases in which hæmorrhage occurs only at long intervals, inquiry as to the former occurrence of hæmaturia should always be made.

Urinary hæmorrhage is most frequently associated with tumors, calculi, and tuberculosis of the kidney, and with tumors and stone of the bladder. Gonorrhœal inflammation of the neck of the bladder also often produces it. In many cases the patients cannot give particulars as to the beginning of this condition, while in others they are able to supply valuable data.

If hæmorrhage always takes place under the influence of motion it bespeaks the existence of vesical or renal calculi. Tumors of the kidney are characterized by bleeding which occurs suddenly, comes on without apparent cause, lasts a long time, and is not easily controlled by treatment. The influence of rest, so favorable upon hæmorrhage due to stone, amounts to nothing in this form of hæmaturia. If hæmorrhage supervenes at the end of micturition, we may conclude with reasonable certainty that the location of the disease is at the neck of the bladder. This form of hæmorrhage, called terminal urinary hæmorrhage, is typical of gonorrhœal inflammation at the neck of the bladder, but it has also been observed in vesical calculus.

If the data obtained by interrogating the patient as just described lead to the formation of certain suppositions concerning the nature of the malady with which we have to do, it behooves us to verify these suppositions by resorting to exact methods of examination, which we shall now proceed to describe.

II. PHYSICAL METHODS OF EXAMINATION.

By physical methods of examination are meant those in which we employ our three principal senses, hearing, touch and sight, in a systematic manner for obtaining important diagnostic data.

We shall refer to details when considering special diseases; at present we shall merely mention a few generalities.

We use **percussion** to give us information concerning the presence of an abdominal tumor; thus, differentiation between tympany and dullness may help us to decide whether we have to do with a tumor of the kidney or with another kind of new growth.

Palpation is of great importance in the recognition of diseases of the kidneys, prostate, testicles, and epididymis.

The sense of sight renders **inspection** possible in the broadest sense of the word. We can examine the region of the kidneys and bladder, the testicles, etc., with the naked eye.

The hidden recesses of the uro-genital tract early prompted the profession to search for expedients which would enable us to use our sense of sight in these deeper and inaccessible portions. The skill of modern times has brought such aids to a high degree of perfection, and by their use our power of diagnosticating has been considerably augmented. We will now turn our attention to these ingenious devices.

I. EXAMINATION WITH SOUNDS AND CATHETERS.

Sounds and catheters are introduced into the urethra and bladder partly for diagnostic and partly for therapeutic purposes. For both it is fundamentally important to possess adequate knowledge of the instruments and the way in which they are used.

For practical purposes we differentiate between inflexible instruments made out of metal, and flexible ones such as vulcanized rubber catheters, and catheters and sounds made of silk and coated with a mixture of rubber and varnish. The vulcanized rubber catheters are generally called Nélaton catheters. A good article of this kind is the so-called Jaques patent catheter, although other excellent ones are manufactured both in Germany and France. They are not very durable and care should be taken to see that they contain no cracks. A cracked catheter should never be used, as it may be broken off in the bladder.

The best of these catheters are those having a blind end and a cylindrical or slightly conical shape.

For certain purposes the Nélaton catheter having a Mercier curve commends itself. In this modification the apex of the instrument forms an angle of 25°—40° with the shaft. (Fig. 1.)

The varnished instruments are called for short silk-web catheters, sounds, or bougies. Excellent qualities are now on the market. The firms of Vergne, Porgès, Rondeau Frères, and Eynard, of Paris, and Ruesch, of Cannstatt, prepare a stable, smooth and readily flexible article. Cotton-woven instruments are not durable and therefore are to be discarded.

The usual form in which these instruments are used is with the olivary tip, the shaft being long, the neck tapering, and the end expanding into a small knob resembling an olive in shape (Fig. 2). The use of conical bougies, formerly so much in vogue, is to be deprecated, because they are difficult of introduction and may injure the urethra.

Of these sounds and catheters a large number of the ones most frequently used should be kept on hand; of the catheters, from No. 12 to 20 will be found most necessary, while of the sounds all sizes will be required. The smallest sounds, from No. 1 to No. 4, are called filiform bougies; they too should have an olivary tip (Fig. 3).

The silk-web catheters are also manufactured with the Mercier curve.

Recently silk-web catheters bent into a pronounced curve have been placed upon the market; they are very useful for many purposes (Fig. 4). Finally there are the sounds with a double curve, *les sondes bicoudees*, as they are called by the French (Fig. 5).

The instruments known as stricture searchers, or bougies à boule, consisting of a cylindrical staff of uniform size with a knob attached to one end, though much used in France [and also in America] may be dispensed with. [Although these instruments may be useful in locating granular patches and areas of infiltration in the **anterior urethra,** misleading and pernicious results have frequently been obtained by their employment. I have demonstrated time and again that in a normal and perfectly healthy urethra resistance is encountered as the head of the instrument passes from the bulbous into the narrow membranous portion, and have seen not a few cases diagnosticated and treated as stricture in which the apparent contraction depended entirely upon the natural anatomical structure of the parts.]

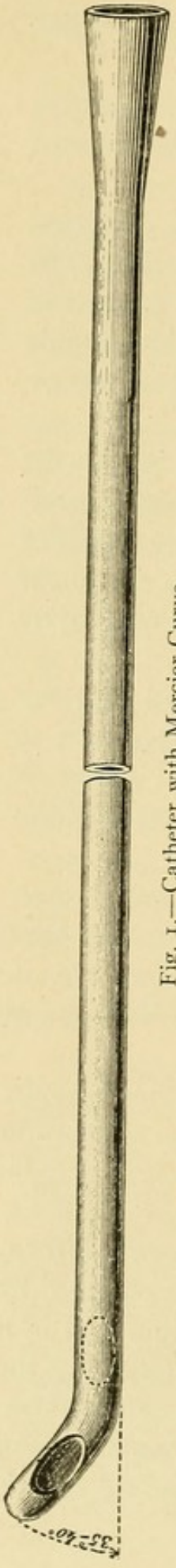


Fig. 1.—Catheter with Mercier Curve.

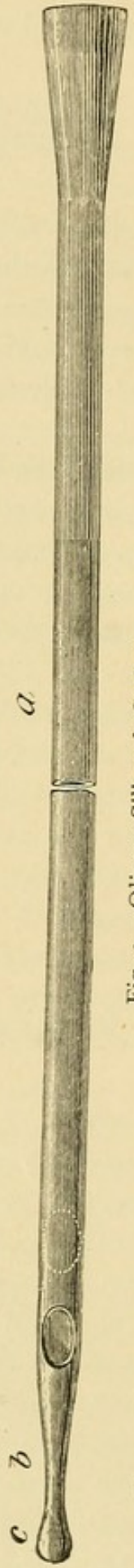


Fig. 2.—Olivary Silk-web Catheter.

Fig. 3.—Olivary Filiform Bougie.

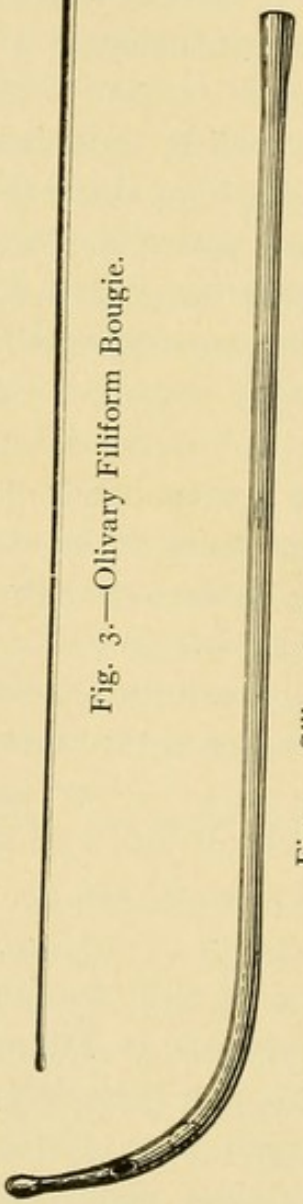


Fig. 4.—Silk-web Catheter with large Curve.

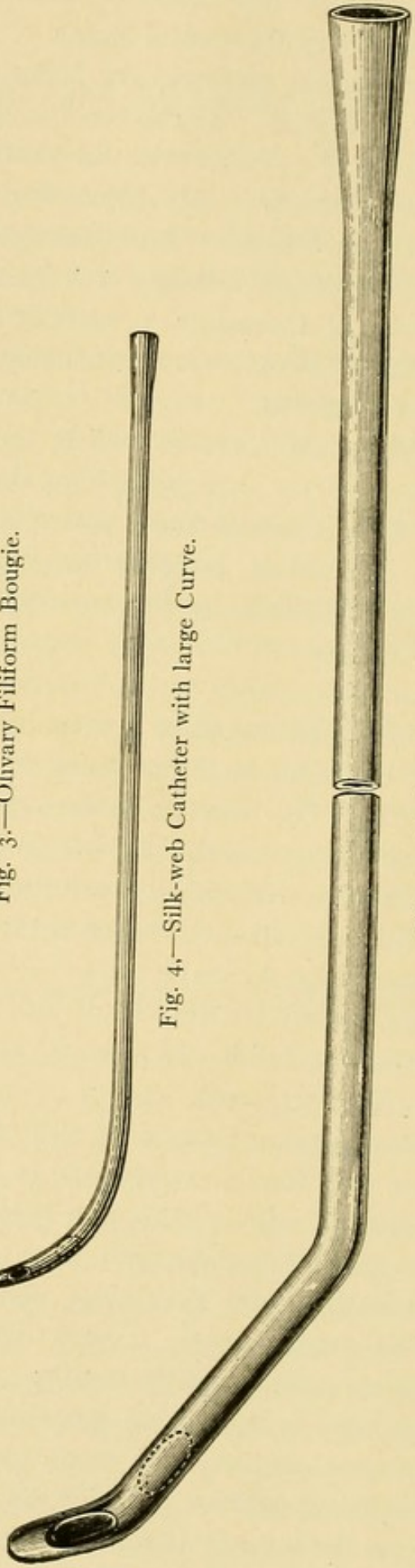


Fig. 5.—Catheter Bicoudée.



Fig. 6.

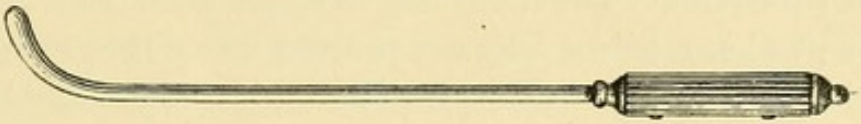


Fig. 7.

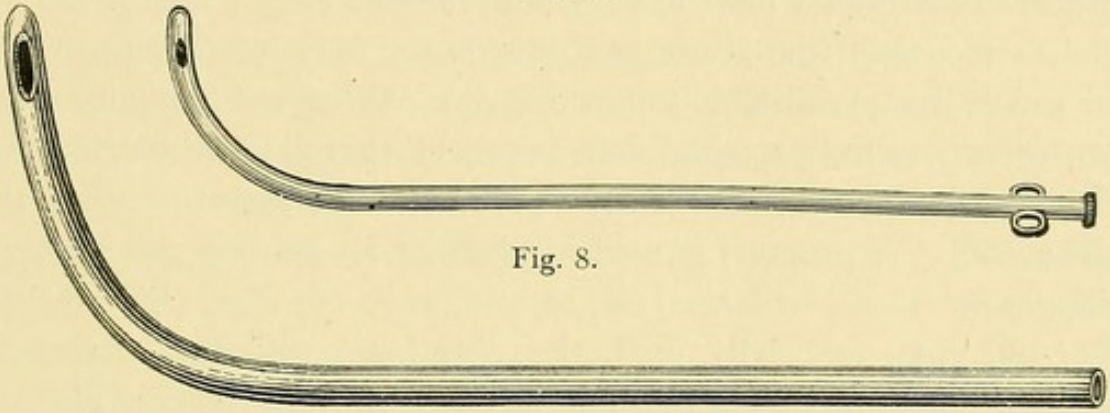


Fig. 8.

Fig. 9.

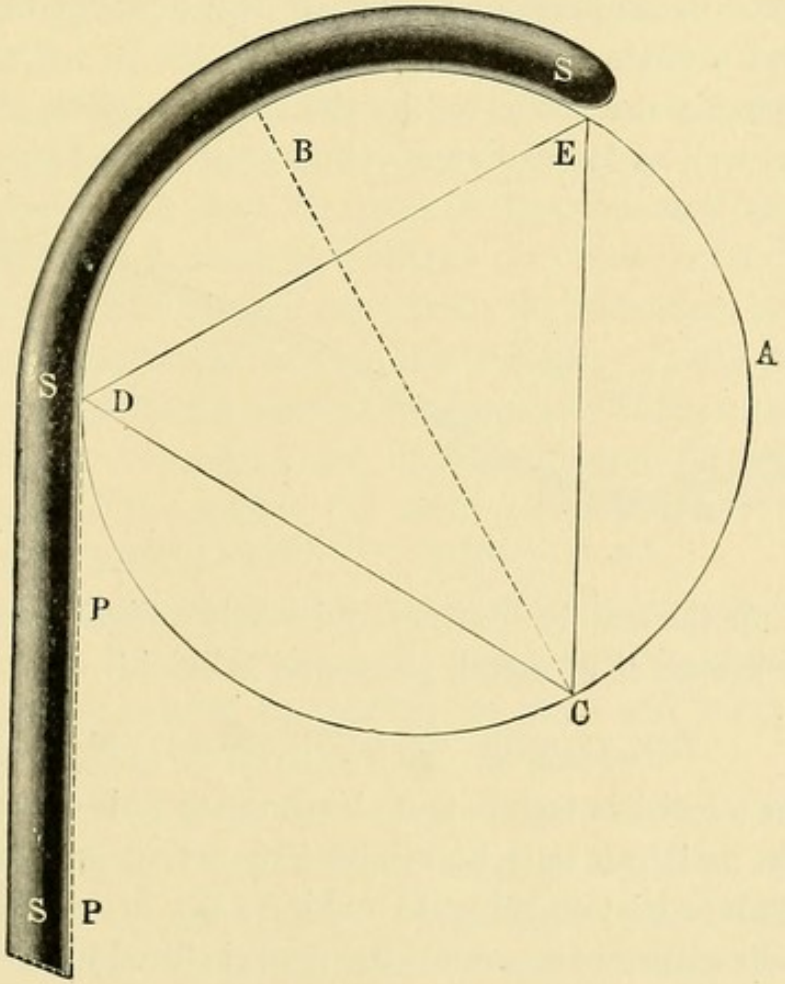


Fig. 10.
Brodie's Catheter.

Metal catheters and sounds have been made out of many different materials, such as lead, tin, silver, and German silver. It is unessential which of these substances is chosen; nickel or silver plated instruments answer every purpose. The only thing of importance is the curve of the instruments, which must be adapted to the various uses to which they are put. In general they must fit the curve which the urethra makes in its fixed part.

Metal instruments having very short beaks (Fig. 6) are to be rejected as incorrect; the **stone searcher** is the only instrument of this kind which it is permissible to use (Fig. 7). When searching for stone it is necessary to have a sound with as short a curve as possible, in order that it may be moved about freely in the bladder without touching the bladder wall. A properly curved instrument for general use is shown in Figure 8.

For old men, especially prostatics, a catheter with the curve bent almost at a right angle with the shaft has done me good service (Fig. 9).

Occasionally even greater curves are useful in this class of cases. A catheter devised by Sir Benjamin Brodie is bent to such a degree that its curve describes a circle (Fig. 10).

Similar purposes are subserved by the Beniqué curve, which is used for sounds as well as for catheters. (Fig. 11.)

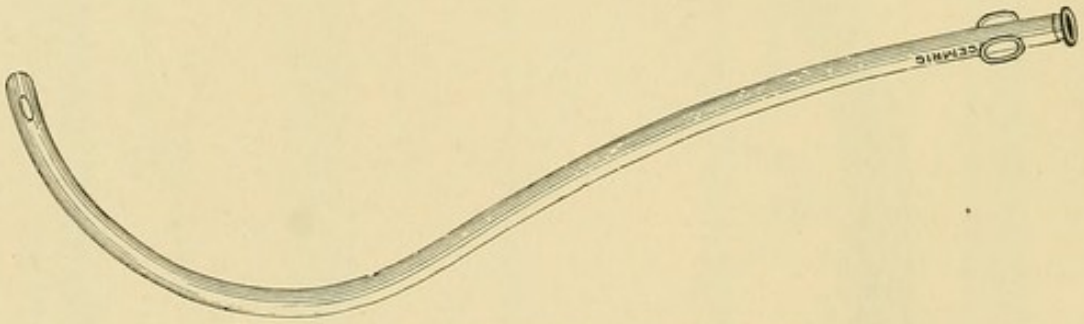


Fig. 11.—Catheter with Beniqué Curve.

Catheters for the female urethra require only a slight degree of curvature. They are made of metal, glass, and celluloid.

THE TECHNIC OF CATHETERIZATION.

It would be a fruitless task to try to learn the technic of catheterization from a book, as it can only be attained by actual practice. For this reason we shall restrict ourselves to making a few necessary allusions.

To pass soft catheters or sounds the penis is lifted up so that the first curve of the urethra becomes obliterated and then the instrument, previously well lubricated, is slowly introduced. Slight resistance is en-

countered as it passes out of the bulb, but this is easily overcome by constant though slight pressure, the instrument passing readily into the bladder. When using the Mercier catheter care must be taken to have the end of the instrument glide along the upper wall of the urethra. It is self-evident **that the employment of any force is to be avoided.** This is the **first principle** to be observed in the introduction of any instrument into the urethra.

The passage of inflexible instruments is performed in **three stages.**

In the first stage the instrument is carried to the bulb. Its outer end is held gently between thumb and fingers and the hand is steadied by placing the little finger on the patient's abdomen; the tip of the instrument is then carried toward the symphysis pubis and the penis is lifted up with the left hand and drawn over the instrument. When the tip reaches the bulb the distal end of the sound will have been removed from the abdomen about 90°.

In corpulent persons it is better to stand on the left side of the patient, and holding the instrument laterally over his left thigh introduce it slowly into the urethra, at the same time swinging the shaft around to the median line of the abdomen. This manipulation is called *tour de demi-maitre,* while if the instrument be held between the patients thighs it is known as *tour de maitre.*

During the second stage the tip of the instrument must pass from the bulbous into the membranous urethra. In order that it do so the distal end must be carried further away from the abdomen, so that the right angle becomes converted into an obtuse angle. It will help materially to press on the perineum, against the convexity of the sound or catheter, with the fingers of the left hand, thereby bringing the tip of the instrument up against the roof of the urethra and thus preventing it from catching in the bulb.

When the catheter enters the membranous urethra the third stage of its introduction begins, in which the instrument is simultaneously lowered and pushed toward the patient, its outer end being carried down toward the thighs as its tip passes into the bladder.

It is of the greatest importance to hold the instrument **gently** between the finger tips, and not grasp it forcibly with the hand, as by holding it gently one is able to feel whether it is going the right way.

When the second stage of catheterization is entered upon, that is, when it is attemped to pass the tip of the catheter into the membranous urethra, the instrument, when lowered, will rotate laterally if its tip

catches in the bulb instead of advancing into the membranous portion. If it be held firmly in the hand, rotation cannot take place, and thus a valuable sign as to whether it is following the right direction is lost.

ASEPSIS OF CATHETERIZATION.

In this present age it is hardly necessary to state that the passage of any instrument into the urethra must be done under the strictest aseptic precautions. The only question which arises is how these precautions may best be observed.

In order to avoid repetition we will discuss this question under asepsis of cystoscopy.

2. URETHROSCOPY.

Urethroscopy is the term applied to that method by means of which the urethra is illuminated for inspection. Its beginning extends back to the first part of the last century. The large number of urethroscopes

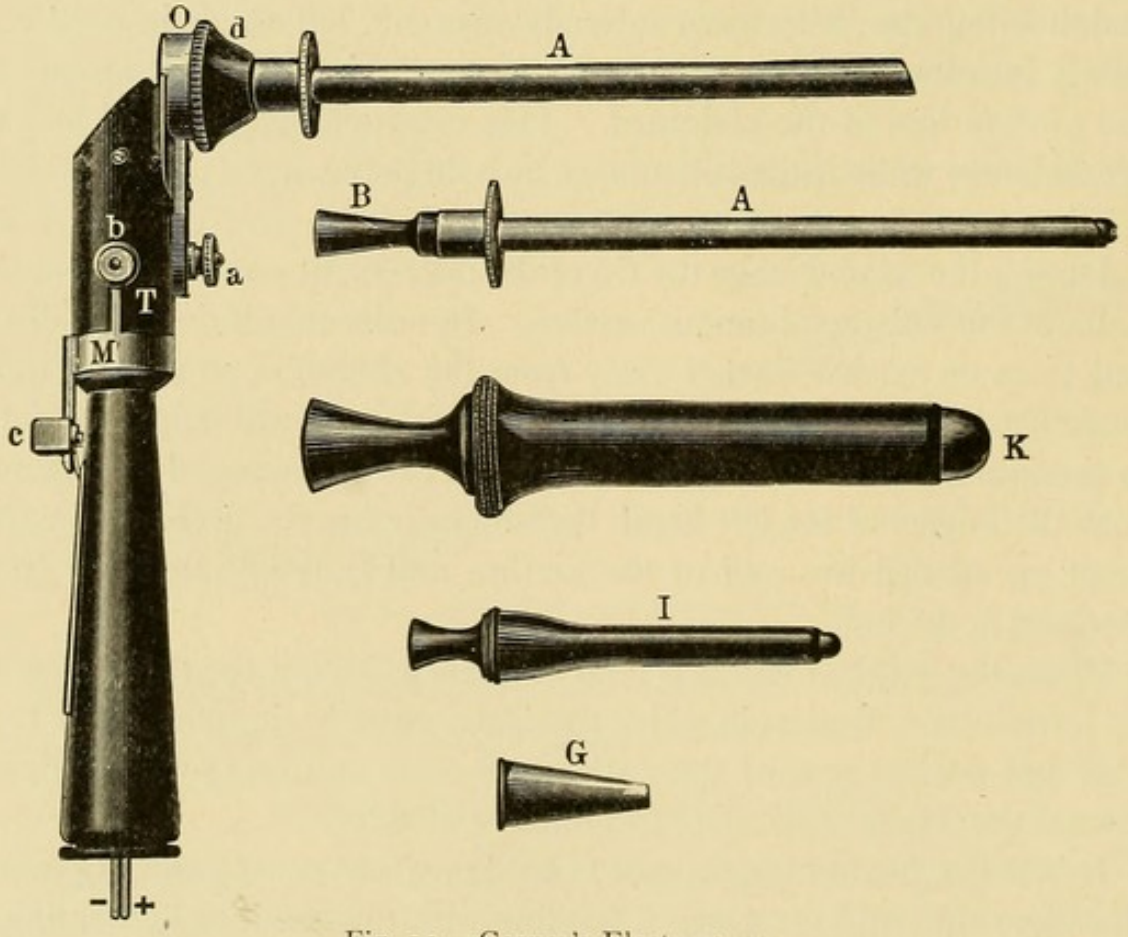


Fig. 12.—Casper's Electroscope.

which have been constructed may be divided, according to the principle of illumination employed, into those in which the source of light is without the body, and those in which the light is carried into the urethra.

The instruments of Bozzini, Ségelas, Désormeaux, Cruise, Fürstenheim, Grünfeld, and others, all belong to the first group. In 1879 Nitze applied the Bruck method of introducing light into the cavities of the body to the urethra, but it was soon abandoned. Leiter, myself, Otis, and some others returned to the earlier procedures, and constructed instruments in which the light was thrown upon the mucous membrane of the urethra from without.

Direct illumination of the urethra, which was carried into effect by means of the urethroscope devised by Nitze and modified by Oberländer, depends for its action upon the light derived from a platinum wire which is contained within a tube introduced into the urethra and heated to a white heat by means of electricity. This wire, surrounded by a stream of water, is brought close to the spot it is desired to illuminate. Valentine has recently made an ingenious change in this instrument, having substituted a minute Edison lamp for the platinum wire.

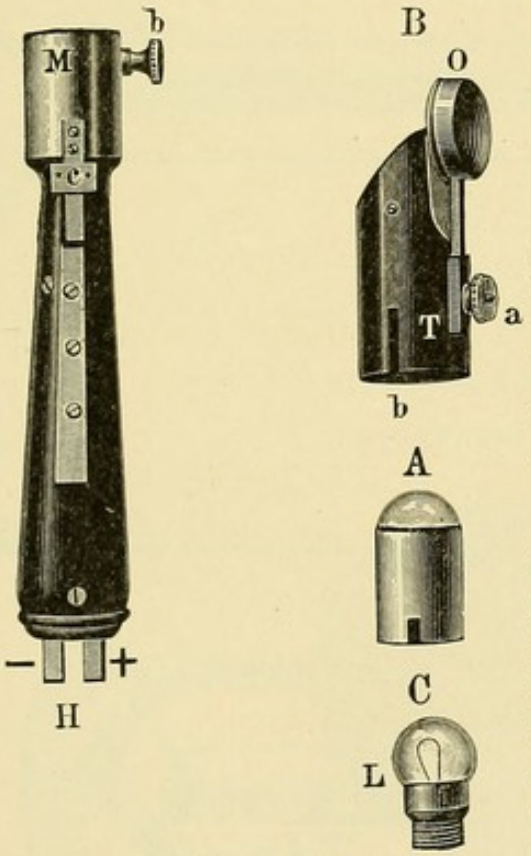


Fig. 13.—Casper's Electroscope.

In the urethroscope dependent upon reflected light a strong Edison lamp generally supplies the illumination. In my instrument a convex lens (Fig. 13 A) is placed over the Edison lamp (Fig. 13 L) for the purpose of strengthening and concentrating the light; over the lens a prism is placed, which breaks the light in such a manner as to cause its rays to fall into the tube (Fig. 12 A) which is passed into the urethra (Figures 12 and 13).

The view obtained with this instrument is so bright that the finest details of the urethral mucosa, as for example, its vascular network, can be plainly seen.*

[Valentine's urethroscope (Fig. 14), consists of a sheath, an obturator and a light carrier. After it is inserted the obturator is withdrawn and the light carrier put in position. A lug on the end of the light

* The electroscope can also be used for the illumination of other organs if appropriate adjoining pieces be used (Fig. 12 A. K. I. G.)

carrier fits securely into a spring slot in the disc and presses against a shoulder on its under side, thus fixing the light carrier firmly to the under side of the tube and preventing it from crossing the field of vision. The light carriers for all tubes of the same length are interchangeable.

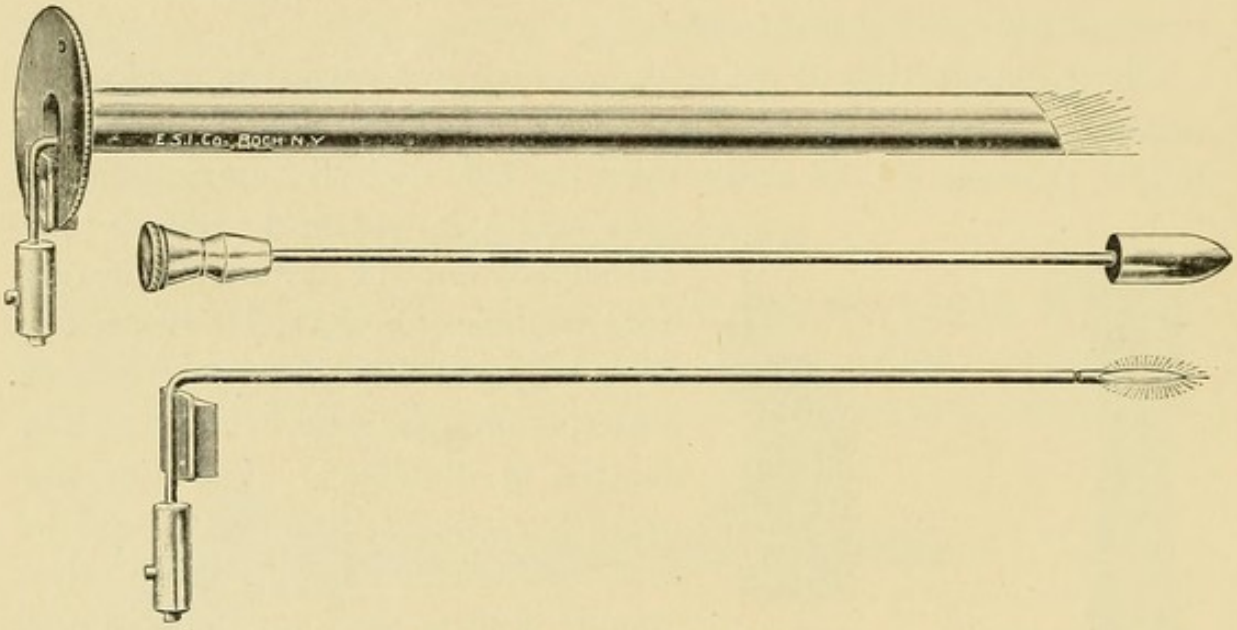


FIG. 14.—Valentine's urethroscope.

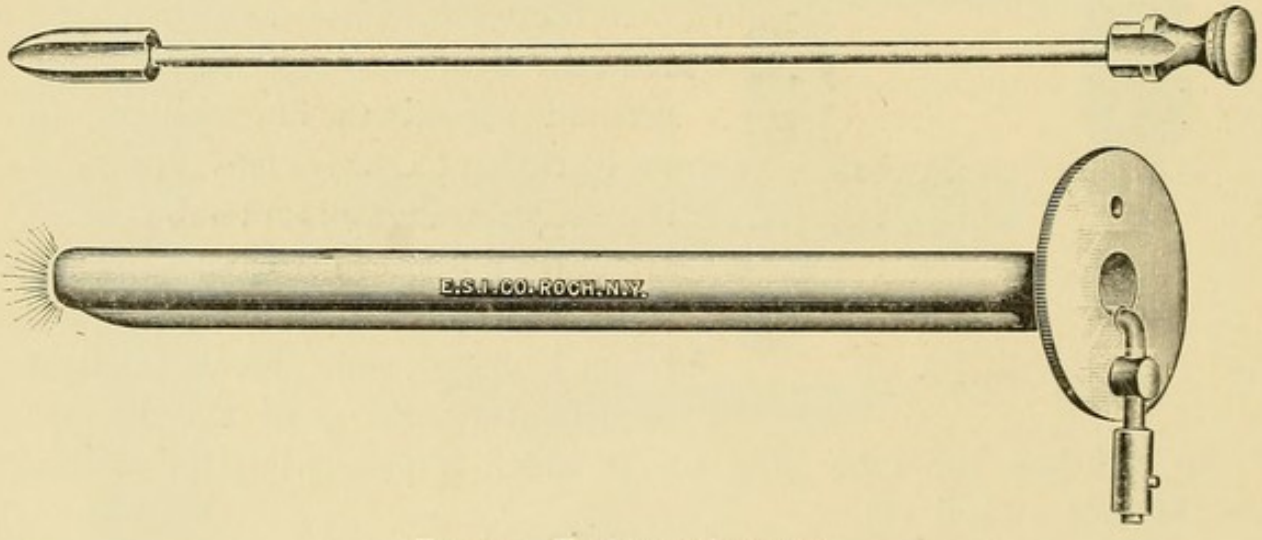


FIG. 15.—Koch's urethroscope.

In Koch's urethroscope (Fig. 15) a small auxiliary tube for the light carrier and lamp is placed along the side of the tube proper. This instrument is inserted with both light carrier and obturator in position. Applications or other manipulations may be made directly to diseased parts under direct guidance of the eye. As the lamp is outside the main tube, it does not obstruct the view nor cast shadows,

nor does the cotton catch on the lamp when the applicator is withdrawn.

Swinburne's posterior urethroscope (Fig. 16), designed by Dr. George K. Swinburne, of New York, consists of a catheter-shaped tube, 16 centimeters long, with a small auxiliary tube containing light carrier and lamp on the upper side. The light is thrown through a fenestra near the distal end, illuminating the floor of the

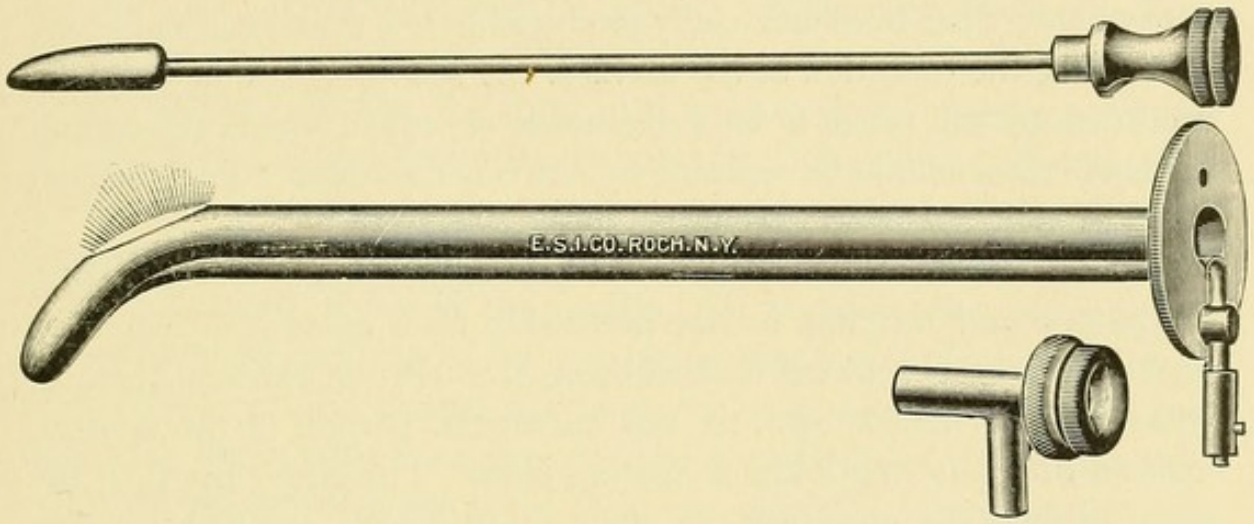


FIG. 16.—Swinburne's posterior urethroscope.

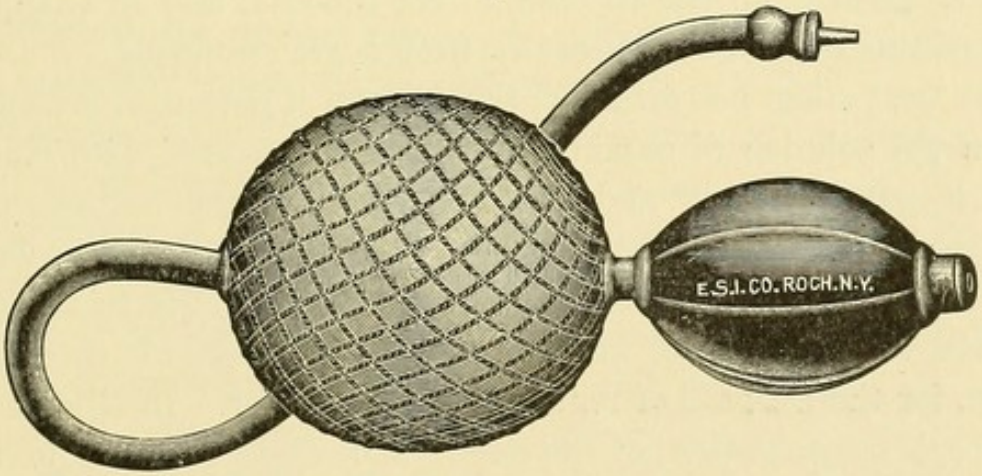


FIG. 17.—Dilating bulb to be used with Swinburne's posterior urethroscope.

urethra. The beak of the instrument has a closed end. The window attachment shown in the illustration, when placed in the visual end of the tube and connected with the dilating bulb (Fig. 17) allows the operator to dilate the posterior urethra, and thus secure a more satisfactory view.]

Whatever instrument may be employed, urethroscopy has only a narrow range of usefulness, being limited by certain anatomical and mechanical conditions beyond which the interpretation of the urethroscopic picture is impossible. When an inflexible tube is forced be-

tween the closely adjacent walls of the urethra, changes in the vessels of the mucosa are produced such as hyperæmia, anæmia, and alterations in color and lustre. These disadvantages are increased during urethroscopy of the membranous and prostatic portions, where the tube has to be pressed with some force against one of the walls, thus further interfering with the natural conditions.

These things must be borne in mind and an endeavor made to eliminate whatever has been artificially produced before drawing conclusions concerning the condition of the urethra. If such a course be pursued, urethroscopy will prove to be a diagnostic expedient which, for certain kinds of cases, cannot be replaced by any other method of investigation at our command.

The technic of urethroscopy is exceptionally simple. Tubes having obturators and varying in size preferably from 22 to 28 French are used. A tube is selected that will pass through the external meatus, which, as is well-known, is the narrowest portion of the urethra, without difficulty and without causing pain. The larger the tube the more distinct the urethroscopic picture, but a tube which is too large produces great pain, causes tears in the mucosa, and so changes the entire picture that inferences drawn from it are erroneous.

After the patient has urinated, the urethra, if sensative, is cocainized with a 2% solution of cocain, and the tube, smeared with Katheterpurin is passed slowly and carefully down to the bulbous portion exactly as any other urethral instrument is passed. I go beyond this limit for only two reasons; first, when there is cause to suspect the presence of a growth or an ulceration in the posterior urethra, and second, for the purpose of removing such a tumor. In all other cases endoscopic examination of the membranous and prostatic urethra is to be avoided. The passage of a straight tube beyond the bulb causes a stretching of the pronounced curve which the urethra here describes. It frequently gives rise to hæmorrhage, and, moreover, so distorts the posterior urethra by the pressure which it exerts that it is impossible to distinguish between the changes produced by disease and those produced by pressure of the instrument.

[These difficulties have been rendered less by the construction of the curved posterior urethroscope above described.]

When the tube reaches the bulb the obturator is removed, the mucous membrane is wiped with a pledget of cotton wound around an applicator, the urethroscope is set up, and its tube placed centrally in

the long axis of the urethra. The tube is now slowly withdrawn and the eye follows the picture which is presented until the external orifice of the urethra is reached. Thus the entire penile portion of the urethra is examined.

In normal cases the following picture is presented: At the end of the tube a tunnel is seen whose base is formed by the edge of the tube, its apex being further back, and its sides being formed by the walls of the urethra. (Grünfeld's central figure.) If the tube lies in the long axis of the urethra, this central figure will form the center of the urethroscopic picture, having the form of a fossette in the deeper portions, and becoming a mere fissure at the meatus. The wall of the tunnel is formed by the walls of the urethra, upon which the **color, lustre, duplicature,** and **striation** of the mucous membrane are to be observed.

In almost all parts of the urethra the normal **color** is white or yellowish white, permeated by a peculiar shade of dark red, which is most intense at and behind the bulb, the color becoming lighter and lighter as the meatus is approached; in the middle of the urethra it is yellowish red in hue, while at the *fossa navicularis* and external orifice it is pale yellow or white.

The lustre of the normal mucosa is uniform throughout, its upper surface appearing moist, shiny, and smooth.

When at rest the walls of the urethra lie in contact with one another in the form of longitudinal folds; if a tube be introduced, the folds assume a radiate arrangement for the reason that the tube lies perpendicularly to a cross section of the canal. The radiations vary according to the size of the instrument which is inserted: the smaller the tube, the greater the number of plications, and vice versa (Figs. 18–21), as pressure of the tube against the urethra obliterates them.

In the spaces between these folds, striations varying in color from pink to deep red are seen, radiating from the periphery to the center the same as the folds themselves. These striations are caused by blood vessels in the submucosa. If the tube be pressed against one of the urethral walls it will be easily recognized that these striations are not exactly straight lines; they may also be obliterated by central pressure (Figs. 18–21).

Likewise, areas of hyperæmia and anæmia may be produced by pressure exerted in different directions.

Sometimes the capillary network in the mucosa can be plainly seen (Fig. 21).

Finally, the lacunæ of Morgagni, from 6 to 12 in number, may be observed as fine longitudinal depressions.

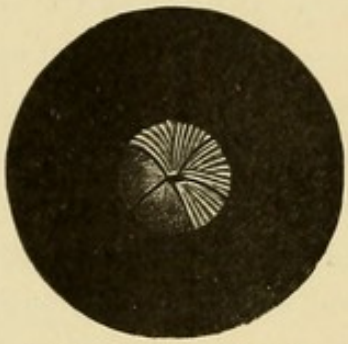


Fig. 18.—Normal urethra in the center of the cavernous portion. Five distinct folds converging toward the center; in three segments striation are seen; in the other two they have been obliterated by the pressure of the tube. The congestion in the periphery of these two segments is due to the same cause.

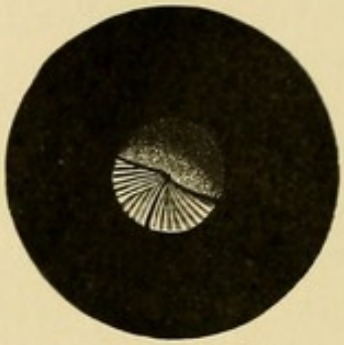


Fig. 19.—Normal urethra. Three folds. In the two segments to the left distinct striations are seen. In the periphery of the right segment there is artificial hyperæmia.

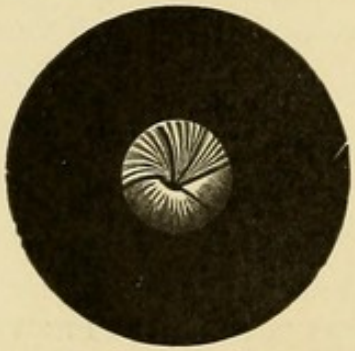


Fig. 20.—Normal urethra. Five folds. In the three upper segments there is marked striation. In the other two the striations are indistinct owing to the artificial hyperæmia at the periphery.

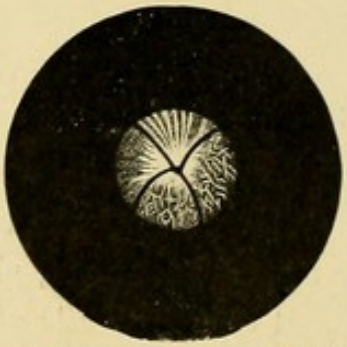


Fig. 21.—Four segments. In the upper one radiate striations are seen; in the left hyperæmia in the periphery; in the right and lower segments the vascular plexus is shown.

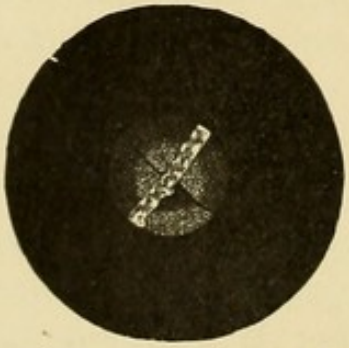


Fig. 22.—Acute gonorrhœa. Deep red color in the periphery to the right and below. A thick streak of pus passing across the field.

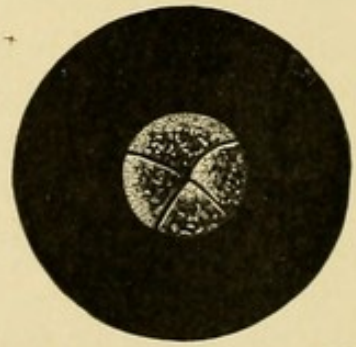


Fig. 23.—Granular urethritis. Elevations varying in color from dark red to black are seen near the center in the segments above and to the right. In the segments to the left and below they are near the periphery.

If we now proceed to a study of pathologic conditions of the urethra, urethritis will be the first to interest us. In the acute stages urethro-

scopy is contraindicated, being permissible only in exceptional cases where doubt exists as to differential diagnosis between chancroid of the urethra and gonorrhœa (Fig. 22).

Several forms of chronic urethritis may be differentiated by means of the urethroscope, a fact which is of some importance in regard to treatment. We have long been familiar with the sharply defined circumscribed areas of hyperæmia first described by Fürstenheim, which occur on different parts of the penile urethra, and also with the granular

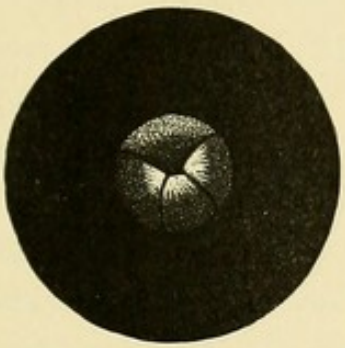


Fig. 24.—Chronic infiltrative urethritis. Four folds; no striations; red maculation.

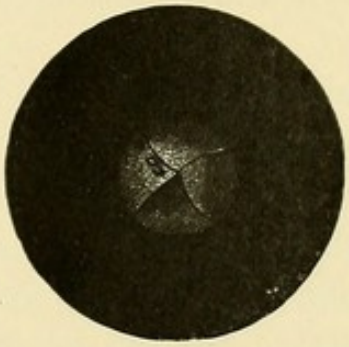


Fig. 25.—Inflammation of Littré's glands In the upper segment circumscribed redness to the left. In the segments to the left and below hyperæmia near the periphery.

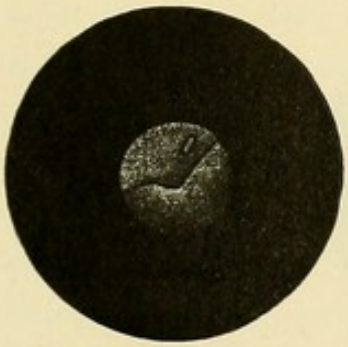


Fig 26.—Chronic glandular and infiltrative urethritis. Only two folds; no striations. In the upper segment a lacuna of Morgagni having dark red edges is seen.

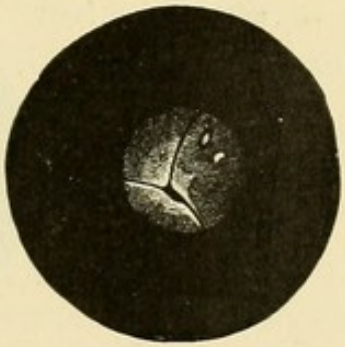


Fig. 27.—Chronic glandular and infiltrative urethritis. The tube is not central but lies toward the upper wall. Three folds are seen. To the right and above there is a lacuna of Morgagni and to the right of this a punctate deposit of pus. There are no striations. The tissues are deep red.

patches of urethritis granulosa, which are dark red or black in color, resembling those seen in trachoma (Fig. 23).

These forms of urethritis, which are confined to the upper layer of the urethra, are closely related to the infiltrative forms, which occur both with and without glandular changes.

Small-celled infiltrations affect circumscribed areas of the submucosa to greater or less extent, sometimes penetrating as deep as the corpora

cavernosa. A part of this infiltrate becomes converted into embryonal connective tissue, which in turn develops into scar tissue (Neelsen, Halle, Wasserman, Finger). As a result of these alterations the appearance of the surface becomes changed. The mucosa, being poorly nourished, looks pale, and in the worst cases has a sinewy white hue; the epithelial cells die and become stratified, as a result of which the lustre of the mucosa is lost. The thickening of the mucosa prevents the formation of folds, or at least greatly reduces their number. The



Fig. 28.—Psoriasis of the urethral mucous membrane. In the upper segment there is a conical white deposit consisting of thickened epithelium.

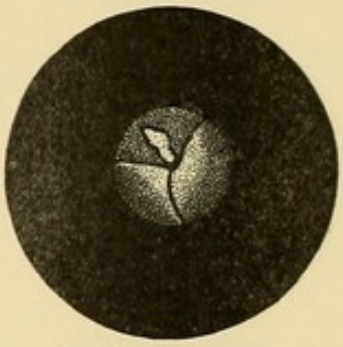


Fig. 29.—Mucous ulceration. Three segments. The ulcer is above; no striations; deep redness in the periphery.

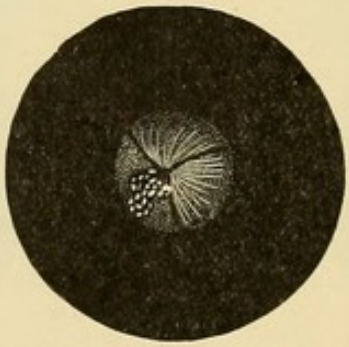


Fig. 30.—Papilloma of the urethra in the upper segment. The surrounding tissues are deep red; below striations are seen, to the right infiltration.

striations are not so well-marked and at times seem entirely wanting. (Fig. 24.)

In other cases these changes are not very apparent, glandular affections dominating the urethroscopic picture. We are indebted to Oberländer for a thorough study of these glandular forms of urethritis.

The infiltrate attacks Littré's glands, some of which have their orifices on the surface of the urethra, while others empty into the lacunæ of Morgagni.

Under normal conditions Littre's glands cannot be seen, but when they become inflamed they show as small, round, dark red depressions about as large as the head of a pin, while Morgagni's crypts are long

slit-like openings with everted, deep red edges. When pressed upon by the tube they gape so that the point of a small sound may be pushed into them. These glandular changes are usually associated with more diffuse infiltrations of the submucous tissue (Figs. 25, 26, 27).

Finally, there remains to be mentioned a peculiar disease of the urethral epithelium known as psoriasis mucosa, which is also due to local nutritional disturbances, and which was first described by Kollmann and Oberländer. In this disease the surface of the urethra is covered with thick, flat, lustreless white patches, which are firmly adherent at their base (Fig. 28).

They are composed of thick layers of dead epithelial cells, both squamous and round as well as cylindrical, which microscopically show only a nucleus and a mass of colorless detritus.

All of these infiltrative forms except the last are associated with some narrowing of the urethra, although a marked degree of contraction is not present. They are the **strictures of large caliber** described by Otis.

In true stricture urethroscopy has neither diagnostic nor therapeutic value, because the constrictions can be better felt than seen; moreover, they can be treated better without the endoscope than with it.

Ulcerations and tumors, on the other hand, offer a very satisfactory field for urethroscopy.

To the first class belong simple erosions, hard and soft chancres, tuberculous ulcers, and degenerated gummata. They are easily recognized, as they always produce loss of substance. A true ulcer is always deeper than the surrounding tissue. Erosions result from simple or gonorrhœal inflammation or from the passage of instruments, and may occur in any part of the urethra. They are small spots about the size of a millet-seed and are not covered with epithelium.

Soft and hard chancres are usually at or near the cutaneous orifice, although the first also occur in the deeper portions of the urethra. The sense of sight does not enable us to determine whether a chancre is soft or hard, so conclusions as to its nature must be drawn from the accompanying circumstances of the case. The area surrounding a soft chancre is usually very red (Fig. 29). In hard sores the infiltration can be felt from without.

If tuberculous ulcers are present or suspected, the urethroscope should not be used, as it may cause dissemination of the tubercles. Tuberculosis of the urethra gives rise to tight strictures which withstand all

forms of treatment except operation. On the surface of the mucous membrane nodular granulations and ulcers are seen.

The tumors affecting the urethra are polypi, papillomata, and carcinomata.

Polypi are very rare; they are pale, pedunculated little growths which can be plainly seen and easily recognized.

Papillomata are more common. They invade all parts of the urethra, but have a predilection for the colliculus seminalis. They are almost always multiple. If they are discovered in the anterior urethra the posterior urethra must be examined with the urethroscope. (Fig. 30.)

Carcinoma of the urethra is very rare. It produces firm, incurable strictures, which can always be palpated from without and therefore require no urethroscopic inspection.

3. CYSTOSCOPY.

Cystoscopy is a term applied to the method of examining the bladder visually by means of an instrument introduced through the urethra. The efforts made to attain this object date from the beginning of the last century. Segalas, Fischer, Desormeaux, Cruise, Fürstenheim, Stein, and Grünfeld followed the German physician Bozzine, of Frankfurt-am-Main (1807) in an attempt to construct cystoscopic instruments. With the exceptions of some unimportant details their methods were the same. They passed a tube through the urethra into the bladder and reflected light into that viscus from without by means of a mirror. Excluding Bruck's diaphanoscopic method, which was never made practical use of, the attempts of all these investigators may be criticised as being totally inadequate for the purpose for which they were intended. Their illumination was defective and, moreover, only a very small area of the bladder wall, scarcely larger than the lumen of the tube introduced, could be seen at one time.

It was Nitze who in 1877 first fully recognized this defect and introduced two new principles in the examination of the interior of the bladder, as a result of which cystoscopy became a serviceable method.

He established the fundamental principle that illumination of a hollow viscus connected with the exterior of the body by a long narrow canal is possible only when the source of light is carried into the viscus itself. Furthermore, he maintained that even if this requisite be fulfilled, satisfactory inspection of the bladder could not be made unless a considerable portion of its surface could be seen at one view. If both con-

ditions could be fulfilled, then by moving the instrument about the whole surface of the bladder could be examined.

Both were realized when it became possible to carry an electric light into the bladder without causing pain or injury, and to construct an optical instrument magnifying the field of vision.

The electric light was devised by Nitze and a Viennese instrument maker named Leiter. It was supplied by a platinum wire heated to a white heat. This wire was covered with glass, the two together being contained in an irrigator which permitted a current of cold water to flow around them while the wire was burning, and thus prevent injury of the bladder. It is the same method which Bruck applied to his diaphanoscopic illumination. To Nitze belongs the merit of rendering Bruck's method of illumination practical for examining the bladder. The optical apparatus, somewhat similar to a telescope, was made by the optician Benèche in conformity with a suggestion of Nitze's. The irrigating apparatus around the platinum wire rendered the instrument so complicated and so uncertain of application that it could be used only with difficulty, or not at all, and for this reason cystoscopy did not gain entrance to the practice of urologists and surgeons.

When the Edison lamp succeeded the platinum wire a change was wrought at one stroke. On the point of the catheter-like instrument where the platinum wire formerly was placed, an Edison lamp was attached and connected with a battery or accumulator which furnished a beautiful bright light without producing much heat. Thus an unserviceable instrument was converted into a useful one.

The irrigator was discarded as superfluous; the instrument, as easy of introduction as any silver catheter, worked well and safely. The change was an important one for cystoscopy. Since it was instituted the method has won universal recognition and become the common property of the profession. To this change are due the surprisingly favorable results obtained as well as the wide propagation the method has undergone.

This improvement in the instrument was made public at about the same time by Nitze and Dittel, the latter being represented by Dr. Brenner at the Surgical Congress at Berlin in the year 1879.

In order to understand the cystoscope and cystoscopy a thorough knowledge of the second principle enunciated by Nitze, namely, increase in the apparent dimensions of the field of vision by means of

an optical contrivance is indispensible. This device consists of a tube (R Fig. 31) having an objective (O) at its vesical end and an eyepiece (L) at its external end. The objective consists of one or more lenses which throw a small inverted image (B) of the opposite object (B′), proportionate in size to its index of refraction, into the interior of the tube, where it lies close behind the objective and is reinverted by a lens (U) in the middle of the tube and then transferred to its outer end against the eyepiece (B″), which acts as a magnifying glass and enlarges the upright image. (Fig. 31.)

When one looks through the eyepiece he sees an image of the object lying opposite, varying in size according to the distance at which it is removed. In the words of Nitze, "one sees in the inner field of vision that part of the opposite object which lies within an imaginary cone whose axis is perpendicular to the free surface of the objective."

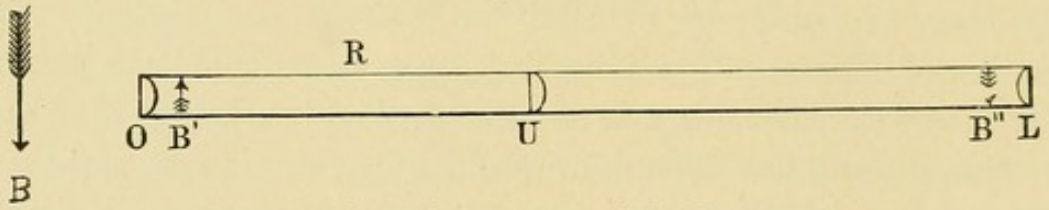


Fig. 31.—Optical Apparatus of the Cystoscope.

The size of this cone varies; the better the objective the larger the cone. In the best instruments which I have seen the divergence of the cone was from 80 to 90 degrees. The size of the opposite surface (bladder) as seen in the inner field of vision, which itself remains constant in size, is increased as the objective is moved away, and therefore the details of the picture become less distinct; it is decreased in size as the objective is carried toward the surface, thus making the details larger and more distinct. The natural size of an object is seen at a distance of about 2 cm. ($\frac{4}{5}$ of an inch). If the instrument be carried nearer less is seen, but the image becomes plainer and larger, whereas if the objective be moved away more is seen, but the picture is less distinct.

From these statements two things bearing on practical cystoscopy may be learned; first, that as errors may result from increasing or diminishing the size of an object beyond its natural dimensions one should form an opinion concerning the size of the object observed by varying the distance of the objective; and second, that objects such as organs of the body will appear distorted because their more distant portions will be diminished in size while their nearer parts will be magnified. If the

examiner knows and considers these facts he will be able by a little practice to eliminate the element of distortion in the image and judge correctly as to its size. If we turn our attention to a description of the cystoscope itself, of which there are many, it may be said that the one

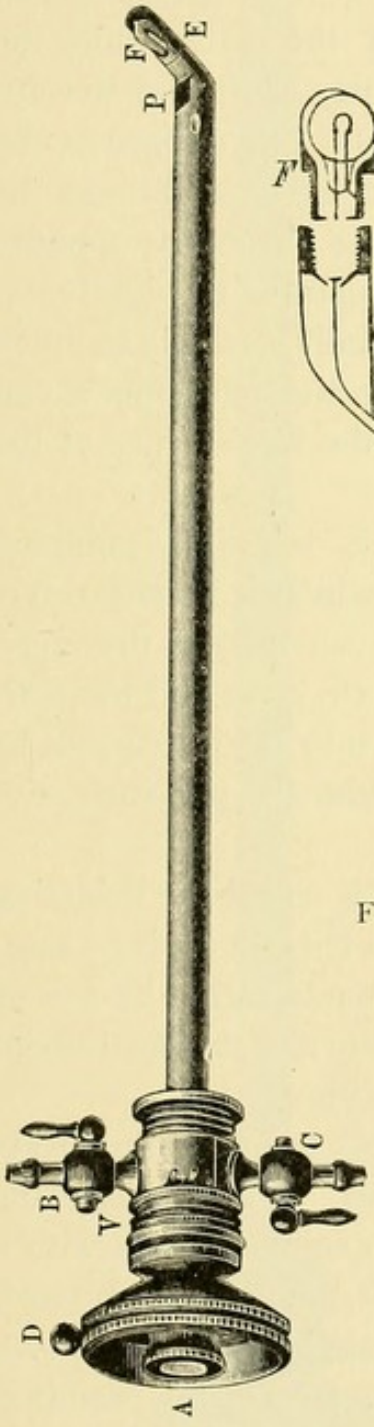


Fig. 32.—Nitze's Cystoscope I.

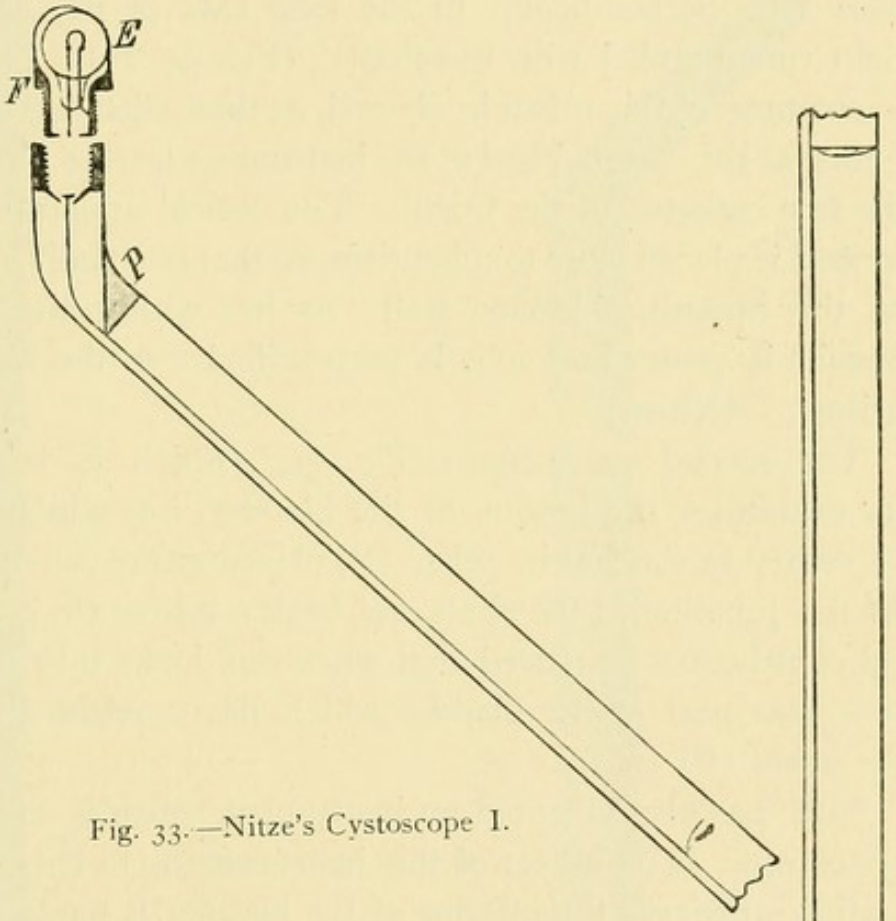


Fig. 33.—Nitze's Cystoscope I.

Fig. 34.—Nitze's Cystoscope II.

which is almost universally used and which suffices for nearly all cases consists of a sound having a Mercier curve and a shaft from 22 to 25 cm. (9 to 10 inches) in length. (Fig. 32.)

On the tip of the sound is an Edison lamp (E) in a setting which is

screwed onto the shaft (F). Under the surface of the lamp is a fine insulated platinum wire which becomes connected with the insulated conducting wire of the shaft when the lamp is attached. (Fig. 33.)

In the concavity of the angle formed by the junction of the shaft with the beak of the instrument there is a right-angled prism whose hypotenuse lies in the elongation of the back, while the base falls perpendicular to the long axis of the shaft and the upright runs parallel with the shaft. (Fig. 33 P.) The surface at the hypotenuse of this prism is silvered, so that when one looks through the funnel at the external end of the instrument he sees the objects opposite the free cathetus of the prism. The optical apparatus previously described is placed close to this prism, so that one really sees only as much of the opposite bladder wall "as lies within the envelope of an imaginary cone whose axis is perpendicular to the free surface of the prism." (Nitze.)

The second cystoscope (Fig. 34), which is especially adapted for examining the fundus of the bladder, but which it is only rarely necessary to use, has its prism (P) placed at the convexity of the angle. At the junction of the shaft and beak a mirror (h) is set and the optical contrivance so placed that when one looks into the instrument he sees that part of the bladder which lies opposite the free surface of the prism (P).

Nitze has also invented an instrument which is called the irrigating cystoscope. The object of this instrument is to irrigate during examination whenever the interior of the bladder is made turbid by pus or blood, and so restore its transparency. In construction this instrument is essentially the same as the one first described. (Fig. 35.)

Underneath the prism are several small openings which communicate with a canal extending down the end of the funnel. On the side of the instrument there is a larger aperture which also communicates with a canal running the whole length of the instrument. These canals terminate in two processes (B) and are opened and closed by stop-cocks (C). Thin rubber tubes are attached to these processes. During examination an assistant injects clear fluid (Hydrarg. oxycyanat solution 1-5000) through the tap leading to the small apertures beneath the prism. In this way the prism is irrigated and freed from blood or mucus. At the same time the other stop-cock is opened and the turbid fluid allowed to run out. This arrangement, concerning the importance of which we shall have something further to say, gives a more limited field of vision,

though withal a clearer one, than other instruments. The instrument itself is somewhat larger, being about 24 to 25 French.

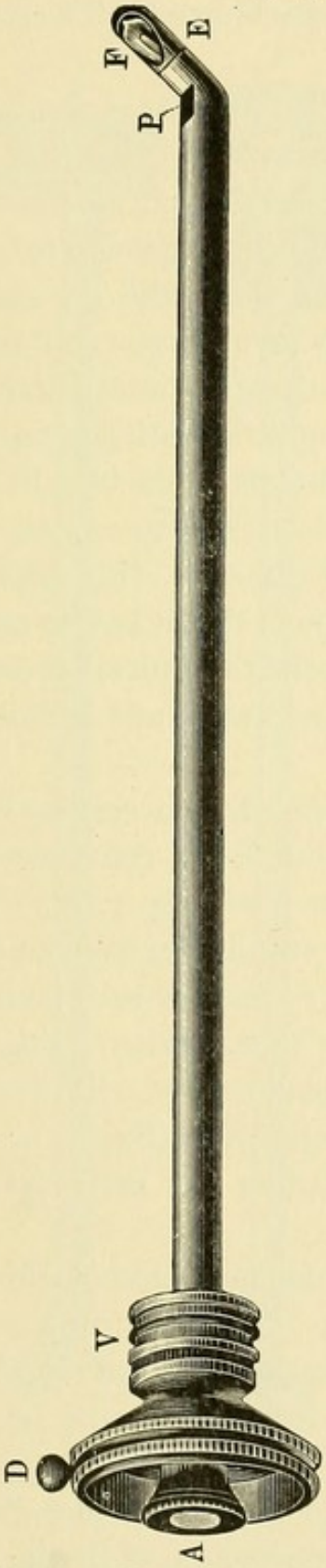


Fig. 35.—Nitze's irrigating cystoscope.

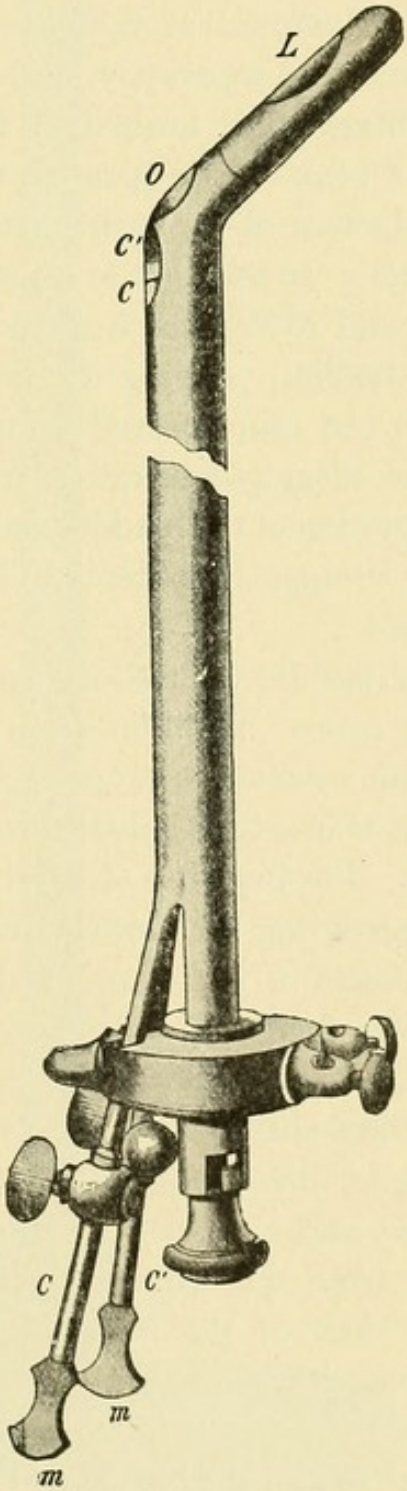


Fig. 36.—Boisseau du Rocher's megaloscope.

This irrigating cystoscope has been improved upon, being made with only one canal, which is larger than either of those in the original instru-

ment and therefore does not become so easily clogged as did the finer ones. In using the new instrument it is necessary to irrigate and allow the fluid to run out as often as the picture becomes blurred. The size of this instrument is 22 French.

Different in construction from any of these instruments is one called the megaloscope, which was invented by Boisseau du Rocher (Fig. 36). It has a lamp (L) at its end on the convex side, and the optical apparatus is introduced separately, a special opening (O) being provided for it at the obtuse angle formed by the junction of the shaft with the shortly curved beak. This opening, which is closed by an obturator during the introduction of the instrument, is used for washing out and filling the bladder. In addition to it there is a special double irrigating apparatus (CC′ and MM′) which serves to keep the contents of the bladder free from turbidity during the introduction of the optical apparatus, and which can also be used for inserting ureteral catheters. (Fig. 36.)

The megaloscope differs from the cystoscope in that it has no prism, that portion of the bladder wall which lies opposite the optical apparatus being brought into view. The instrument is awkward and unsuitable for use.

The late Dr. Güterbock invented a cystoscope which is very useful in many cases. It differs from all cystoscopes previously constructed in that the cystoscope proper consists of an inner tube (Fig. 37 b.) which is passed into the bladder through another catheter-like instrument (Fig. 37 a). For the lamp (L) and prism (P) of the cystoscope-tube there are corresponding notches (F and B) in the outer tube. When using this instrument it is not necessary to wash the bladder out with another catheter, for it can be irrigated through the outer tube (Fig. 37 a.) and the inner tube introduced as soon as the bladder has been cleansed and filled with water.

Winter has prepared a cystoscope for the female bladder which is thicker and shorter than those used for men. Otherwise it does not differ from the ordinary instruments. As the male cystoscopes give a good view of the female bladder Winter's instrument may be dispensed with.

For the purpose of fixing pathologic conditions of the bladder, Nitze, and after him the instrument maker W. A. Hirschmann, of Berlin, constructed a **photographic cystoscope** by means of which very good pictures of the interior of the bladder can be taken. The principle of this instrument is, that the image in the interior of the tube is

brought to the ocular end and photographed by a camera which is

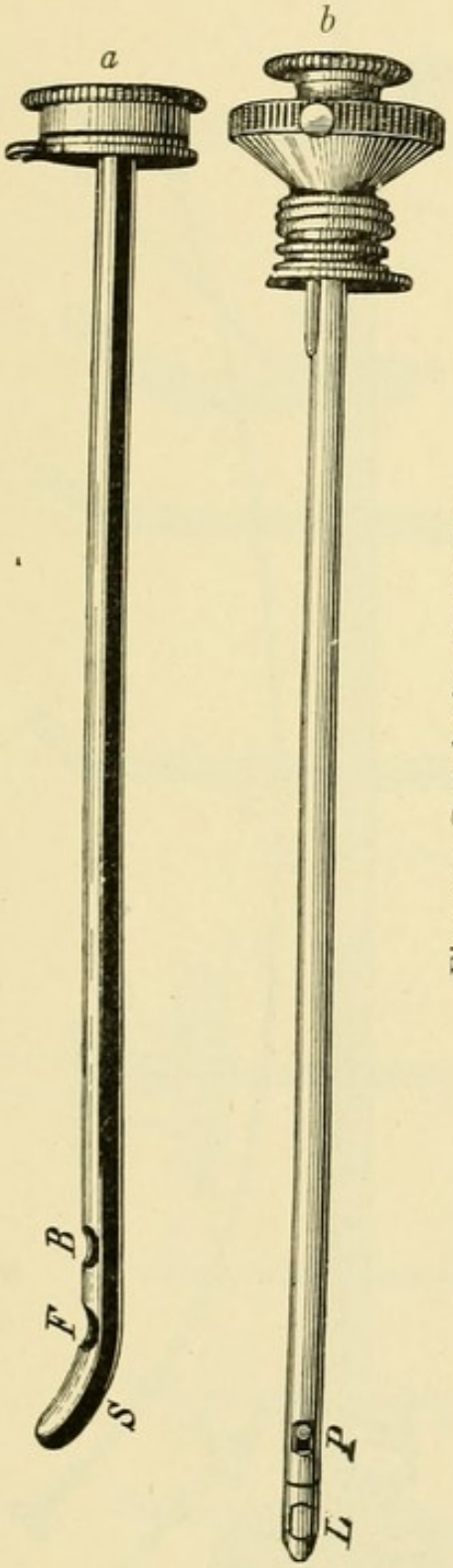


Fig. 37.—Güterbock's Cystoscope

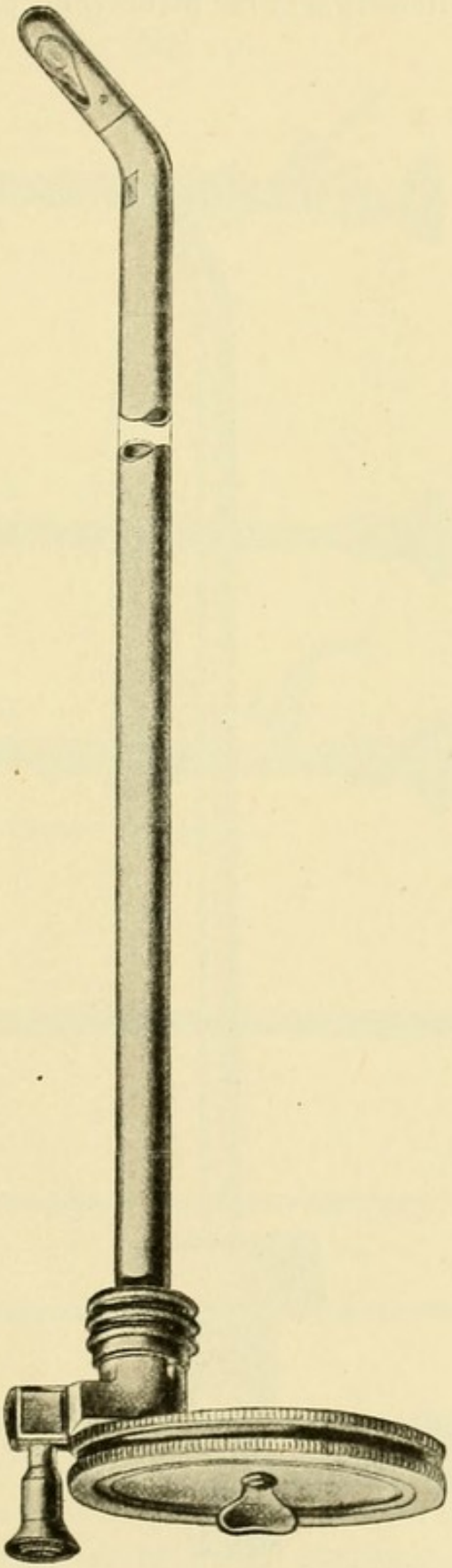


Fig. 38.—Nitze's Photographic Cystoscope.

placed there. In Nitze's instrument the camera is round and eccentric (Fig. 38), while in Hirschmann's it is angular (Fig. 39). The latter is

easier to handle and also permits of an exceptionally rapid insertion and withdrawal of the plates (Fig. 39).

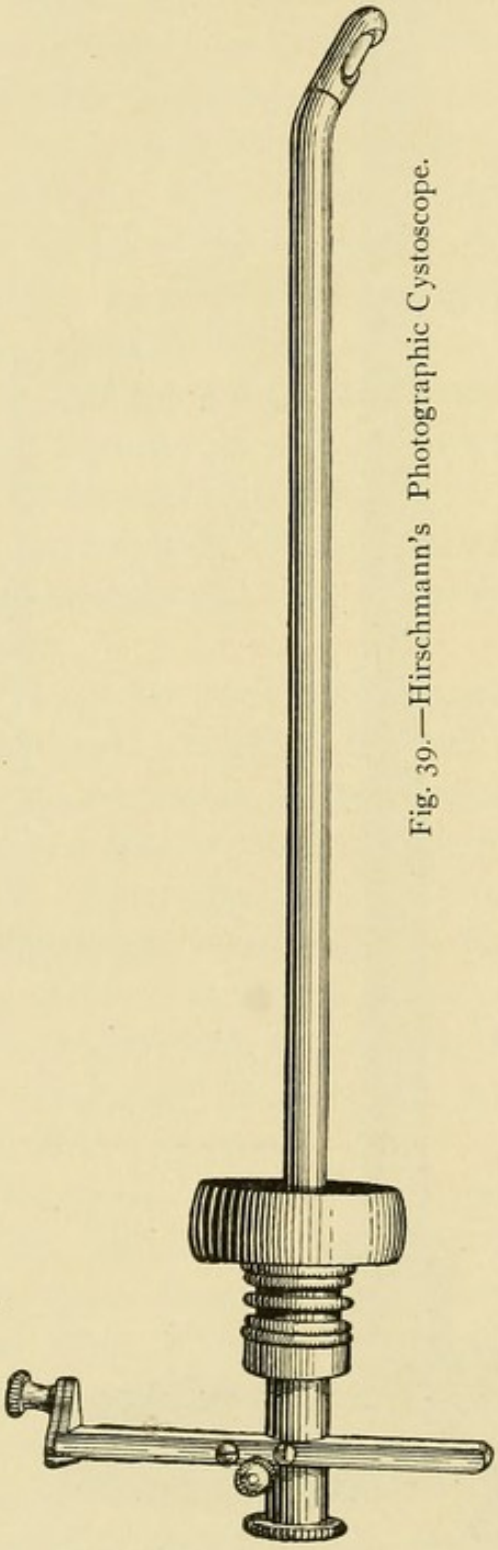


Fig. 39.—Hirschmann's Photographic Cystoscope.

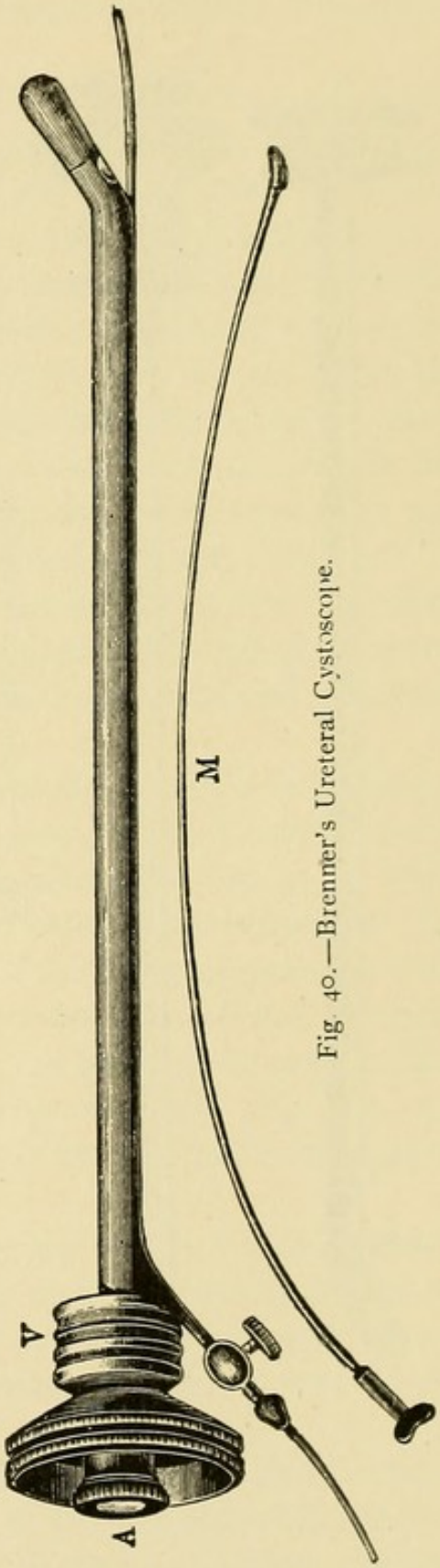


Fig. 40.—Brenner's Ureteral Cystoscope.

Many cystoscopes for catheterizing the ureters have been devised. For the female bladder Brenner's, which was one of the first, fulfills all

requisites. It has a tunnel on its convex side through which the ureteral catheter is passed; the lamp is also on the convex side, so that one looks straight through the tube into the bladder (Fig. 40).

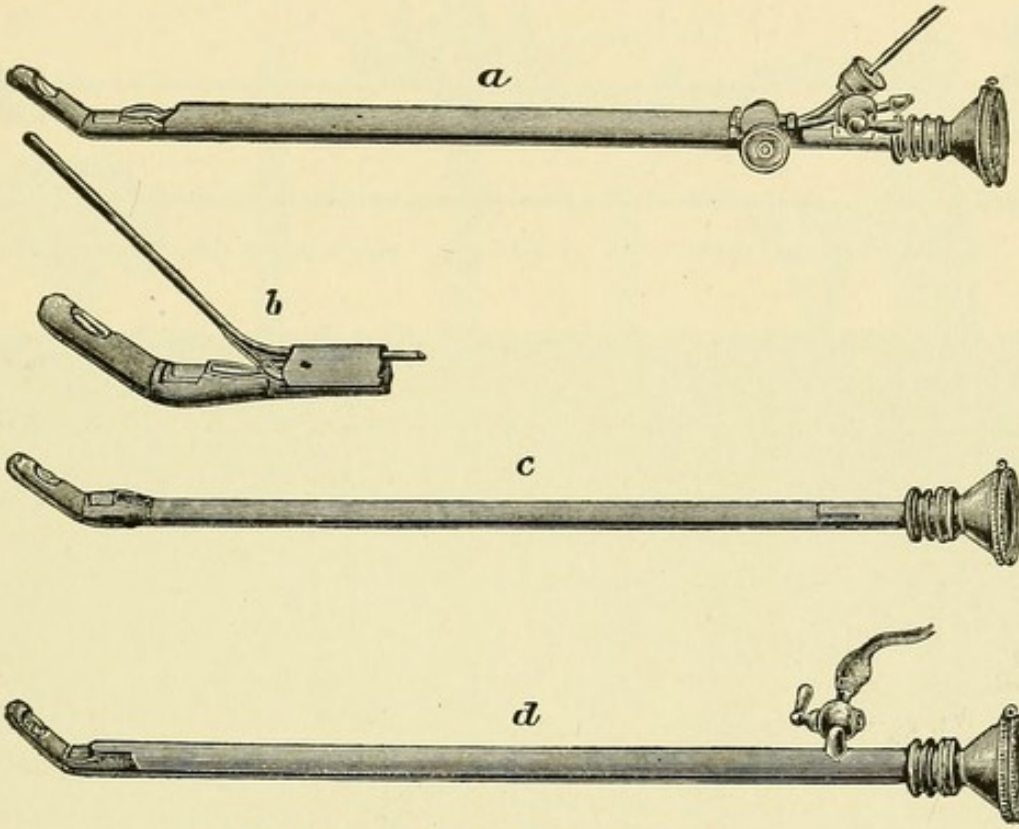


Fig. 41.—Albarran's Ureteral Cystoscope.

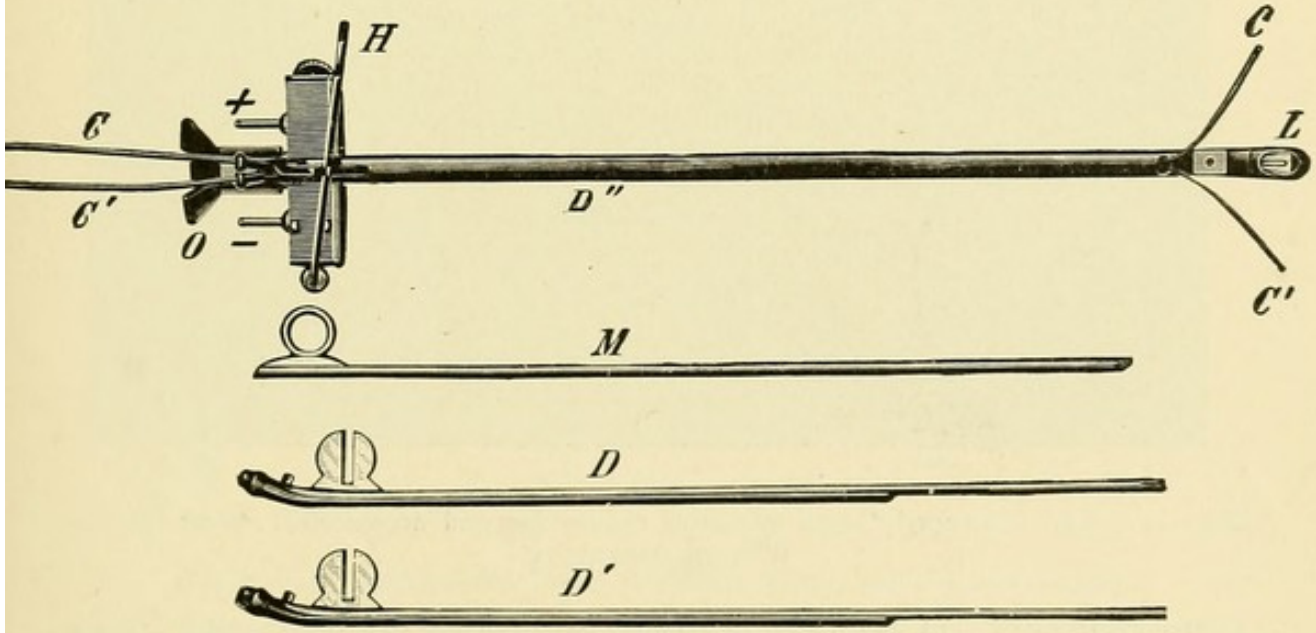


Fig. 42 —Casper's Ureteral Cystoscope.

An instrument intended for catheterizing the ureters must be applicable to both sexes. It must fulfill the following conditions: the catheter must have a variable curve and must remain in the ureter when the metal instrument is withdrawn; it must be so constructed as

to permit the introduction of a catheter into both ureters at a single sitting. These requirements are nearly met in Albarran's ureter-

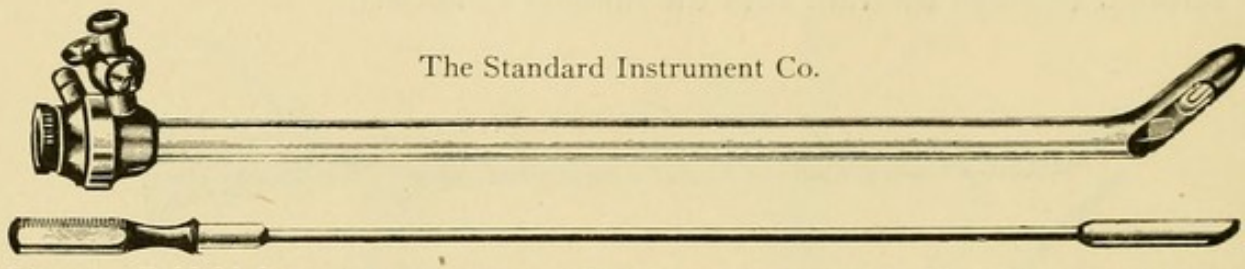


Fig. 43.—Belfield diagnostic cystoscope. Cold lamp—water or air dilatation—direct vision

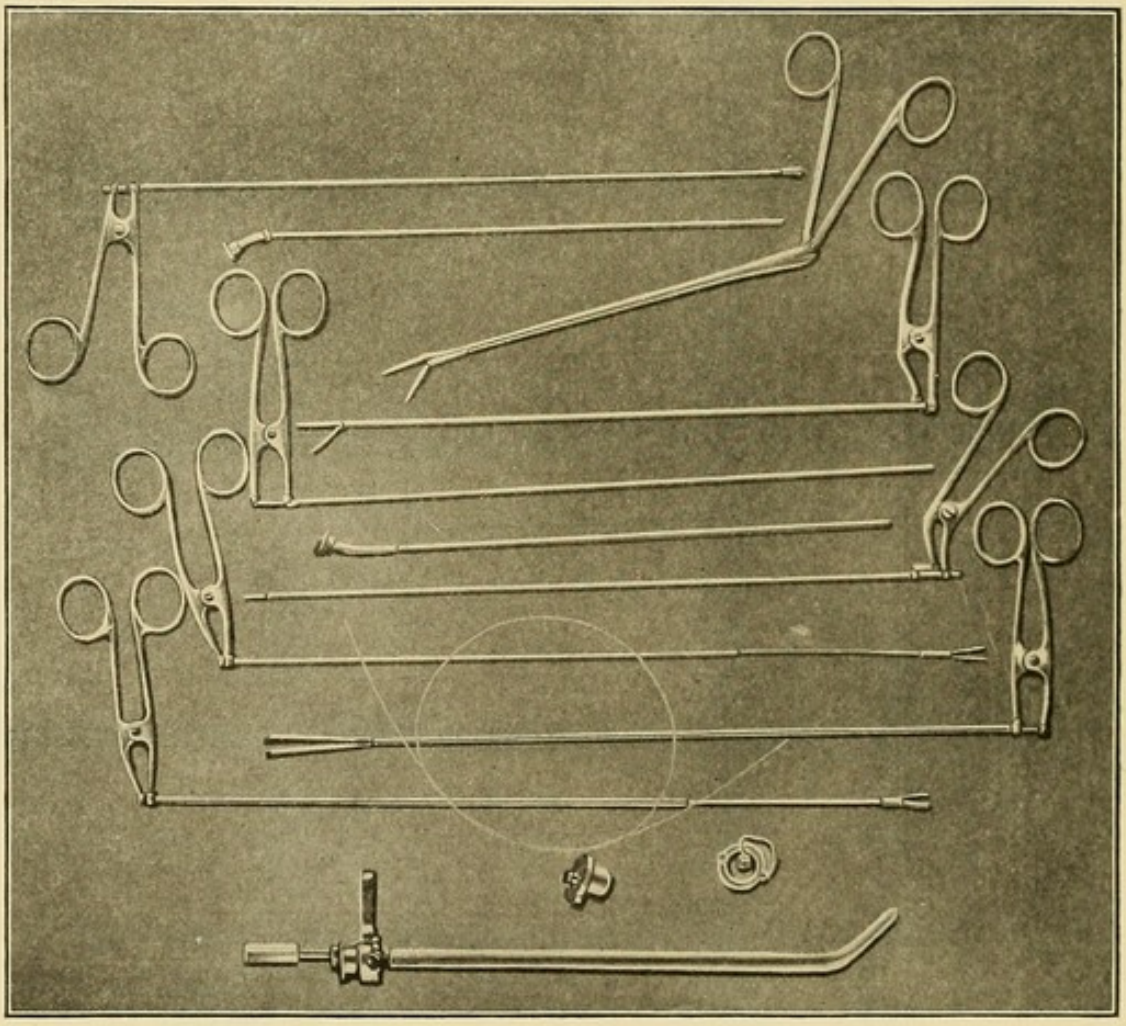


Fig. 44.—The Bransford Lewis operative cystoscope and accessories; ureter forceps, dilators, scissors, etc.

cystoscope (Fig. 41), and are entirely supplied by my new ureter-cystoscope, the cut of which (Fig. 42) offers sufficient explanation.

Finally the instruments intended for use in endovesical operations remain to be mentioned. Nitze devised a good snare and galvanocautery and Hirschmann manufactures one for me which serves the same purpose and has in addition cystoscopic forceps.

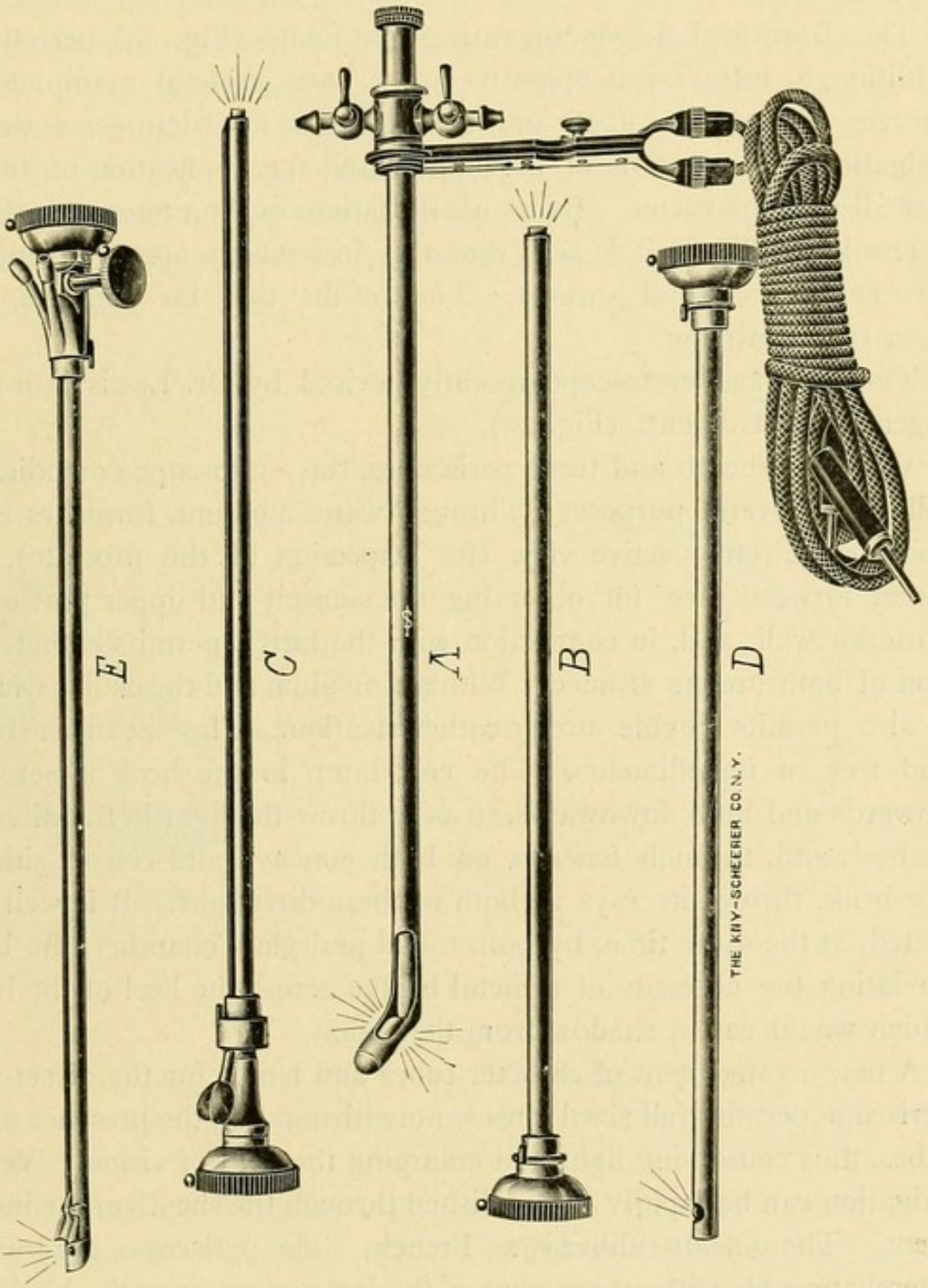


FIG. 45.—The Bransford Lewis Universal Cystoscope.—Latest model.

[Among the principal American cystoscopes may be mentioned the instruments of Belfield, Bransford Lewis, Otis, Winfield Ayres, F. Tilden Brown, and Bierhoff.

Belfield's instrument (Fig. 43) is for air or water-distention, with or

without a lens system, and is the first air-distention cystoscope ever devised.

The Bransford Lewis operative cystoscope (Fig. 44) permits, in addition to intravesical operative work, intra-ureteral manipulations for the removal of calculi and the dilatation of strictures, as well as irrigation of the pelvis of the kidney and the application of topical remedies to the ureter. By its use deviations of the ureter may also be determined. Thus it is seen that this instrument opens an entirely new field in ureteral surgery. The results thus far obtained have been very gratifying.

The universal cystoscope recently devised by Dr. Lewis is a most ingenious instrument. (Fig. 45).

With one sheath and three periscopes, this cystoscope embodies the following several purposes: Through water-medium, furnishes right-angle view, retrospective view (for inspection of the prostate), and direct forward view for observing the summit and upper part of the posterior wall; and, in connection with the latter, permits catheterization of both ureters at once. With air-medium and the ocular window it also permits double ureter-catheterization. The sheath is simple and free of impediments. The cold lamp in the beak is set base upwards and bulb downwards, so as to throw the light in the direction desired; and, through fenestra on both concave and convex sides of the beak, throws its rays in both of these directions. It is well protected, at the same time, by both metal and glass chamber, the latter obviating the necessity of a metal bridge across the heel of the beak, which would cast a shadow from that point.

A new arrangement of catheter-tubes and lenses for the direct-view periscope permits full-sized lenses, notwithstanding the presence of the tubes, thus conserving light and enlarging the field of vision. Vesical irrigation can be rapidly accomplished through the sheath of the instrument. The outside caliber is 23 French. The periscopes are quickly interchangeable without removal of the instrument from the bladder.*

The late W. K. Otis, by substituting a hemispherical lens for the prism, has produced a cystoscope having a field four times as large as that of any other rectangular instrument. The lamp in this instrument emits but little heat. It is set at the vesical end of the sheath, one pole being on the metal of the shaft, the other being supplied by an

*A recent improvement in this instrument permits catheterization of the ureters by the indirect as well as the direct method.

especially insulated wire, which does not encroach upon the internal caliber of the shaft and permits the use of a larger telescope than has been heretofore employed, thereby affording a greater amount of light and consequently a brighter image. (Figs. 46 and 47.)]

Winfield Ayres' cystoscope combines direct observation of the bladder, giving a very clear view of the trigone, floor and posterior wall, and indirect observation, giving a view of the summit, side-walls, trigone and floor. Also a retrograde observation, giving a view of the vesical neck.

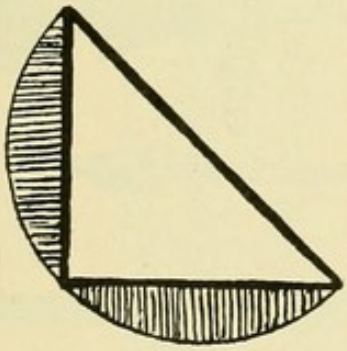


Fig. 46.—Triangular lens of the Otis cystoscope.

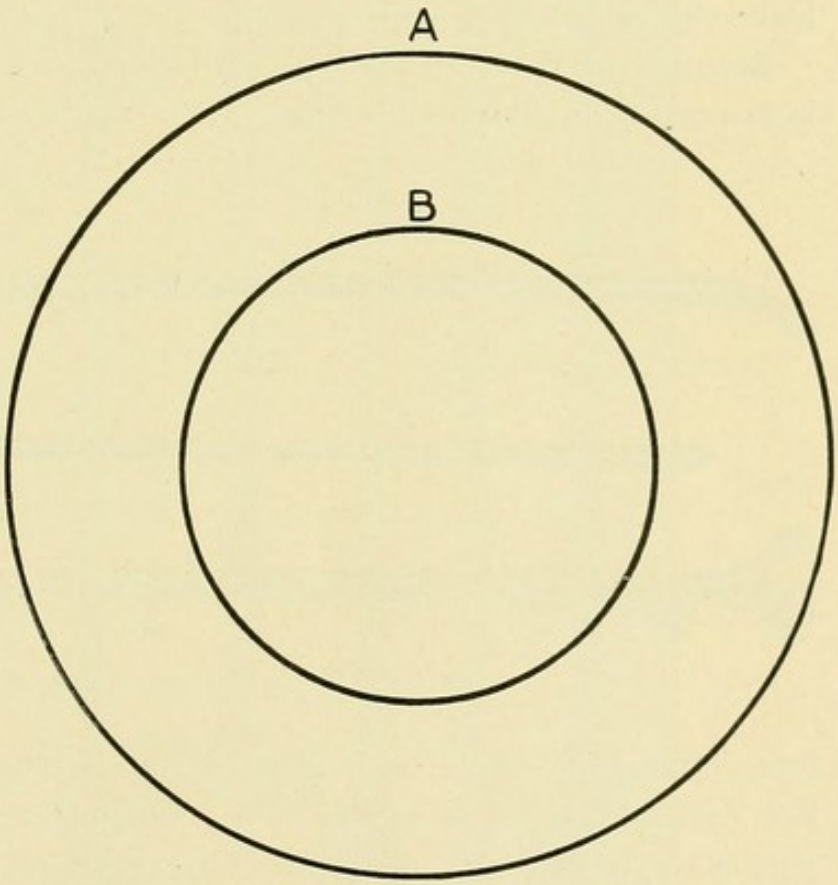


Fig. 47.—A, field of vision given by the Otis cystoscope, B field of vision given by Nitze's cystoscope.

Bilateral catheterization of the ureters may be done with this cystoscope by the direct method. The catheter introducing tubes are only one inch in length and are therefore easily kept clean and dry. Attached to the under surface of the direct telescope is a fin which divides the sheath into two catheter chambers. This arrangement makes it possible to remove the cystoscope after the catheters have been inserted in the ureters without disturbing their position. Also the catheter chambers are easily kept clean and sterile. The cystoscope carries two No. 6½ catheters easily. (Fig. 48.)

F. Tilden Brown's composite cystoscope, constructed for the male

and female bladder, may be used with either water- or air-distention. It consists of a sheath with an obturator and lock nut and also two stopcocks for irrigating. Upon withdrawal of the obturator, the telescope, fitted with two catheter channels, is introduced and securely locked, thus permitting a direct view of the bladder wall. Either single or double catheterization of the ureters can be made with this instrument. The catheters protrude from the distal end in a straight position, and therefore a special guide is unnecessary. Fenestration of the catheter canals makes it easy to remove the cystoscope and leave the catheters in the ureters.

Because of the independent and open sheath employed in this instrument, auxiliary telescopic tubes can be utilized, being readily

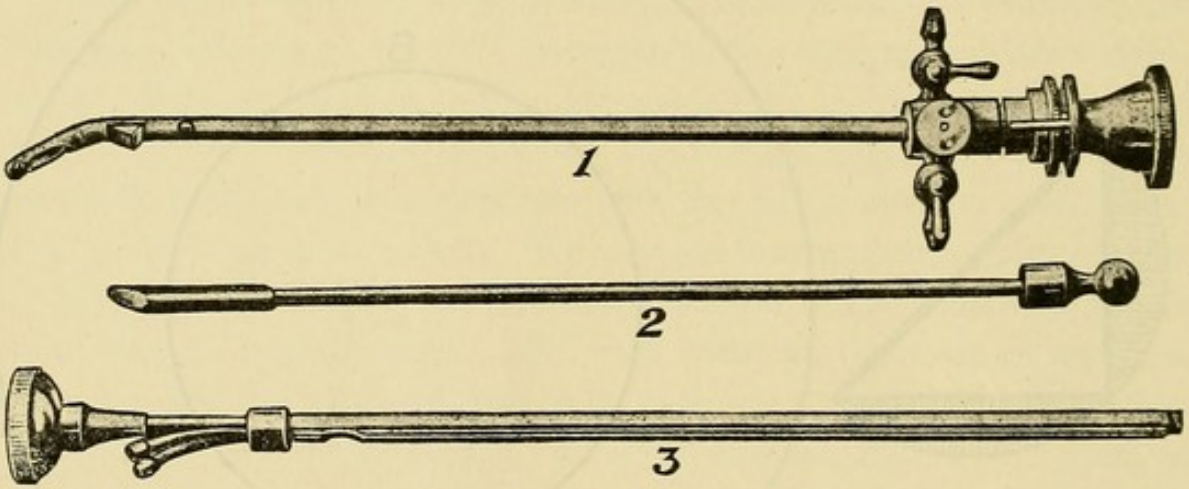


FIG. 48.—Winfield Ayres' cystoscope.

interchangeable once the sheath has been passed into the bladder. For example, there is a telescope giving a retrograde view and one with a single large catheter canal for carrying a dilatation catheter or permitting the use of forceps for grasping calculi, foreign bodies or tumors. Through the irrigating cocks the bladder may be washed or the distending medium changed while any of the tubes are in the sheath or before one is introduced. (Fig. 49.)

Bierhoff's double catheterizing and irrigating cystoscope consists of a plain examining cystoscope (No. 16 French scale), with beak and lamp removable for introducing into an outer sheath, which is furnished with a double channel for ureter catheters. This double channel permits two No. 6 catheters to be introduced simultaneously.

A catheter guiding attachment is fitted to the distal end of the instrument near the optical part, controlled by a lever at the proximal end, which raises or lowers the tip of the catheter to guide it into the

ureter. The principal advantage of this instrument is that, in cases in which it is desirable to leave catheters in the ureters for a certain length of time, it can be withdrawn without causing the catheters to

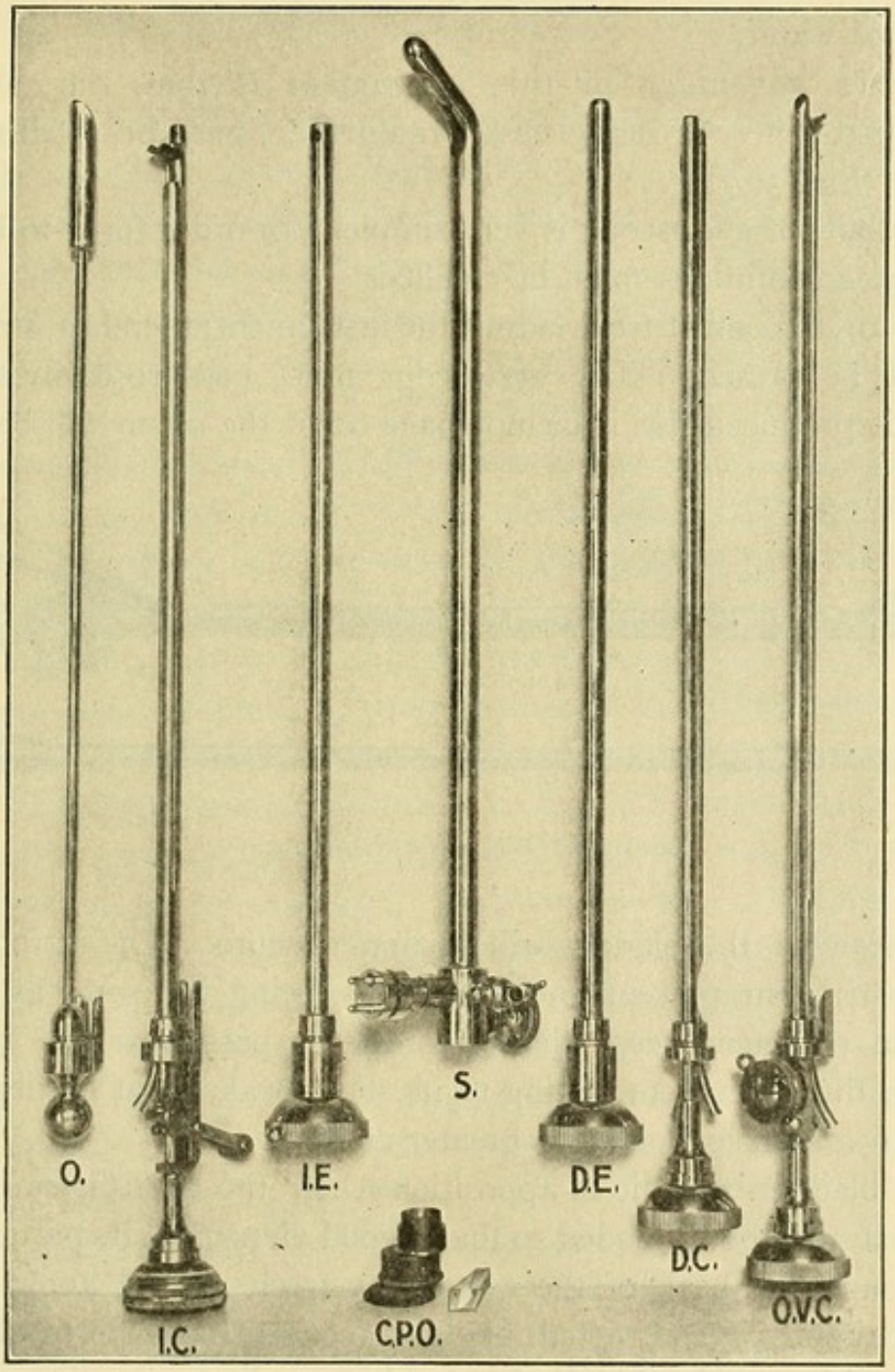


FIG. 49.—F. Tilden Brown's composite cystoscope. 1908 model. S., common sheath for various telescopes; O., obturator; I. C., indirect vision (double catheter) telescope; I. E., indirect vision examining telescope; D. E., direct vision examining telescope; D. C., direct vision (double catheterizing) telescope; O. V. C., oblique vision (double catheterizing telescope; C. P. O., correcting or compensating prism ocular, interchangeable with the ocular on I. C. and I. E.

become twisted. When removing the cystoscope, it is not necessary to turn the entire instrument, but the telescope only, as this can be

fully revolved within the outer sheath; the size of the instrument is No. 23 French scale. The above can also be used as a plain examining cystoscope by removing the outer sheath, and with the latter, as an irrigating cystoscope, by using the catheter channels for the injection of water.

A further advantage of this instrument is that, the catheter-carrying part thereof, being easily removable, may be sterilized by boiling. (Fig. 50.)]

The technic of cystoscopy is very simple. In order for it to be successful three conditions must be fulfilled:

1. The urethra must freely admit the instrument; therefore strictures must not be present. The cystoscope must pass so easily that no bleeding is produced, for if hæmorrhage occur the prism will be soiled

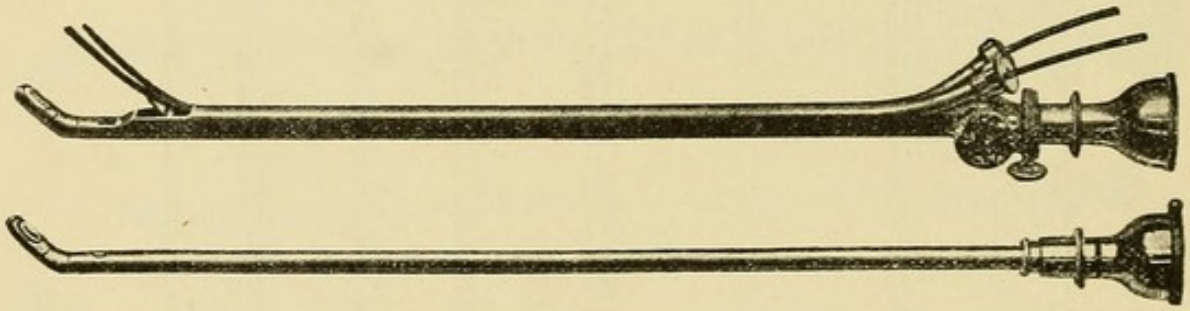


FIG. 50.—Bierhoff's cystoscope.

and the view of the bladder will become obscure. The introduction of the instrument presents no difficulties, being the same as that of any metal catheter, except that in order to pass over the internal sphincter, the instrument, owing to its short beak, must be depressed more than a catheter having a greater curve.

2. The bladder-walls lie in apposition when the viscus is empty and therefore it must be distended so that a good view of all its parts can be obtained and the beak of the cystoscope freely moved about in the vesical cavity. A contracted bladder (concentric hypertrophy), for example, with considerable diminution in capacity makes the performance of cystoscopy impossible.

3. The bladder must be filled with a clear medium so that its walls can be plainly seen.

Distention of the bladder with a transparent medium is secured by injecting into it a 1:5000 solution of oxycyanate of mercury by means of a catheter and hand-syringe or irrigator. From 100 to 150 cm. [3 to 5

fluid ounces] are injected and allowed to run out again until the fluid returns absolutely clear and transparent. Then from 150 to 200 cc. [5 to 7 ounces] are injected, the catheter withdrawn, and the cystoscope, carefully disinfected and smeared with "Katheterpurin" (see page 50) introduced. Oil and vaseline cannot be used because they soil the prism.

In sensitive patients the urethra may be cocainized by injecting from 5 to 8 grammes [1 to 1½ fluid drachms] of a 2 per cent cocaine solution, and having the patient hold it for three minutes. Cocainization of the bladder is inadmissible an account of the danger of poisoning. Before introducing the cystoscope it is well to test the strength of the current which lights the lamp. During its introduction the current must be turned off.

We now come to a short consideration of what can be accomplished with cystoscopy, and in order that pathologic conditions may be better understood we will first describe the pictures presented by the normal bladder.

As to its color, the normal mucous membrane of the bladder varies from bright yellow to pink; it is only at the base that a somewhat redder hue is seen. The longer an examination is continued the greater the quantity of urine poured out from the ureters into the bladder, and consequently the color becomes redder because of the constantly increasing yellowness of the medium. Likewise as the brightness of the light diminishes, the tone of color assumes a redder tint, so that it behooves us always to examine with a bright white light.

Besides the color the delicate ramifying blood vessels, which are especially well developed in the fundus, attract attention. They form pictures similar to those seen in the fundus of the eye with the ophthalmoscope (Figs. 51, 52, 53).

On the bladder-walls, especially on the superior and lateral portions, small longitudinal and transverse protruding arches are seen, which are composed of bundles of muscular fibres given off from the detrusor vesicæ (Fig. 54). On the fundus they are not so distinct because of their firm attachment to the neighboring parts.

If these bands become firm and form unyielding columns, we have the so-called trabecular bladder (*vessie à colonnes*), a condition which always results from increased work put on the detrusor, as for instance, that caused by stricture or hypertrophy of the prostate. (Figs. 55 and 56).

Between these trabeculæ are often found deep pocket-like recesses,

the so-called diverticula, which look like deep excavations in the bladder-wall.

If the instrument be drawn back from the middle of the vesical cavity, a portion of the circular field of vision representing the bladder-wall will disappear. This will be taken from the semilunar shadow corresponding to the internal orifice of the urethra. This shadow,

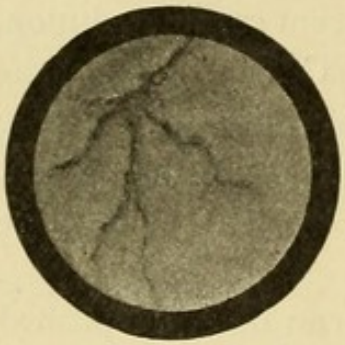


Fig. 51.

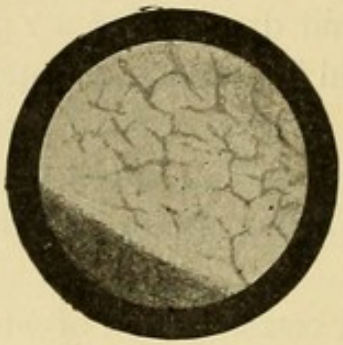


Fig. 52.

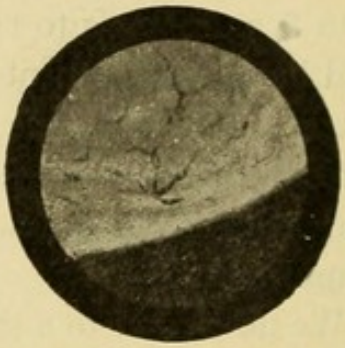


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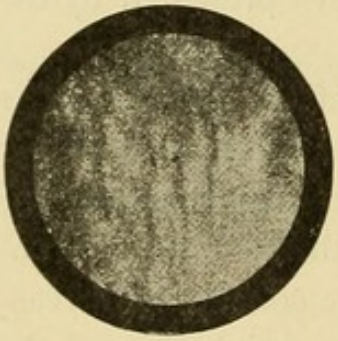


Fig. 54.



Fig. 55.

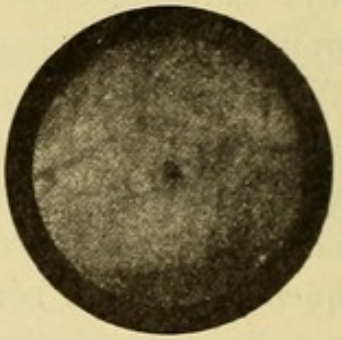


Fig. 56.

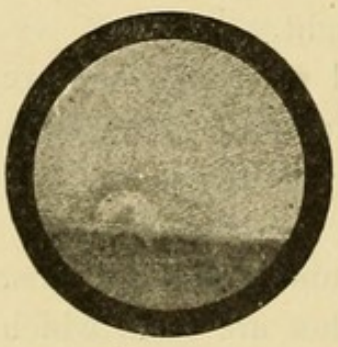


Fig 57.

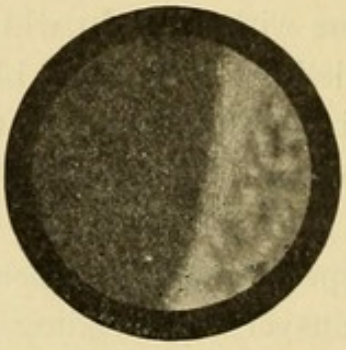


Fig. 58.

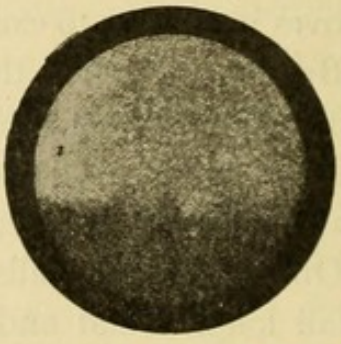


Fig. 59.

which has an upward incurvation, is due to the fact that a part of the prism is covered by the sphincter vesicæ muscle. Under normal conditions this shadow or fold is smooth, fine, and partly transparent. (Figs. 57, 58, 59, 60).

Any arched prominences which may be present at the sphincter, as for example, such as occur in prostatic hypertrophy, are character-

ized by protuberances or irregularities of the sphinteric fold, together with darkened areas here and there (Fig. 61). If the beak of the cystoscope be carried downwards, the base of the bladder is brought into view; and if it be pushed a little backwards and turned a little to the side, the ureteral elevations are seen, although they are not always equally well-marked. They generally resemble the frustum of a cone

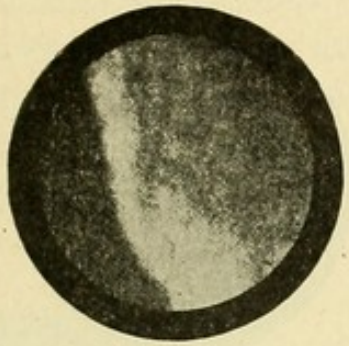


Fig. 60.

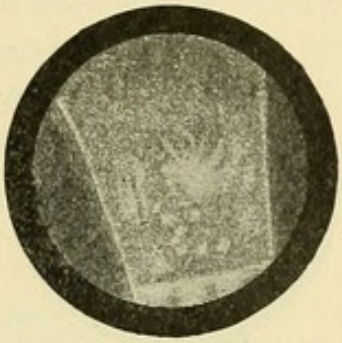


Fig. 61.

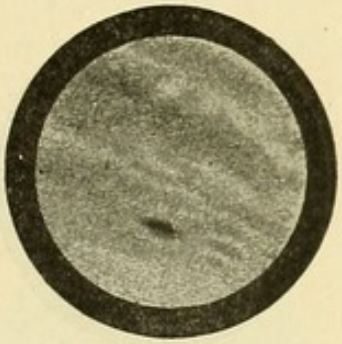


Fig. 62.



Fig. 63

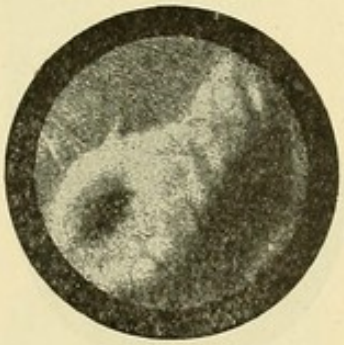


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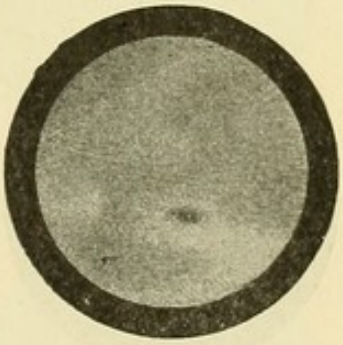


Fig. 65.

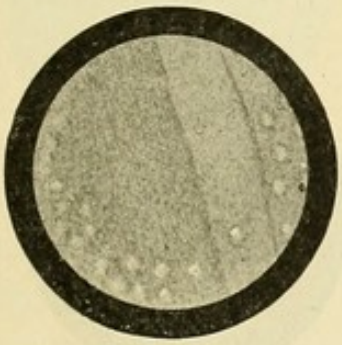


Fig. 66.

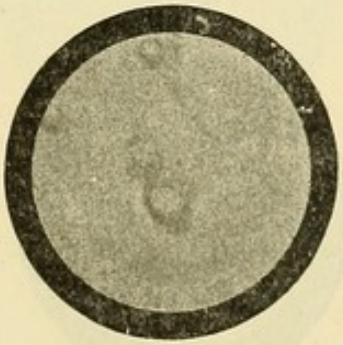


Fig. 67.

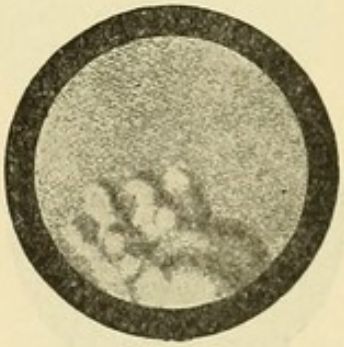


Fig. 68.

in shape, and on their summit have the slit-like opening of the ureters. (Figs. 62, 63, 64, 65).

If one watches these fissures for a short time, they will be seen to swell up suddenly, or make a convulsive movement, and at the same time an eddy will be observed in the vesical fluid. These phenomena are caused by the discharge of urine, which occurs at greatly varying intervals.

Furthermore, in cases of **inflammation, ulceration, tumors, stones,**

and **foreign bodies** and also in certain renal affections, the cystoscope shows striking pictures which are of great diagnostic value.

The pictures of cystitis are exceptionally varied. In the acute forms, in which cystoscopy should be avoided if possible, the base of the bladder, especially around the sphincter, is seen to be deep red. Upon closer inspection it is seen that this redness is due to a well-devel-



Fig. 69.

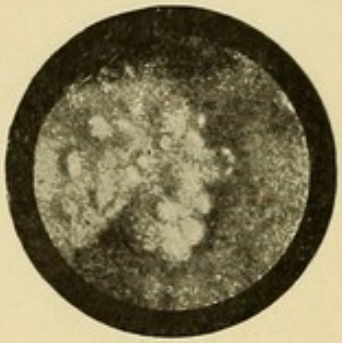


Fig. 70.



Fig. 71.



Fig. 72.

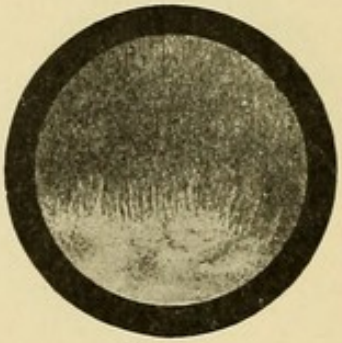


Fig. 73.



Fig. 74.

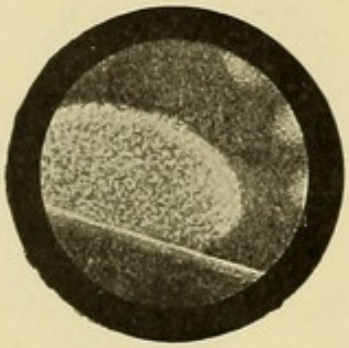


Fig 75.

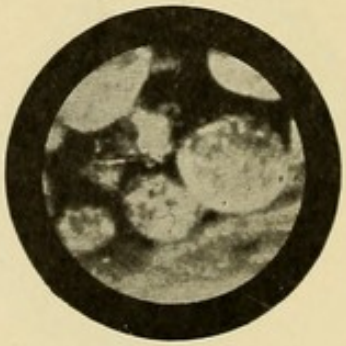


Fig. 76.

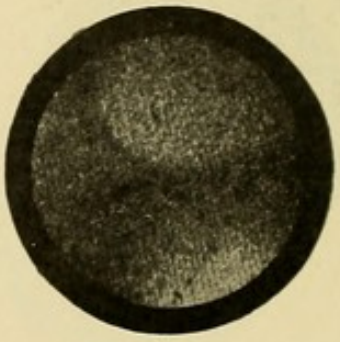


Fig. 77.

oped, fine vascular network (*cystitis colli gonnorrhoica acuta et subacuta*).

In the chronic forms, which correspond to the different varieties of vesical catarrh, puffiness, softening and redness of the mucous membrane, together with the secretion present are the conditions which meet the eye. The mucous membrane has a spongy appearance, looks velvety, and sometimes presents swellings so thick that they may be mistaken for tumors. A distinct vascular network is no longer per-

ceived, the surface of the bladder looking dull and cloudy. The secretion is shown in different ways. Despite careful irrigation scales and flakes are seen floating in the fluid, or grayish white shreds resembling snowflakes are observed clinging to the bladder-wall or floating free in the liquid medium (Fig. 61).

Tuberculous cystitis, according to my experience, only rarely gives charasteristic pictures. In such cases nodules circumscribed by a dark red border are seen; they are most plentiful on the floor of the bladder (Figs. 66 and 67). Advanced cases show distinct ulcers.

Tumors of the bladder show remarkably beautiful pictures in which polypi, pedunculated and sessile papillomata, cauliflower and fram-



Fig. 78.



Fig. 79.

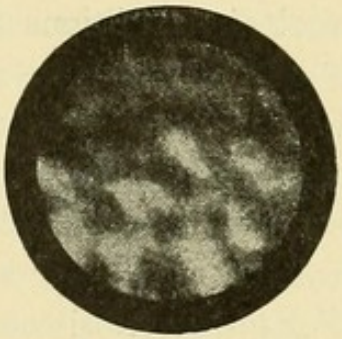


Fig. 80.



Fig. 81.

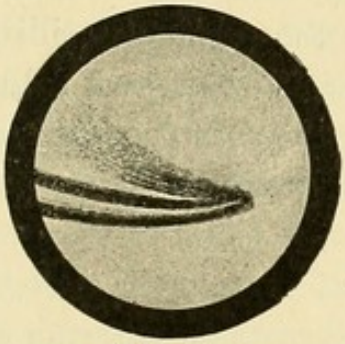


Fig. 82.

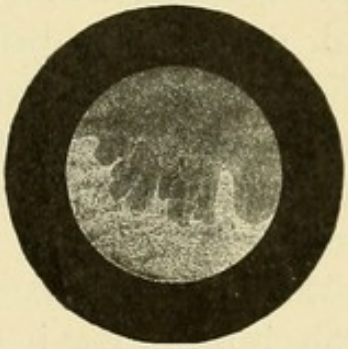


Fig. 83.

besioid excrescences are clearly seen projecting from the bladder-walls (Figs. 68, 69, 70, 71, 72, 73, 74).

Vesical calculi offer not less profitable pictures. They are seen either in their entirety unsurrounded by the mucosa, or partly concealed by it (Figs. 75, 76, 77). One can form an opinion as to their size and shape, discern whether they are smooth or rough, and also recognize their color; from these attributes conclusions concerning the nature of the stone can be drawn.

Foreign bodies, such as catheters and hairpins (Figs. 78 and 79) are easily seen and their size and position recognized.

Vesicles are seen most frequently at the sphincter (Fig. 57). White placques, called leucoplakia vesicæ, are shown in Fig. 80. Groups

of red pellucid vesicles resembling clusters of grapes, the so-called œdema bullosum, are shown in Fig. 81.

A catheter lying in the ureter with the shadow above is depicted in Fig. 82, while in Fig. 83 a proliferation of tissue often found at the neck of the bladder, known as *cystitis colli proliferans œdematosa*, is displayed; it may be mistaken for a tumor.

If after this brief sketch we were to review the practical value of cystoscopy in the diagnosis of diseases of the bladder, we should say that it surpasses all methods heretofore employed in the certainty with which it enables us to make a diagnosis and in the abundance of its results, furnishing us as it does with a means of recognizing all pathologic conditions that occur.

Formerly those cases of hypertrophy of the prostate in which only the vesical portion of the gland was involved could be diagnosticated only within probability, whereas now, the cystoscope, by bringing the protuberances directly before the examining eye, makes their recognition absolutely certain.

For the diagnosis of cystitis the cystoscope is generally not required, although by its use tubercles can be demonstrated in the early stages of their development, before the specific bacilli are found in the urine. Therefore the methods may prove of great value in certain cases.

Without the cystoscope the existence of ulcerations of the bladder can only be conjectured; cystoscopy, however, makes their recognition certain.

The greatest triumph of cystoscopy, though, is in vesical tumors. While it is true that in most cases the presence of tumors can be inferred from the course of the disease, yet the symptoms may deceive us and sounding and palpation may fail us, whereas cystoscopy affords assurance of their presence.

A matter of even greater importance is their early recognition which cystoscopy renders possible. Cases in which the course of the malady furnishes scarcely an inkling as to the nature of the disease are made clear by inspection of the bladder. Thus the advantage of early operation is conferred. That the chances of cure are greater the earlier the tumor is removed requires no explanation. In many cases cystoscopy will teach us the kind of tumor with which we have to do, and finally it will apprise us of the location of the growth.

For determining the site of the growths the irrigation cystoscope is of great value. If the bladder be examined while it is being irrigated, the

parts composing the field of vision will be replaced by others previously concealed. Therefore this method is especially applicable for studying the condition of the pedicle with reference to subsequent operation.

As far as vesical calculi are concerned the sound suffices for the majority of cases. It is well-known, however, that there are stones which cannot be felt despite the most careful examinations. The same thing may also happen in cystoscopy, a stone being overlooked though the bladder be well illuminated. Such failures occur especially in those difficult cases in which the calculus lies embedded in a saculation and is partly covered by the bladder-wall. At all events two methods will enable us better to avoid making an erroneous diagnosis than will one.

Cystoscopy is incontestably better than any other method of examination for determining the presence of a foreign body in the bladder. It also supplies information concerning the location, form and size of the foreign body, and makes its removal *per vias naturales* possible in cases which otherwise would have to be subjected to a cutting operation.

Finally there remains to be mentioned diseases of the kidneys, the diagnosis of which made an unanticipated advance as a result of cystoscopy. We need not explain how difficult it was in many cases to determine whether bladder or kidney was the seat of the malady. All the aids which we formerly possessed would at times fail us. The course of the disease, palpation, estimation of the quantity of pus, polyuria and oliguria, the character of the hæmorrhages, and microscopic examination were in many cases assuring, but in others they did not enable us to reach a positive diagnosis. Here, again, the cystoscope instituted a welcome advance.

By examining the bladder we can learn whether the source of hæmorrhage be here, by bringing the ureters into the field of vision we can ascertain whether there are two kidneys and watch the urine coming from each, noting whether one is bleeding and whether pus is issuing from one or both ureters.

In exceptionally well-marked cases no difficulties are offered, but when the amount of pus is small in proportion to the quantity of urine poured out, then the ingress of the slightly turbid fluid into the liquid medium contained within the bladder is perceived only with difficulty, or not at all; when the pathologic urine is clear and free from blood, or contains blood only in microscopic quantity, it will be quite impossible to make a diagnosis by observing the ureters.

Cystoscopy has helped us over these difficulties by enabling us to

catheterize the ureters without discomfort or injury to the patient. This can be easily done in all cases in which the ureters are visible; when they lie embedded between folds of mucous membrane, or are covered over by trabeculæ, or have their orifices distorted beyond recognition, then, naturally, ureteral catheterization has limitations. Such conditions, however, are exceptional. In most cases it can be determined with certainty even in the earliest stages of a disease not only whether the kidneys are affected, but, moreover, which kidney is the seat of the affection. Furthermore, an idea can be gained as to how far the other, relatively healthy kidney, is functionally active, and thus conclusions drawn as to whether operation promises results. We shall discuss these conditions in full in another part of our work.

In conclusion we will say a few words in regard to the therapeutic value of cystoscopy. There can be no correct therapy without correct diagnosis. As cystoscopy is the only certain method of diagnosis in a multitude of cases, it is manifest that its therapeutic value, though indirect, is really greater than its diagnostic value.

But cystoscopy also plays a direct rôle in treatment in that it enables us to seize favorably located tumors with the snare and cut them off, and to cure pyelitis by flushing the pelvis of the kidney. We shall refer to these things again.

ASEPSIS OF CATHETERIZATION AND CYSTOSCOPY.

The requisites of aseptic catheterization and cystoscopy are three in number; namely, 1. to render the instruments aseptic; 2. to keep them aseptic; 3. to introduce them into the bladder still aseptic.

The disinfection of catheters and the cystoscope must be considered separately.

All kinds of catheters---Nelaton's, the silk-web, the English and metal instruments—can be sterilized with boiling water, the only difference being that all soft instruments have to be boiled for five minutes in a super-saturated solution of ammonium sulphate, while for metal instruments plain water may be used. The ammonium solution is not to be used for metal instruments because it makes them unsightly in appearance, and it is required for soft instruments only when they must be sterilized quickly. When there is sufficient time for their preparation they may be done up separately in lint or linen clothes and kept for two hours in a steam sterilizer. This latter method is the best one for the long, slender ureteral catheters.

The striking point about this method of sterilization is that the catheters do not touch one another, and that the parts of an individual catheter do not come in contact; otherwise the varnished silk-webbed catheters, in which class ureteral catheters also belong, would become sticky. Each catheter must therefore be wound up separately. If this be done they will remain in good condition, neither looks nor consistency being affected, whereas repeated boiling in ammonium solution makes them soft and unsightly. Thus it is seen that while metal instruments always should be boiled, the pliable ones should be so treated only when it is necessary to sterilize them in a patient's house, or when already sterilized ones cannot easily be obtained. In hospital and dispensary practice it will be found most convenient to sterilize them in a steam sterilizer, tying up a number of similar instruments, each individual one being wound around with cotton or lint as previously described, and put into a cloth, having one for Nélaton catheters, one for silk-web, one for Mercier's, and so on.

Both methods, either boiling for five minutes or sterilizing by steam for two hours, renders the instruments thoroughly aseptic. As regards vesical catheters it has long been known that these methods suffice, so it is not necessary to adduce experimental proof of the fact. Whether the slender ureteral catheters could be made aseptic by subjecting them to steam sterilization required demonstration, and so for the purpose of deciding the question I instituted the following experiment. The catheters were thoroughly soaked inside and outside in streptococcic bouillon and after being dryed were placed in the steam sterilizer for two hours, and then cultures taken from them in two tubes of bouillon and two Petri dishes of fluid agar. These four culture media remained sterile after three inoculations.

In reference to keeping the catheters sterile, the method of sterilization by steam is to be preferred, as the instruments remain perfectly aseptic as long as they are not taken out of the cloth in which they are done up, and it is not necessary to take them out until just before they are to be used. Boiled instruments must be kept in sterilized cases, as it does not do to leave them in the ammonium solution because they become soft and also lose their smoothness. That their transference to sterile cases complicates the proceeding is self-evident.

If the patient has to catheterize himself, I find the best method for him to employ is to place the instrument, after washing it carefully in running water, in a 1 : 1000 solution of corrosive sublimate, laying it horizon-

tally, so that the fluid can gain access to the inside of the catheter as well as coming in contact with its exterior. Enamel catheter-cases are the best. The instrument is kept in one for twenty-four hours and then taken out and laid on a sterile towel or a clean handkerchief. It can be used at once or be rolled up in the cloth until it is used.

That the sublimate solution remaining on the catheter produces irritation of the urethra is a tradition which I have not been able to confirm, and, moreover, is one which has no probability, because the catheter is smeared with a lubricant, so that the sublimate does not come in contact with the urethra. However, if it be desired, the instrument may be rinsed with sterile water.

The cystoscope requires different treatment than sounds and catheters, for it bears neither boiling nor heat of the sterilizer even though its ocular be protected. The reason why it cannot be heated to 100° C. or more is because the prism is cemented into a solid metal setting. This accouplement between metal and glass withstands the heat very badly because the expansion of the two materials is entirely different. Furthermore, as the cement used to unite the two has a special expansiveness, it is impossible to prevent the prism from becoming loosened by repeated boilings and thereby permit water to gain access to the space produced between the prism and its setting. The manner in which further damage is done depends entirely upon circumstances. If it should happen now and then that a cystoscope be heated repeatedly to 100° C. without injuring it and allowing water to get into it, the circumstance must be considered as altogether fortuitous.

Boiling is also impossible on account of the sensitiveness of the reflecting surface of the prism, its silvering being very susceptible to the influence of gross oscillations of temperature such as are produced by boiling. It has been known for years that laryngeal mirrors, even though their setting is the best, bear boiling only a few times. The reason for the delicacy of these mirrored surfaces lies in the fact that they are not composed of a single stratum, but of two layers having a very minute space between which steam or gas can force an entrance and cause oxidation of the silvering, as the result of which the clearness of the reflected image becomes impaired.

Protection of the prism from fluid by setting it with waterproof cement is practically worthless, because there is an air-space within the cystoscope itself which cannot be occluded. Much more dangerous than the moisture surrounding the instrument is the steam generated within it

and thrown against the prism. A further disadvantage of heating the cystoscope lies in the fact that the moisture remains in the form of steam until the instrument cools and is then gradually condensed upon the glass and metal walls. As the humidity absorbs everything soluble, it is evident that when it is condensed deposits will be made upon the surface of the prism and lenses which will be both troublesome and injurious.

For these reasons I have also abandoned immersing the cystoscope for twenty-four hours in 5 per cent carbolic acid solution, and have adopted a method of sterilization which has proved to be most satisfactory. This method, which is similar to the one used by Karl Gerson for cutting instruments, is applied as follows: the cystoscope and the undetachable parts of the urethroscope are rubbed with three cloths and compresses of cotton dipped in spiritus saponatus [a preparation official in the German pharmacopœia; an alcohol or ethereal solution of green soap may be used instead], each being used for one minute and special attention being given to the borders and angles. After this has been done the instrument is wound up in a sterile towel likewise wet with the solution of soap and allowed to remain until it is used. The removable metal parts of my ureteral cystoscope are boiled for five minutes. I have proved experimentally that a cystoscope thus prepared is perfectly sterile and that it remains so until used.

Unfortunately this method cannot be used for sterilizing catheters because it does not fulfill the prerequisite of rendering the inside of the instruments aseptic; according to Gerson, however, it may be employed for bougies.

The first two requirements of asepsis, that is, to sterilize the instruments and keep them sterile, can be carried into effect by employing the methods above described, and we have now to consider the feasibility of fulfilling the third requirement, which is to preserve their asepticity from the time they are taken from their sterile container until they have reached the bladder. We say feasibility purposely, for the requirement cannot be entirely accomplished because the instruments have to pass through the urethra, which, as is well-known, contains microörganisms even when in a healthy condition. To attempt to get rid of these organisms is a vain endeavor. Moreover, it has not been determined whether these parasitic inhabitants of the urethra infect the bladder even though they do gain access to it. These questions become abeyant to the more important one of securing a lubricant for the instruments which shall neither carry infection nor facilitate its development.

Oil, which is most frequently used at present, is not at all suitable. It can be sterilized only by boiling, and to boil oil is both difficult and dangerous. It cannot be used on the cystoscope because it greases the prism and thereby injures the picture. The same applies to vaseline and lanoline. In addition to these disadvantages there is another more important one to which too little attention has been paid. Oil and fats form an adherent coating on catheters which is not dissolved by sterilizing processes and thus acts as a protective covering for germs. This is especially true of the sublimate disinfection recommended for use by patients themselves, as the mercurial solution is prevented from coming in contact with the catheters by the protective layer of fat. Therefore it may be said that the use of fatty lubricants directly favors infection.

For this reason I long since abandoned oil and vaseline for glycerine, which is superior to them, but which is not fit for use, its disadvantages being greater than its advantages. It must be boiled in order to be aseptic. Disagreeable vapors are given off and, moreover, boiling is very difficult. Besides it is not slippery enough. It answers fairly well for easy catheterizations, but for difficult ones where it is necessary to have the instrument thoroughly lubricated it fails.

In view of the above mentioned reasons I have adopted a lubricant similar to one previously recommended by Guyon and Kraus. It is composed of a definite quantity of glycerine, water, and tragacanth. It seemed essential to incorporate in place of the carbolic acid recommended by Kraus an antiseptic which would preserve the lubricant for a long time, and which, moreover, would not irritate the urethra. After many trials such a one was found in the oxycyanate of mercury, which is used in the strength of 1 : 500. The lubricant, which is sold in Germany under the name of **katheterpurin,** has the following composition:

℞

Hydrarg. oxycyanat.	0.246	(gr. iii ss)
Glycerini	20.0	(f℥vss)
Tragacanth.	3.0	(gr. xlvi)
Aquæ dest. steritisat.	100.0	(f℥ iii)

The mixture is put up in tin tubes.*

For practical purposes the result of my investigations proving that this lubricant remains sterile eight days after being exposed to the air is a most important one, showing that catheters and sounds smeared

*[Any pharmacist can prepare this mixture.]

with it suffer no damage as to their asepticity. Moreover, it has the power of destroying or inhibiting the virulence of any microörganisms which may be met with, provided, of course, that they be brought into close contact with it. To what degree this intimate contact actually occurs is altogether conjectural.

As this compound is found experimentally to fulfill the requirements theoretically demanded of a lubricant, so likewise is it found in practice to possess all the necessary requisites. No cases of infection traceable to its use have occurred; it does not irritate the urethra; it makes the instruments exceptionally smooth and slippery; it is soluble in water, so that it does not prevent instruments from being sterilized or washed by forming an adherent coating full of bacteria; it does not act injuriously upon the cystoscope, inasmuch as it quickly dissolves in the fluid present in the bladder, and does not diminish the clearness of the picture; and, finally, as it is put up in tin tubes, it can be used without any preparation.

With this it is seen that the third necessity for aseptic catheterization and cystoscopy is secured. It has already been stated that the urethra cannot be rendered sterile. Our chief aim, therefore, must be to render harmless those microörganisms which despite our precautions get into the bladder.

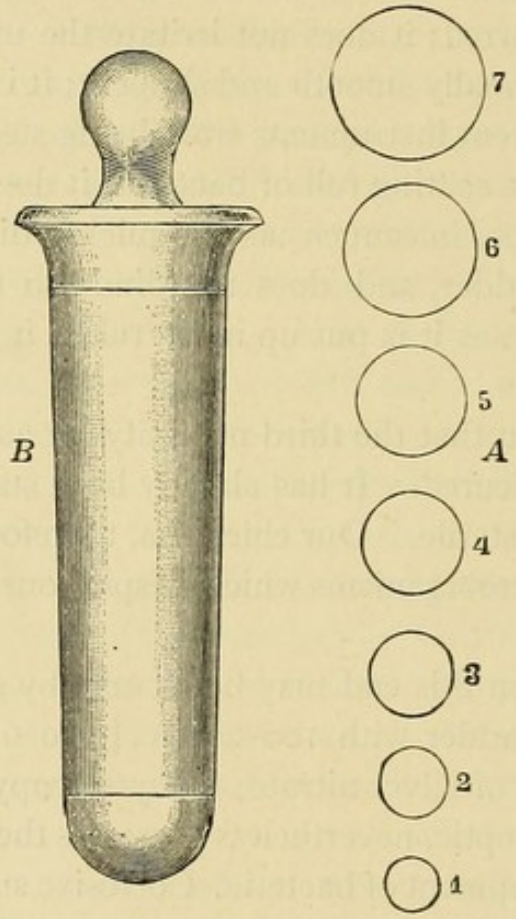
For catheterization this end may be secured by giving a prophylactic irrigation of the bladder with 100–200 cc. [3 to 6 ounces] of a 1.1000 or a 1.2000 solution of silver nitrate; for cystoscopy I use a fluid which, if not strongly antiseptic, nevertheless possesses the power of materially inhibiting the development of bacteria. Corrosive sublimate and carbolic acid are not suitable because they irritate the bladder, are painful, and produce contractions of the viscus. The fluid employed must be limpid, transparent, and non-irritating. In place of the formerly employed boric acid solution I now use a 1.5000 solution of oxycyanate of mercury, which is perfectly clear, non-irritating, and painless, and which considerably diminishes propagation of microbes if it does not entirely inhibit their growth. I am now using this substance for irrigating the bladder in all cases in which I formerly employed boric acid.

4. DIGITAL EXAMINATION OF THE BLADDER.

The examination of the male bladder with the finger has been entirely abandoned. About twenty years ago Thompson recommended this

procedure for the purpose of diagnosticating tumors. The examination was made through a median incision. This procedure has been replaced by cystoscopy.

In the female there may be cases in which it is advisable to palpate the bladder with the finger. G. Simon has demonstrated that the female urethra can be sufficiently dilated with specula to admit the introduction of the finger into the bladder. His instruments are graduated, conical



Fig, 84.—Simon's speculum.

hard rubber specula provided with obturators (Fig. 84). General anæsthesia is not necessary, cocainization of the urethra being quite sufficient. If tears are produced, they should be sutured immediately after completion of the examination, in order to prevent paralysis of the sphincter.

5. EXAMINATION WITH THE RÖNTGEN RAYS.

Röntgen's epoch-making discovery has been made use of in the diagnosis of diseases of the bladder and kidneys. Up to the present time, however, the only objects we have succeeded in portraying with enough accuracy to make their recognition positive are **stones and foreign**

bodies. In all other affections the method fails. Moreover, it is not always successful in the case of calculi and foreign bodies.

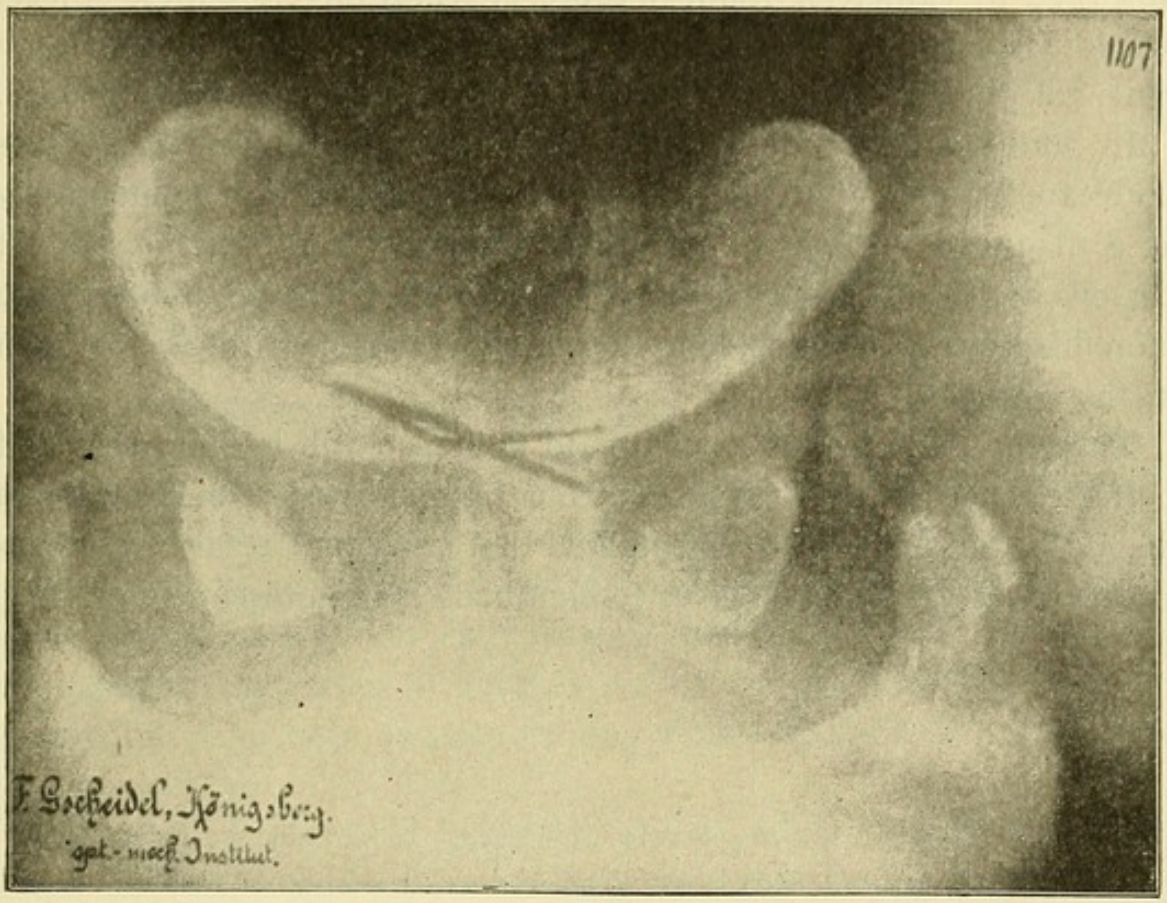


Fig. 85.—Hairpin in the bladder. (Dr. Levy-Dorn).

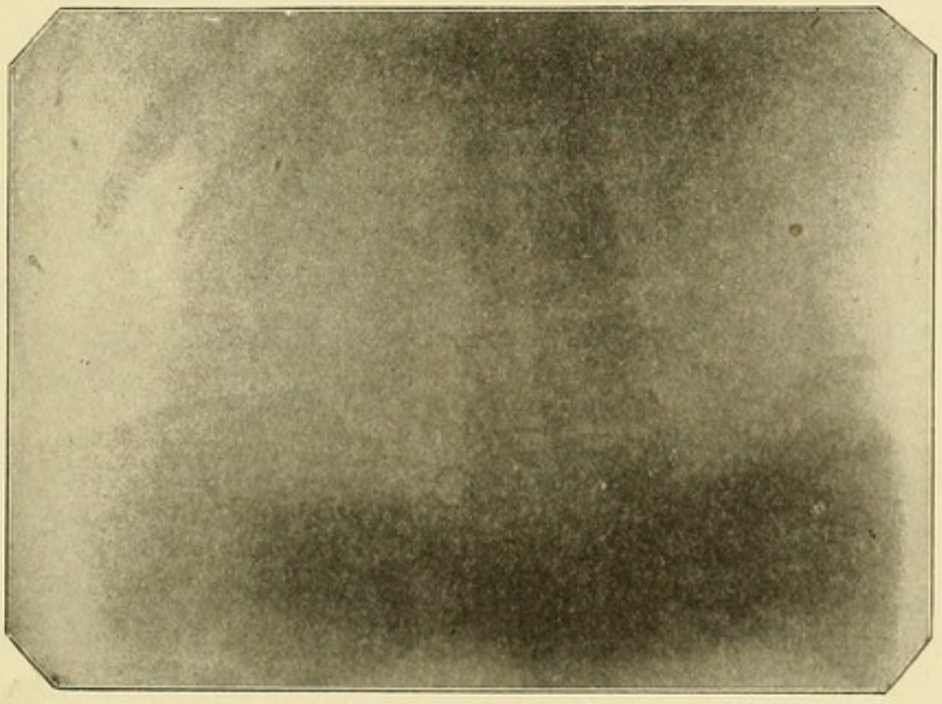


Fig. 86.—Phosphatic renal calculus (Dr. Levy-Dorn).

In regard to foreign bodies it may be said that metal objects such as

needles and hairpins take the best pictures. Figure 85 shows a very good picture of a hairpin in the bladder. The Röntgen rays are not absorbed by catheters, drainage tubes, etc., and therefore these objects are not visible on the photographic plate. Figure 86 shows a picture of a renal calculus (phosphatic). Those composed of oxalates show the best.

In addition to the difficulties presented by the objects themselves there are individual peculiarities which affect the value of actinography as a diagnostic expedient. Thus, for example, X-ray pictures of fat persons are almost always failures, while in those who are thin they are more likely to be valuable, as in this class the rays penetrate better than in the corpulent.

Therefore, this method, which is to be hoped will be improved and perfected, may be tried as a supplementary and very refined means of diagnosis, but it must be remembered that a negative result is not conclusive evidence that a stone or foreign body is not present.

III. PHYSICAL, CHEMICAL AND MICROSCOPIC EXAMINATION OF THE SECRETIONS.

Under this title we shall not describe the various secretions which are discharged through the urethra, such as the prostatic fluid and semen, because they are discussed under the headings of specific diseases. We shall devote our attention here to the urine. An adequate knowledge of its normal and pathologic properties forms the foundation of every diagonsis.

I. PHYSICAL PROPERTIES OF THE URINE.

The quantity of urine voided by a healthy adult in twenty-four hours usually averages 1500 cc. (50 ounces). Abnormal conditions such as profuse sweating or copious ingestion of fluid may cause great variations, either diminishing or increasing the average quantity. A lessened or augmented quantity of urine is not pathologic, however, unless it persists for some time and occurs irrespective of the above mentioned causes.

The color of the urine is golden yellow, although such variations occur in health that an almost colorless urine having only a slight tinge of yellow, as well as one brownish red in hue may be considered normal. Concentration plays an important rôle in coloring the urine.

The specific gravity of the urine depends upon the weight of the elements which it holds in solution. Normally it averages from 10.15 to 10.20, although here again fluctuations occur: the greater the amount of urine passed in a given time the lighter is its specific gravity, and vice versa. The specific gravity is taken with the ureometer, the figure at the meniscus being read off.

The average analysis of the total quantity of urine for twenty-four hours—1500 cc.—is as follows:

Water 1440 grammes, solids 60 grammes, of which 35 grm. are organic and 25 inorganic.

Urea	35. g	Organic.
Uric acid	0.75 g	
Sodium chloride	16.5	Inorganic.
Salts of phosphoric acid (Ca. Mg. N. K.)	6.0	
Salts of sulphuric acid	3.0	

[The urine also contains substances closely related to urea—xanthin, creatin, creatinin; the ethereal sulphates of phenol, cresol, indoxyl and skatoxyl; hippuric acid, aromatic oxyacids, and pigments].

The quantity of the urine and its specific gravity stand in inverse proportion to one another. If the quantity be increased the gravity, under normal conditions, will fall, and vice versa. A disproportion between the two points to some pathologic condition.

The amount of solids in the urine can be estimated approximately by multiplying the last two figures of the specific gravity by Haeser's coefficient, which is 2.33. This gives the number of grammes of solids in 1000 cc. of urine.

Example for normal urine: quantity for twenty-four hours 150 cc. specific gravity 10.17.

2.33×17=39.61 g. for 1000 cc. of urine.
19.80 g. for 500 cc. of urine.

59.41 approximately 60.0 g. for 1500 cc.

Example for **diabetes:** quantity for twenty-four hours 6000 cc. specific gravity 10.35.

2.33×35=81.55 g. for 1000 cc.
6

489.30 g. for 6000 cc.

In diabetes the gravity is enormously increased as well as the quantity of urine voided.

Example for **contracted kidney:** quantity 4000 cc. specific gravity 10.04.

2.33×04=9.32 for 1000 cc.
4

37.28 for 6000 cc.

In **contracted kidney** (**chronic interstitial nephritis**) the gravity is much diminished despite the existence of polyuria.

Normal urine is clear and transparent and has an aromatic odor somewhat resembling that of bouillion. It is acid in reaction, the acidity being due to acid mono-phosphate of sodium. The reaction, however, depends upon the kind of food ingested, a meat diet making it acid and a diet rich in vegetables, as well as the drinking of alkaline mineral waters, making it alkaline. As the vegetable acids (citric, malic, acetic,

tartaric) are converted into alkaline carbonates in the blood, their use causes a diminution in the acidity of the urine, rendering it neutral or even alkaline (dietetic phosphaturia, carbonaturia).

The reaction of the urine is tested with litmus paper, acid urine turning blue litmus red and alkaline turning red litmus blue. It may also be amphoteric, that is, it may turn red litmus blue and blue litmus red. This property is present when in addition to mono-phosphate of sodium the urine contains the alkaline sodium diphosphate. It is not significant of any morbid condition.

If the urine is alkaline and its alkalinity cannot be referred to diet, then the condition is due either to fixed alkalies or to ammoniacal decomposition. In the latter case, if a piece of red litmus paper be hung in a bottle containing the urine, but in such a manner that the urine does not touch it, it will be turned blue by the escaping alkaline gases, while in the first case it will retain its red color.

2. CHEMICAL EXAMINATION OF THE URINE.

It is my practice to collect the urine to be examined in two portions. The first consists of the urine from the bladder mixed with the secretions taken up by it in its passage through the urethra, while the second consists solely of urine from the bladder. This is of great importance. If, for instance, we wish to test for albumen and do not observe this precaution, any purulent secretion present in the urethra would cause a positive reaction; for whenever there is pus in the urine there is also albumen, it being derived from the protoplasm of the pus corpuscles. In a case of this kind we would have to do with what is known as albuminuria spuria, which is of an entirely different significance than **albuminuria vera,** with which we most frequently have to do.

A. TESTS FOR ALBUMEN.

By albuminous urine in the general sense of the term we mean a urine containing serum-albumin and serum-globulin, the excretion of these substances constituting the clinical conception of albuminuria.

A urine to be tested for albumen must be clear. If it is turbid it must be filtered repeatedly until the filtrate is clear. If it does not become clear after simple filtration, it may be shaken with calcined magnesia, lime-water, barium carbonate, or charcoal, and the resulting mixture filtered.

For clinical purposes the following qualitative tests fully suffice:

(*a*) THE HEAT TESTS.

If clear acid urine containing albumen be boiled it becomes turbid. As a turbidity also arises from the presence of earthy phosphates a few drops of nitric or acetic acid are added to the boiled urine; these acids clear up the turbidity produced by the earthy phosphates, but do not affect that caused by albumen.

Albumen may be present and yet no cloudiness appear on boiling; this occurs in alkaline urine in which the albumen combines with certain bases which are present, especially potassium, forming albuminates which are not soluble by heat. If in such cases acetic or nitric acid be added drop by drop to the clear boiled urine the albumen will be precipitated.

Owing to this property of potassium albuminate it was formerly recommended to acidulate the urine with acetic acid before boiling, but such a procedure is not to be advised, because if an excess of the acid be added a soluble combination of acid albumen is formed which is not precipitated by heat. If it be desired to acidulate the urine before boiling it, then only a few drops of nitric acid should be added.

(*b*) THE NITRIC ACID TEST (HELLER'S TEST).

The urine is put into a test tube and a few cubic centimeters of concentrated nitric acid allowed to run down the side while the tube is inclined; or the acid may be put into a reagent-glass and the urine allowed to fall upon it drop by drop through a filter. In either case the two fluids must not intermingle. If albumen is present a white or grey ring will form where the two fluids come in contact.

This ring must not be confused with the brown ring which is formed in every urine, whether it be albuminous or non-albuminous, and which consists of urea nitrate.

Resinous acids due to the ingestion of turpentine, copaiba, and sandal-oil may be mistaken for albumen, as they make a yellowish-white ring when brought in contact with nitric acid. If the question of their presence arise apply the heat test. A cloudiness will ensue, but it will disappear upon adding an excess of alcohol and thoroughly shaking the tube.

(*c*) ACETIC ACID AND POTASSIUM FERROCYANIDE TEST.

The urine is acidulated with acetic acid and then a few drops of a 10 per cent solution of potassium ferrocyanide added. If albumen

be present a flocculent precipitate, or perhaps only a slight turbidity, is produced, the intensity of the reaction depending upon the quantity of albumen present. This test is extraordinarily sensitive and therefore especially appropriate for demonstrating small quantities of albumen.

(*d*) SULPHO-SALICYLIC ACID TEST.

This is a still more delicate test. It is performed by adding a few drops of a 20 per cent solution of sulpho-salicylic acid to the suspected urine, whereupon, if albumen be present even in the minutest quantity, a cloudiness will be produced.

QUANTITATIVE ESTIMATION OF ALBUMEN.

The heat test yields approximate quantitative results which are given in the following table:

Solid coagulation of the entire quantity of urine represents								2-3 %	of	albumen
"	"	"	½	the	"	"	"	1 %	"	"
"	"	"	⅓	"	"	"	"	0.5 %	"	"
"	"	"	¼	"	"	"	"	0.25%	"	"
"	"	"	1-10		"	"	"	0.1 %	"	"
Coagulation only at the surface of the fluid							"	0.05%	"	"
Slight cloudiness but no coagulum							"	0.01%	"	"

A more accurate but still only approximative test is that made with Esbach's albuminometer (Fig. 87). To estimate the quantity of albumen fill the tube to the line marked U with urine which has been slightly acidulated with acetic acid and then add Esbach's solution of picric acid (acid picric 10 grammes, or 155 grains; citric acid 20 grammes, or 310 grains; water enough to make 1000 cubic centimeters, or 33⅓ fluid ounces) up to the line marked R.

Mix the liquids by reversing the tube a few times and allow it to stand for twenty-four hours. The coagulum of albumen which forms is read off on the scale, the number with which it is level denoting the number of parts of albumen per liter. [This number divided by 10 gives the percentage.]

[For rapid and accurate quantitative estimation I have found Purdy's centrifugal method very satisfactory. It is performed as follows: into a graduated centrifuge tube having a capacity of 15 cc. pour 10 cc. of urine, 3 cc. of a 1 to 10 aqueous solution of potassium ferrocyanide, and 2 cc. of 50 per cent acetic acid. Mix thoroughly, and after allowing the tube to stand for ten minutes, place it in Purdy's electrical

centrifuge (or any other having a radius of $6\frac{3}{4}$ inches) and revolve for three minutes at the rate of fifteen hundred (1500) revolutions per minute. The coagulum of albumen is then read off on the graduated scale, the number with which it is level representing the bulk percentage. The late Dr. Chas. W. Purdy, of Chicago, who originated this method, carefully compared the results obtained by it with those obtained by the gravimetric method and found that they did not vary more than 0.01 per cent.]



FIG. 87.—Esbach's albuminometer.

B. ALBUMOSURIA OR PROPEPTONURIA.

In addition to albumen another substance called hemi-albumose, or propepton, is sometimes present in the urine. If nitric acid be added to it coagulation occurs, but the coagulum dissolves upon heating. This property distinguishes it from albumen. The excretion of this substance constitutes albumosuria or propeptonuria.

If it be found that the coagulum produced by nitric acid becomes smaller when heated and assumes its original size after cooling, propepton is to be suspected. To determine its presence add to the urine $\frac{1}{6}$ its volume of concentrated salt solution and a few drops of acetic acid and boil. Filter the mixture while hot, and if propepton be present it will show as a coagulum in the cooled filtrate.

C. THE BIURET TEST.

If albuminous urine (that containing albumen or hemi-albumose) be rendered alkaline with potassium or sodium hydrate and then boiled, and a few drops of a 10 per cent solution of copper sulphate added, a violet-red color will be produced.

This test serves also for the detection of peptone, the presence of which, however, will be questionable for the reason that both albumen and hemi-albumose give the reaction, as has just been stated. If these substances be absent the test may be used for the detection of peptone.

Considerable obscurity prevails in regard to albuminuria due to pus and blood. If urine containing either be filtered repeatedly until it becomes perfectly clear, it will nevertheless contain albumen, because

some of the protoplasm of the pus and blood-corpuscles has been dissolved by the urine and cannot be removed by filtration. This quantity of albumen, however, is never very large; when due to solution of pus it does not exceed 1.5-1000, and when due to solution of blood it does not go higher than 1-2000.

D. TESTS FOR SUGAR.

Minute quantities of glucose (grape-sugar) are present in normal urine. These traces are not demonstrable by the practicable tests which we are about to describe and so do not require our consideration.

As the amount of sugar in the urine of diabetics varies at different hours of the day, and also under the influence of diet, it is well to obtain a specimen of the twenty-four-hour urine for examination, or else get several specimens voided at intervals during the day.

(*a*) TROMMER'S TEST.

To the filtered urine in a test tube add one-third its volume of potassium hydrate and a few drops of a 10 per cent solution of copper sulphate. Heat the upper part of the resulting blue fluid carefully until it boils. If sugar be present a yellow or red, fine granular precipitate of cuprous oxide will be slowly deposited. Reduction taking place before the boiling point is reached is the only one that is characteristic of grape-sugar; deposits occurring after the fluid has cooled are not significant.

This test may give rise to errors because other urinary constituents such as uric acid, and especially creatinin, possess the same reducing power as glucose. [In my opinion the most reliable copper test is the **glycerine-cupric,** which is performed as follows: A few drops of a solution containing 28 grains of copper sulphate to an ounce of glycerine are added to a drachm of potassium hydrate in a test tube. The mixture is boiled and urine added drop by drop. If grape sugar be present cuprous oxide will be thrown out as in Trommer's test.]

(*b*) BOTTGER'S BISMUTH TEST.

This test depends upon the property of grape-sugar to reduce bismuth in the presence of an alkali. The suspected urine is made strongly alkaline with potassium hydrate, as much bismuth subnitrate as can be taken up on the tip of a pen-knife added, and the

mixture then boiled. In the presence of grape-sugar reduction to black metallic bismuth takes place.

If the urine is albuminous the albumen must be removed before this test is applied, because it will form black sulphide of bismuth, which cannot be distinguished from the metallic form produced by glucose.

The urine, if acid, may be freed from albumen simply by boiling and filtering, but if it is neutral or alkaline it must be acidulated with acetic acid before it is boiled.

This test is very useful if a large quantity of sugar is present. [The same method of freeing the urine from albumen should be used if one of the copper tests is employed.]

(*c*) MOORE'S TEST.

If saccharine urine be mixed with one-third its volume of concentrated potassium hydrate and boiled a few minutes it will turn brown. Less than 0.5 per cent of sugar is not shown by this method.

Approximate quantitative estimation may be made from the color of the boiled fluid:

Canary yellow signifies ..... about 1% of Sugar
Amber signifies ..... from 1 to 2% " "
Light brown signifies ..... about 5% " "
Dark brown (non-transparent) signifies .... more than 5% " "

(*d*) THE FERMENTATION TEST.

This affords a very good quantitative method. [It may be performed with Lohnstein's or Einhorn's saccharometer (Fig. 88), the latter being commonly used in America. One gramme of compressed yeast (or $\frac{1}{10}$ of a cake of Fleischmann's yeast) is mixed with 10 cc. of urine in the graduated test tube and the mixture is poured into the bulb of the saccharometer; the instrument is then tipped on its side, whereupon the fluid flows into the cylinder. It is then left for twenty-four hours in a warm room. Fermentation will be complete at the end of that time and the upper part of the cylinder will be filled with carbonic acid gas. The percentage of sugar is read off on the graduated scale at the level of the fluid.

If the urine contains more than one per cent of sugar it must be diluted with water before the test is applied. Dr. Einhorn directs that diabetic urine having a specific gravity of 1.018–1.022 be diluted twice; 1.022–1.028, five times; 1.028–1.030 ten times. The percentage

of sugar in the undiluted urine is found by multiplying the percentage contained in the diluted specimen by the number of times it was diluted.]

If the urine is free from albumen quantitive estimation of sugar can be made very readily by polarization. If albumen be present, however, its left rotary power will counteract or overcome the right rotary power possessed by grape-sugar.

Turbid or very dark urine should be treated with a 10 per cent solution of lead acetate and filtered. In examining the clear filtrate its degree of dilution must be taken into account.

E. ACETONE AND DIACETIC ACID.

These substances are frequently combined, a urine which contains diacetic acid also containing acetone. Acetone may be present, however, when there is no diacetic acid. Diacetic acid is easily decomposed into acetone and carbonic acid.

Acetonuria occurs in various febrile conditions, in diabetes mellitus, in gastric and intestinal carcinoma, in inanition, in autointoxication and chronic morphinism, after the gastric crises of tabetics, in peritonitis, and in pregnancy as a sign of fœtal death. It indicates albuminous putrefaction, although it may occur as a physiologic phenomenon when an excess of animal food is being taken.

The presence of diacetic acid, or diaceturia, is always a very unfavorable prognostic sign. It occurs in diabetes, prolonged inanition, gastric and intestinal carcinoma, and malignant scarlet fever and measles.

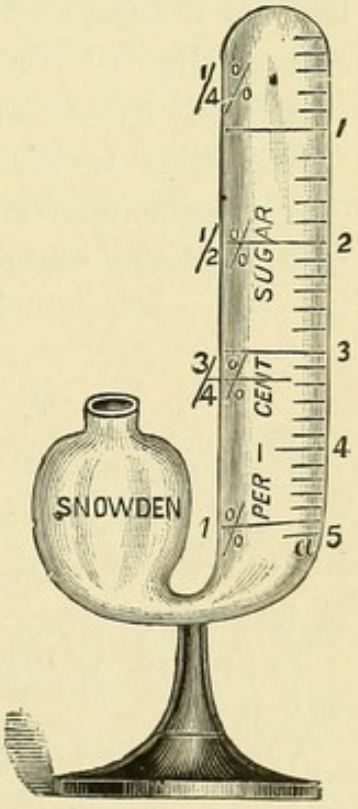


Fig. 88.—Einhorn's Saccharometer.

For the detection of acetone the urine is mixed with a freshly made solution of nitroprusside of potassium and sodium hydrate added until it becomes alkaline. Acetic acid is then added, whereupon, if acetone be present, a purple or red color develops.

For the detection of diacetic acid a few drops of ferric chloride solution are added to the urine; if a phosphatic deposit is thrown down the mixture is filtered and more ferric chloride added. In the presence of

diacetic acid a deep red color develops, which disappears upon the addition of sulphuric acid. Antipyrin, salicylic and carbolic acid give a similar reaction with iron chloride.

F. BILE-PIGMENT.

During an attack of jaundice bile-pigment is excreted in the urine. If it be present in large quantity, it can be detected with the naked eye, the urine having a greenish-brown color and a green foam forming when it is shaken. Similarly colored urine due to the ingestion of rhubarb and senna is distinguished from bile-stained urine by the fact that it produces no yellow foam and is turned red by the addition of sodium hydrate.

The primary bile-pigment present in urine is bilirubin, from which are formed by oxidation biliverdin, biliprasin, and bilifuchsin.

For the detection of bile-pigment the suspected urine is poured upon a layer of fuming nitric acid (Gmelin's Test). At the line of contact a colored ring is formed which changes from green to violet, then to red, and finally to yellow.

According to Rosenbach, the test can be performed by putting a drop of urine upon a filter paper and allowing a drop of nitric acid to fall upon it; when the two fluids meet the above described play of colors occurs.

G. LIPURIA AND CHYLURIA.

Fat may be mixed with the urine mechanically (from bougies, specula etc.,) or it may occur as the result of a diet rich in fats. The urine is turbid, grayish white, and under the microscope shows a large number of fat-corpuscles.

In chyluria the urine has a milky appearance and contains albumen as well as fat.

To detect fat in the urine add potassium hydrate and shake with ether; the cloudiness disappears, or at least becomes less. If a drop of the mixture be evaporated upon a piece of white paper, it leaves a greasy spot which does not disappear upon being heated.

H. HYDROTHIONURIA.

Sulphuretted hydrogen is found in fresh urine in purulent cystitis, in pyelitis, in cases where a communication exists between the bladder and bowel, and also very rarely when accumulation of gas occurs in the rectum.

It is easily recognized by its odor. To detect it, acidulate the urine carefully and close the bottle containing it with a cork to which is attached a piece of paper previously wet with acetate of lead solution; if sulphuretted hydrogen be present the paper will turn black.

Pneumaturia, that is, a condition in which free gas escapes with the urine and causes a blowing sound, has been observed when diabetic urine has undergone decomposition in the bladder.

I. INDICAN.

How far the presence of an increased quantity of indican in the urine is of diagnostic value has not yet been determined. We know, however, that an increase very often occurs in putrid suppurative conditions, in intestinal obstruction, and especially in gastric and intestinal diseases associated with decomposition of food.

For the detection of indican 10 cc. (about 3 fluid drachms) of urine, previously freed from albumen by boiling and filtration, are mixed with 2 cc. ($\frac{1}{2}$ fluid drachm) of chloroform and 10 cc. (about 3 fluid drachms) of concentrated hydrochloric acid, and 1 or 2 drops of a fresh concentrated aqueous solution of chlorinated lime added and the mixture thoroughly shaken. If an excess of indican be present the chloroform will settle to the bottom of the tube as a blue-colored fluid.

J. BLOOD.

If to urine containing blood, about one-third its volume of potassium-hydrate be added and the mixture boiled, earthy phosphates colored with blood pigment will be precipitated; in the absence of blood this precipitate will be white or yellowish white.

[Hæmoglobin may also be detected by adding a few drops of freshly prepared tincture of guaiacum to the urine, together with a like quantity of ozonized ether, and shaking the mixture thoroughly; if hæmoglobin be present, the ether, which rises to the top of the tube, will assume a blue color.]

K. PROPERTIES OF THE URINE AFTER THE INGESTION OF CERTAIN DRUGS.

Urine containing phenol, naphthalin, and salol, the last of which is decomposed into salicylic and carbolic acid, is greenish-brown in color, and becomes darker after being exposed to the air. The urine possesses similar characteristics after the use of uva ursa and preparations of tar.

Balsam of copaiba causes it to assume a red color upon the addition

of hydrochloric acid. After the internal and external use of this drug, and also of sandal-oil and styrax, the urine contains resinous acids, which upon being subjected to heat or brought into contact with nitric acid, produce a turbidity resembling that due to albumen. It may be distinguished from the latter by adding to the urine twice its own volume of alcohol, whereupon all turbidity immediately disappears. If the heat test is used do not add the alcohol until the urine has cooled; if the nitric acid test is employed an excess of acid must not be present, because it will cause decomposition of the alcohol with violent liberation of gas.

After the ingestion of turpentine the urine has the odor of violets.

The salts of iodine and bromine are detected by adding a few drops of hydrochloric acid and chloroform to the urine and shaking it well; the chloroform, which sinks to the bottom of the tube, is colored violet-red by iodine and brownish yellow by bromine.

The presence of potassium chlorate is determined by acidulating the urine with hydrochloric acid and adding a fresh solution of potassium iodide in starch-water. Upon heating the mixture, it will assume a blue color, which is due to the formation of iodized starch.

Salicylic acid gives a violet color with ferric chloride.

Antipyrin gives a red color with ferric chloride.

Santonin colors the urine bright yellow; upon the addition of potassium hydrate it becomes scarlet red.

Rhubarb and senna also give a red color with potassium hydrate, but it is permanent, while that produced by santonin soon disappears. If baryta water be added a red precipitate is produced by senna and rhubarb, whereas if santonin be present the fluid will be colored red.

A test requiring more precision, but yet one which is at times most important, is that for mercury. To 300 cc. (10 fluid ounces) of urine a small quantity of sodium hydrate and sugar is added and the mixture heated to the boiling point. The phosphates, carrying the mercury with them, will be precipitated. The supernatant fluid is drawn off and the precipitate dissolved in hydrochloric acid. The resulting solution is boiled over a slow fire for an hour and a half, during which time a copper wire, previously heated to a glowing heat, is suspended in it. The wire is then taken out, boiled in a very weak solution of sodium hydrate, and dried between two filter papers. If the wire now be heated in a fused glass tube, the mercury will be sublimed and deposited in the form of minute globules in the upper and cooler part of the tube.

For the purpose of quickly securing practical information at the bedside the following urine-examination is recommended:

I. **Turbid urine** is put into a test tube and the upper portion boiled. Three possibilities exist:

1. The turbidity may disappear; if so it is due to urates.

2. The turbidity may become more intense in the boiled portion; in this case we have to do with pyuria, phosphaturia, or carbonaturia. Distinction between the three is made by the addition of a few drops of acetic acid. If the increased turbidity be due to pyuria it remains, whereas if caused by phosphaturia or carbonaturia it disappears entirely, the urine becoming perfectly clear. Turbidity due to carbonates clears up with evolution of gas, but when produced by phosphates no such phenomenon occurs.

3. The turbidity may remain unchanged, in which case it is to be attributed to the presence of mucus (mucinuria), semen (spermaturia), or bacteria (bacteriuria). These conditions are to be differentiated by the microscope.

The following table may serve to impress these differences upon the mind.

If the upper portion of the turbid urine be boiled			
The turbidity disappears	The turbidity is increased		The turbidity is unchanged
in the boiled portion.			
Urates.	If it remains after the addition of acetic acid, Pyuria.	If it disappears upon the addition of acetic acid, Phosphaturia. Carbonaturia.	Mucinuria. Bacteriuria. Spermaturia.

II. **Clear urine** is examined in the same way, the upper portion in the test tube being boiled.

1. If turbidity arise it is due either to albumen or phosphates. A drop of acetic acid serves to differentiate: if the turbidity is caused by albumen it remains; if produced by phosphates it disappears.

2. If the urine remains clear, then a drop of acetic acid must be added; if it still remains clear, it is free from albumen; if cloudiness appears, then albumen is present. The albumen was combined with an alkali and could not be brought forth by heat, but the addition of

acetic acid gave rise to the formation of an alkaline acetate with liberation of the albumen. Such a condition occurs only when the urine is alkaline.

The following table may be used for reference:

If the upper portion of clear urine be boiled		
The urine becomes turbid in the boiled portion		The urine remains clear
If the turbidity remains after the addition of acetic acid, Albuminuria.	If the turbidity disappears upon the addition of acetic acid, Phosphaturia.	If it becomes turbid upon the addition of acetic acid, Albuminuria.

3. MICROSCOPIC EXAMINATION OF THE URINE.

In every case chemical examination of the urine should be supplemented by microscopic examination. Even though the urine be perfectly clear, this should be done; for frequently things are revealed by the microscope which cannot be seen macroscopically, nor even be suspected from the physical characteristics of the urine. For an exact diagnosis it is indispensable that all the constituents of the urine be examined under the microscope.

Formerly it was customary to allow the urine to settle in a conical glass and then examine the sediment. This method is no longer in vogue. We know that bacteria develop in urine which stands for any length of time, and that the urine itself undergoes changes. Therefore it is desirable to examine it as soon as possible after it is voided. For this purpose the centrifuge is employed; by its use the sediment of the urine is prepared for examination in a few minutes. We differentiate between the organized and unorganized elements of the sediment.

A. ORGANIZED SEDIMENT.

1. **Blood-corpuscles.** The number of red blood-corpuscles, or erythrocytes, vary with the severity of the hæmorrhage. Generally they occur singly, forming rouleaux only when very severe hæmorrhage has occurred. In recent hæmorrhages they appear as small round discs with a light red central shadow (Fig. 89 a); when lying on their edges, they are biconcave. (Fig. 89). Very soon, especially in concentrated acid urine, they shrink owing to abstraction of water (Fig. 89 b), and finally

assume a stellate appearence (Fig. 89 c). In dilute and alkaline urine they become swollen, lose their color, and appear in the form of bright rings (Fig. 89 d). Red blood-corpuscles which have entirely given up their coloring matter, are known as "blood shadows" (Blutschatten). They have a faint circular outline and are generally smaller than the blood-cells from which they were derived (Fig. 90). They show that the blood-cells have been in the urine for some time, and if the specimen of urine be fresh, that the hæmorrhage took place sometime before.

Minute spherical bodies, which in contrast to the blood-shadows have retained the coloring matter of the blood, are called microcytes.

White blood-corpuscles (leucocytes), pus-corpuscles, lymph-corpus-

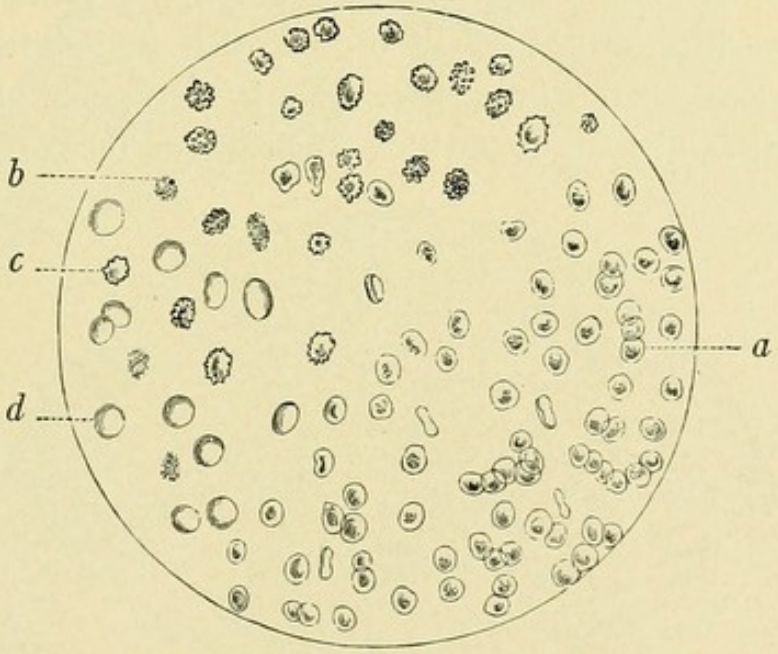


FIG. 89.—*a*, Blood-corpuscles showing depressions in center. *b* and *c*, shrunken corpuscles. *d*, swollen corpuscles.

cles, and mucus-corpuscles have a round form, but change it by means of amœboid movements. When perfectly fresh they do not show a nucleus, but have a granular appearence (Fig. 91). In time, and also upon the addition of acetic acid, they develop one to four nuclei from their granular protoplasm, which when highly magnified show nucleoli in their interior.

Leucocytes may be mistaken for small round epithelial cells. To differentiate between the two let a drop of Gram's solution run under the cover-glass; the leucocytes will be colored an intense mahogany-brown, while the epithelial cells will be stained light yellow. Mucus and lymph-corpuscles cannot be differentiated under the microscope.

2. **Epithelium.** Various forms of epithelium are found in the urine. The epithelium from the renal tubules, from the pelvis of the kidney, from the bladder and urethra, from the prostate gland, from the vagina—all these are found occasionally in the urine. It has long been attempted to locate the source of the epithelium by its form.



FIG. 90.—Blood-shadows and microcytes.

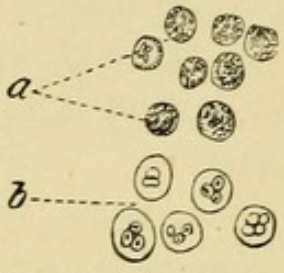


FIG. 91.—Leucocytes.

Figures 92, 93 and 94 show the various forms of epithelium:

From these illustrations it will be seen that the epithelium of the different parts of the genito-urinary tract is very much alike. Thus, polygonal cells, which are found very frequently in the pelvis of the kid-

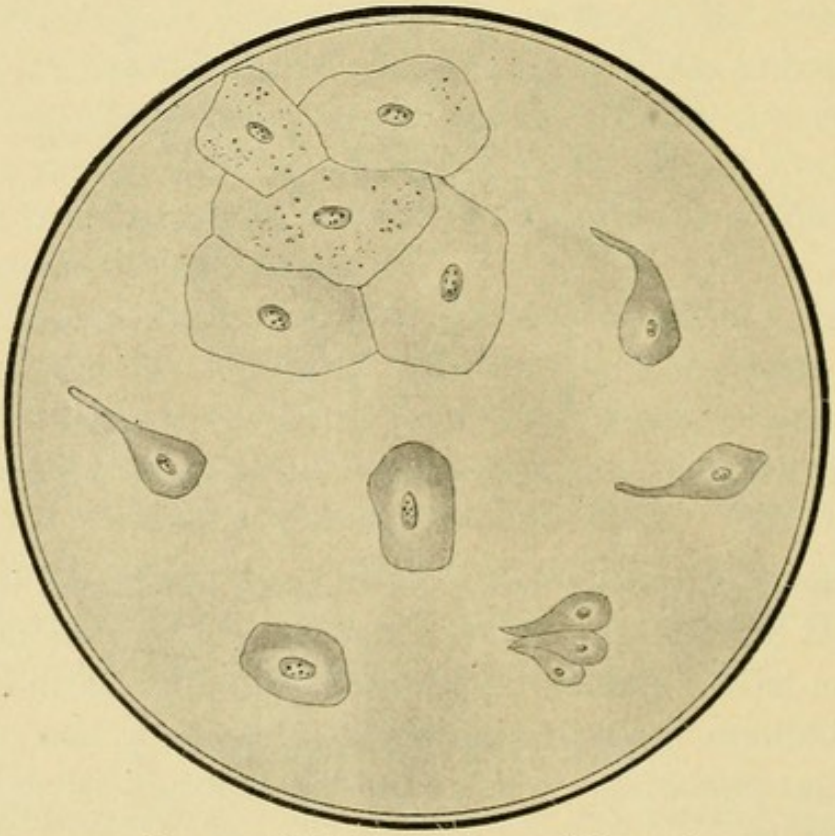


FIG. 92.—Vesical epithelium.—(Greene.)

ney, also occur in the deep layers of the urethra and in the prostate. The recognition of different kinds of epithelia by their form or shape is often impossible, and so in reply to the oft repeated assertion that the form of the epithelium enables us to tell the site of the affection, we

must say with Eichhorst and Bizzozero, that this is possible only in the rarest cases. The sole exception to be made is that of the renal epithelium, which unfortunately is not often found, being greatly outnumbered by other varieties. These sharply outlined, round cells with large nuclei are characteristic, but they may be easily confused with leucocytes. Their size is an important point of distinction, they being larger than the leucocytes.

3. **Urinary Casts.** The great diagnostic significance of urinary casts is generally known. Their origin has been explained in various

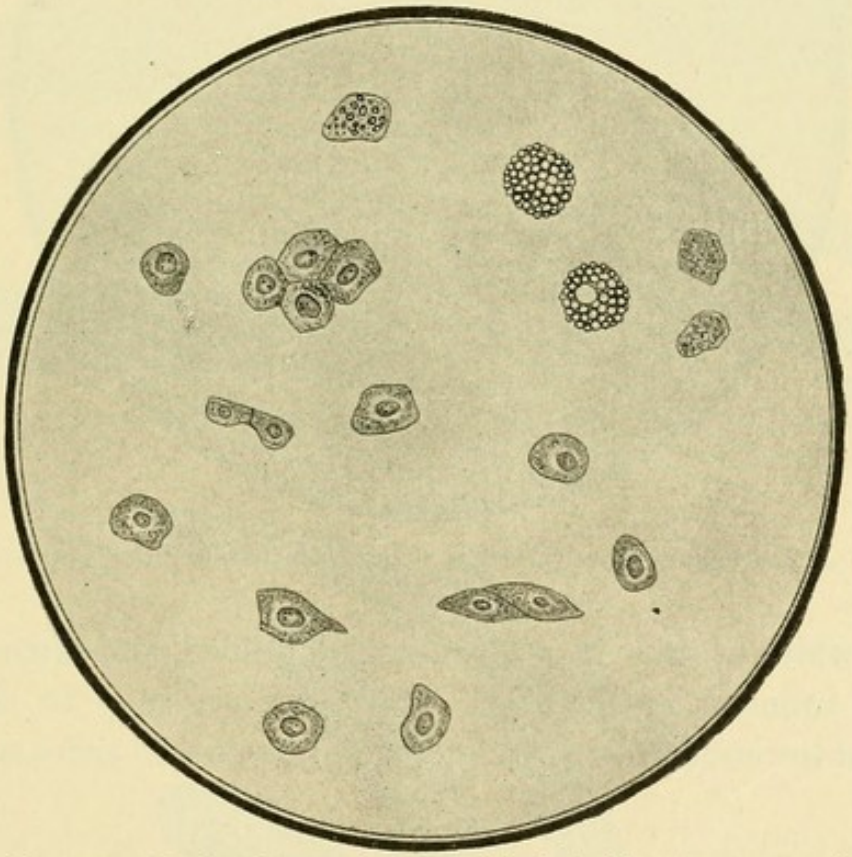


FIG. 93.—Various forms of renal cells, including "compound granule cells."—(Greene.)

ways. According to one theory, as a result of disease of the glomeruli the albuminous constituents of the blood filter through into the renal tubules and become moulded into their shape (hyaline casts). If epithelium from the tubules, or blood cells, or any other substances become united with these cylinders, then epithelial or blood casts, etc., are formed. Another view is that all casts, hyaline included, are composed of metamorphosed epithelium.

The following varieties of casts are met with in urinary sediment:

(a) **Hyaline Casts.** These are of homogeneous structure, translucent, and so pale that they can hardly be distinguished from their

surrounding medium. When searching for them the microscopic field should be darkened (Fig. 95).

(b) **Granular Casts.** These are of varying length and breadth, are

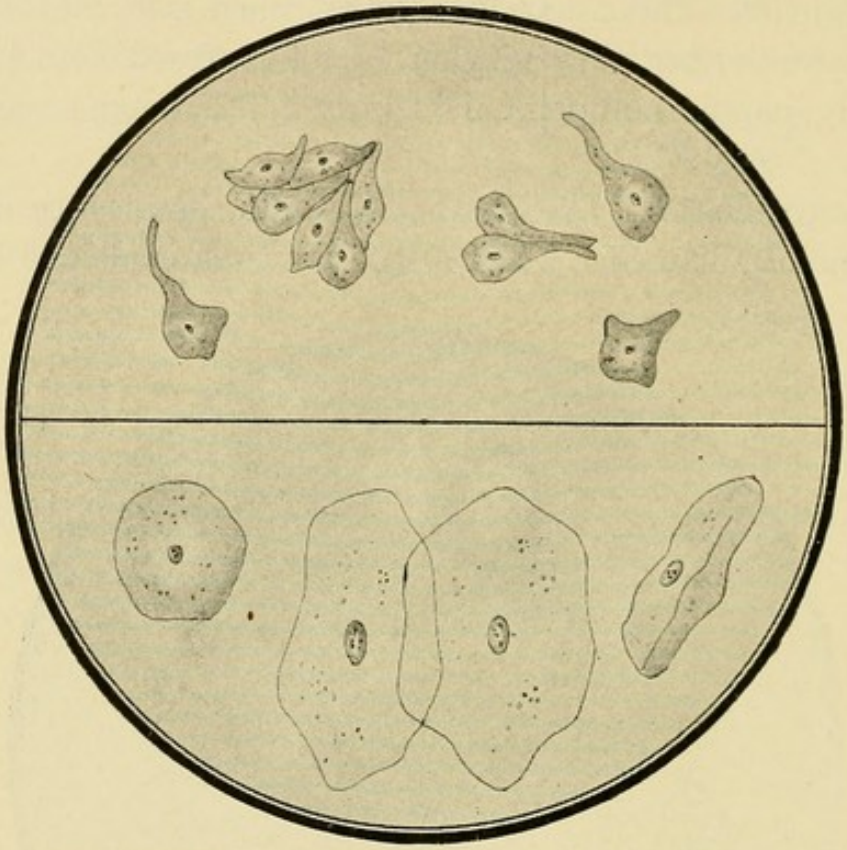


FIG. 94.—*a*, Epithelium from the renal pelvis; *b*, vaginal epithelium.—(Greene.)

yellowish white or gray in color, sharply outlined, and often indented. They are rounded at the ends. The granules may be distributed throughout the entire cast, or scattered only here and there so that it is

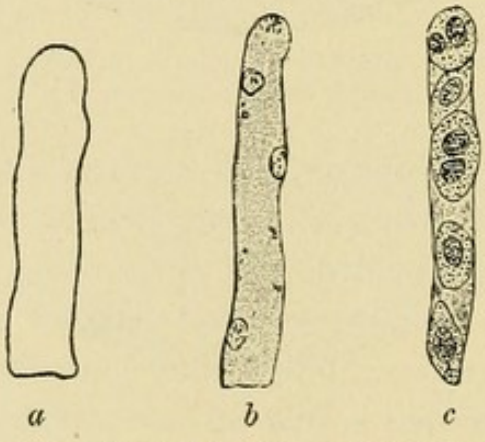


FIG. 95.—*a*, Hyaline cast. *b*, Hyaline cast studied with a few leucocytes. *c*, Hyaline cast studied with renal epithelium.

partly hyaline. Isolated leucocytes are now and then observed in different portions of the cast (Fig. 96).

(c) **Epithelial, Leucocyte, and Blood Casts.** These have a very characteristic appearance. Free blood-corpuscles, mostly the so-called "blood-shadows," lie close to the cast; the epithelial cast shows epithelium only in its upper portion, being granular below (Fig. 97 *a*, *b*, and *c*).

(d) **Waxy or Amyloid Casts.** This variety is characterized by its strong refractive power whereby it is given a shiny, wax like appearance.

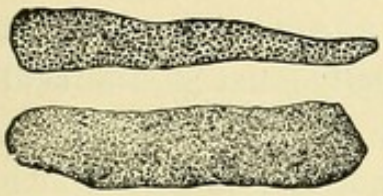


FIG. 96.—Granular cast.

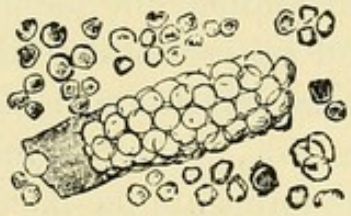


FIG. 97*a*.—Blood cast.



FIG. 97*b*.—Leucocyte cast.



FIG. 97*c*.—Epithelial cast.



FIG. 97*d*.—Cast of acid sodium urate.—(*v.* Jaksch.)

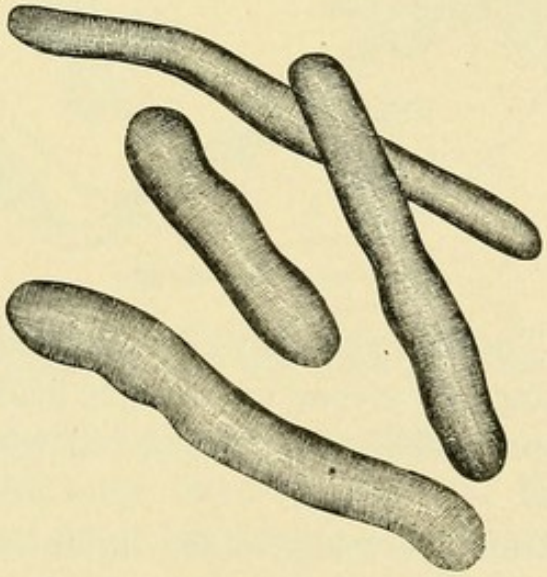


FIG. 98 —Waxy cast.—(Tyson.)

These casts are often large and broad and show clefts and indentations. Frequently shining, irregularly shaped flakes are seen near them. Some, but not all, waxy casts give the amyloid reaction, that is, they stain red with methyl violet. For an explanation of their origin it is necessary to assume that the albuminous substance originally entering into their composition undergoes amyloid degeneration (Fig. 98).

(e) **Fatty Casts.** These are casts containing globules of oil. In addition to droplets of fat needle-shaped crystals of fatty acids are sometimes observed.

From these varieties of true casts, the so-called false casts composed of urates and micrococci must be differentiated, as must also cylindroids.

Figure 97 *d* shows a cast-like structure composed of acid urate of sodium. Such masses are easily distinguished from granular casts, because they shrivel up when brought in contact with acetic acid.

Crystals of uric acid and calcium oxalate may be precipitated upon cylindrical coagula of mucus, which are then designated as uric acid casts or oxalate of calcium casts, as the case may be.

Closely resembling these forms are the micrococcic cylinders, which consist of aggregations of micrococci. They resist both potassium hydrate and nitric acid.

The mucoid structures called cylindroids are likely to be mistaken

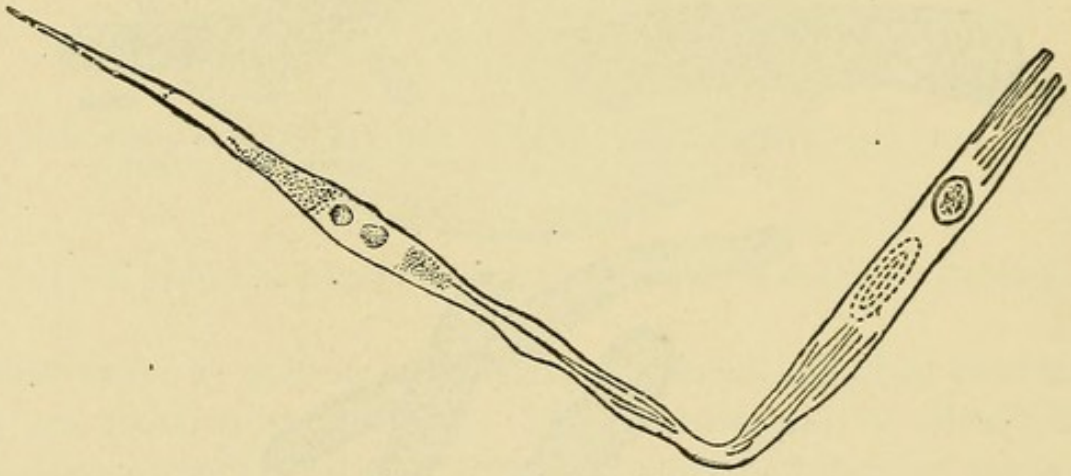


FIG. 99.—Cylindroid.

for hyaline casts. They are generally characterized by their enormous length, often extending over several microscopic fields. Figure 99 shows such a structure upon which an epithelial cell and a few leucocytes have been deposited.

4. Microörganisms. Freshly voided urine is free from microörganisms, and may be considered sterile. If it contain microörganisms their presence is due to some pathologic condition. For these reasons the necessity of examining fresh urine with the aid of the centrifuge becomes apparent.

Bacteriuria is a name applied to a mycotic affection of the bladder or kidneys in which the urine contains microörganisms without an associated presence of pus. This is exceptional for the two are almost always associated.

It must also be borne in mind that in a great variety of systemic diseases bacteria are excreted in the urine without producing any lesions of the urinary organs.

Blastomycetes, hyphomycetes, and schizomycetes are found in the urine Some of them are met with only after the urine has stood a long time, but as it is not always possible to examine the urine when it is fresh, it is necessary to know the appearance of these organisms.

Of the blastomycetes, the yeast-cells or saccharomycctes are most common, especially in diabetic urine. They appear as small round vesicles connected with one another like a string of pearls, and gener-

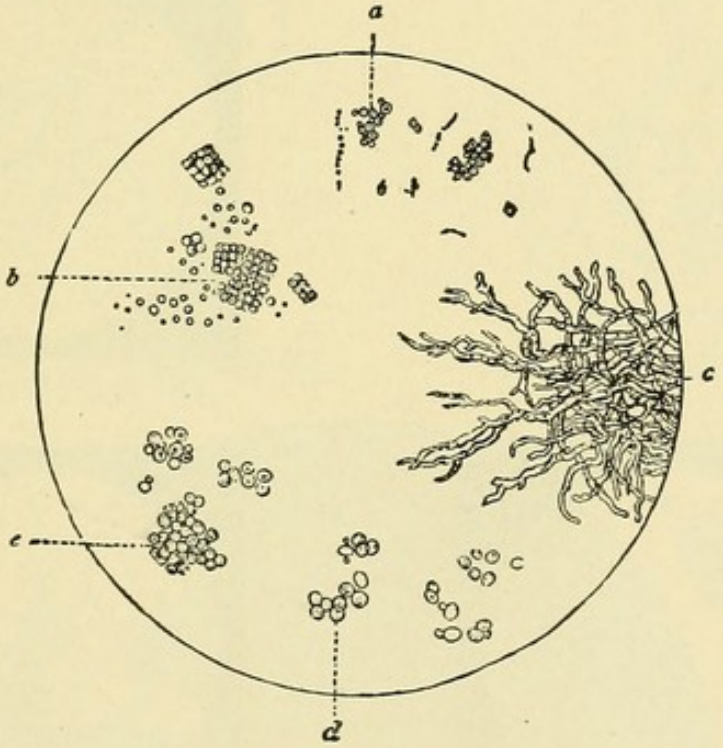


FIG. 100.—*a*, Micrococci in short chains and groups. *b*, Sarcinae. *c*, Fungi from acid fermentation. *d*, Yeast cells from diabetic urine. *e*, Mycelium.

ally arranged in clusters. On some of the cells germination may be seen (Fig. 100 *c*). Besides these there are vesicular blastomycetes which closely resemble yeast fungi, only they are smaller (Fig. 100 *d*).

That they may not be confounded with other cells (leucocytes, microcytes) a drop of acetic acid should be allowed to flow under the cover glass: blastomycetes remain unchanged, while the nuclei of leucocytes come out with great distinctness.

Hyphomycetes are found in the urine only when it has stood a long time. *Penicillium glaucum* which is often present may be easily recognized by its tuft-like or arborescent branches. Outside the retiuclum, or mycelium, spores are seen.

We shall have very little to say concerning the schizomycetes, as the significance of their presence in the urine has not been clearly determined. By some one organism has been deemed pathogenic, by others another. Many of them are merely excreted in the urine, having their origin in distant parts of the body and passing through the kidneys into the bladder without causing disease of the latter organ. We will not discuss this question here, but will proceed to enumerate the principal forms which are met with.

The micrococcus ureæ appears in the form of long, comparatively



FIG. 101.—Micrococcus ureæ.—(*v.* Jaksch.)

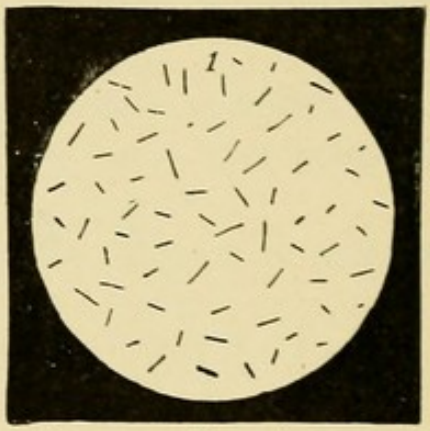


FIG. 102.—Bacterium ureæ.

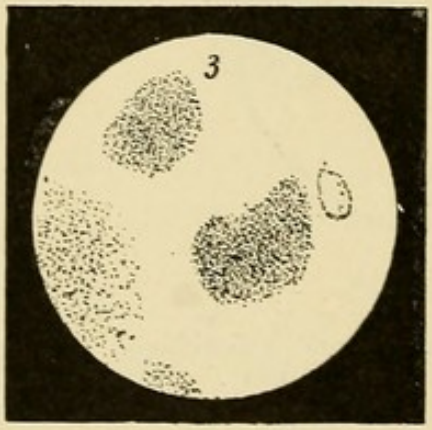


FIG. 103.—Micrococcus ureæ arranged in masses of zoöglea.

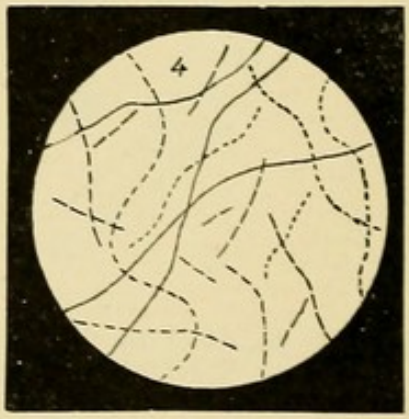


FIG. 104.—Leptothrix.—(Peyer.)

large cocci arranged in chains (Fig. 101). It decomposes urea into carbonic acid and ammonia. There is also a bacterium ureæ which possesses the same property of decomposing the urine (Fig. 102). Both these varieties occur as masses of zoöglea (Fig. 103). Furthermore we recognize a kind called vibriones, which represent a union of several rodlets. When highly magnified their articulations may be discerned. Their movement is slow and sluggish. A longer succession of bacteria is known as leptothrix (Fig. 104).

Rarely the packet-like cocci called sarcinæ are found (Fig. 100 *b*)

Among the other organisms which are found may be mentioned bacterium coli, proteus, staphylococcus pyogenes albus and aureus, gonococci, tubercle bacilli, the bacilli of anthrax, typhoid and relapsing fever, glanders, and finally the smegma bacillus. This number by no means completes the list.

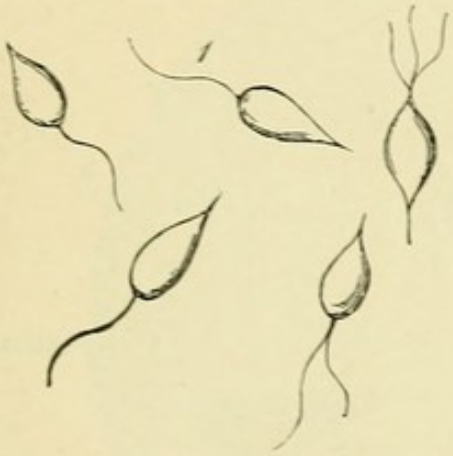


FIG. 105.—Trichomonas vaginalis.

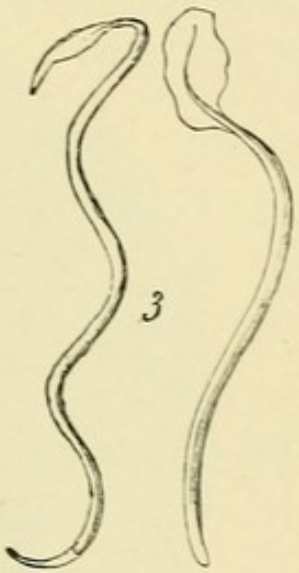


FIG. 106.—Filaria sanguinis.

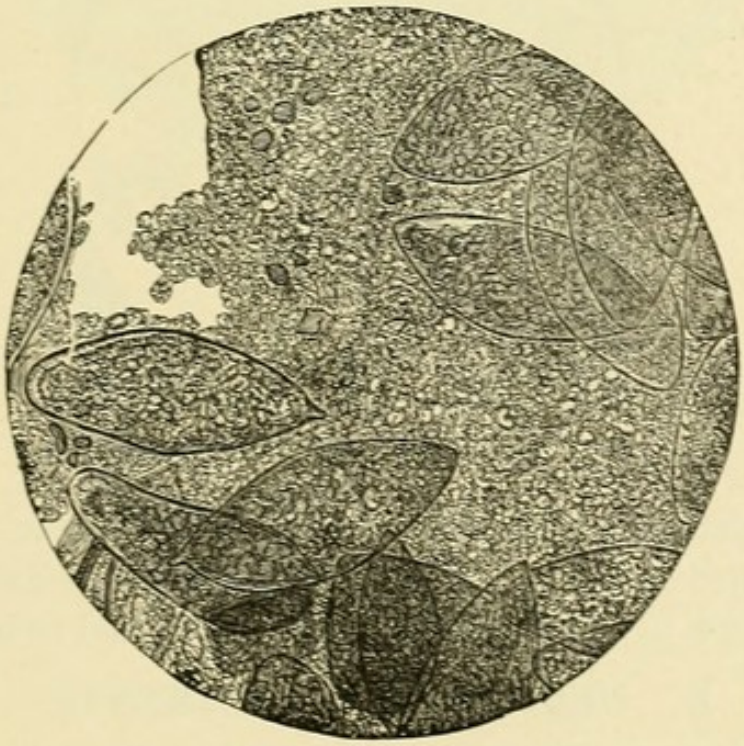


FIG. 107.—Ova of the distomum hematobium.—(Uitzmann.)

Animal Parasites. Trichomonas vaginalis is occasionally found in the urine of women suffering from leucorrhœa (Fig. 105). More rarely the oxyuris vermicularis, ascaris lumbricoides, and filaria sanguinis are found (Fig. 106).

Of greater importance is the distoma hæmatobium, a parasite which is prevalent in Egypt, Brazil, and other tropical countries, and which causes vesical and renal hæmorrhage. The spores of this parasite (Fig. 107) have an oval form and are rounded at one end, the other end tapering into a short spine.

Equally important is the occurrence of hydatid cysts, which may reach the size of a walnut. If they are sterile they consist of a structureless

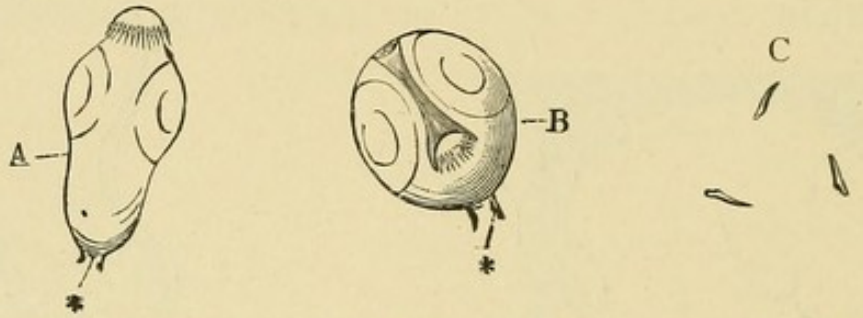


FIG. 108.—Echinococcus. A and B, head of the parasites. C, Hooklets.

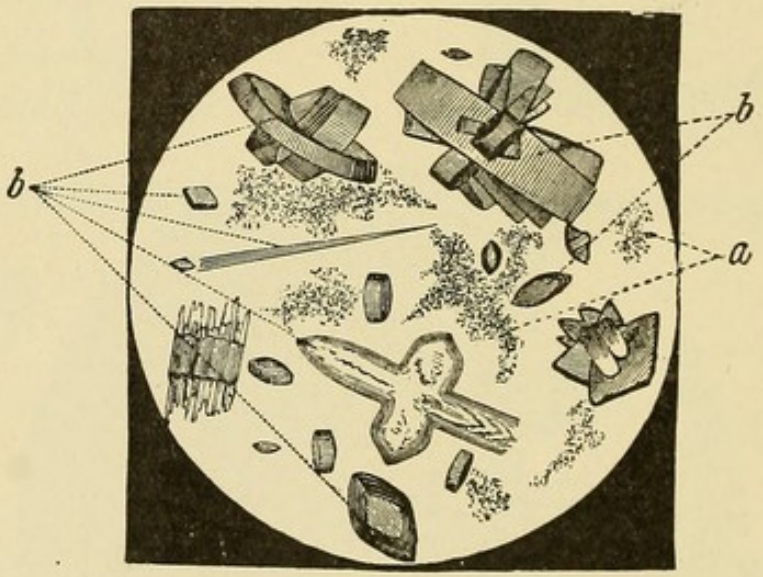


FIG. 109.—*a*, Acid sodium urate. *b*, Uric acid.

membrane containing fluid. Frequently, however, the bladder contains fecundated sacs (Fig. 108). The head of the parasite (A and B), and the hooklets (C) floating free in the urine should be looked for.

B. UNORGANIZED SEDIMENTS.

The unorganized sediments are classified according to the reaction of the urine in which they occur.

THE SEDIMENTS OF ACID URINE.

1. Acid urate of sodium and more rarely the corresponding potassium salt. They occur as moss-like masses of amorphous granules varying

in color from gray to bright yellow or brown (Fig. 109 *a*). If a drop of hydrochloric acid be added to them they are decomposed and in course of half an hour precipitate crystals of uric acid.

2. Uric acid, which forms gray, yellow, or brown crystals of various shapes, such as rhomboid, spindle, cylindrical, whetstone-shape, and

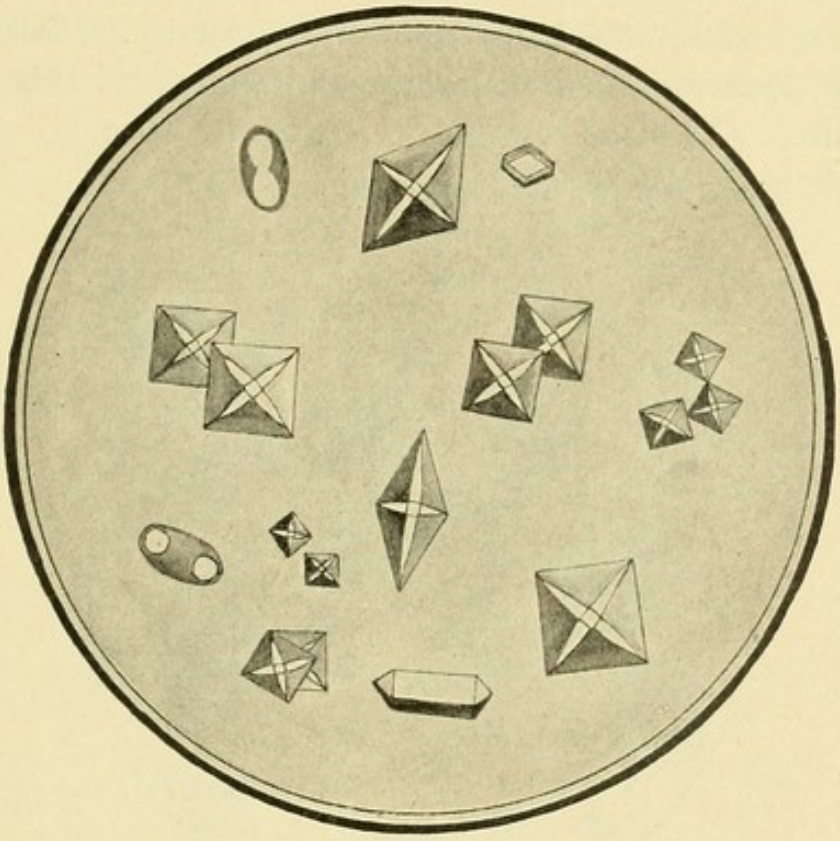


FIG. 110.—Calcium oxalate.—(Greene.)

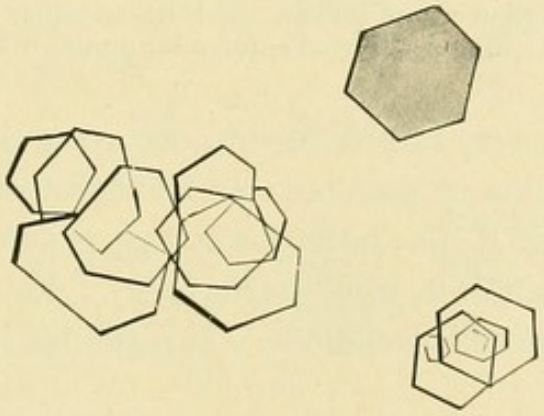


FIG. 111.—Cystin.

also, rosettes which are formed by a combination of the others (109 *b*). Rarely uric acid occurs in the form of irregular crystalline spicules which Ultzmann has associated with the development of renal stone.

Micro-chemical test: Run a drop of potassium hydrate under the

cover-glass and the uric acid crystals disappear, being converted into soluble potassium hydrate. If hydrochloric acid now be added recrystallization of uric acid begins.

3. Calcium oxalate appears in the form of small glistening octahedrals, which when seen from above look like envelopes [or squares crossed diagonally by two lines]. Less commonly prismatic and hour-glass forms are seen [the so-called dumb-bell crystals]. Calcium oxalate is soluble in hydrochloric acid, insoluble in acetic acid (Fig. 110).

4. Cystin. Colorless, irregular, six-sided crystals, soluble in hydrochloric acid, alkalies and ammonia. (Fig. 111.)

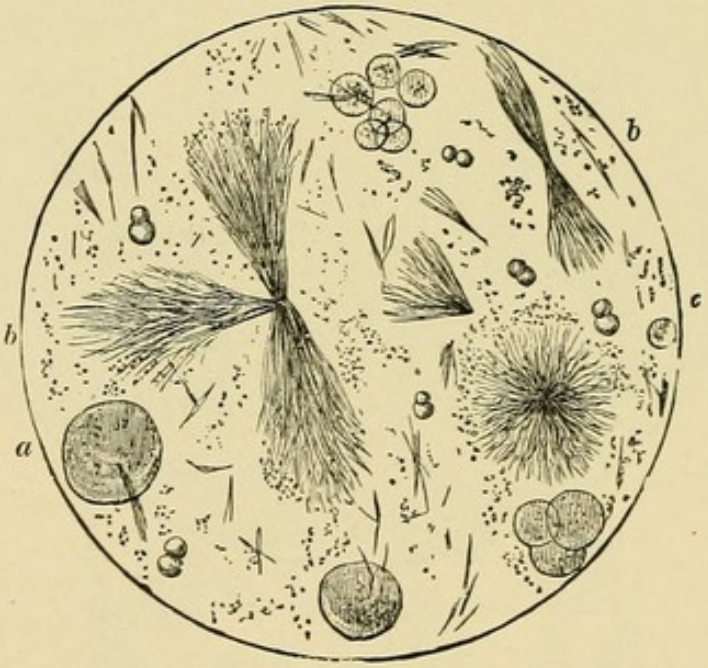


FIG. 112.—Leucin and tyrosin. *a.a*, leucin balls; *b.b*, tyrosin sheaves; *c*, double balls of ammonium urate.—(Holland.)

5. Xanthin. A very rare sediment, occurring as regular hexagonal laminæ. It is soluble in ammonia and hydrochloric acid.

Leucin and tyrosin. The latter forms fine, colorless, shining needles, which are readily soluble in alkalies (Fig. 112). Leucin occurs as yellow spheres having concentric striations. It is soluble in acids and alkalies (Fig. 112).

[These substances are the products of rapid retrograde metamorphosis, such as occurs in acute yellow atrophy of the liver and phosphorus poisoning. They are said to occur in severe cases of typhoid fever, small pox, and pyæmia.]

A sediment of rather infrequent occurrence is sulphate of calcium, which appears as long, colorless needles or as lamellæ with sharply trim-

med ends. It is somewhat similar to neutral phosphate of calcium (Fig. 113).

8. Indigo. Blue lamellæ or black scales, rhomboid in shape, with tapering ends.

THE SEDIMENTS OF ALKALINE URINE.

1. Crystalline neutral phosphate of calcium (Fig. 114 *b*). These crystals cannot be produced artificially by the ingestion of alkalies, and

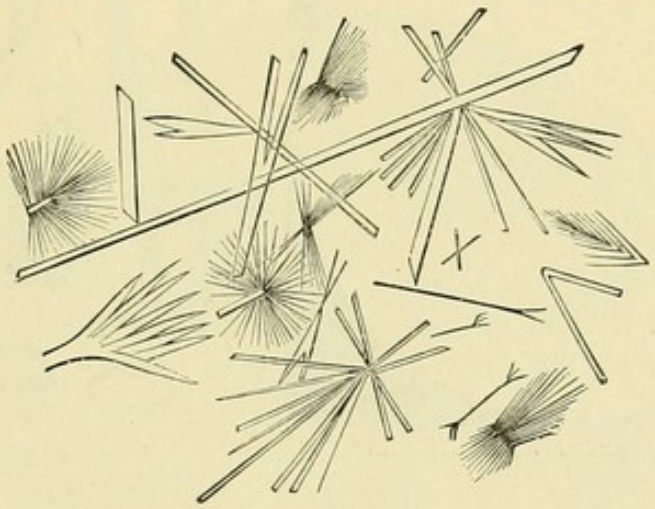


FIG. 113.—Crystals of calcium sulphate.—(Van Nuys.)

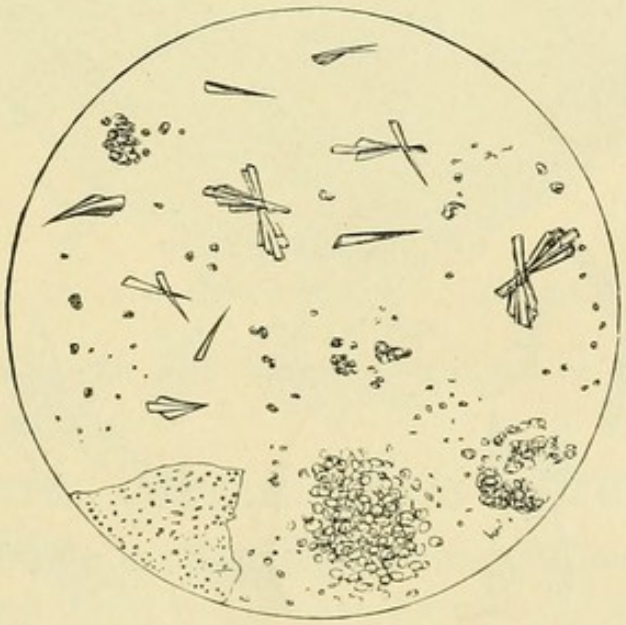


FIG. 114.—*a*, Finely granular carbonate of calcium; *b*, crystalline neutral phosphate of calcium.

consequently are characteristic of essential phosphaturia. Their presence excludes the possibility of ammoniacal decomposition of the urine, for as soon as the minutest quantity of ammonia is added to them they disappear.

2. Crystalline phosphate of magnesium, which is much like the ammonio-magnesium phosphate shown in Fig. 116, although the crystals are longer than they are broad. They are still further differentiated by the fact that they may occur irrespective of the presence of bacteria, with which ammonio-magnesium phosphate is always associated.



FIG 115.—Carbonate of calcium.

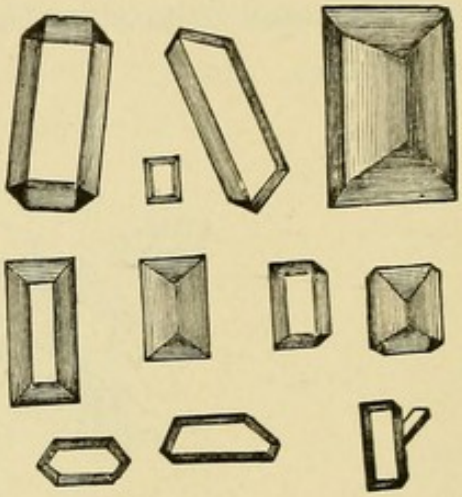


FIG. 116.—The more usual forms of triple phosphate.—(Holland.)

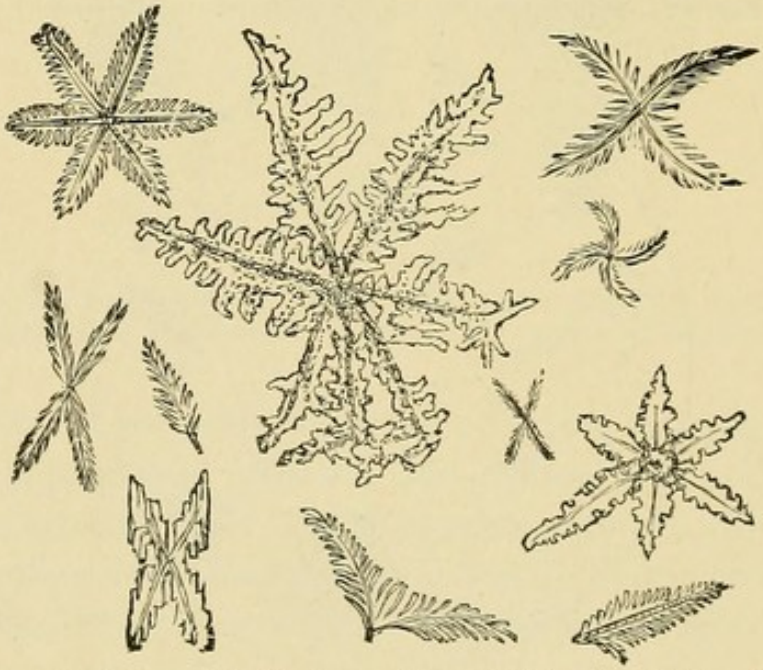


FIG. 117.—Stellate and feathery crystals of triple phosphate.—(Harley.)

3. Calcium carbonate, which may be either amorphous or granular crystalline, the latter forming small, shining, mulberry-shaped granules (Figs. 114 and 115).

4. Ammonio-magnesium phosphate, which occurs in two forms, rhomboid plates, the so-called coffin-lid crystals, and large prisms with

slanting ends (Fig. 116). If the crystals be precipitated, serrated, cruciform, or fern-shaped structures will be observed (Fig. 117). The crystals are soluble in acetic acid.

5. Urate of ammonium is yellow or brown in color the same as all urates. It forms needles with spherules on their ends, and also double globules having processes similar to the rays of a star-fish (Fig. 118).

Micro-chemical test: The addition of a drop of hydrochloric acid forms ammonium chloride and liberates uric acid. The ammonium

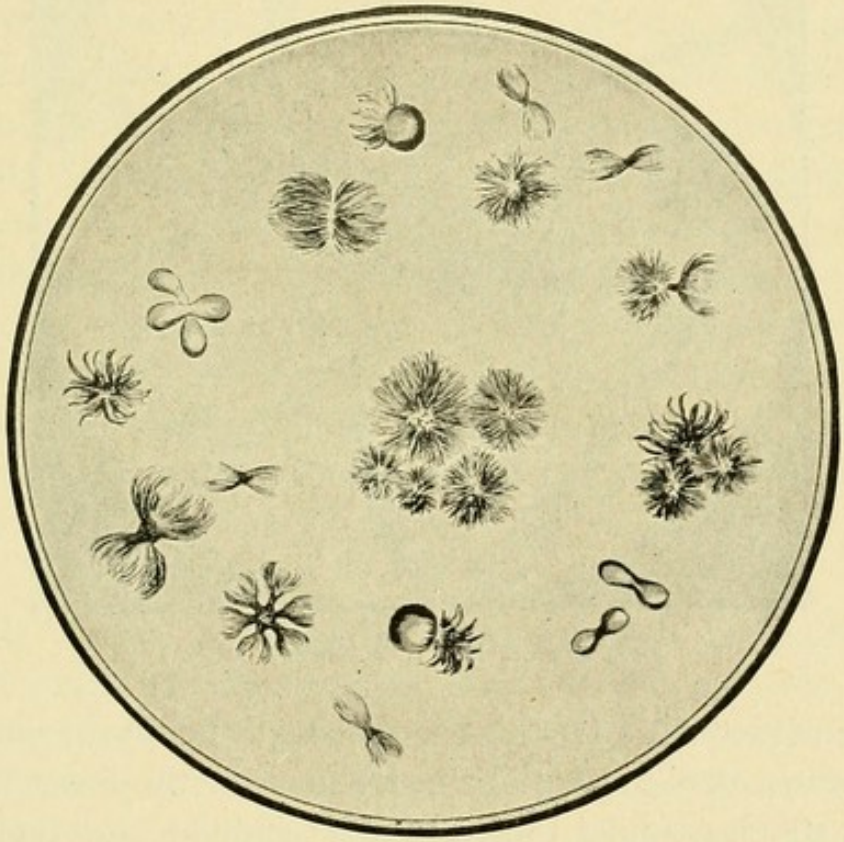


FIG. 118.—Ammonium urate.—(Greene.)

crystals soon disappear and whetstone-shaped or rhomboid crystals of uric acid are formed.

ACCIDENTAL CONTAMINATION OF THE URINE.

During microscopic examination of urinary sediment structures are often found which might be mistaken for essential constituents of the urine, but which are really due to contamination of that fluid. It is self-evident that it is necessary to be familiar with their appearance in order to guard against errors.

Among those most frequently met with are hairs, fragments of feathers, animal and vegetable fibers, both colored and uncolored, (wool, hemp, silk, linen), starch-granules, fat-globules, and air-bubbles.

Figure 119 shows those most frequently encountered. To the left is a twisted cotton-fibre, and close beside it is the barb of a feather. A long, slender, cylindrical silk-fibre runs across the picture from left to right and from above downwards. At the right is a hemp fibre plainly

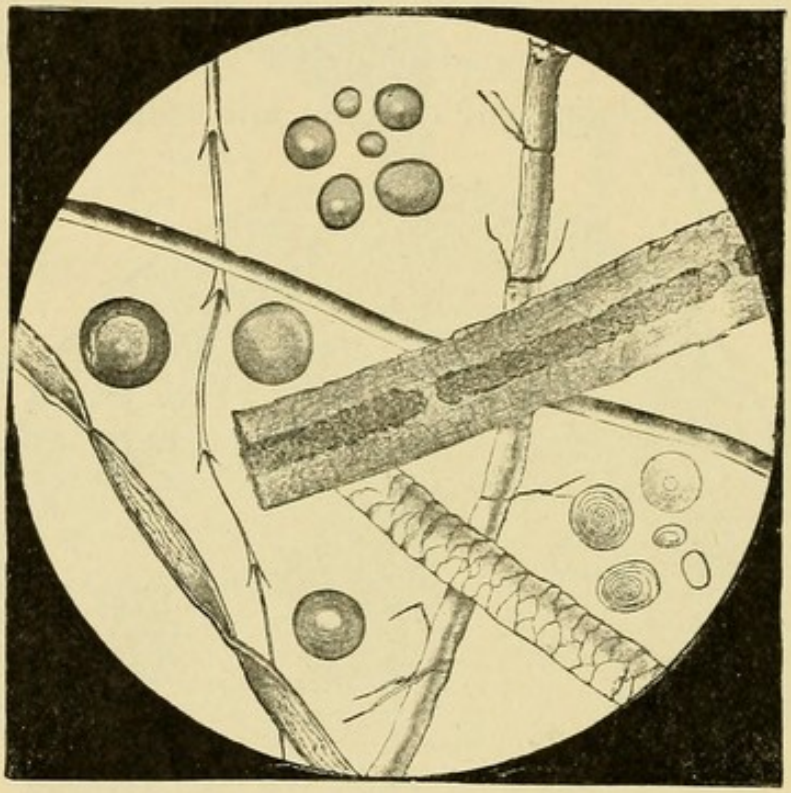


FIG. 119.—After Kratschmer-Senft.

showing constrictions. Of the two crossing it the upper one is a hair, the lower one a wool-fibre. The bodies seen in the lower right hand corner are starch-granules, those above fat-globules, and the two to the left are air-bubbles.

SPECIAL PART.

DISEASES OF THE URETHRA AND PENIS.

ANATOMY.

(*a*) DIVISION.

Instead of adhering to the old anatomical division of the urethra into a penile, membranous, and prostatic portion, we will divide it into an anterior and posterior portion. The anterior part corresponds to the penile, while the posterior includes both membranous and prostatic portions. Some other terms in use explain themselves. Thus the name *pars mobilis* is applied to that portion which lies within the penis, and *pars fixa* to the remaining portion. The boat shaped-depression in the anterior urethra is called *pars* (or *fossa*) *navicularis*, and the pouch-like expansion at the termination of the anterior portion the *pars bulbosa*. Finally there are the *pars scrotalis* and the *pars perinealis*.

(*b*) FORM.

The male urethra is shaped like an elongated S, having two curves, the first of which extends convexly forwards and upwards, while the second is concave in the same direction. The first curve exists only when the penis is flaccid. It begins at the point where the penis is attached to the symphysis pubis by the suspensory ligament (see Fig. 120 *a*). During erection, or when the penis is lifted up, the curve becomes entirely obliterated, so that the whole anterior urethra down to the bulb extends in a straight line. From a technical point of view relating to the introduction of instruments this anterior curve may be entirely disregarded.

The second curve which the urethra describes around the symphysis cannot be obliterated, and is, therefore, of much greater importance surgically than the first. The curve is equal to about one-third of a circle whose radius is 6 cm. ($2\frac{3}{5}$ inches.) The summit of this curve at the internal orifice of the urethra lies about 3 cm. ($1\frac{1}{5}$ inches) behind the under half of the posterior surface of the symphysis pubis, and its deepest part about 18 mm. ($\frac{3}{4}$ of an inch) below the inferior margin of the symphysis. This curve, of which an adequate conception may be

gained by a study of the accompanying illustration, varies with the age of the individual and also with the condition of the bladder and rectum. A full rectum pushes the prostate upwards; a full bladder pushes it

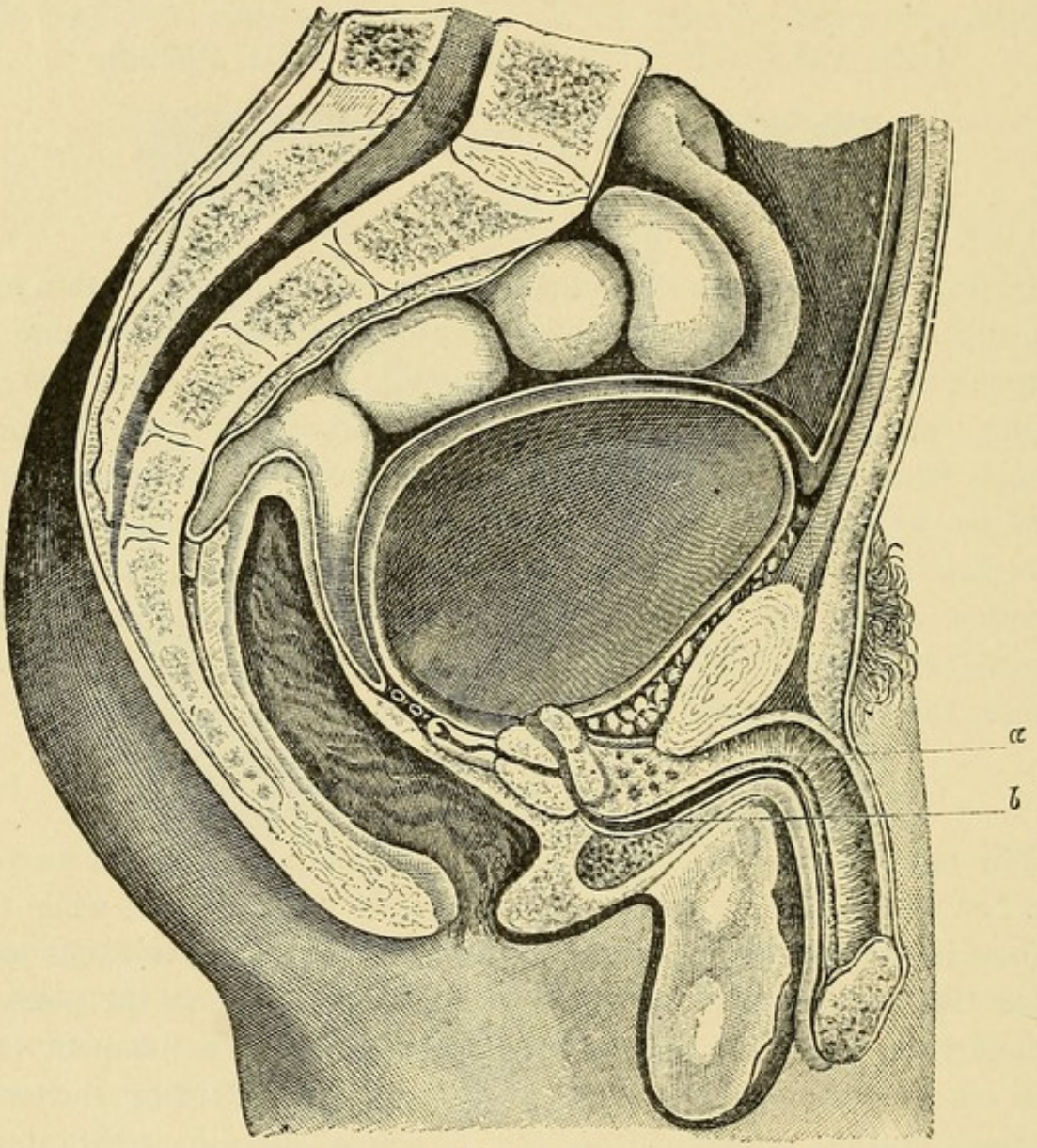


Fig. 120.

downwards and thereby lessens the circumference of the urethral curve.

(*c*) LENGTH.

The length of the male urethra varies from 18 to 20 cm. (7 to 8 inches) about 13 ($5\frac{1}{2}$ inches) of which are taken up by the anterior portion, (Fig. 121 *a d*), 2 ($\frac{4}{5}$ of an inch) by the membranous, (b) and 2 to 3 ($\frac{4}{5}$ to 1 inch) by the prostatic part.

(*d*) CALIBER.

The caliber of the urethra is not uniform, varying in its different parts. The wide-spread error that the urethra is an open tube must be corrected,

for in reality it is a **long, closed canal,** the walls of which lie in apposition except when an instrument is introduced, or when urine or semen passes through it. The urethral mucous membrane is arranged in flabelliform folds placed one upon the other, and it is for this reason that the two walls come in contact.

The narrowest part of the urethra is at the external orifice, behind which there is an expansion, the *fossa navicularis* (Fig. 121 *a*); behind this the canal remains of equal caliber down to the bulb, where the greatest expansion takes place in the form of a sac or pouch (Fig. 121 *d*). A considerable degree of narrowing occurs at the point where the bulb passes into the membranous portion, and then a further dilatation is found in the middle of the prostatic part. A slight narrowing is present at the internal orifice. These relations are well represented in Figure 121, taken from the work of Sir Everard Home. It will be seen that the expansion and contraction occur on the posterior wall, or floor, of the urethra, the anterior wall, or roof, being practically uniform throughout its length.

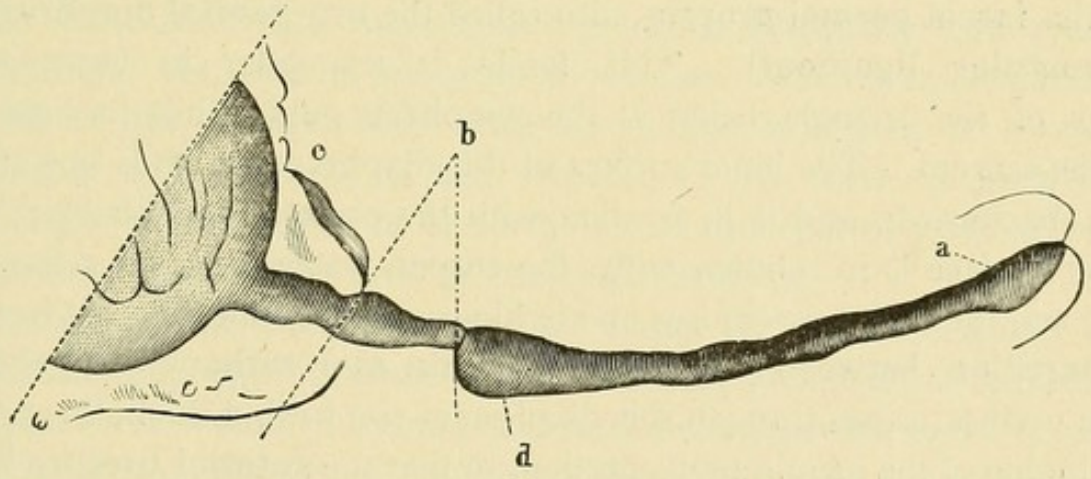


Fig. 121.

The absolute caliber of the urethra is determined by the size of instruments which it will admit. The instruments are measured by means of a draw-plate, the apertures of which are supplied with numbers representing their circumference in millimeters. This method of measuring is of French origin, having been devised by Charrière; therefore we speak of such and such a number of the Charrière scale, No. 20, for instance, being an instrument which just passes through the opening numbered 20. [In America and England it is customary to refer to this scale as the French scale instead of calling it by the name of its originator.]

The English scale is also often used. Its relation to the French scale

is about that of 1 : 3, so that No. 6 English corresponds approximately to No. 18 French.

It is incorrect to measure the urethra with an **Urethrometer,** after the method of Otis, because this instrument stretches the urethra and thus makes it impossible to tell how much of the dilatability is natural and how much artificial. The urethrometer is a staff-like instrument one end of which opens into a bulb by means of a thumb screw. [A dial at the other end registers the degree of expansion in millimetres].

Otis's declaration that the circumference of the penis and the caliber of the urethra bear a definite relation to one another is also erroneous, for oftentimes a man with a small penis will have a capacious urethra and one having a large penis will have a narrow urethra.

(*e*) THE RELATIONS OF THE MALE URETHRA TO THE TRUE PELVIS.

It is of great practical importance to understand that the male urethra lies partly without and partly within the true pelvis. The pelvic floor is closed by a part of the pelvic fascia, the **lamina media,** or the **fascia perinei propria,** also called the **uro-genital diaphragm [triangular ligament].** This fascia is triangular in form, the apex of the triangle being at the symphysis pubis, while its base is at the sacrum. The inner surface of this diaphragm extends upwards and backwards and is in relation with the prostate and bladder; its outer surface is in relation with the corpora cavernosa and a fissure between the bulbo cavernosus and ischio cavernosus muscles. It forms a **partition between the organs within and without the pelvis.** The urethra passes through this diaphragm just behind the bulb, at the beginning of the membranous portion, so that the **anterior urethra lies without the pelvis, while the posterior urethra is a pelvic organ.**

URETHRITIS.

Every inflammation of the urethra is called urethritis. It is due either to trauma or to infection.

Tears of the urethra, wounds, caustic injections such as corrosive sublimate or carbolic acid, foreign bodies such as calculi or the retention catheter, all produce catarrhal conditions in the urethra which are manifested as purulent discharges, or when of lesser severity, by the presence of filaments in the urine.

It is not necessary to assume that, owing to accidental conditions of the urethra—as irritation for example—the microörganisms normally

present there require power to produce inflammation, because similar processes in which no microörganisms whatever are present also occur (*urethritis aseptica*).

Thus, if a 5 per cent solution of carbolic acid be injected into the urethra, an intense suppurative inflammation results, although neither microscopic examination nor culture methods reveal bacteria in the discharge. It is true that the period during which they are absent is of short duration, for wherever suppuration exists bacteria soon appear. In these cases, however, they should not be considered the primary causative agents, but rather nosoparasites in the true sense of the word.

I cannot acknowledge the existence of urethritis resulting from excessive indulgence in alcohol, nor have I observed it in association with gout and rheumatism. The occurrence of herpetic urethritis, however, is not to be questioned, for herpes may attack the mucous membrane of the urethra just as it attacks any other mucous membrane, and so give rise to circumscribed inflammation resembling that produced by any other source of irritation which we have mentioned.

All these forms are characterized by their **benignity and ready curability.** As soon as the cause is overcome—the irritation discontinued or the foreign body removed—a few injections of a weak astringent solution, such as zinc sulphate 1 : 100, serve to check the discharge. These forms of urethritis are so rare that they are of little importance in comparison with bacterial urethritis.

Concerning the bacterial forms all except the gonorrhœal may be dismissed with slight mention. A few cases of urethritis due to microörganisms other than the gonococcus have been reported, and I myself have seen some cases of undoubted authenticity. The potentiality of producing an urethritis has been imputed to numerous microörganisms, but the observations are so few and the bacteriologic relations as yet so obscure that we must restrict ourselves here to the mere mention of the occurrence of such cases.

I do wish to state, however, that the prognosis in these forms of bacterial urethritis, which are called **simple urethritis,** is not so favorable as has generally been supposed. There are cases of chronic non-gonorrhœal urethritis which in spite of treatment lead to complications—as for example, prostatitis—identical with those produced by true chronic gonorrhœa.

The so-called *urethrorrhœa ex libidine*, and bacteriorrhœa are quite harmless affections. In the first, as the result of frequent sexual

excitement, a viscid drop of mucus, or perhaps only a slight moisture, appears at the meatus. This is merely the normal secretion of the urethral glands, which has exuded as a result of the increased volume of the penis produced by erection.

Bacteriorrhœa manifests itself as a thin, grayish, mucoid secretion at the meatus, being most profuse in the morning, although occurring in lesser degree during the day. It retains its original characteristics as long as it remains untreated. If this discharge be examined under the microscope it is seen that leucocytes and epithelial cells are not predominant, as they are in urethritis, but that a large number of bacteria of different forms are present, bacilli, cocci, diplococci, and organisms arranged in chains and clusters all being in the field. Cellular elements are almost entirely wanting, although here and there a few round or epithelial cells may be discovered. I have never observed any injurious effects from this discharge; it does not increase, causes no annoyance, and I have never known infection to be conveyed by it. This bacteriorrhœa often remains as a sequel of gonorrhœa, especially after an attack of long duration.

Gonorrhœal Urethritis, or clap, as it occurs in man (the disease in woman not being pertinent to our subject) is caused by the lodgment of a specific organism, the gonococcus, in the urethra. It is not always enough for the gonococcus to gain access to the urethra, since there are undoubted instances in which two men have been exposed to the same infection and only one of them developed disease, the other remaining perfectly well. Persons of the latter class are only slightly susceptible to gonorrhœal virus. Unfortunately, however, they constitute the exception, exposure being almost synonymous with infection.

The **gonococcus** of Neisser is a diplococcus characterized by the following properties. In form it is a diplococcus somewhat resembling a coffee-bean, its flat surfaces being divided by a fine cleft and its convex surfaces lying outward (Fig. 122). In *a* are seen pus-corpuscles containing gonococci, in *b* gonococci on epithelial cells, in *c* gonococci between the cells. During propagation the young bacteria are arranged with their long axis perpendicular to the old ones; that is, they occur in clusters instead of chains.

They are intracellular, penetrating both epithelium and leucocytes, especially the latter, and taking up their abode close to the nuclei. If the cellular membrane bursts they are also found between the cells.

Diplococci can positively be pronounced gonococci only when they are observed within as well as between the cells.

Gonococci stain with the basic aniline dyes; they differ from other diplococci occurring in the urethra in that they are decolorized by Gram's stain (iodine, potassium iodide and absolute alcohol).

[To examine urethral discharge for gonococci make spreads on perfectly clean cover-glasses, which may be done either by smearing a small quantity of the secretion over them with a platinum needle, or by touching the meatus with one cover-glass, placing a second one upon it, and then drawing the two apart so as to distribute the secretion thinly and evenly over both. Care must be taken not to

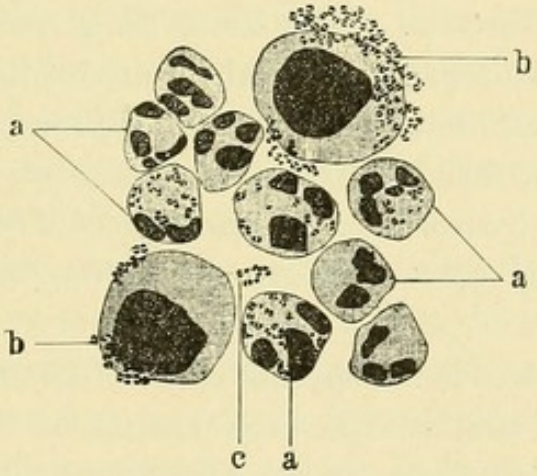


FIG. 122.—Gonococci. *a*, Masses inclosed in pus-cells. *b*, The same in epithelial cells. *c*, Gonococci floating free in the secretion.

get too much secretion lest the spreads be made too thick. The spreads are allowed to dry and are then passed through the flame of a Bunsen burner or spirit lamp three times.

A number of different stains are satisfactory. A concentrated aqueous or alcoholic solution of methylene blue stains the protoplasm and nuclei of the pus cells, as well as the gonococci, a deep blue. This is a very simple method of staining.

A saturated alcoholic solution of methylene blue may be used from five to fifteen minutes, the specimens washed in water and then stained for the same length of time in a saturated alcoholic solution of eosin, after which they are again washed in water and then mounted. The gonococci and the nuclei of the pus-corpuscles are stained blue and the protoplasm of the pus-cells pink.

In either of these two methods Gram's solution should be applied to one specimen to determine if the diplococci decolorize.

Mallory and Wright recommend the following method:

1. Stain in a solution of aniline gentian-violet for thirty seconds.
2. Wash in water.
3. Place in Gram's solution for thirty seconds.
4. Wash in water.
5. Immerse in 95 per cent alcohol until the color ceases to come out.
6. Wash in water.
7. Stain in a saturated aqueous solution of Bismarck brown for thirty seconds.
8. Wash in water and mount.

The gonococci are stained brown, other pyogenic cocci blue-black.

Dr. W. F. Whitney uses a 1 per cent aqueous solution of pyronin instead of Bismarck brown. This stains the gonococci red.]

The gonococci also require a special culture medium for their growth which is not the case with other urethral diplococci. They grow on human blood-serum, thriving best upon a mixture of blood-serum, or serous fluid such as hydrocele-fluid, and agar. They grow excellently at a temperature of 30° C. Above 38° C. they lose their power of development.

That the gonococcus is the specific cause of gonorrhœa is at present not doubted. The urethra has been inoculated with this organism after it had passed through several successive cultures and a typical gonorrhœa has resulted in every instance.

The gonococcus retains its virulence outside the body, a property which explains the occurrence of infection by means of contaminated linen, dirty instruments, chamber-vessels, etc. This form of infection occurs most frequently in little girls, although I have seen a case in a boy two years old.

We divide gonorrhœa according to its clinical manifestations into an **acute** and **chronic** form, and also into an **anterior** and **posterior** form, which may be either acute or chronic.

PATHOLOGICAL ANATOMY.

The gonococci, after gaining access to the urethra, penetrate the mucous membrane and begin to multiply very rapidly. They are present not only in the discharge, which consists mostly of pus-cells cast off from the surface of the urethra, but also in the subepithelial tissue, the crypts of Morgagni, and the glands of Littré. Their enormous increase in number causes an inflammation, as the result of

which the urethral mucous membrane becomes swollen, œdematous, and injected.

Leucocytic infiltration occurs, the white cells collecting between the epithelium and destroying it. They invade the outlets of the glandular ducts, penetrating as deep as the subepithelial connective tissue, between the cells of which they may be seen if a section of tissue is examined under the microscope. They likewise attack the glandular cells and periglandular tissues, forcing their way even into the crypts of Morgagni and the glands of Littré; in fact, this infiltration of polymorphonuclear leucocytes is universal.

The process involves the surface of the urethra as well as its deeper layer, and tends constantly to extend backwards. As long as it does not pass beyond the bulb we designate it as **anterior gonorrhœa;** when it exceeds this limit it is known as **posterior gonorrhœa.**

Fortunately the latter occurrence is not very frequent during the acute stage of the disease, but it happens almost invariably in the chronic stage, as we shall see later.

The transition from anterior to posterior urethritis may take place at any time, and I have seen it occur as early as the second day; the time of predilection, however, is during the second or third week. The gonorrhœal inflammation travels backward slowly, and in a certain number of cases, which generally subside in from four to six weeks, is arrested at the bulb. If it goes beyond this point into the posterior urethra, a further involvement of both the deep and superficial strata is the usual result. When the deep layers are affected catarrhal inflammation of the prostatic ducts, the orifices of the seminal vesicles and their surrounding tissue, and finally of the prostate itself, the seminal vesicles, and even the epididymis occurs. If the extension takes place superficially the bladder becomes affected and a gonorrhœal cystitis is produced. In many cases the deep and superficial layers suffer simultaneously.

This acute process, which affects both the anterior and posterior urethra, may terminate in either one of two ways. If, under appropriate treatment, the number of gonococci diminish and their virulence becomes attenuated, then the leucocytic infiltration decreases. The small embryonal cells disintegrate and are absorbed and normal epithelium forms on the previously diseased areas, so that a complete *restitutio ad integrum* is brought about.

Unfortunately this is not the invariable termination, for although

the inflammation and small-celled infiltration decrease, they do not entirely disappear, and what is known as **chronic urethritis** results. In this condition gonococci may be present or absent. Thus it is seen that the continuation of a chronic urethral catarrh is not dependent upon the presence of gonococci. Indeed, the inflammatory infiltrate may persist for years or even decades after the primary cause of the affection has been removed.

This chronic process is essentially a small-celled infiltration, which may affect any part of the urethra from the meatus to the neck of the bladder and involve both its superficial and deep structures, but which seems to have a special affinity for the glandular portions, such as Littré's glands and Morgagni's lacunæ, together with their adjacent tissues; moreover, it may penetrate to the deeper layers of sub-epithelial and connective tissues, and even force its way into the corpora cavernosa.

Some of this infiltrate undergoes absorption and some of it becomes converted into connective tissue, the latter forming a callus or scar. Obliteration of blood-vessels follows, as the result of which the cylindrical epithelium is changed into squamous epithelium, which becomes partly cornified. These infiltrations do not effect the whole length of the urethra, but are localized. More and more plastic material is deposited, so that scar is superimposed upon scar until finally, in course of time, a perceptible degree of thickening results, which is known as a callus, and which constitutes a **stricture of the urethra.**

Chronic urethritis, however, corresponds rather to that period of time during which the infiltrative process does not increase to such an extent as to produce perceptible narrowing of the urethra; in fact, a large number of these cases never advance to stricture formation because the infiltrate is confined to a few limited areas, mostly glands and their neighboring tissues. Thus it continues as a chronic, discharging urethritis, the secretion being due to disintegration of the newly formed infiltrate; the leucocytes likewise accumulate again, and so the process continues, often for an indefinite period.

SYMPTOMATOLOGY.

(*a*). **Acute gonorrhœa.** The incubation period of gonorrhœa, which pursues its course without any symptoms, lasts from one to six days. Generally the signs of infection begin to manifest themselves by

the third day after exposure. A slight burning sensation is experienced in the urethra, and an itching is felt during urination, while between the acts of micturition there is a sense of moisture at the meatus. Very soon the secretion develops in abundance. At first it is mucoid, then muco-purulent and finally purulent; occasionally it is stained with blood (Russian clap). In this discharge gonococci are always found in the typical form above described.

The inflammatory phenomena increase, the pain becomes more severe, urination frequently causing such exquisite pain that the patient refrains from passing his water. The area around the meatus is red and swollen, the lips of the meatus œdematous.

The inflammation produces erections, which are frightfully painful, for the reason that the swollen mucous membrane cannot expand to accommodate itself to the increased volume of the penis.

This acute stage soon passes into the subacute stage, the time required for its transition depending upon the appropriateness of treatment. The inflammatory phenomena diminish from day to day; micturition becomes less painful until finally only a slight smarting is felt; the discharge diminishes and loses its greenish yellow color, becoming again a grayish yellow, muco-purulent secretion.

This stage may supervene at the expiration of a week or ten days, although there are many cases in which the inflammatory stage lasts until into the third week. Then the symptoms become milder and milder, the discharge dries up and only a small drop of mucus-like secretion is seen at the meatus after long intervals between micturition. All pain and discomfort have now entirely disappeared. If the urine be voided in two portions, the second will be found entirely clear, while the first will contain flocculi. Finally these will disappear, and the disease can then be considered cured.

In many cases of acute gonorrhœa the inflammatory stage just described is entirely wanting. They begin with slight purulent or mucoid secretion which retains its original character throughout the course of the disease. Signs of inflammation, such as swelling of the meatus and painful micturition, do not occur. These non-inflammatory claps are seen especially in patients who formerly have passed through an attack of gonorrhœa. It even happens that the infection produces so little disturbance as to pass unnoticed by the patient until he discovers it accidentally or an exacerbation attracts his attention to it. In this way are explained the cases in which gonorrhœal shreds, or even discharge are

found, notwithstanding the fact that the patients assert they never had gonorrhœa.

In most instances, though not always, the disease pursues the favorable course above described, from four to six weeks usually being required for its subsidence. In all these cases, which may best be called those free from complications, the inflammatory process does not extend beyond the bulb of the urethra.

If it pass beyond this point during the acute stage, an **acute posterior gonorrhœa** results, and the entire symptom-complex becomes immediately changed. While acute anterior gonorrhœa produces scarcely any general disturbance, patients having acute posterior urethritis are often feverish and present the appearance of being afflicted with a serious malady. Although the purulent discharge becomes less, or disappears entirely, three symptoms develop which make the clinical picture a typical one: **1. Severe strangury occurs, the patients being forced to urinate frequently both day and night, sometimes as often as every fifteen minutes; 2. Micturition is painful, the pain most commonly supervening at the end of micturition and lasting for some time thereafter; 3. The second portion of the urine is cloudy, the turbidity being due to pus. Not uncommonly terminal hæmorrhage occurs, the last drops of urine being tinged with blood. In exceptional cases the entire quantity of urine voided is blood-stained.**

The turbidity of the second portion of urine is explained as follows:—We know that the anterior urethra is shut off from the posterior by contraction of the *musculus compressor partis membranosæ urethræ*, also termed the *sphincter vesicæ externus*, so that fluid in the anterior urethra (be it an accumulation of pus or an injection), flows toward the external orifice. If a considerable quantity of pus accumulate in the posterior urethra, or if fluid be injected into it, the resistance of the internal vesical sphincter is overcome and the fluid flows into the bladder. The pus is dissolved by the urine and renders it turbid. Thus it is that in every freely suppurating posterior urethritis the second portion of the urine is cloudy. The first portion is even more turbid than the second, because it contains not only pus derived from the bladder, but also that which it washes out from the urethra.

This property serves to distinguish it from the urine of cystitis, the second portion of which is more turbid than the first, because no secretion is added to it in its passage through the urethra; morover, the

portion first voided represents the upper part of the urine contained in the bladder, whereas the second portion consists of the purulent sediment.

In such cases gonorrhœal cystitis usually develops. Posterior urethritis, unless promptly and energetically treated, is the forerunner of cystitis. A series of complications is threatened. Unfortunately the gonorrhœal process often extends to the prostatic ducts and produces a prostatitis. In like manner inflammation of the vasa deferentia, epididymis and seminal vesicles may develop.

On the other hand acute posterior urethritis, especially under rational treatment, may pursue a favorable course; all symptoms and signs—tenesmus, pain, cloudy urine—disappear and the patient escapes complications. Most frequently, however, the inflammation becomes chronic, and when it does gonorrhœal prostatitis is almost always the result.

(*b*). **Chronic gonorrhœa.** If the disease has not subsided by the end the the sixth week we then speak of it as chronic gonorrhœa, a condition in which the distinction between anterior and posterior gonorrhœa is less pronounced; and is also less significant, because nearly all cases of chronic gonorrhœa involve both the anterior and posterior urethra.

Ordinary chronic gonorrhœa cannot be distinguished from the last stage of the acute form. Urethral discharge is present in a certain number of cases, and may either be profuse enough to be detected at the meatus or so slight as to be manifested only by the presence of filaments in the urine. If the patient urinates in two glasses the filaments will be present chiefly in the first glass, although some may be observed in the second. The more abundant the secretion, the thicker the flocculi, for heavy pus-flakes sink quickly to the bottom of the glass whereas thinner mucous shreds float in the fluid for some time.

Subjective symptoms may be entirely absent; neither painful urination nor strangury are necessarily present even when the disease affects the neck of the bladder.

With the exception of filaments the urine becomes clear as soon as the discharge becomes slight. As the purulent secretion is confined to the posterior urethra and first mingles with the urine when the latter is voided, it cannot produce turbidity. When the urine is allowed to stand for a long time then, of course, the filaments are dissolved and cause a cloudiness. If the secretion of pus be very abundant then the second portion of the freshly voided urine will also be turbid. There-

fore, although a freshly voided clear urine does not show that posterior urethritis is not present, a freshly voided turbid urine assures us of its existence.

In addition to the not very important classification of chronic gonorrhœa into an anterior and posterior form, another division must be made from the standpoint of treatment, namely, that of a superficial and deep catarrh.



FIG. 123
Otis's urethrometer.

We have considered the morbid anatomy of chronic gonorrhœa and seen that it is a small-celled infiltration which partly undergoes resorption and partly changes into scar-tissue, whereby relapses frequently occur. If this process is confined to the surface of the urethra, to the glands and their surroundings, only a superficial catarrh is the result; if it penetrates into the deeper parts, into the submucous connective tissue or even into the corpora cavernosa, and displays a tendency to develop scar-tissue from the embryonal cells instead of undergoing resorption, a deep seated catarrh is produced, and we have to do with **infiltrative processes.**

This latter condition is characterized clinically by perceptible narrowing of the caliber of the urethra, while in the superficial form no such narrowing is present. This encroachment upon the lumen of the uerthra is not always so great that it can be detected with an ordinary sound, especially since the external meatus is the narrowest part of the urethra. If we assume that the meatus just allows the passage of an instrument whose caliber is 22 F., while the bulb, which normally may be dilated to 40 mm. has undergone a diminution of 10 mm. as the result of infiltration, it is evident that the narrowing cannot be detected by a 22 sound. The bougie à boule, or the Otis urethrometer, will often reveal its existence, but the urethroscope is more certain than either of these instruments.

The urethrometer (Fig. 123) is an instrument having at its tip a bull composed of separate blades, which may be opened to 40 F. by means of a thumb-screw. A dial at the other end registers the degree of expansion in millimeters.

The surest method of diagnosis is urethroscopy (*q. v.*), which gives a typical picture of the infiltrate. Diminution or absence of the plica-

tions, disappearance of the striations, irregular blemishes of the mucosa, abnormal paleness, loss of luster, and rigidity are all revealed.

Of greater importance is the question of the **infectiousness of gonorrhœa.** It is self-evident that as long as gonococci are present in the discharge so long is the discharge infectious. The difficulty lies in the fact that gonococci may be present and yet not be found. Daily experience teaches that they are not constantly demonstrable, being present at one time and absent at another. The reason for this is that they remain latent in the deeper portion of the urethra and only come to the surface at intervals, or when perchance an exacerbation of inflammation increases the discharge. They burrow in the glands, in the submucous infiltrate, and especially in the prostate, retaining their vitality for months and even years.

In view of these circumstances when shall we permit a man who has had gonorrhœa to marry? The dictum, "not before the last remnant of discharge has disappeared" cannot be accepted in practice. We know that a large number of men who have had gonorrhœa are never entirely free from the relics of their disease, as their urine contains filaments. If we were to forbid all such to marry they certainly would not obey us; and if they did the number of unhappy mortals in the world would be greatly increased, the list of neurasthenics and hypochondriacs would become larger, and mankind would even be in danger of extinction. We well know that many such men marry and never infect their wives, although it is true, too, that infection has been conveyed by men in whom the most careful examination failed to show gonococci. In my experience, however, the latter occurrence is rare. Concerning the question of marriage I have adopted the following rule:—

If the patient has any abnormal secretion, be it shown by urethral discharge or by filaments in the urine, it must be repeatedly examined at long intervals for gonococci. If filaments are present the urine is centrifuged and the precipitate stained. If all examinations are negative the urethra is irritated by natural or artificial means (cohabitation, free use of strong alcoholic beverages, irritant injections like nitrate of silver). If the increased secretion thus produced shows no gonococci then marriage may be permitted. Possibly this course may result in an occasional mistake, but in the present state of our knowledge we possess no other criteria of infectiousness and so are obliged to choose the lesser of two evils.

The composition of the secretion is of no special consequence, it

being immaterial whether it consists chiefly of pus-cells with a little epithelium, or whether it be made up entirely of pus-cells. Epithelium alone shows that the process is distinctively desquamative and pus-cells denote the existence of catarrh. The principal question to be determined is whether gonococci are present.

Every case of gonorrhœa, from its very inception to its termination, is subject to a series of complications; this is true even in the period when gonococci no longer are present and the condition may be rightly termed urethritis. We will now briefly discuss the principal complications.

LYMPHANGITIS AND LYMPHADENITIS.

Both occur almost exclusively in acute gonorrhœa. The gonorrhœal process extends into the lymphatic vessels and glands. Occasionally, though not often, it happens that the lymphatics become so acutely inflamed as a result of previous swelling of the prepuce and penis that they rupture and from periurethral abscesses. Much more frequently they become chronically swollen and indurated, so that they are palpable, especially on the dorsum of the penis.

Inguinal adenitis consists almost always of an enlargement of the glands which rarely suppurates but generally undergoes resolution.

FOLLICULITIS, PERIFOLLICULITIS, PERIURETHRAL ABSCESS.

We have already stated that the glands of the urethra are attacked by the gonorrhœal process. If several glands are thus involved they can be felt from without as small bodies about the size of a hemp-seed. They may last indefinitely and act as a fresh source of infection, or they may degenerate into little cysts, or if their surrounding tissue become involved they may be converted into small periurethral abscesses.

This is typical around the frænum where the glands are near the external surface. Further back in the urethra where they reach into the corpora cavernosa suppurations can extend outward as easily as inward, so that the final result is often a urinary fistula. They are much less common, however, than periurethral abscesses near the corona.

PARAURETHRAL FISTULÆ.

Very often minute openings surrounded by a zone of red are seen near the meatus. Upon pressure pus exudes, in which gonococci are usually present. These paraurethral or periurethral fistulæ are blind,

that is, they do not communicate with the urethra. They may continue to suppurate for a long time, and unless they are destroyed will prevent cure of the gonorrhœa.

COWPERITIS AND PERICOWPERITIS.

In like manner the gonorrhœal process may invade Cowper's glands. If marked infiltration occur the glands can be felt beneath the skin of the perineum as small nodules about the size of a pea. This infiltration may extend to the surrounding tissue. It may be entirely resorbed or it may suppurate; in the latter case the pus is usually absorbed, although rarely it works its way to the exterior and produces a urinary fistula.

[Chronic inflammation of Cowper's glands is sometimes responsible for chronic relapsing urethritis. The glands can be palpated through the rectum by passing the index-finger into the bowel as far as the apex of the prostate, then withdrawing it slightly, and at the same time making lateral pressure on the perineum with the thumb so as to push the urethra lateralwards. The glands will then be felt between the thumb and finger as small nodules about the size of a pea.

The treatment of this condition consists in massage, which must be done very gently, together with the usual measures employed for the urethral lesions.]

The other complications which result from direct extension of the infectious process are cystitis, urethritis, pyelitis, pyelonephritis, prostatitis, deferenitis, epididymitis, orchitis, and spermatocystitis. (*See under these diseases*).

EXTRAGENITAL COMPLICATIONS OF GONORRHŒA.

Organs which lie more or less remote from the classical seat of gonorrhœa may be infected by the gonorrhœal virus in two ways: either by direct contact, or through the blood or lymph-channels (gonorrhœal metastases). Among complications arising in the first manner may be mentioned gonorrhœa of the rectum, mouth, nasal cavities, and eye.

Gonorrhœa of the rectum is a very rare disease. The gonococcus can be brought to the rectum by indulgence in unnatural sexual practices, or in the uncleanly it may infect erosions or fissures produced by hemorrhoids and thus gain access to the bowel. Infection of the

rectal mucous membrane may also occur when a gonorrhœal abscess of the seminal vesicles or prostate ruptures into the bowel (Jadassohn).

In this disease the mucous membrane around the anus is red and excoriated. The discharge, which occurs during or after defecation and also independently thereof, is malodorous and purulent, or perhaps sero-purulent or sanguinolent. It contains gonococci. Fissures and excoriations form on the anal folds, which makes defecation painful; burning, itching of the anus, and rectal tenesmus, which may lead to prolapse, are the most common symptoms. Small, pointed condylomata may also appear at the anus.

The treatment of this benign disease consists in scrupulous cleanliness, sitz-baths, injections of tannin, alum, or potassium permanganate, applications of zinc ointment, and if fissures develop, nitrate of silver ointment or the fused nitrate of silver.

It is most uncommon for the gonococcus to infect the mucous membrane of the mouth and nose, although cases have been reported in which transmission of gonorrhœa has been effected by dressings, handkerchiefs, etc. Buccal gonorrhœa is also said to have occured as a metastasis. The most plausible view is that infection results from unnatural intercourse with a man suffering from gonorrhœa. Kast has reported a case of gonorrhœal stomatitis occurring in an infant. The disease was mild and yielded readily to frequent astringent mouth washes.

Of greater importance is **gonorrhœal ophthalmia,** which begins as a gonorrhœal inflammation of the conjunctiva, produces a purulent discharge containing gonococci, and often leads to destruction of sight. It occurs in the new-born as well as in adults.

For a detailed treatise on this affection the reader is referred to text-books on ophthalmology. We only desire to call attention to its seriousness. The inflammation easily extends to the cornea and may partly or entirely destroy it by ulceration. Every case of gonorrhœal ophthalmia should be referred to an ophthalmologist for treatment.

Prophylaxis of the disease is what concerns us. We must impress our patients most forcibly with the danger of this complication and instruct them to practice the most scrupulous personal cleanliness, such as frequently bathing the penis, protecting their linen by means of gauze or cotton placed over the meatus, washing the hands after urinating or using an injection, etc.

Credé's admirable method of touching the conjunctiva with 2 per

cent solution of silver nitrate immediately after birth is an effectual preventive of gonorrhœa neonatorum.

Of the gonorrhœal metastases the most important and most frequent is **gonorrhœal arthritis.**

For a long time it was doubted whether a true gonorrhœal arthritis existed. After the presence of the gonococcus in the joints had been demonstrated beyond cavil by means of pure cultures grown from arthritic effusions there was no further room for difference of opinion. Gohn, Schlagenhaufer, Finger and others have demonstrated gonococci in the secretion of the joints by means of the microscope, have grown them on culture media, and studied them in morbid tissues. It must be remembered, however, that those cases in which gonococci are found in the exudate are not the only ones which are to be considered as gonorrhœal, because many cases in which the specific organism is not present are undoubtedly of gonorrhœal origin. In such cases micro-örganisms of suppuration have gained access to the joint simultaneously with, or subsequent to, its invasion by the gonococci and destroyed the latter organism. These are examples of mixed and secondary infection, respectively. It may happen, too, that the gonococci perish without the intervention of other microörganisms.

In this way is explained the so-called germ-free exudate (or according to others ptomaine infection) in gonorrhœal joints.

Gonorrhœal arthritis occurs in about 2 per cent of all cases. It may develop in any stage of the disease, although its incidence is most common in the later stages. The knee-joint is most frequently affected, the ankle-joint comes second and the joints of the fingers and hands third. Involvement of other joints is rare.

The disease begins with moderate fever, together with pain and swelling of the affected joint. The exudate increases by degrees until it becomes profuse. It causes distension of the joint which impairs or even entirely abolishes movement. Fluctuation is generally demonstrable. From this acute stage the disease passes into a subacute condition. The fever and swelling subside and the exudate becomes less, being often completely resorbed. In some cases acute relapses follow this improvement. The disease does not invariably proceed to resorption of the exudate and *restitutio ad integrum*, but results in permanent hydrarthrosis or terminates in suppuration.

It is important to remember that gonorrhœal arthritis is often of a subacute or chronic type from its very inception, a hydrarthrosis

developing gradually without any premonitory symptoms or pain, being accompanied only by swelling and impairment of function. In such cases resorption may occur; in others the exudate persists and leads to plastic changes in the joint, to deformities and ankyloses which interfere partly or entirely with its function.

The most unfavorable termination of all is suppuration. It may persue an acute or chronic course, rupture externally, lead to ankylosis, and also to fatal pyæmia.

Diagnosis is easy in most cases, true rheumatism being the only disease from which gonorrhœal arthritis must be differentiated. It is to be remembered that when gonorrhœal arthritis has once developed as a complication it has a tendency to recur whenever fresh infection is contracted, and that only a few joints at most are affected, the disease often being monarticular; when it is polyarticular it seldom affects more than two or three joints. Moreover, the several joints are not involved simultaneously, but become affected one after another. Furthermore, the duration and intensity of the subjective symptoms are less than in articular rheumatism; fever and pain subside more quickly, although the joint remains swollen and its function is impaired. Oftentimes increased intensity of the articular manifestations occurs simultaneously with an exacerbation of the urethral symptoms. Finally it is to be mentioned that gonorrhœal arthritis does not yield so promptly to specific treatment—salicylic acid, aspirin—as does articular rheumatism; indeed, it may be said that these remedies have absolutely no specific action in gonorrhœal arthritis.

The prognosis of gonorrhœal arthritis is not unfavorable. Its progress is slow, and, as above stated, it may terminate in permanent hydrathrosis, ankylosis, or suppuration; generally, however, resolution slowly but surely takes place.

Treatment is purely symptomatic, as we possess no specific. Internally oil of gaultheria in doses of ten to twenty drops three times a day has been recommended, as have also potassium iodide, salol and antipyrin. We consider the best treatment to be immobilization of the joint by means of a splint and bandages, associated in the later stage with inunctions of iodine preparations, local hot-air baths, and eventually sand and mud-baths.

[Torrey's antigonococcic serum has been used with apparent success in a number of cases. Further experience, however, is necessary before its exact value can be determined.

Bier's passive hyperæmia has been employed with some success, although it is said not to shorten the duration of the disease (Hirsch). That it relieves pain in many cases, however, it attested by the experience of several surgeons who have used it.

In chronic cases tonics are indicated. Full doses of syrup of iodide of iron are valuable; arsenic may also be employed. For restoring motility of the joint massage and passive movements are useful. When suppuration occurs incise the joint, irrigate, and drain, the same as in any other infective arthritis.

Gonorrhœal ankylosis of the wrist has recently been successfully treated by completely resecting the carpus and interposing a muscular flap. Good motion in flexion and extension and also ability to lift weights has been obtained. See *Nelaton's paper in la Revue d'Orthopœdie, January*, 1905.]

Of the metastases affecting other organs and tissues we will first mention **gonorrhœal tendovaginitis.**

This is a relatively rare affection, which almost never occurs before the third week of the gonorrhœa, and which begins with slight febrile disturbance and pain in the joints. The pain is confined to one or more tendon-sheaths, which appear slightly swollen and impart a sense of fluctuation when palpated. The skin over them is somewhat reddened and œdematous. Pressure or motion increases the pain. Usually the pain persists after the swelling and redness have subsided. Most frequently the tendons and tendon-sheaths of the extensor communis digitorum, flexor pollicis, and the dorsal extensors of the toes are the ones involved. The complication is not serious and resorption almost always leads to cure; relapses, however, are frequent.

Gonorrhœal bursitis, which rarely occurs alone, being almost always associated with disease of the joints or tendon-sheaths, is a decidedly benign affection.

Gonorrhœal myositis likewise is generally a complication of arthritic infection, although it may develop independently thereof. Cases in which the vastus internus, the sterno-cleido-mastoid, and the trapezius were effected with rigidity, tenderness upon pressure, and impairment of function have been reported. With a single recorded exception resolution and cure have always taken place. In Eichhoff's case sclerosis of the affected muscles occurred.

Gonorrhœal periostitis is a rather more common complication of gonorrhœal arthritis. A classical case occurring after gonorrhœal

ophthalmia has been reported by Ghon, Schlagenhaufer and Finger. The disease is manifested by circumscribed elevated swellings on the joint, which are painful and sensitive to pressure. The skin over them is doughy and œdematous. The periosteal thickening generally undergoes resolution, but it may persist.

Achillodynia (pied blennorrhagique) is the name given to a periostitis affecting the calcaneum at the insertion of the tendon of Achilles and the plantar aponeurosis. It manifests itself as a painful swelling below the insertion of the tendon and interferes with walking. Sometimes there is also a cystic enlargement of the bursa beneath the calcaneum.

Ullman has reported a case of **acute gonorrhœal osteomyelitis** affecting the radius. Pus obtained by boring into the bone contained gonococci, which were found by microscopic examination.

Gonorrhœal phlebitis has been observed by Mertel and Batat, the presence of the specific organism being demonstrated.

As to complications affecting the respiratory system cases of **pulmonary infarct** have been known to follow gonorrhœal arthritis (Finger, Scholtz) and several cases of **pleurisy** have been observed. In Mazzas case polyarthritis developed in a girl aged eleven a few days after she had been raped, and a double pleurisy immediately followed upon the arthritis. In the pleuritic exudate gonococci were found microscopically and also by culture.

Special importance is to be given to **gonorrhœal affections of the nervous and circulatory systems.**

The peripheral nerves and also the nerve-centers may be affected. Fournier, Lesser, A. Fraenkel and others have observed ischialgia, Eulenberg has seen neuralgia of gonorrhœal origin in areas supplied by the sensory nerves of the arm, and Engel-Reimers has described similar cases in the region of the ischiatic, crural, obturator, and auditory nerves; Spillman, Engel-Reimers, and Welander have observed cases of gonorrhœal polyneuritis.

As to central disturbances von Leyden's description of **transverse gonorrhœal myelitis** has become authoritative. The symptoms are muscular atrophy, pain, hyperæsthesia of the extremities, increased reflexes, neuralgia, pain in the spinal column, a sense of constriction around the body (girdle pain), and disturbances of micturition. Examination of the spinal cord in von Leyden's case revealed only slight evidences of myelitis in comparison with the severe nervous symptoms

which were present during life. Gonococci were not found in the spinal nerves. This case teaches us that even severe gonorrhœal spinal myelitis and myelo-meningitis may be cured.

Litten has reported two cases of **post gonorrhœal chorea.**

Gonorrhœal endocarditis. Within the last decade it has been positively determined that gonorrhœa can produce cardiac metastases. Von Leyden first described a case of genuine gonorrhœal endocarditis. In the vegetations he found microörganisms which in form, size, arrangement and staining reaction possessed the attributes of the gonococcus, although cultures could not be grown. Later Lenhartz, Ghon, Schlagenhaufer and Finger described cases in which the gonorrhœal nature of the endocarditis seemed assured, and in which gonococci in pure culture were obtained from the ulcerated endocardium. In the case of Ghon and Schlagenhaufer an acute gonorrhœa was produced by inoculating the urethra with the culture thus obtained.

The endocarditis which develops in gonorrhœa generally as a complication of arthritis, but also independently thereof, is therefore a true gonorrhœal metastasis, although of course a similar condition may be produced by mixed or secondary infection.

There are two forms, a benign and a malignant. The first begins without elevation of temperature, only slight cardiac disturbance, irregular pulse, palpitation and a feeling of oppression being present. Upon auscultation murmurs are heard. The symptoms either subside rapidly under rest-treatment or become accentuated and lead to a valvular lesion and its sequelæ. The malignant form, which almost without exception is preceded or accompanied by gonorrhœal arthritis, is ushered in by chilis and high fever. The sensorium is benumbed. Anxiety, a sense of oppression, dyspnœa, rapid pulse, loud cardiac murmurs, albuminuria and polyuria are the principal symptoms.

Remissions occur but they are soon followed by exacerbations. The disease terminates either in death or in an incurable cardiac lesion. Death is caused by embolism, infectious nephritis, or by extension of the morbid process to the heart muscle (acute myocarditis). Pericarditis and multiple metastases are almost always present; thrombi are found in the spleen, kidneys and brain. Microscopic examination of the endocardial vegetations reveals gonococci, pyogenic bacteria (secondary infection), or both (mixed infection).

The **prognosis** of the benign form is good, that of the malignant form bad; in the most favorable cases of the latter form a permanent cardiac lesion results.

The **treatment** does not differ from that of other forms of endocarditis.

In addition it may be mentioned that post-gonorrhœal septicæmia, though exceedingly rare, has certainly been observed. The patients suffer from protracted fever with evening elevation of temperature as high as 40.5° C. (105° F.) The enlargement of the spleen and icteric discoloration of the sclera leave no doubt as to the nature of the malady, although as yet the presence of gonococci in the blood has not been positively demonstrated. It is also an open question whether mixed or secondary infection with the organisms of suppuration takes place.

Exanthemata in gonorrhœa. Formerly when eruptions occurred during or after gonorrhœa they were attributed to the medicines which had been used, as for example, balsam of copaiba. It was found out, however, that occasionally an exanthema may develop in cases in which no drugs are administered. Therefore it may be assumed that there is a causative relation between gonorrhœa and these dermatoses.

Up to the present time no one has succeeded in finding gonococci either in the blood of patients having the eruptions or in the skin lesions themselves. Vidal and Besnier consider them to be **trophic myelopathic toxicodermata.** Buschke believes that they are the result of the gonorrhœal toxin. They appear in the form of erythema, herpes, urticaria, purpura and hyperkeratoses, the palms of the hands and soles of the feet being their most common site, although they affect other parts, as for example, the thighs and genitalia.

Having now discussed the complications of gonorrhœa we will proceed to the consideration of its prognosis and therapy.

The prognosis as to life is good. It is only with the greatest rarity that, as the result of blood-infection, a severe complication such as endocarditis develops and endangers life.

The prognosis as to recovery is doubtful. A small percentage of acute cases get entirely well; the majority, however, become chronic. As a rule, chronic gonorrhœa can be converted by protracted treatment into the simple non-infectious urethritis, but even then we cannot in the strictest sense consider it cured, inasmuch as the chronic catarrhal

process lasts for years or tens of years, and generally the complications which it produces by extension—as for instance prostatitis—also persist.

Furthermore it is to be borne in mind that as long as the chronic process remains, sudden exacerbations may occur, and that the catarrhal condition affords a good soil for the growth of bacteria, which may cause ascending affections such as cystitis or pyelitis to develop, even though gonococci be no longer present. Gonorrhœa, therefore, is a serious disease which requires careful attention on the part of the physician.

TREATMENT.

The first and most important thing to be enjoined upon a man suffering from gonorrhœa is the practice of scrupulous cleanliness. He must be warned of the danger of conveying infection with the purulent discharge and especially against carrying it to his eyes. He should bathe several times a week and wash the penis, after drawing the prepuce back, three times a day, and afterwards cover it with cotton in order to prevent the discharge from contaminating his linen and thus furnishing a constant source of infection.

Coitus is of course forbidden. The patient should wear a suspensory bandage and avoid all severe bodily effort, especially gymnastic exercises, riding, bicycling, swimming, etc.

He should partake of a mild, unirritating diet. All highly seasoned and sour foods, herring, radishes, salads, mustard, spiced sauce, smoked and salted meats, cheese, and all alcoholic beverages are to be interdicted. As patients are usually obliged by social reasons to conceal their disease, they may be permitted, when it becomes necessary, to drink a little red wine mixed with water, this being the least harmful alcoholic beverage of which they can partake.

During the acute stage large quantities of water should be drunk, so that frequent urination will be produced and the pus washed out of the urethra. I allow as much as 6 liters (12.6 pints) of water to be drunk daily. Mineral waters, such as manufactured soda-water, Fachinger, Sauerbrunnen, etc., have been decried as injurious. I have never observed any harmful action from them, and prescribe them as diuretics.

Of internal remedies the **balsamics** and **diuretics** are the only ones posessing any value; the **antiseptics,** such as boric acid, salol, etc.,

have proved useless. Vegetable diuretics in the form of tea taken several times a day, oil of sandalwood, balsam of copaiba, fluid extract of pichi in doses of 20 to 40 drops daily are appropriate drugs, especially in those cases in which inflammatory symptoms or strangury are present. The balsams may be given in the following prescription:—

℞ Ol. santali (or Bals. copaibæ)
Ext. pichi fl. aa 15.0 (f℥. iv.)
Ol. menth. pip. gtt. v.
m
Sig. 20 drops three times daily.

Oil of sandalwood or balsam of copaiba may also be given alone in capsules containing 0.5 (7½ minims), of which from 1 to 3 three times a day may be taken.

The action of these drugs must be watched, because they sometimes produce gastritis and also irritate the kidneys. In such cases they must be immediately stopped.

For painful erections large doses of the bromides may be given or heroin in doses of 0.004 to 0.006 ($\frac{1}{16}$—$\frac{1}{10}$ gr.) may be used instead. Cold applications to the penis, cool sitz-baths, regulation of the bowels, and avoidance of late suppers are useful measures.

In lymphangitis it is well to bind the penis to the abdomen and apply a 3 per cent solution of aluminum acetate or lead water.

As to local treatment it is first to be borne in mind that uncomplicated gonorrhœa is a trivial disease, but that complications frequently convert it into a serious malady, the consequences of which cannot be foretold; furthermore, it must be remembered that injudicious local treatment frequently causes, or at least favors the development of these complications. Therefore, if the complications are more serious and dangerous than the original disease itself, it seems logical to conclude that, if possible, **treatment must so be conducted as to prevent their supervention.**

Acting in accordance with this principle I have come to abandon under all circumstances the **abortive treatment** of gonorrhœa, of which I have essayed four kinds, namely; instillations of 2 per cent silver nitrate solution with Guyon's apparatus; injections of a $\frac{2}{5}$ per cent protargol solution; irrigation of the urethra according to Janet's method with potassium permanganate solution, and irrigation with

weak silver solutions. In not a single case was the disease aborted; the morbid process already begun pursued its course.

This ineffectiveness will not cause surprise if we stop to consider that, while the symptoms of gonorrhœa usually manifest themselves several days after exposure, the gonococci penetrate the upper surface of the urethral mucous membrane within a few hours after infection takes place. Abortive methods then offer a prospect of success only when they can be applied before penetration occurs. This may be possible in exceptional instances, but the majority of cases will not be favorably influenced. Even granting that in this or that case results might be expected from the abortive treatment still I would not resort to its employment because I believe it subjects the patient to too great risk. I have observed great harm result from its use, having seen cases of lymphangitis, lymphadenitis, prostatitis and cystitis develop in such a way as to leave no doubt that treatment and complications bore the relation of cause and effect. While these complications in themselves may not be dangerous their results are incalculable. As the abortive method is uncertain, and as the customary and more protracted methods of treatment offer prospect of success in the majority of cases, I believe the plan of abandoning every abortive method to be well-founded.

For like reasons care must be taken not to begin instrumental treatment of gonorrhœa **too early.** If instruments be introduced while a florid discharge rich in gonococci is present, the danger of producing infection in parts which have thus far remained free will be incurred. This applies not only to acute gonorrhœa, but also to chronic which for any reason has become exacerbated and so resembles the acute form. In such cases the indication is to continue injections until both the amount and virulence of the discharge have been lessened. The only exceptions to this rule are cases in which the passage of an instrument cannot possibly be avoided, as for example, retention of urine which cannot be relieved in any other way.

Relative to the treatment of acute gonorrhœa it is to be remembered first of all that the gonococci thrive better in inflamed tissues than they do in tissues free from inflammation—a fact which daily experience teaches us. The greater number of gonococci are found in the early stages when inflammation is at its height. With progressive improvement and diminution of inflammation the discharge becomes less and the number of gonococci diminish. Let an exacerbation occur, so that pain returns, together with swelling and redness of the meatus, and the

gonococci almost always increase. These observations led the older physicians to refrain from using injections during the inflammatory stage and to wait until the acuteness of the attack had subsided. They possessed the correct idea that irritation of the urethra aggravated the disease.

In addition to the kind of gonorrhœa which we have just described there is a form in which all inflammatory symptoms are absent from the beginning. Neither pain nor swelling and redness are present, there being only a purulent discharge containing gonococci.

In both forms I recommend injections from the very beginning. When we consider that we are dealing with a local infection it is correct to endeavor to expel the infecting germs from their local foci. The only objection to this method is the danger of carrying the microörganisms into unaffected portions of the genito-urinary tract. We must of course endeavor to prevent such an occurrence. The patients should use their injections only after urinating, and in order that the urethra may be thoroughly cleansed by the stream of urine they should take large quantities of liquids, which will make them pass their water frequently. I order from 4 to 6 l. (8 to 12 pints) of fluid a day; water, milk, carbonated waters, tea, and infusions of diuretic herbs may be prescribed.

The injections used in the inflammatory form of gonorrhœa must be absolutely **unirritating;** irritant injections which increase or produce inflammation are to be excluded. The best of the non-irritant remedies is a 1 per cent solution of **thallin sulphate,** which was recommended by Goll many years ago. It has a specific, antigonorrhœic and antiseptic action, reducing inflammation and checking the discharge. Under its use the gonococci rapidly decrease in number and the thick, yellow, profuse pus soon becomes converted into a scanty muco-purulent or mucoid secretion. The injections should be taken as often as possible, at least from six to eight times a day.

There are cases in which thallin fails; in such, very weak solutions of **potassium permanganate** (1 : 10000–1 : 8000.) or a 1 per cent solution of **resorcin** may be substituted. Their action though similar to that of thallin is, as a rule, not so prompt and efficient.

After a few days of this treatment the inflammatory symptoms will have abated and the only evidence of disease will be a thin muco-purulent discharge containing gonococci; in other words it will be the same as the non-inflammatory form at its inception. At this time a modified

form of the well-known antiseptic treatment with various salts of silver may be instituted.

In my opinion the best antiseptic injection is the oldest one, namely, **silver nitrate.** At first it should not be used stronger than 1 : 10000, but it can be gradually increased in strength up to 1 : 4000. In many cases even these weak solutions produce pain and irritation. In such cases I discontinue their use and employ protargol in the strength of $\frac{1}{4}$ per cent, gradually increasing to 1 per cent. This drug apparently has a less irritating effect. I say apparently, because while it is less painful and not so irritating as silver nitrate, it increases the discharge the same as the latter salt.

The fact that both these silver preparations have an irritating action and increase the discharge has induced me never to employ them alone, but instead to use **in association with them** injections which diminish secretion and control irritation; in this modification lies the value of the treatment. The patients are directed to use these injections, using during the first period nitrate of silver or protargol with thallin, permanganate of potassuim, or resorcin; during the second, silver and zinc (zinc sulphate 1 : 1000–1 : 250); and during the third, when the morbid process is near its end, potassium permanganate and zinc. The gonococci will be most vigorously assailed by the silver preparations, but the discharge will be increased; the potassium permanganate used afterwards will overcome the increased secretion. Then the silver is used again and is again followed by the permanganate. The injections should be taken at least six times daily, the oftener the better, as Unna has well demonstrated.

An endeavor has been made to meet both indications by a single remedy, namely, zinc hypermanganate, in which the permanganate is supposed to destroy gonococci and the zinc to exert an astringent effect. I have found that both drugs work better when used separately.

Acetate of lead in the strength of 1 grain to the ounce and bismuth subnitrate 15 grains to the ounce are also good astringents; copper and alum are not so valuable. In order to make these injections more tenacious from $\frac{1}{10}$ to $\frac{1}{5}$ their volume may be composed of mucilage of acacia or glycerine.

Rest, diet, and the use of diuretics and balsamics in the manner previously recommended are valuable auxiliary measures.

The results obtained by this method are on the whole very satisfactory. Generally the disease will be cured in four or five weeks, so that neither discharge nor shreds in the urine can be detected. A

thing of much more importance and one which we designated as being most desirable at the beginning of our remarks on treatment is the rarity of complications under this regimen.

[The treatment of acute posterior urethritis varies somewhat with its mode of onset. In cases in which involvement of the posterior urethra manifests itself by **sudden onset** of the violent local and constitutional symptoms already referred to, the patient should be put to bed, given a brisk saline purge, placed on liquid or soft diet, and ordered a hot sitz bath night and morning. Local treatment of the anterior urethra should be immediately stopped, as experience has shown that patients do better when the urethra is let entirely alone than when antiseptic injections are employed.

Narcotics are always required to control the frequent and painful micturition. Opium and belladonna hold the first rank. They may be given hypodermatically, internally, or per rectum. For the severest cases $\frac{1}{6}$ gr. of morphine and $\frac{1}{150}$ gr. of atropine may be injected hypodermatically twice or thrice in twenty-four hours. As a rule, however, the use of opium and belladonna suppositories will be found efficacious. A suppository containing one grain each of powdered opium and extract of belladonna may be inserted into the rectum every three or four hours until relief is obtained or the safe limit of physiological action of the drugs is reached. I frequently employ a suppository containing two grains of the extract of hyoscyamus, which seems particularly potent in controlling tenesmus. A mild alkaline diuretic should be given internally, and if desired a narcotic may be combined with it. The following mixture will be found useful.

℞. Potassii acetatis ℥ iv.
Tr. hyoscyami f℥ iss.
Spts. ætheris nitrosi q. s. ad f℥ iii.
Sig. Teaspoonful in water every three hours.

Other drugs which have been employed in this condition are oil of sandalwood, in the dose of five minims every four hours; urotropin, in the dose of 7½ grains three times a day; salol; boric acid; and the stimulating vegetable diuretics, such as buchu and uva ursa. I have tried each and every one of these drugs and have failed to obtain any better results from them than from a simple alkaline diuretic. Sandalwood and buchu are probably the best in the list.

ERRATA.

Page 115, line 12: for "one per cent." *read* "one-tenth per cent."

Page 116, line 12: for "1%" *read* "0.1%."

Urotropin has failed me entirely, and in some instances has seemed to aggravate the symptoms.

If desired the mixture above mentioned may be given in the infusion of buchu instead of water. It may be necessary to use opium suppositories in conjunction with it.

Usually a few days of this regimen will so reduce the severity of the symptoms that **local treatment** may be resorted to. This will consist in the employment of one of three measures:—

1. Instillations of five to twenty minims of a one or two per cent solution of silver nitrate into the posterior urethra by means of the Keyes-Ultzmann syringe; 2. irrigation of the posterior urethra and bladder with three to six fluid ounces of a one per cent solution of silver nitrate, after the method of Diday, with a soft rubber catheter and hand syringe; 3. irrigation of the anterior and posterior urethra and bladder with hot permanganate solution, beginning with 1–8000 and gradually increasing the strength. Of these three procedures the silver irrigations have given me the best results. The exact technic of this procedure will be found on page 116, under the treatment of gonorrhœal cystitis.

In those cases in which posterior involvement develops gradually, in which tenesmus and strangury are only moderate, and constitutional symptoms mild or absent, recourse may be had at once to local treatment. For patients thus affected, hot permanganate irrigations, after the method of Janet, given morning and evening, or even once a day, will be found very effectual. They must not, however, be given under strong pressure. When the subjective symptoms subside a few silver irrigations may be required to clear up the turbidity of the second portion of the urine. Silver may be used from the very beginning of the treatment if preferred, being given on alternate days.

In this form of the disease narcotics will also be required, but they may be used in smaller quantities than in the hyperacute form. Usually the internal administration of belladonna or hyoscyamus, with an opium suppository at bedtime will suffice. A balsamic or an alkaline diuretic may also be used. In this class of cases, too, some surgeons allow the patient to use hand injections of weak antiseptics, such as potassium permanganate, protargol, and albargin. I have occasionally followed this course myself, but, as a rule, particularly one to be observed by the general practitioner, I believe it better

that all local treatment, except that administered by the doctor himself, should be stopped.]

The same principles should guide us in the treatment of acute gonorrhœal cystitis, which often begins as a cystitis colli.

Experience teaches that many of these cases get well under rest, diet, narcotics, and liberal use of diluent drinks. If after reasonable trial of these measures the urine does not clear up, but remains turbid as to its second portion, I resort to **irrigations** after the method of Diday, which was also later practised and taught by Ultzmann. A thin French olivary catheter (Fig. 124), or Ultzmann's irrigating catheter (Fig. 125), is passed down to the beginning of the membranous urethra, and from 100 to 200 ccm. (3 to 6 fluid ounces) of a 1 per cent silver nitrate solution injected through the posterior urethra into the bladder by means of a hand-syringe. As the anterior urethra is almost always affected it should also be irrigated. For this purpose the catheter is drawn forward a few centimeters so that its eye lies in the bulb of the urethra and then the silver solution is injected. It flows out between the catheter and the urethra. During the injection it is well to press the lips of the meatus together at short intervals so as to distend the urethra and thereby force the medicated fluid into all its nooks and crannies. This procedure usually works like magic; strangury, pain and hæmorrhage quickly subside and the urine rapidly becomes clear. The injections are given every second day; in the intervals the patient uses weak unirritating injections of thallin or potassium permanganate 1:10000–1:6000.

Care must be taken not to employ this procedure **too early,** as it may then favor the development of epididymitis or prostatitis; if we delay too long, though, care must be taken lest extension of the process to the ureters and pelvis of the kidneys be furthered. In general, however, the latter accident is of less frequent occurrence than the former, and therefore it is less injurious and less dangerous to wait too long before resorting to this local treatment than to begin it too early.

If other indications are present they must of course be met. In lymphangitis the penis must be kept at rest and cold dressings applied. Periurethral abscesses must be opened. Periurethal or paraurethral fistulæ must be destroyed or excised. Generally is suffices to cauterize them with a fine thermocautery.

We come now to consider the treatment of **chronic gonorrhœa**

and urethritis. By the term chronic gonorrhœa is meant a catarrhal discharge in which gonococci are present, whereas the term urethritis is applied to a similar condition in which gonococci are no longer found.

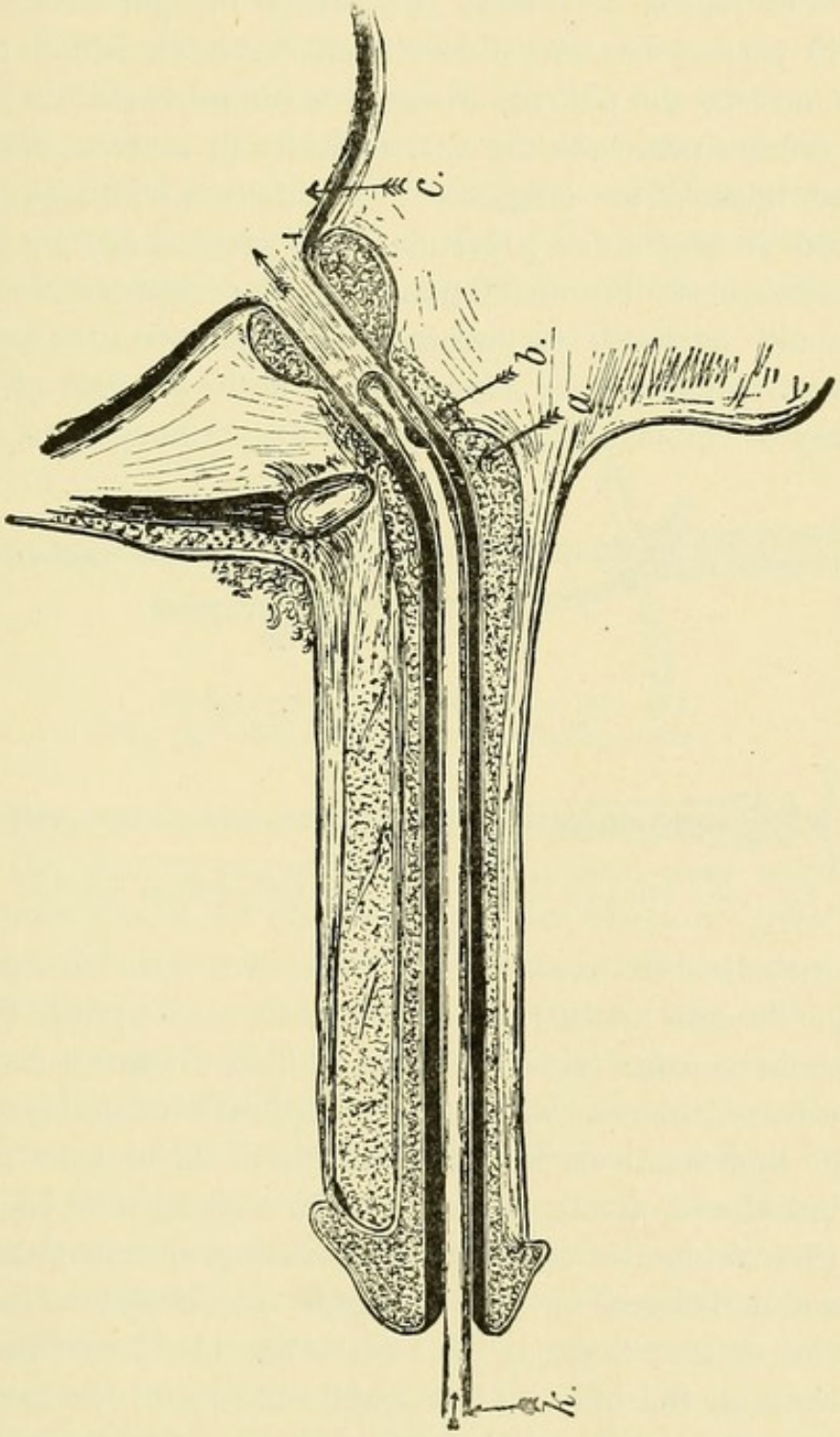


FIG. 124.—Irrigation after the method of Diday.

It is desirable to make certain discriminations in this disease of multiform manifestation and to be guided therein solely by practical considerations.

Frequently met with and most grateful for a properly conducted course of therapy are those subjects of chronic urethral catarrh who, despite months of treatment with every conceivable injection, remain uncured. In the discharge gonococci may or may not be present. The reason why these patients do not get well is because the morbid process has established itself in places which the usual injections used by the patients themselves cannot reach, that is, in the posterior urethra, which in the vast majority of cases is affected, and in the upper layers of the submucosa. For these cases instillations after the method of Guyon, or irrigations as recommended by Janet are excellent measures. For instillation a 1 or 2 per cent solution of silver nitrate should be used; for irrigation a 1:5000–1:1000 solution of potassium permanganate; or silver solution in the strength of 1:10000–1:2000, may be employed alternately with the permanganate.



FIG. 125.—Ultzmann's irrigating catheter.

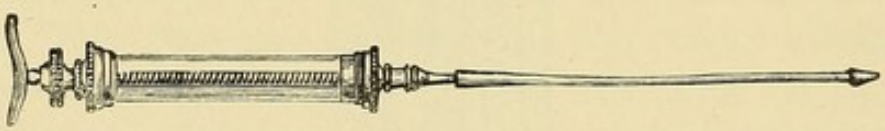


FIG. 126.—Guyon's instillating syringe with catheter attached.

By the use of instillations a few drops of concentrated medicinal solution may be brought to every part of the urethra. A syringe (Fig. 126), holding about 10 ccm. (approximately 2½ fluid drachms) is connected to a long olivary catheter by means of a hard rubber canula, and after a little of the fluid has been forced to the eye of the catheter the instrument is introduced as far as the sphincter vesicæ; then by simultaneously withdrawing the catheter and pressing on the piston of the syringe the fluid is forced out drop by drop. If it be desired to cauterize the posterior urethra begin at the neck of the bladder; if the anterior urethra, begin at the bulb. Occasionally the tip of the catheter will not pass over the bulb even though no stricture be present. This is due to spasmodic contraction of the compressor urethræ muscle. For such cases the Keyes-Ultzmann instillating syringe (Fig. 127) is suitable as it also expels the fluid drop by drop. With this instrument a ½–2 per cent solution of silver nitrate is generally used.

In Janet's irrigation method the fluids already mentioned are forced into the urethra with an irrigator, which is placed at variable heights above the patient. At first ½ liter (1 pint) is allowed to run into the anterior urethra, then from ¼ to ½ liter (½ to 1 pint) is forced into the posterior urethra. When it is desired to irrigate the anterior urethra a conical glass nozzle, attached to the tube of the irrigator, is inserted in such a manner that the fluid can flow out between it and the walls of the urethra. To irrigate the posterior urethra the nozzle is held firmly against the meatus and the irrigator raised somewhat higher, say about 1 to 1½ m. (3 to 4½ ft.), so that the pressure of the fluid will overcome the resistance of the compressor urethræ muscle and flow into the posterior urethra and thence into the bladder.

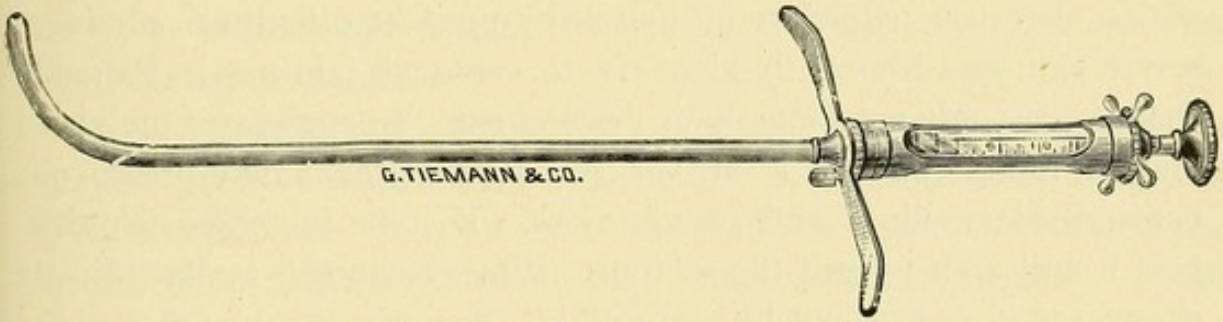


FIG. 127.—Keyes-Ultzmann instillating syringe.

Instillations erode the surface of the urethra, so that the silver, and also the zinc or permanganate injections used subsequently, come in contact with the diseased structures beneath. Janet's irrigations cause the tissues to swell and become infiltrated with fluid. Both procedures also bring the medicament into the posterior urethra, the true seat of infection, and it is to these facts that the excellent results obtained with either method, or with a combination of the two, are to be attributed. During the period of this treatment the patients should use weak astringent injections, such as zinc sulphate or lead acetate 0.2:100 (1 grain to the ounce).

Much more difficult are those cases which despite the employment of this treatment do not get well. Such cases may be divided into two classes according to the cause upon which they depend.

One class is characterized by the fact that the symptoms, whether they be discharge, morning-drop, gluing of the meatus, or only filaments in the urine, remain uninfluenced by any treatment whatsoever; in the second class the symptoms are held in abeyance as long as treatment is continued, but unfortunately return as soon as it is stopped.

The first are almost always due to **infiltrative catarrh,** a condition in which an infiltrative process affects the walls of the urethra and constantly causes pus cells to be thrown off from the surface, while in the second the glandular sexual organs, especially the prostate, are the seat of an inflammatory catarrhal process. In these cases it is immaterial whether gonococci are present or not, for the existence of the catarrh has nothing to do with the presence or absence of micro-organisms.

In urethral catarrh there is an associated prostatitis in 85 per cent of all cases, a fact of great importance as regards treatment. The **diagnosis of prostatitis** can be made solely by examining the prostatic secretion. Not a single subjective symptom may be present and yet a catarrh of the prostate exist. No dependence is to be placed upon palpation, because palpation of a healthy prostate oftentimes produces severe pain and frequently gives rise to a sense of faintness. Palpable changes can only occasionally be determined. In such cases the gland may be found enlarged in any of its diameters, or it may present circumscribed swellings and prominences. If it be increased in thickness it will arch toward the rectum. When examined cystoscopically changes may or may not be perceptible. Sometimes the border of the sphincter, which in health looks perfectly or nearly smooth with a slight upward concavity, presents a serrated or dentated appearance. It is obvious that this picture will be shown only when that part of the prostate which lies near the urethra or bladder is affected.

A prostatitis may cause subjective disturbance, which consists principally of a sense of heaviness in the rectum with pain radiating to the anus and hips. Sitting is often uncomfortable. Severe exertion, especially horseback riding and bicycling, increase the pain. The bowels are constipated and evacuations are often painful; occasionally the prostatic secretion is ejected at stool. Sexual power is usually diminished, as a result of which the patients easily become neurasthenic. All these symptoms, however, may be absent and yet a catarrh of the prostate exist; the urine may even be absolutely clear, so that there is nothing whatever which points to the existence of prostatitis.

The sole means of detecting its presence is by examining the prostatic secretion, which in normal cases is seen when examined microscopically to consist of small refractive fat-globules, resembling lecithin-bodies, with a sprinkling of epithelia and a few white cells. Now and then, but on the whole very rarely, concentric stratified

corpuscles and a few red cells are found, which result from massage of the gland.

If prostatitis be present leucocytes dominate the picture. We distinguish three degrees of inflammation: in the first there are only a few pus-cells—not more than ten or twenty in the entire field; in the second lecithin-corpuscles are outnumbered by pus-cells; in the third there are very few if any lecithin-corpuscles, pus-cells filling the entire field.

To obtain the prostatic secretion the prostate must be massaged, which can be easily done through the rectum. We must be certain that the secretion does not become mixed with pus in its passage to the external orifice of the urethra, and thereby lead to error in diagnosis. If the urine is clear and there is little urethral discharge, the patient is instructed to retain his water until the bladder becomes full and then is made to urinate and thereby cleanse his urethra; the gland is then immediately massaged.

In case there is an abundant discharge both the anterior and posterior urethra must be irrigated until the return fluid comes away clear and free from flocculi. In acute cases this would be impossible because pus would collect in the urethra before the gland could be massaged. It can be done very well in chronic cases, to which we now have reference.

Sometimes it will not be possible to force the secretion out of the urethra, as it will flow back into the bladder. The examination of the usually turbid urine passed immediately afterwards can not be entirely depended upon, but it is so rare for the prostatic secretion to flow back that the occurrence need not be reckoned with.

The treatment of these cases is difficult and tedious. As long as treatment is continued they appear to improve or to get well; if the treatment is stopped the symptoms—discharge, gluing of the meatus, filaments in the urine—recur. This is easily explained by assuming that the urethral catarrh is suppressed by the irrigations or instillations, but that as soon as they are stopped the morbid process affecting the prostate extends to the urethra by way of the excretory ducts.

I have not been able to convince myself of the efficacy of the numerous remedies recommended for gonorrhœal prostatitis. Great value has been attributed to local applications of iodine or ichthyol, made in the form of suppositories introduced into the rectum. Electrization of the gland and hot irrigations by means of Arzberger's apparatus have also been highly recommended. All these procedures are good inasmuch as they relieve the subjective symptoms of the patients, who are

frequently of a nervous type. This is especially true of the hot-water irrigations. Under their use the anal pain and the sense of compression and rectal tenesmus become less or temporarily disappear, but no change in the objective symptoms is wrought. The composition of the prostatic secretion is not altered; it remains purulent as before.

Very recently cauterization of the prostate by the Bottini-Freudenberg method has been tried. In two cases thus treated the result was negative; moreover, in both cases the neurasthenic symptoms were intensified. Up to the present time only one procedure has proved both efficacious and harmless, namely, **systematic massage of the prostate.** I generally have it done thrice weekly by a masseur, and combine with it Janet's irrigations with weak potassium permanganate or silver nitrate solutions. These are always necessary, for the urethra is almost invariably affected. They should be used twice or three times a week and in the intervals between their employment the patient may be allowed to use weak injections of potassium permanganate or zinc sulphate. Under this treatment the discharge disappears, the flocculi become less and, what is of more importance, the pus-cells in the prostatic secretion considerably diminished. In a few cases it is possible to cause them completely to disappear, but most frequently a few permanently remain; from this condition, however, I have never observed any injurious effect. This treatment must be persevered in for months.

Much less amenable to treatment are the so-called **chronic infiltrative forms of urethritis,** the pathogenesis of which we have already described. They are characterized by the obstinacy with which they resist all our therapeutic efforts. While the cases complicated with prostatitis are at least temporarily benefited, in these the discharge, the agglutination of the meatus, and the flocculi remain practically uninfluenced. The infiltrative process frequently remains confined to the glands and crypts in which it originates, although it may extend and involve other structures of the urethra. In both instances, but especially in the latter, the result is a partial rigidity of the urethral walls, which in the worst cases leads to perceptible narrowing of the canal. When the walls lose their elasticity the delicate urethral musculature becomes deprived of its tonicity and allows the glands to dilate, so that their secretion instead of being retained flows out into the urethra, from which it is carried away by the urine in the form of filaments.

In view of its pathogenesis it has long been the custom to treat infiltrative catarrh by a combination of mechanical and chemical methods, the mechanical being used for the purpose of removing the infiltrate, the chemical for the purpose of healing the accompanying catarrh. To obtain this end Ultzmann recommended the introduction of sounds of increasing size, which were allowed to remain in the urethra for sometime. The patient also used injections.

Unna, wishing to combine both treatments in one, smeared the sounds with cocoa-butter containing 2 per cent of silver nitrate. The heat of the body dissolves this mixture so that it gains access to the glands and crypts opened by passage of the sound. Later, in order to render this procedure more efficacious, I recommended the use of a tunnelled sound in the hollow of which the silver-lanoline preparation is placed.

[Better than either of these devices are the modern ointment applicators, such as Young's and Robbins'. Young's instrument consists of

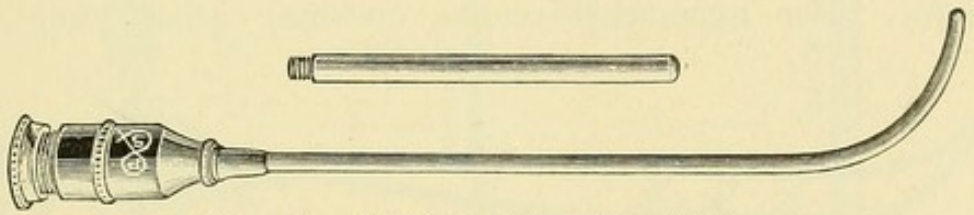


FIG. 128.—Robbins' ointment applicator.

an outer tubular sheath of a little more than half a circle extent and a removable solid obturator of a corresponding size. This can be rotated in the outer sheath so that a large trough to be filled with ointment is furnished. When this has been filled the rotation is continued until it furnishes a closed round instrument with the ointment inside. In this position it is ready for insertion. After being introduced into the urethra, the obturator is rotated back to its first position and the ointment is thus pushed out of the instrument into the urethra. The instrument is then withdrawn, the operator making pressure upon the glans and the meatus to prevent the escape of ointment.

The deep urethral applicator, devised by Dr. F. W. Robbins, of Detroit, Mich. (Fig. 128.) consists of a hollow catheter-like metal tube, a cup and a plunger. The tube and plunger are detachable from the cup. The cup is filled with ointment, which is pressed down with a spatula so as to obliterate all air spaces, the plunger introduced and turned slightly around until the ointment appears at the end of the urethral tube, and the tube then passed into the urethra. While turning the plunger the instrument is slowly with-

drawn the length of the surface to be medicated. When this surface has been passed over the escape of ointment is prevented by stopping the movement of the plunger and the instrument is withdrawn from the urethra.*

For preparing urethral ointments lanolin is a better base than cocoa butter for the reason that it has the power of taking up aqueous secretions. I am of the opinion too that it adheres better to the mucous membrane of the urethra than does cocoa butter. The medicinal substances incorporated in the ointments must be made to suit the pathological condition against which their action is directed. For periurethral infiltrations iodine is undoubtedly the best. For cases in which the urethral epithelium has been changed from its normal type to pavement epithelium, with much thickening and rigidity of the mucosa and constant exfoliation of cells, 1 per cent salicylic acid, as recommended by Young, will often prove serviceable. For hypersensitiveness, cocaine, carbolic acid, boric

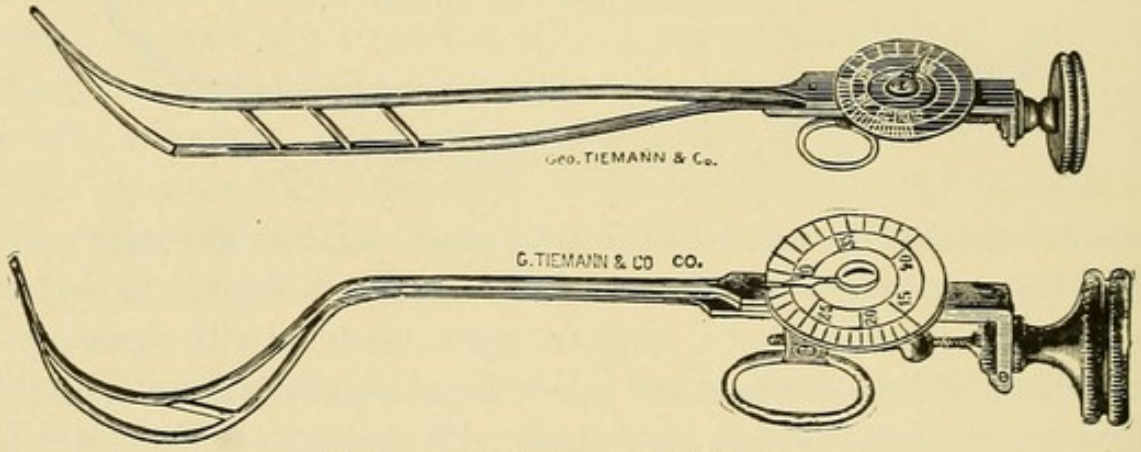


FIG. 129.—Oberländer's dilators.

acid, zinc oxide, singly or in various combinations, may afford relief. I have used cocaine gr. iiss, zinci oxidi ℥ss, ungt. acidi borici ℥iiss, ol. amygdalae dulc. f℥i, lanolin, ℥iv, with excellent results in these cases. For deep urethral applications, silver nitrate and iodine are the ones most frequently indicated.]

Then came the era of dilators, the first of which was designed by Oberländer. As the urethral orifice will not permit the introduction of large instruments he constructed an instrument which, when closed, is about the size of a 16 F. sound, but which can be unscrewed and the branches thus separated after it is introduced into the urethra.

*The short tube shown in the illustration may be used for rectal applications. It is to be attached to the cup after the urethral tube is unscrewed.

Lohnstein, Kollman and others followed with four and eight bladed dilators.

From my own experience I believe **mechanical treatment,** com-

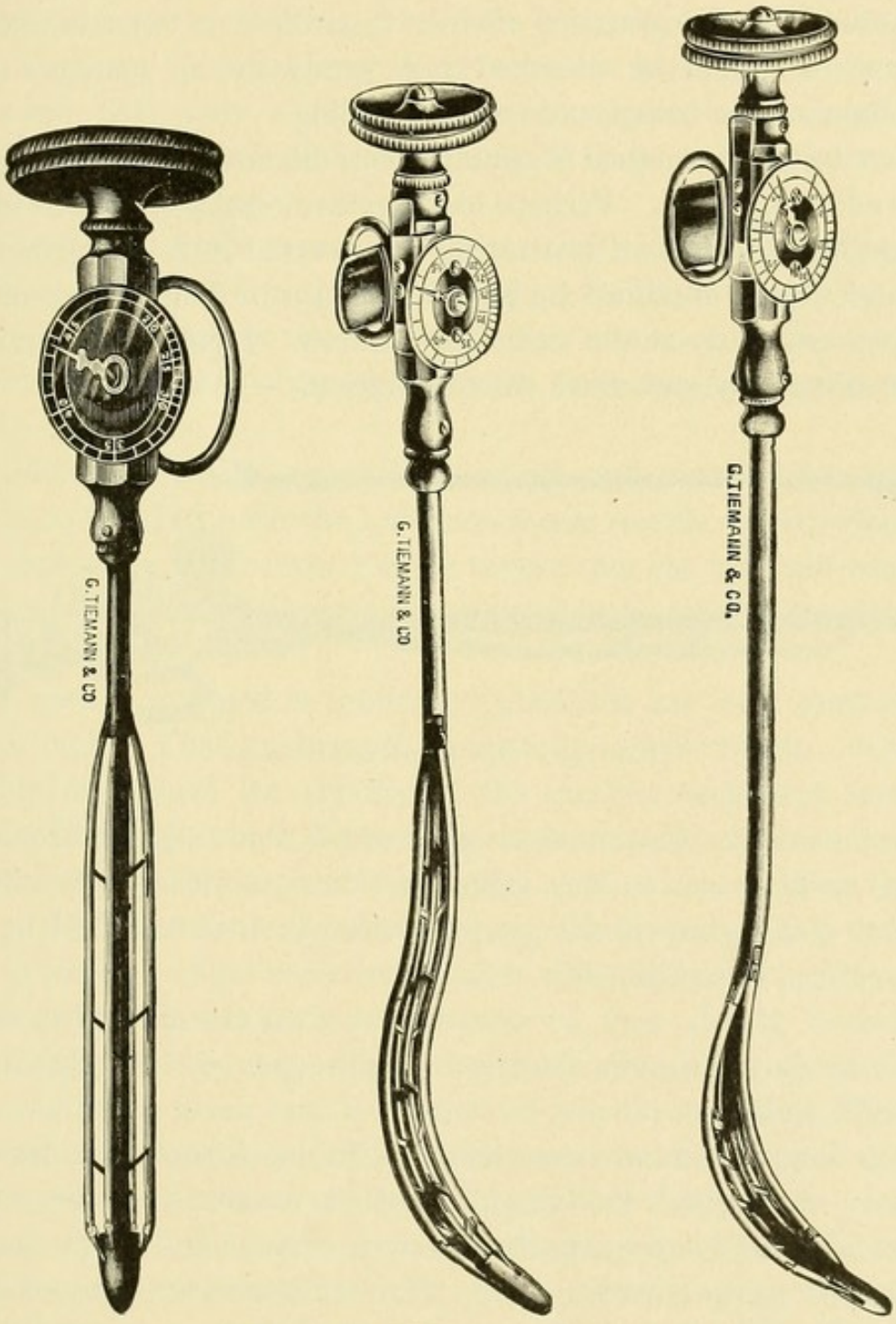


FIG. 130—Kollmann's dilators.

bined with local medicinal measures to be good and useful if practised with great caution and within wise limits. All measures which lacerate the urethra are evil; they add new scars to the old process. At first sounds as large as the urethra will admit are passed twice a week.

In the intervals the patient uses injections or receives irrigations. When 23 or 24 F. is reached dilators are used, and of these I prefer the excellent instrument of Oberländer (Fig. 129). [Kollmann's four-bladed dilators are also admirable instruments. (Fig. 130.)] Dilatation should not be practised oftener than once or twice a week and the urethra should be stretched very gradually, an increase of not more than 1 mm. being made at each sitting.

I have tested the method of simultaneous dilatation and irrigation and see no advantage in it. Perhaps local urethrotomy may lead us further. It is performed with an instrument constructed after the principle of Otis and slightly modified by Kreisl (Fig. 131). With it one or more incisions are made at the site of infiltration. I believe that this procedure is quicker and surer than dilatation.

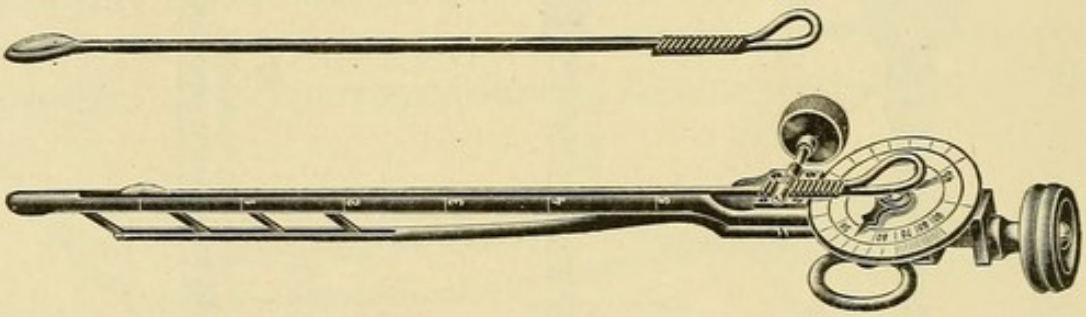


FIG. 131.—Otis-Kreisl urethrotome.

[Urethroscopic examination may show that slight chronic discharge or filaments in the urine are due to chronically inflamed urethral glands, superficial granulations which have failed to yield to dilatation, or papillomata.

Diseased glands may be destroyed by means of Kollmann's or Oberländer's electrolytic needles, or split open with Kollmann's or Bierhoff's knife.

These instruments are used through the urethroscope under direct guidance of the eye. Kollmann's needle is connected to the negative pole of a battery supplying the constant current and a flat electrode is attached to the positive pole. The flat electrode is placed on the thigh, the needle is passed through the urethroscope and its point inserted into the opening of the diseased gland. From three to five milliampères of the current are now turned on and the needle left in situ for one or two minutes.

Oberländer's double needle may be used in this way, or one needle may be attached to the positive pole and the other to the negative.

The current should always be turned off before the instrument is withdrawn from the urethra. Not more than two or three glands should be destroyed at one sitting.

From observations made in Wossidlo's clinic, Mundorff states that the delicate scars resulting from this procedure may develop into true strictures if too strong a current be used. Therefore, it is important that only a weak current, as above recommended, be employed. Mundorff advises the use of large steel sounds during the process of healing.

The urethral knife serves not only to split open diseased glands, but also to divide infiltrations and delicate bands of cicatricial tissue.

Granulations may be touched with silver nitrate or copper sulphate. A solution containing sixty grains to the fluid ounce of distilled water may be used.

Papillomata may be snared, or torn off with urethral forceps, and their base touched with the galvano-caustic needle or trichloracetic acid, preferably the former, for the reason that the acid diffuses itself over surrounding healthy tissue unless great care be employed in applying it.]

The results attained in infiltrative urethritis are very moderate as regards cure. That such must be the case is self-evident. Until we are able to remove the rigidity of the urethra we cannot expect to arrest a discharge which depends upon this rigidity.

This leads to the important question as to what we shall do with those patients in whom we fail to suppress the discharge, that is to say, those in whom a slight secretion persists either in form of a drop at the meatus or as filaments in the urine.

According to my experience the whole situation depends solely upon whether a given case is considered infectious, and by infectious we mean only those in which the gonococcus has been found or those which are known to have conveyed infection to the female.

In regard to the gonococcus it has already been stated that its isolation sometimes presents great difficulties, and that for this reason the decision as to whether a case is infectious or not may be most difficult. It has been observed that the filaments present in the urine may contain no gonococci and yet these bacteria be present in the secretion obtained with the bulbous bougie. Authentic cases are met with often enough in which a healthy man contracts gonorrhœa from a woman in whom not the slightest evidences of disease are manifest; conversely, women

whose husbands show no recognizable symptoms may develop the disease. Furthermore there are cases in which the urethral secretion is free from gonococci although these bacteria are present in the prostatic secretion; the reverse is also true. We have already mentioned those cases in which the gonococci remain latent for months and then suddenly reappear in the secretion.

These conditions enormously increase the difficulty of deciding as to whether a case is infectious, and mistakes doubtless occur. Notwithstanding this, experience has supplied us with certain data which help us in passing judgment. Thus, cases in which gonococci are lurking are characterized by variations in the quantity of discharge, whereas in those free from gonococci the discharge is fairly constant in quantity, although it resists every therapeutic measure.

We must see to it that such cases remain under observation a long time so that they can be frequently examined. If the secretion obtained by stripping the urethra, massaging the prostate, and probing with the bougie à boule has been found free from gonococci after repeated examination, and if they do not appear after the urethra has been subjected to different forms of irritation, then we may discharge the patient from treatment and also give our consent to his marriage. In my opinion it is not necessary to treat the patients as long as pus-cells continue to be found in the filaments or in the discharge. The shreds often remain permanently. We have already said: "Of two evils choose the lesser."

The greater evil is to subject men thus affected to a protracted course of treatment which frequently not only fails to suppress the secretion, but, moreover, changes a mild type of neurasthenia into a severe one.

Herein lies the difficulty of the whole matter. What a large number of men suffering with cerebrasthenia, myelasthenia, impotence, hypochondria, melancholia and kindred affections come to us year in and year out! These people, who unfortunately are often honorable and estimable members of society, have been reduced to their wretched condition by a "clap which would not heal;" the more conscientious they are and the more they lose faith in the curability of their urethral catarrh, the more certain are they to become the victims of sexual neurasthenia. When they go from one doctor to another and take from each a fruitless, protracted, and usually painful course of treatment, and are forbidden by each to marry, the predisposition to neurasthenia is enhanced.

Although excessive treatment is harmful the patient must not be denied necessary attention. It is self-evident that the urethritis should

be cured if possible. The experienced and judicious physician will be able to tell within a short time what he can accomplish in a given case. If he decides that the case cannot be cured in the ideal sense of the term, then it becomes his duty to assure the patient of the harmlessness of his condition, of the triviality of his affection.

It is generally known that this is no easy task. Gonorrhophobiacs want to be treated under all circumstances, even though treatment is painful. They do not trust a physician who assures them that the filaments in their urine are of no significance. In spite of this it must be our aim to convince them that what seems to them to be disease is in reality no longer disease, but merely its sequel. Do not deny these persons help. They need medical advice. A general hygienic regimen should be prescribed for them. Baths constitute an important part of such a regimen, but it is not necessary for me to describe them in detail as they are known to every well-informed physician.

If we follow this course we shall save from neurasthenia many so-called gonorrhœal patients who in reality are not gonorrhœal, and shall also be able to restore to health and strength many neurasthenics whose disease depends upon gonorrhophobia.

CHANCROID OF THE URETHRA.

Soft chancres of the urethra are of relatively uncommon occurrence. They are located in the anterior part of the urethra, seldom being further back than the termination of the glans. They cause painful micturition and a profuse purulent discharge, which differs from gonorrhœal discharge in that it contains no gonococci and is little influenced by the ordinary injections used for clap. The presence of associated sores on the penis or edge of the meatus, and finally the the use of the endoscope, facilitates diagnosis. From hard sores they are differentiated by abscence of induration and œdematous swelling; the short period of incubation has also some bearing on the case.

Hard chancres heal without scar-formation and therefore produce no strictures; extensive soft sores may lead to stenosis.

As to treatment the introduction of urethral cylinders composed of cocoa butter and iodoform is to be recommended. The patient urinates and then a cylinder is passed into the urethra as deep as it will go without producing pain. The meatus is then covered with a pledget of cotton or gauze, so that the iodoform can remain in the urethra for some-time. Under this treatment cure is rapid.

ACUMINATED CONDYLOMATA OF THE URETHRA.

These growths may occur either in association with or independently of others on the external parts. They are generally near the external orifice, but are also encountered in the posterior urethra. They do not differ in any respect from those found on the external structures. Usually they appear as small isolated warts within the urethra; it is very rare for them to grow large enough to cause obstruction.

They generally, though not always, follow gonorrhœa; they may develop in the urethra just as they do on the skin of persons who have never had the disease.

The symptoms of urethral condylomata are very slight. They consist of slight burning, scanty discharge which does not yield to injections and which therefore may simulate chronic gonorrhœa, and occasionally trifling hæmorrhage from the urethra, or the passage of blood-tinged urine. With the endoscope they can be brought plainly into view.

Treatment requires their removal, because if left they may grow and produce symptoms of stricture, or apparently keep up a gonorrhœa. Those situated near the urethral orifice can be made accessible by everting the meatus, and can then be cut off and their base cauterized with nitrate of silver or trichloracetic acid. Those situated further back may be reached through the cystoscope, if practicable, and cauterized. Often it will suffice to pass large bougies which tear them from their base.

SYPHILIS OF THE URETHRA.

Syphilis may affect the urethra in three ways: first as the initial lesion, the hard chancre; second as a symptom of secondary syphilis; third as a gumma.

The most common of the three is the hard chancre, which has been observed as far back as the coronary sulcus. A hard nodule, which eventually becomes merely a firm indurated mass, is felt from without, although there are no signs of disease on the penis.

The urethra is œdematous and the lips of the meatus are swollen, a condition which produces the symptoms of stricture. The sore causes no special symptoms; it simulates gonorrhœa, only the discharge is not so thick, purulent and creamy, but sero-purulent or sero-sanguinolent and does not contain gonococci. The urethra is so swollen and œdematous that it is impossible to introduce a tube sufficiently large to enable

anything positive to be determined. Moreover, the introduction of instruments is contraindicated because it may beget lymphangitis.

In reference to **diagnosis,** the condition may be confounded with thick periurethral infiltrates, although these are scarcely if ever so large as the nodules of syphilis; the short period of development—infiltrates require a longer time—the ineffectiveness of antigonorrhœal therapy, the associated indolent buboes, and the appearence of other symptoms of syhpilis all serve to confirm the diagnosis.

Secondary syphilitic affections of the urethra consist of exanthemata such as occur on other mucous membranes. They occur very seldom and are much more seldom detected. They progress under the guise of gonorrhœa, from which they can be distinguished only by the absence of gonococci, the inefficacy of antigonorrhœal therapy, and the use of the endoscope.

Gummata of the urethra are seen more frequently, occurring in the form of circumscribed nodules before disintegration occurs and as ulcers after disintegration has taken place. Their recognition is of great importance, because if not interfered with they may produce considerable disturbance. Many urethral fistulæ near the meatus owe their origin to an unrecognized gumma. A thorough examination, above all things a careful anamnesis, the presence of other late manifestations of syphilis, and the fruitlessness of the usual treatment make the diagnosis not difficult.

As to **treatment** it may be said that these secondary syphilitic affections of the urethra do not demand any local measures; they get well under general treatment. In hard chancre Unna's gray plaster may be applied to the penis over the site of the internal sore and a general mercurial treatment instituted, whereupon the ulcers will rapidly heal. For gummata large doses of the iodides are required, 5, 10, or even 15 Grm. (from 75 to 225 grains) a day being given. The result is surprising.

STRICTURE OF THE URETHRA.

Conception of stricture. If we bear in mind the so often forgotten fact that the urethra when at rest is a closed canal the walls of which are in direct contact, there can hardly be a better definition of stricture than the one given by Sir Charles Bell, who described it as a condition in which the affected portion of the urethra has lost its dilatability. The acceptance of this definition excludes two conditions which,

though generally classified as strictures, are not such in reality; namely, spastic and inflammatory obstruction.

The urethra can doubtless be contracted or entirely occluded at any part of its course by spasm or inflammation, as for example, by the œdematous swelling of acute gonorrhœa; these, however are only transitory phenomena, the urethral walls still retaining their elasticity. As soon as the spasm or the inflammation has been subdued by antispasmodic or antiphlogistic treatment they reassume their normal extensibility. These conditions, therefore, may be considered as spasmodic and inflammatory obstructions, as occlusions and the like, but not as strictures. In contradistinction to them true strictures present a permanent narrowing caused by plastic changes in the urethral walls. Tumors (epithelioma, sarcoma, fibro-sarcoma) and tubercles which grow from the wall of the urethra, infiltrating it and also sometimes projecting so as partly or entirely to occlude its lumen, are not classed as strictures.

ETIOLOGY.

If we exclude congenital strictures, which will be discussed under malformations of the urethra, we recognize only two causes for the development of organic stricture: first, inflammation of the urethra, or in other words gonorrhœa; and second, loss of substance in the urethra due to either trauma or ulceration.

The vast majority of all strictures are due to the first cause, more than 90 per cent being of gonorrhœal origin. Simple urethritis hardly ever leads to stricture formation.

All strictures which result from loss of substance and consequent production of scar-tissue during the process of healing are to be considered as traumatic. The trauma may consist of a blow or wound from without, of a tear during coitus, injury due to introduction of instruments, or to passage of a calculus through the urethra. Cauterization, as for example, that due to injections of corrosive fluids such as carbolic acid, and destruction due to a wide-spreading chancroid belong in the same category.

In my opinion syphilitic strictures do not exist. Hard sores, which seldom affect the urethra, heal without a scar, and urethral gummata produce only a transitory obstruction; after proper constitutional treatment is instituted the urethra becomes pervious.

PATHOLOGICAL ANATOMY.

The origin of urethral stricture will be understood if the origin of the primary causative disease, gonorrhœa, be borne in mind.

As in all inflammatory processes there is in the beginning a small-celled infiltration of the affected part resulting either from emigration of leucocytes or from proliferation of connective-tissue cells. The chronicity of the process by which strictures are formed speaks rather in favor of connective tissue proliferation, although as a matter of fact the question as to the origin of the primordial round cells has no bearing on the further course of the morbid process.

As more and more intercellular substance becomes interposed between these cells they become separated from one another and at the same time change their form. At first round, they later give off processes and thereby become changed into spindle or star-shaped bodies. During these changes in the cells it is observed that the intercellular substance is split into the finest and most delicate fibers and fibrils; in short, true connective tissue develops, a so-called scar being formed.

If the process continues more connective tissue develops from the newly proliferated or extravasated round cells, so that a well formed tumor, or callus, results. This recently formed connective or scar-tissue possesses a tendency to contract, to shorten, to shrink; accordingly the vessels contained within it suffer, and as a result of the ensuing impairment of nutrition it gradually becomes paler and paler, eventually causing the white, tendinous striæ often found in callous stricture-tissue. The fact of greatest importance, however, is that the tendency of the callous mass to contract and shrink leads to distortion, narrowing, and even complete occlusion of the urethra.

Loss of urethral tissue, likewise, be it occasioned by trauma or by ulceration, can only be replaced by scar-tissue having a tendency to contract.

The individual stages of chronic gonorrhœa and their transition to stricture are well shown by the microscope. In comparatively recent cases the subepithelial layer of the urethral mucosa is seen to be thickly and evenly infiltrated with leucocytes throughout a wide extent. Some of the glands are considerably dilated and certain parts of the periglandular tissue show a moderately thick infiltration of leucocytes. In cases further advanced the transformation of inflam-

matory product into scar-tissue is plainly recognizable. Although the center of this diseased area is already made up of scar-tissue, its borders consist of young granulation tissue rich in round cells. The epithelium of the mucosa undergoes variable degrees of thickening and may become partly cornified. Since the uppermost cells of this necrotic epithelial layer exfoliate and become mixed with the mucous secretion of the glands, that discharge so characteristic of chronic gonorrhœa or gleet is produced.

During the further progress of the disease the glands become more or less destroyed. The desquamated epithelium is too dry to assume the form of a discharge, so the latter drys up, and in its place filaments composed partly of round cells and partly of epithelium are washed out by the urine, in which they are easily found. Thus the morbid process may exist for years and pursue its further course unnoticed. The small-celled infiltration also affects the deeper parts, in which it likewise becomes changed into a layer of connective tissue. The corpora cavernosa, the overlying muscles, and the erectile tissue of the penis may all be converted into a firm, dense scar; thus the urethral walls slowly become rigid, unyielding, and in the most advanced cases so closely apposed to one another that a hair can scarcely be passed through.

It is seen, therefore, that the specific cause of gonorrhœa has nothing to do with the development of stricture except that strictures of gonorrhœal origin show a tendency to invade the deep layers of the urethra, whereas those due to simple urethritis confine themselves more to the superficial layers; however, a simple traumatic urethritis or one due to any other cause may result in stricture if the inflammatory infiltrate advances deeper into the urethral walls.

On the other hand, this hyperplastic connective-tissue formation may not only infiltrate the walls of the urethra, but may also grow outwards into its lumen. Such free connective-tissue tumors lead to the development of firmly adherent stratifications, as the result of which valves and funicles are formed (valvular stricture).

Many chronic gonorrhœas, then, represent the early stage of stricture, or may even be considered as strictures themselves, being the so-called strictures of large caliber described by Otis. When a certain part of the urethra is infiltrated with round cells which have become partly converted into connective tissue or are in the process of undergoing such an alteration, great rigidity of the affected area is produced.

This portion, although still more or less dilatable, will offer greater resistance to the impingement of the urinary stream than the other parts of the urethra. The narrowing may be very slight, perhaps so slight that a 16 F. sound can easily be passed through it. In such cases the so-called stricture of large caliber exists even though it may not be noticed.

The evolution of stricture does not always terminate in the way above described, for the firm, callous masses occasionally, though rarely, undergo still further transformation. Just as bony callus can undergo involution, so likewise can the connective tissue masses from which stricture is developed pass through a process of retrograde metamorphosis.

It happens, as Dittel has said, that the greater part of the embryonal connective tissue in the callus becomes resorbed, so that a perfectly shrunken and dryer connective tissue remains. In callous strictures the urethra feels thick and cartilaginous, but in this form it is hard, inelastic, and much thinner than in health (scar-stricture, or atrophied stricture).

To this class belong strictures produced by ulceration and injury. The degree of narrowing and the amount of dilatability depend upon the amount of substance lost and upon the direction which the injury takes. Small superficial ulcerations which do not go beyond the mucous membrane make only a minimum of narrowing. The deeper the scar goes the more it distorts the urethra. If laceration due to injury extends in the long axis of the canal so that a longitudinal scar results, the contraction will be much slighter than if it occurs in the transverse diameter or in a zigzag direction. Phagedænic chancres situated near the meatus may cause great destruction, as a result of which very narrow and unyielding strictures develop.

The macroscopic appearance of strictures varies according as they are of the callous or cicatricial variety. In the first form often nothing is seen but an irregular scar, the surface of which lacks the luster of the normal mucous membrane, the scar itself being firmly adherent to the deeper layers of the urethra. The lumen is perceptibly narrowed.

The surface of callous strictures also lacks the velvety appearance of normal mucous membrane. The latter is still visible at certain places, but in the main it is replaced by a dull white, parchment-like tissue which is smooth on its free surface. The mucous membrane is thick-

ened, hard, and adherent to the erectile tissue, forming a scar which is more or less bloodless.

The parts behind the stricture are generally dilated; in slight cases they show merely a little chronic inflammation, but in severe ones enormous pouches with fibrillation and destruction of tissue are present, producing a condition which presents the appearance of a net-work. (Fig. 132).

The site of the stricture is generally in the penile portion, being most common at the bulb, where it becomes continuous with the membranous part. Next the region of the cutaneous orifice is the seat of predilection, while the third rank is held by the entire anterior urethra.

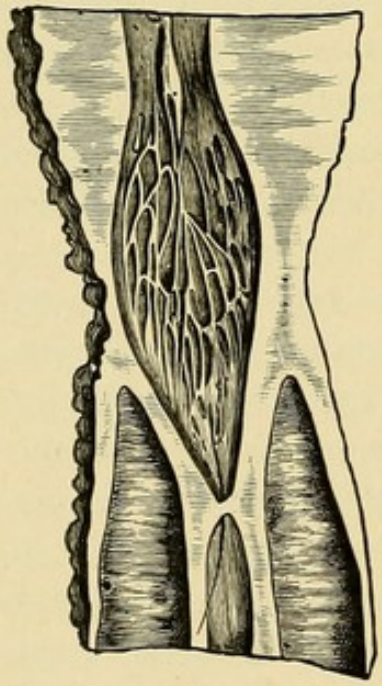


Fig. 132.—Net-work of tissue behind a stricture.

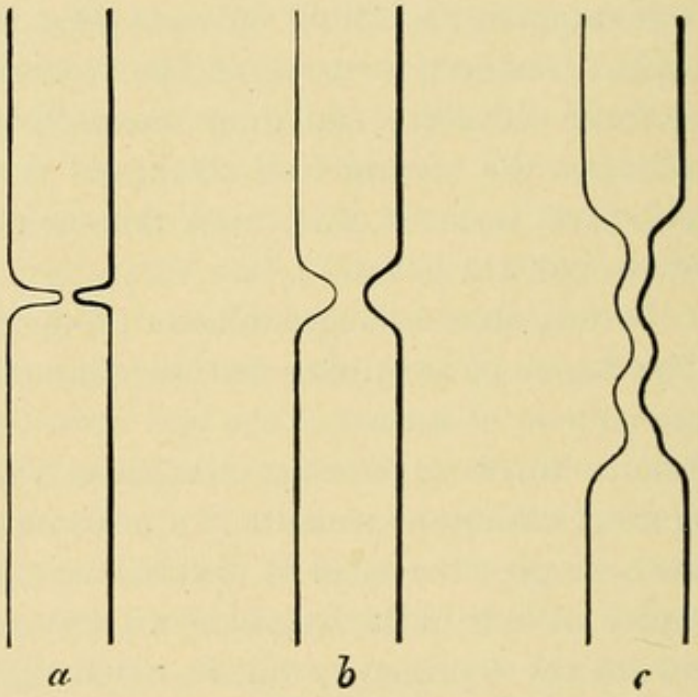


Fig. 133.—Different forms of stricture.

Strictures originating from chancres are usually located near the meatus, and gonorrhœal strictures are generally in the region of the bulb. The latter variety, however, are for the most part multiple, so that in addition to those at the bulb, which are generally the narrowest, others are found further forward in the urethra. **Gonorrhœal strictures are never situated beyond the membranous urethra.** Traumatic strictures may occur anywhere in the urethra, but generally are at the bulb or in the membranous or protatics portion.

The form of strictures is very different. Oftentimes the diminution

in caliber occurs equally from all sides (Fig. 133 b). It may, however, be very irregular, so that the opening of the stricture lies eccentric (a); indeed, the urethra may be so distorted by a callus of irregular growth as to present a zigzag appearance, a condition known as sprial stricture (c).

Likewise the length of strictures varies within certain limits. They seldom exceed 5 mm. [about $\frac{1}{5}$ of an inch], but occasionally several lie so close to one another that they give the impression of a single long stricture.

The lumen of the urethra is often little diminished, although it frequently is reduced to the smallest numbers of the French scale, and in extreme degrees of contraction no opening at all can be found.

SYMPTOMS, DIAGNOSIS AND PROGNOSIS.

In general, strictures produce very slight disturbance, so that in persons who take little care of themselves they are not usually noticed until they are very far advanced in their development. Careful, intelligent men observe that it takes them longer to urinate than it should. This fact is explained by physical laws. It takes longer for a definite quantity of urine to flow through a narrow tube than through a wide one.

The time required to start the stream of urine is in many cases not longer than that taken by healthy men. The frequency of urination, too, may be entirely normal. It is only when the stricture is very narrow and the patient does not completely empty his bladder that micturition becomes frequent. Under these conditions it is self-evident that the bladder will become filled with that quantity of urine necessary to cause micturition in a shorter time than under normal circumstances. This incomplete retention, however, is absent in cases in which the bladder is strong and the stricture not very narrow.

Pain may also be entirely absent, but usually the patient complains of a slight burning upon urinating, which is experienced the moment the urine impinges upon the contracted spot. The site of the stricture, then, is also the site of the pain.

Only in extreme degrees of stricture is micturition really painful. In such cases the patients are obliged to strain violently in order to force out the urine; they bend forward so as to secure the aid of abdominal pressure, and occasionally employ so much force that the rectum prolapses or cerebral hæmorrhages take place.

The most striking deviation from the normal is shown by the **urinary stream.** The narrower the stricture and the more anterior its location the greater the loss of volume in the stream. It becomes thinner and thinner until it is reduced to the size of a thread, and then finally becomes obliterated altogether, the urine being voided only drop by drop. The projectile power of the stream may not be lessened; although small, it can often be cast some distance forward. In extreme degrees of narrowing this power is also lost.

In such cases ejaculation of semen is likewise attended with difficulty. The fluid is not ejected forcibly outward, but flows along slowly, or is regurgitated into the bladder.

Incontinence of urine, or more properly speaking, overflow of urine from the bladder, is one of the most common occurrences during this stage of the disease. Behind the stricture the urethra is dilated into a funnel-shaped expansion, so that the internal vesical sphincter becomes stretched. The bladder is in a condition of incomplete retention. The urine which rises above the level of the sphincter flows slowly over it into the urethra and passes drop by drop through the stricture. It is therefore characteristic of this incontinence that the urine is not voided in large quantities, but is passed in drops, so that the patient is constantly wetting his clothing.

A highly unpleasant occurrence is the development of **sudden complete retention** in which the patient cannot void a drop of urine. This condition is not entirely dependent upon total occlusion of the urethra, for it happens sometimes when the stricture is not very tight; it may then be due to spasm, or to engorgement superimposed upon the contraction. A cold or the free use of alcohol may cause such congestion or spasm.

The urine of men affected with stricture is usually not clear. Owing to impingement of the urinary stream upon the narrowed spot, the latter together with the portion of the urethra behind it becomes inflamed, as a result of which the secretion is augmented and becomes mixed with the urine, in which it appears as flakes or filaments. Oftentimes this catarrhal process extends backward into the bladder and causes a cystitis, which produces turbidity of the urine.

In most cases the symptoms and signs already mentioned are sufficient to make a diagnosis of stricture probably correct, although they must not be entirely depended upon, for narrow stream, slow micturition, pain, incontinence, and retention occur in other affections,

notably, in paralysis of the bladder and hypertrophy of the prostate. A physical examination must always be made.

This consists in passing a soft, not too small olivary bougie into the urethra. I advise against the use of bougies à boule, also called stricture-searchers, because they easily become caught at the bulb even in the healthy urethra, and thus are not adapted to discrimination between the normal and the diseased. The ordinary French silk-web bougies with olivary tip may better be used, as they always pass through the healthy urethra into the bladder. If they are arrested anywhere choose smaller ones until a size is found which just exactly passes. This one will represent the size of the stricture.

If several strictures are present a wide one behind one which is narrow cannot be diagnosticated.

After the diagnosis of stricture is made the general condition of the patient must be investigated, because stricture has a whole series of complications and sequels following in its train.

We have already spoken of dilatations and pouches behind the stricture, and the inflammatory softening which occurs in them. If urine collects in these pockets it may undergo decomposition and lead to inflammatory changes in the tissue, giving rise to a condition which is known as phlegmon when it affects the superficial structures and as **urinary infiltration** when it involves the deep parts. The tissue becomes disintegrated by pus, the phlegmonous process forces its way more and more toward the surface, and, unless promptly interfered with, breaks externally and forms a urinary fistula. Loss of substance corresponding to the size of the gangrenous slough occurs in the urethra and its coverings.

The destructive process is effectuated in exactly the same manner when a follicle behind the stricture inflames, suppurates, and becomes filled with decomposed urine, or when the impingement of the urinary stream produces a tear behind the stricture, or injury is inflicted by making a false passage. In all these cases a rapidly progressing infiltration of urine leading to gangrene may supervene.

If the infiltration begins at any point in front of the bulb, swelling, redness, and subsequent discoloration will develop on the penis and scrotum. The phlegmon may extend upward as far as the epigastrium. I once saw suppuration at the arch of the ribs. If the point of egress be behind the bulb, the urine will infiltrate from the perineum backwards toward the rectum, peritoneum, and bladder. A pericystitis with its attendant danger of rupture into the peritoneal cavity is present.

If the process progresses in this acute manner it is accompanied by high fever; chills and elevation of temperature as high as 41° C. [105.8 F.] often occur.

More frequently, however, the process is slower in its development. On the perineum firm, hard swellings of irregular form are found, which to the inexperienced give the impression of new growths. The usual termination of such slowly progressive inflammations, provided that they do not become diffuse and form infiltrations, is **urinary abscess**, which if it is not opened seasonably, may gradually involve the contiguous tissues and lead to urinary fistula. The diagnosis of all these conditions will not be difficult if the urethra be examined and the presence of a stricture determined, for then the relatively rapid development of the swelling can be accounted for.

Very often, as has already been stated, the stricture is associated with **cystitis.** This cystitis does not differ from the ordinary forms (*quod vide*). It heals very rapidly as soon as the stricture is relieved, so that oftentimes no special treatment is needed, dilatation of the stricture in itself sufficing to produce a cure.

In consequence of the resistance which the musculature of the bladder has to overcome in forcing the urine through a contracted passage it very frequently hypertrophies. In most cases of narrow stricture of long duration this condition of the bladder will be revealed by the cystoscope after the narrowing has been overcome.

If the obstruction lasts very long it may cause dilatation of the upper urinary tract. The ureters become dilated and the pelvis of the kidneys distended into a sac.

Under such conditions infection is not long postponed; the dilated ureters become inflamed and the hydronephrosis becomes converted into a pyonephrosis.

That the inflammatory process in the posterior urethra often extends into the duct of the glands the same as in posterior gonorrhœa is easily understood; we observe, therefore, during the course of stricture, epididymitis, prostatitis, and spermatocystitis.

The **prognosis** of urethral stricture is on the whole favorable, although it depends somewhat upon the kind of stricture and its location.

The further forward a stricture lies the more difficult it is to cure, so that those situated near the meatus are the most unfavorable of all. Gonorrhœal strictures are much more benign than traumatic. The

latter are very obstinate and often difficult to influence. All depends upon the nature of the causative injury.

Complications endangering life generally arise as the result of neglect. If a stricture is carefully watched and the caliber of the urethra properly kept open, these complications do not arise even though the stricture is not cured. If the condition be allowed to go untreated for years, it leads to the above described processes, such as urinary infiltration, fistulæ, hydronephrosis, pyonephrosis, etc.

TREATMENT.

The treatment of urethral stricture is one of the most satisfactory tasks of the surgeon. With proper skill nearly all cases can be quickly helped.

It is self-evident that treatment must be solely mechanical and directed to re-establishing the caliber of the urethra.

We set forth beforehand that cure in an anatomical sense is hardly ever possible. We have to do with a narrow canal, the passage through which is contracted by the formation of scar-tissue. The scars can be dilated and enlarged, but as every scar has an inherent tendency to contract there will always be danger of their becoming narrow again. Only in those cases in which the stricture can be entirely cut out and the free ends of the urethra re-united can a cure in the anatomical sense of the word be spoken of.

We must be satisfied with effecting a cure in the clinical sense, that is, improving the patient's condition by freeing him from all difficulty and keeping him free for a long time. This is thoroughly feasible.

The methods of treating stricture may be divided into three groups: 1. forcible bursting of the stricture, which is known as the divulsion method; 2. dilatation; 3. operative procedures by which the stricture is divided or cut away.

We will mention divulsion methods first so as to dismiss them from consideration. They are antiquated, their employment is irrational, and they are productive of harm rather than of good. An appreciation of the morbid anatomy of stricture will of itself suffice to show that forcible rupture of a stricture will cause a new scar to form, and therefore increase rather than relieve the contraction of the urethra. For this reason we will omit a description of the various instruments devised for divulsion; they are solely of historical interest.

For the same reason I am opposed to the electrolytic method of

treating stricture. Formerly strictures were often treated with caustics. Attempts were made to bore a passage through with these substances, but the method was abandoned because it was seen that cauterization as well as forcible rupture must later prove advantageous to the process of contraction. I am of the opinion that the treatment of stricture by electrolysis can be no more successful than treatment with any other caustic; in the one instance cauterization is effected with chemicals, in the other with the electric current.

The above mentioned procedures, moreover, are not at all necessary, as the majority of all strictures can be successfully treated by dilatation.

We distinguish **gradual temporary dilatation, and continuous dilatation.**

Gradual temporary dilatation is the proper procedure for nearly all strictures. It consists in introducing into the bladder a soft silk-web bougie of such a size that the stricture will just admit of its passage. The instrument is allowed to remain in the urethra for a few minutes; to leave it in longer is of no advantage. At the next treatment, which is best given on the second day, the same bougie is passed once and then the next larger number is introduced. The employment of any force whatsoever is wrong; the stricture must be slowly stretched, not torn. With this gradual dilatation much better and safer results will be obtained than if the stricture be forcibly enlarged at one sitting by using several instruments. From the latter course chills and fever not uncommonly result. Moreover, if the stricture is not causing urgent symptoms there is no indication for rapidly widening it. Treatment should be continued slowly and gradually until the urethra will admit a good sized bougie (21–23 F.).

[American surgeons continue the dilatation much higher. If the meatus be too small to admit sounds of large caliber, meatotomy may be done or recourse had to dilators. With Kollmann's dilators it will be found possible to attain a higher degree of dilatation than with sounds. The minimum dilatation which I eventually reach with these instruments is 30 F.]

As before stated only soft olivary bougies should be used. Metal sounds are also employed, but I do not deem it advisable to use a smaller one than 16 F. because the slenderness and rigidity of the tip of smaller sizes make the danger of forcing a false passage too great; even the greatest skill and gentleness will not always prevent the point from catching in a lacuna and then making a false passage if it be

pushed onward. In these cases, therefore, I always use the soft French olivary bougies. A great deal depends upon the tip of the instrument. It must rest upon a neck which is thinner than the body of the instrument. By this construction considerable mobility of the tip is obtained, which makes it easier for it to find its way through the stricture. The pointed conical French bougies are to be utterly discarded. I know of no instrument which can do great damage as easily as these. The point seems to be made for catching in a fold of mucous membrane or in the opening of a gland.

The after treatment of these cases is very important. It consists in passing a bougie at certain intervals so that the caliber to which the urethra has been dilated may be maintained. At first the instrument should be passed every two weeks, later every four weeks, and if the same size passes readily the intervals may then be increased to three or six months or even a year. Intelligent patients can be taught to carry out this treatment themselves.

Although this procedure will suffice for the majority of strictures, which may be designated as light cases, there are a certain number in which the first requisite of the method, namely, the introduction of a bougie, however small, cannot be accomplished.

The difficulty may depend upon inability to find the opening of the stricture, or upon the impossibility of penetrating the stricture because of its narrowness, after the bougie has entered the opening. These are two entirely different conditions which demand a totally different method of procedure. In the latter case, when the tip of the instrument has entered the stricture but will not advance, it should be left in situ for a while, after which an attempt to pass it will often prove successful; it may be allowed to remain as long as an hour. Under these circumstances a certain amount of force may be employed until the tip of the instrument is pushed through the constriction. When the instrument is actually in the opening of the stricture injury can hardly result by pushing it through. The employment of force is not permissible, however, unless one is absolutely certain of the position of the bougie. If any doubt remain that the tip of the instrument is not in the opening of the stricture, then the employment of force becomes a gross error, which can cause nothing but harm; it is then our duty to find the opening, for which patience and delicacy of touch, but not force, are helpful. The cause of this difficulty in entering the stricture is generally due to the fact that its opening is not central in

the axis of the urethra, but is eccentric; the opening, too, may be so narrow that the instrument cannot penetrate it.

In the latter case it is well to inject a small syringeful of olive-oil into the urethra and then introduce a filiform bougie. The oil enlarges the opening so that the instrument can often be made to enter it. The same difficulty is encountered in passing an instrument through

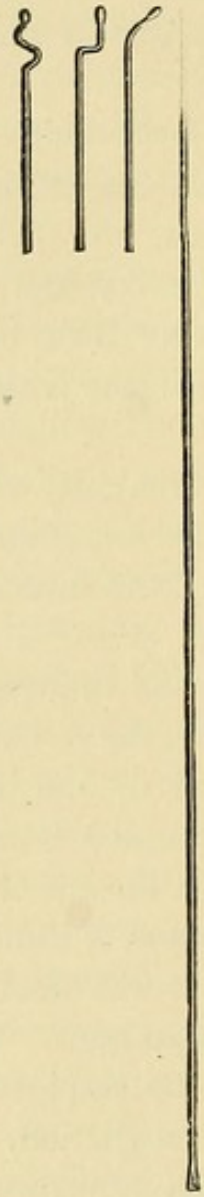


FIG. 134.—Spiral and bayonet-bougies

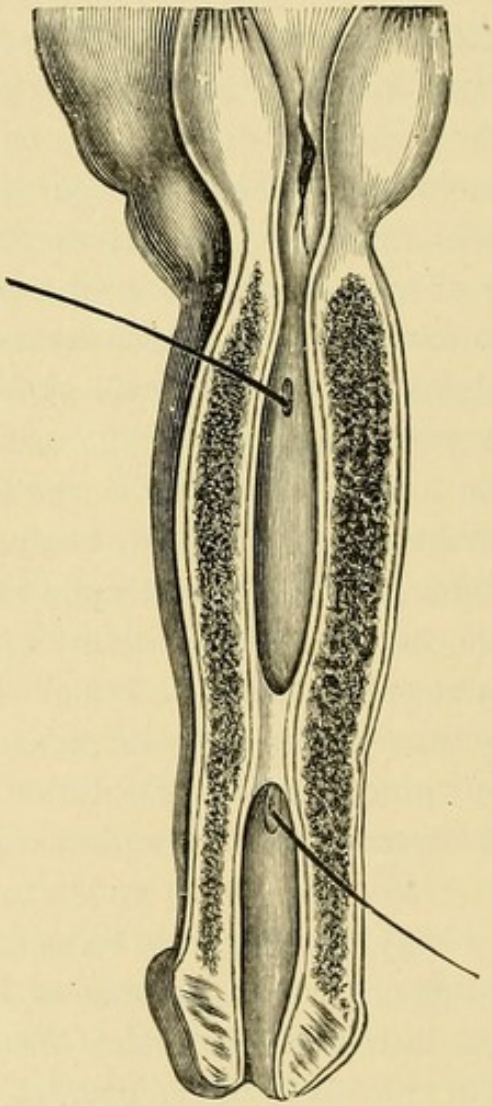


FIG. 134.—False passage in the urethra.

spiral strictures. The point of a straight bougie naturally strikes against the wall of the stricture. Therefore an attempt should be made to pass a spiral or bayonet filiform (Fig. 134).

If the stricture is eccentric and its opening cannot be found, the artifice of introducing several bougies down to the stricture and then patiently and gently trying to work one into the opening may be tried

with advantage. The value of this procedure has long been known, and it will often succeed after all other measures have failed. This is easily explained. While the point of a single filiform strikes against the wall of the urethra, if four be introduced it is probable that one will hit the opening. At least the chances of such an occurrence are favorable, for if three of the bougies miss the opening the chances of the fourth one reaching it are increased. [It may be necessary to fill the urethra completely with filiforms and then try to insinuate first one and then another through the orifice of the stricture.]

Frequently the difficulty of entering the stricture is due to the presence of one or more false passages. (Fig. 135.) The diagnosis of such a case is not easy, although there are certain criteria which are of assistance, such as deviation of the bougie from the median line, perception of an unusually thin layer of tissue between the rectum and the bougie, and especially sudden arrest of the bougie after it has been passed 18 cm. [$7\frac{1}{5}$ inches] or more into the urethra. This sudden arrest is evidence that the instrument is not in the bladder. Since strictures do not occur behind the membranous urethra, and as the distance from the meatus hitherto seldom exceeds 17 cm. [$6\frac{4}{5}$ inches] the bougie must have penetrated the mucosa, that is, entered a false passage. The only other possibility is that the bougie may have entered the stricture and is firmly held there. This condition cannot be confounded with the one just described, because the clasping of the instrument by the stricture can be distinctly felt, whereas when in a false passage it can be rotated on its axis. If the point be caught in a pocket of the retiform tissue behind the stricture, it will generally be possible to pass it into the bladder by drawing it out a little, turning it on its axis, and then pushing it onward again.

The difficulty of passing a bougie when such a complication is present consists in the almost invariable tendency of the instrument to seek the false rather than the true passage. In such cases I have found the following artifice of value: I introduce a moderately slender bougie, one about 6 French, as deep as it will go without forcing it. It will almost always enter the false passage. With this one still in place a second one introduced beside it will often enter the stricture. This is explained by the fact that the false passage is occluded by the first instrument so that the second passes *nolens volens* into the true opening.

With the help of all these measures it will often be possible to overcome strictures which at first seemed impermeable, and when they

have once been passed to proceed to further dilatation. There are cases, however, in which these gradual procedures fail. There are circumstances, too, which absolutely indicate rapid dilatation. For example, if a purulent cystitis with stinking, sanious urine is present, or an inflammation of the upper urinary tract with attacks of fever, then a more rapid subjugation of the stricture is necessary. An appropriate procedure here is **continuous dilatation.**

It consists in passing a catheter one size smaller than the stricture into the bladder and fastening it there. This catheter, which must be only a soft silk-web one, is allowed to remain from twenty-four to forty-eight hours. Owing to the continuous contact of the catheter with the stricture an inflammatory process develops which leads to softening of the callus and makes it possible after forty-eight hours to dilate the stricture from 4 to 6 mm. without tearing it. The largest instrument passed is then fastened in and at the end of two days another rapid dilatation made, and so forth. In this way strictures which are not too hard can be brought up to a caliber of 20 F. or higher in a week.

If the stricture is so narrow that recourse must be had to filiforms one should be tied into the urethra. The patient then forces his urine out beside the bougie, which acts in the same manner as a retained catheter.

This continuous dilatation is a good method for quickly overcoming soft strictures, but is appropriate only when there is an associated cystitis. If the latter be absent and the urine clear, it is contra-indicated. The inflammation excited in the urethra almost always extends to the bladder. This viscus becomes infected and cystitis develops.

Whenever a catheter is retained the bladder must be irrigated several times daily so as to wash out some of the germs which have gained access and render those which remain innocuous. An injection of 100 cc. [about 3 fluid ounces] of a 1:1000 silver nitrate solution, alternating with mercury oxycyanate 1:4000, may be given by a nurse every two hours and the fluid allowed to flow out through the catheter.

Another very valuable and gladly employed procedure by which a permanent catheter is inserted is that of Le Fort. The methods of Desault and Maisonneuve were the precursors of this one which we are about to describe.

The multifarious measures which, as we have seen, are at times neces-

sary to gain entrance to a stricture show how difficult entrance may often be. Therefore it is not surprising that surgeons long since endeavored to render permanent any opening which they once succeeded in making. It can happen, says Thompson, that the most skillful surgeon may fail to get an instrument through a stricture after having once successfully penetrated it. Acting in accordance with this knowledge Desault used a thin elastic catheter open at both ends, which he pushed down as far as the stricture, and then tried to pass another through it into the bladder. Over this he then endeavored to slide a larger instrument. Maisonneuve's well-known procedure was an improvement on Desault's. After he had succeeded in passing a slender guiding sound into the bladder he screwed a somewhat thicker flexible bougie onto its external end and then pushed it through the urethra, whereupon the first one became coiled up in the bladder. Upon the second instrument there followed a third larger one, and so on until the stricture was considerably dilated at a single sitting.

Both these methods are to be rejected because they are nothing more nor less than skillfuly performed divulsions, which, as already stated, we consider injurious.

Le Fort's method differs from Maisonneuve's only in that Le Fort allows the filiform guide to remain in the urethra from twenty-four to forty-eight hours before attaching and passing the second instrument, which is preferably a metal catheter such as is shown in Figure 136. Le Fort aims to create inflammatory softening of the stricture by means of the retained catheter, and thereby prepare the way for larger instruments. It is not successful in the sense that the metal instrument can always be passed the next day without the employment of any force, but yet it is a very good method which can be used in many cases with great benefit.

A slight application of force is, moreover, permissible because we are certain that the instrument is within the stricture so that a false passage cannot be made. It is only when too much haste or force is used that the filiform can nick the urethra; if under such circumstances it be pushed onward great harm will naturally be done.

Varnished silk-web catheters are now manufactured which correspond to Le Fort's instrument. The anterior part, about 30 cm. [12 inches] is filiform, while the remaining portion increases gradually into a thick large shaft [Rat-tail catheter]. (Fig. 137.) This instrument can often be passed when Le Fort's metal catheter fails. It may

be impossible, however, to overcome very indurated strictures; the softening produced by retention of the filiform is too slight to admit the passage of either the attached metal instrument or the gradually thickening soft catheter. Moreover, there are many circumstances under which it is not advisable to employ any of the above-named

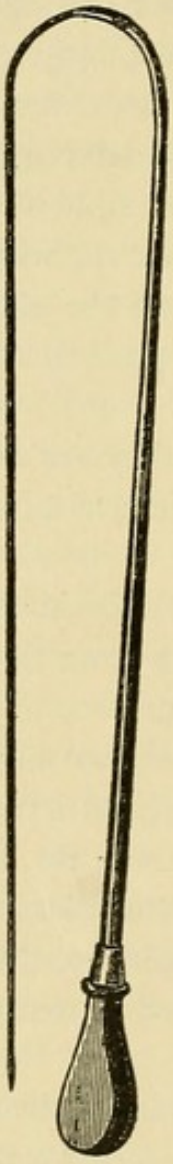


FIG. 136.—LeFort's instrument.

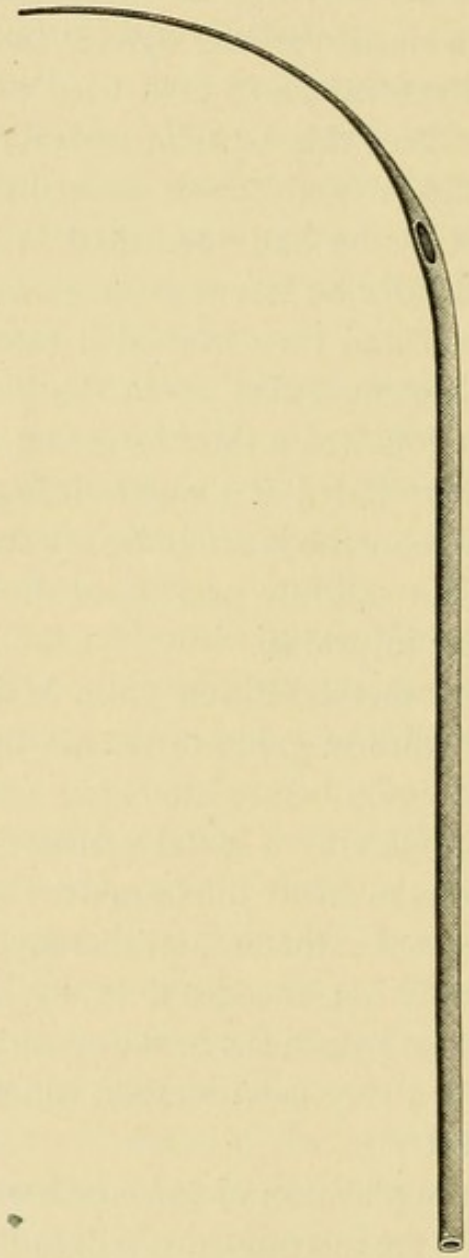


FIG. 137.—Rat-tail catheter.

methods, and which compel us to treat the stricture by operative measures.

Of these we will first mention **hypersensibility of the urethra,** which manifests itself by derangement of the nervous system. There are patients who experience disturbances in various organs after every catheterization, no matter how carefully it may be performed. Apart

from the intolerable pain caused by the passage of the instrument there remains for a considerable time an irritability of the urethra which incapacitates the patient for work, deprives him of appetite, and robs him of sleep. Slight attacks of syncope and symptoms of shock occur. If several soundings attest the permanency of this state of hypersensibility and the usual antagonistic measures such as preliminary cocainization of the urethra remain without effect, we must desist from attempts at dilatation.

Urethral fever must not be confounded with this shock-like condition. It occurs in three forms: first as a single transitory attack of fever; second as a recurrent fever; third as a chronic continuous fever. Cases of this kind occurring after the passage of instruments are at present regarded exclusively as infectious; they indicate the presence of renal complications, but may occur independently thereof. In every such case we should use the utmost caution in employing dilatation, or even resort to some other procedure for removing the stricture.

A second condition is the so-called **resilient stricture,** which shows a tendency to contract after every dilatation. The use of the bougies here amounts to nothing. The constriction occurs again, and even so rapidly as to demand the daily passage of an instrument to keep the urethra patulous.

Some authors explain this condition by the supposition that the resorptive power of the tissue is no longer present, that the stricture is composed of an unalterable dry scar which always contracts. However this may be, the fact remains that such strictures are not suitable for dilatation.

In like manner experience has demonstrated that strictures near the external meatus are exceptionally obstinate. Dilatation is generally useless and also very painful. They are conquered much more easily and quickly by a free internal incision with a small blunt-pointed knife, or a concealed bistoury. The exceedingly rare valvular strictures should be cut (Fig. 138). In the very rarest instances they are due to consolidation of free masses of exudate projecting from the surface of the urethra, but generally result from congenital duplication of the mucous membrane. Treatment consists in dividing the valve with a fine-pointed bistoury on a tunnelled sound.

For the division of all strictures situated further back special instruments and procedures are required. We distinguish between internal and external urethrotomy.

INTERNAL URETHROTOMY.

Internal urethrotomy is performed by carrying a knife into the urethra and evenly dividing the constricted portion. The object aimed at is to cut through the callous or contracted scar-tissue in such a manner that

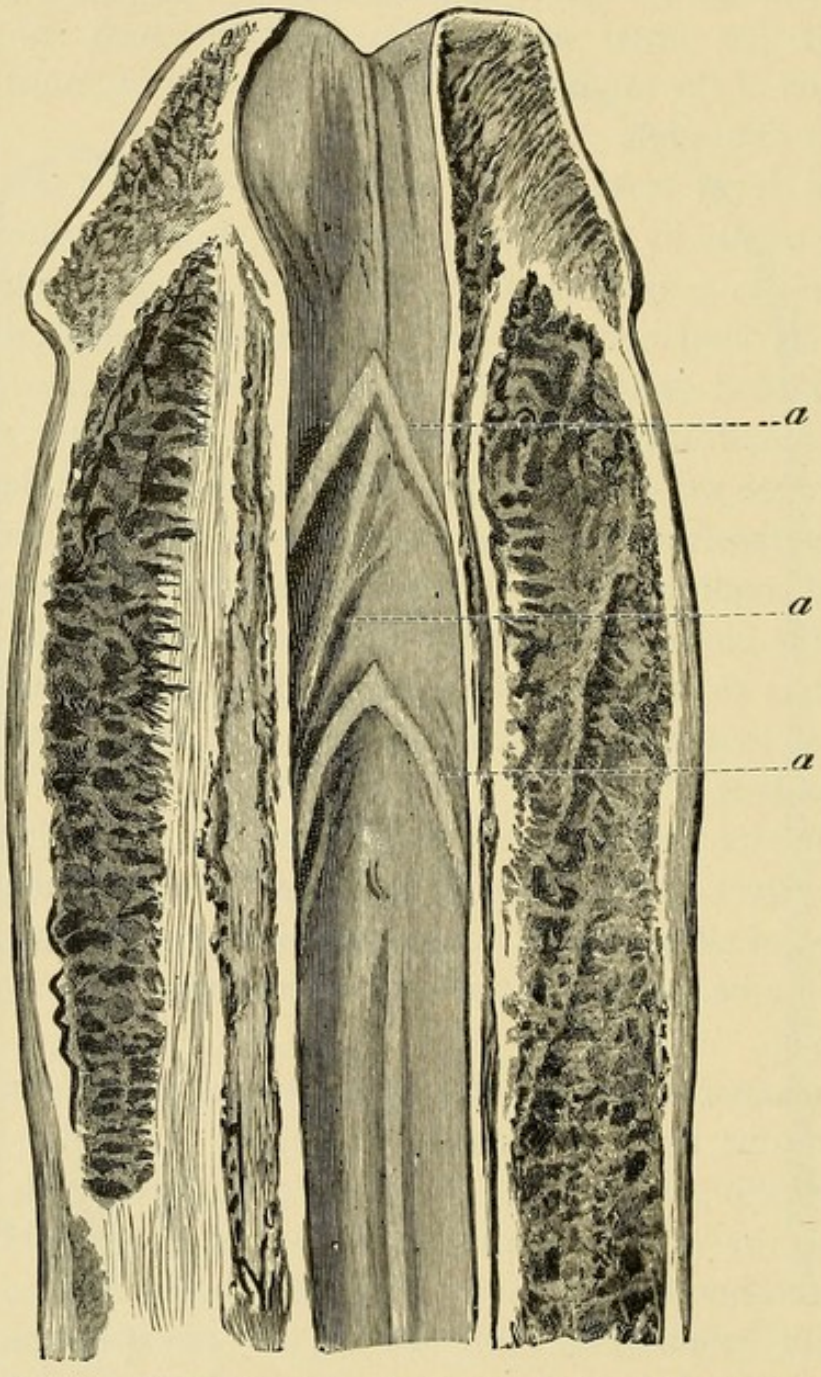


FIG. 138.—Valve-stricture. Stricture en bride of Voillemier.

a new layer of scar-tissue shall be interposed between the cut edges, with the result that the stricture becomes widened.

Internal urethrotomy may be performed from behind forward or from before backward. A prototype of the first method is that of Maisonneuve, while Thompson's represents the second. Many other

surgeons have devised urethrotomes, and each thinks his own is the best.

The construction of Thompson's instrument, which cuts from behind forward, is shown in the illustration (Fig. 139). The blade D is concealed in the sheath C. The instrument is passed through the stricture, the blade is liberated by pressing upon B and the instrument is then drawn forward. This urethrotome, the caliber of which about corresponds to No. 12 of the French scale, can be used only for strictures large enough to admit of its passage. I am of the opinion that a stricture which admits a No. 12 instrument seldom requires bisection, and therefore do not employ the method.

A much more useful procedure is that of Maisonneuve, in which the incision is made from before backward, the only prerequisite to its per-

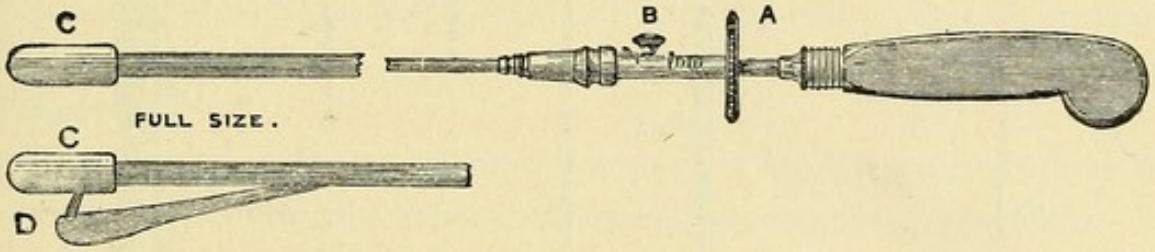


FIG. 139.—Thompson's urethrotome.

formance being the passage of a filiform bougie. The instruments necessary are shown in the accompanying illustration. (Fig. 140.) The filiform bougie (F) is introduced into the bladder and allowed to remain twenty-four hours. Upon the end of this the urethrotome (U) is attached by means of a screw-tip and pushed through the urethra into the bladder, whereupon the filiform curls up in the bladder the same as in Le Fort's method. The knife (M) is now inserted into the groove of the shaft; it cuts only forward and backward, being blunt at the summit. In consequence of this procedure the urethra is stretched wherever it is dilatable, so that the knife does not cut when it is inserted and withdrawn. In the places where the urethra cannot expand it cuts through the tissue. There are three blades of different sizes, M, M1, M2, to be used according to the extent of the incision it is desired to make. The knife is carried down to the internal sphincter and then withdrawn, cutting as it returns any contractions not previously divided. The shaft of the instrument is now withdrawn until the filiform attached to its end appears at the meatus; the staff (St.) is now fastened to the filiform, and over it the catheter (K) is slipped and passed into the bladder; finally the staff and filiform are withdrawn and the catheter fastened into the bladder

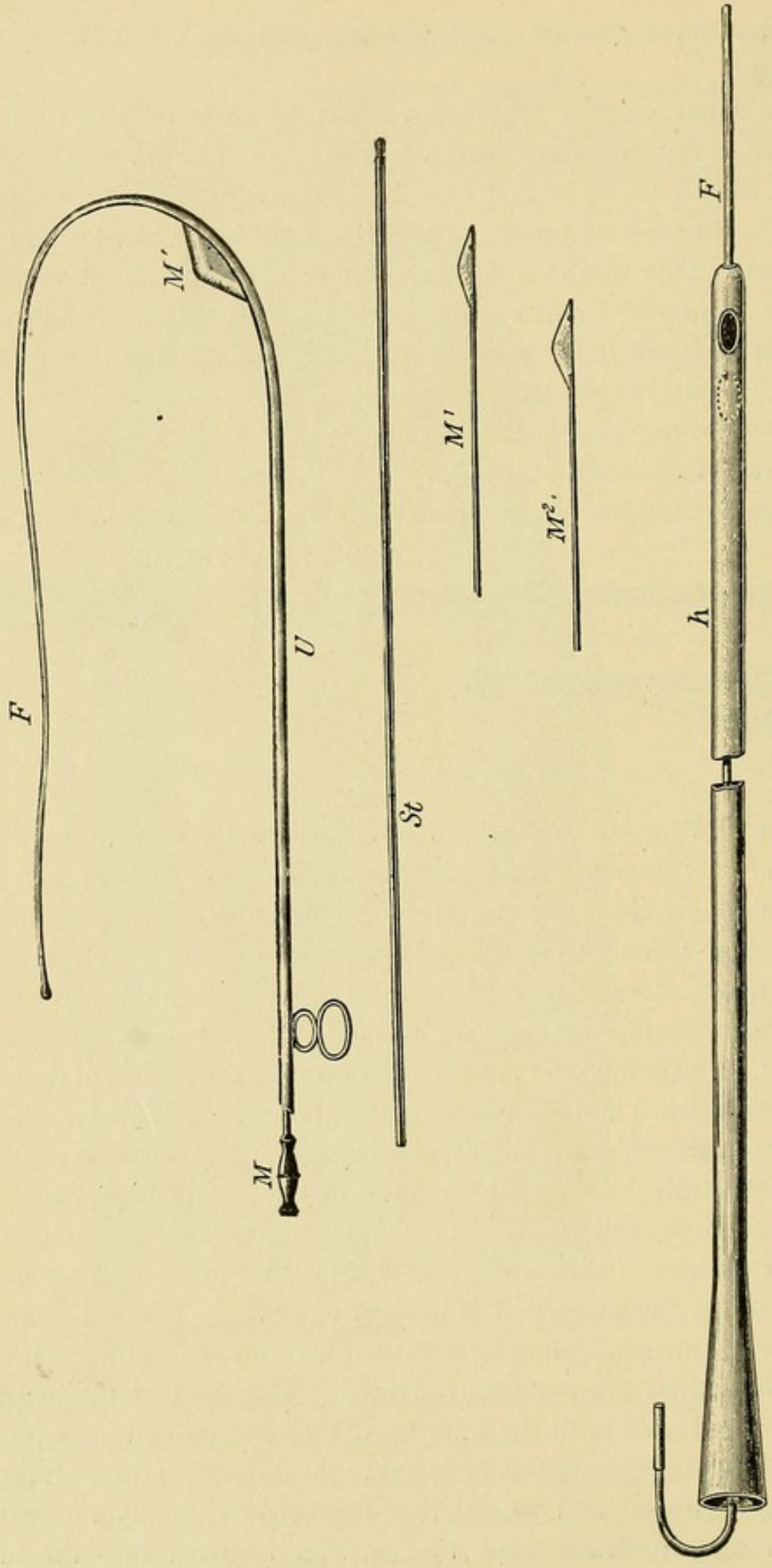


FIG. 140.—Maisonneuve's urethrotome.

and kept there for three days. This method is an excellent one, succeeding in nearly all cases, even in those in which the strictures are considerably indurated. It may happen, however, that the catheter cannot be slipped over the filiform if the calloused masses are very large.

Moreover, the procedure is not entirely without danger, and therefore is to be resorted to only when urgently indicated and after the other and milder methods have failed. The danger lies first in the possibility of **infection** taking place through the incision, and secondly in the propensity to violent hæmorrhage, most difficult of control. I have seen both conditions.

In the first instance chills occur; this is not of much import if only one takes place, but the condition responsible for their occurrence may develop into a true sepsis, especially if a purulent cystitis be present. It is well to give 1.0 [15 grains] of quinine before and after the operation.

Copious hæmorrhages are more frequent. The operation is done in the dark, as it were, and the size of the incision canot be measured. It may open the corpora cavernosa widely, so that a continuous and uncontrollable oozing of blood will take place from the urethra. These hæmorrhages are particularly malign because the source of the bleeding cannot be reached. Compression of the urethra upon the catheter, and injections of gelatine may be tried; if they do not succeed external urethrotomy must be performed and the bleeding spot tamponed through the opened urethra.

Do not be deceived by the absence of hæmorrhage from the meatus, as the blood often flows backward into the bladder. A flow of clear urine free from blood through the retained catheter is proof that hæmorrhage is not occurring. Severe hæmorrhages may even develop days after the operation and upon these likewise must great attention be bestowed.

EXTERNAL URETHROTOMY.

External urethrotomy is reserved for those rare cases in which the milder procedures already described have failed.

The method of performing it varies according to whether the urethra will admit the passage of an instrument. In those cases in which the operation is done for urinary abscess caused by infiltration of urine, and in which a metal sound passes through, it is extremely simple, a tunnelled staff (Fig. 141) being passed into the bladder, the urethra

opened in the groove of the staff and the stricture divided [Syme's operation].

Its performance is much more difficult when only a filiform can be passed; in this condition the incision must be made exactly in the median line in an endeavor to cut down upon the filiform. As the urethra is often distorted it may be difficult to find the bougie through the incision, although with care and patience the difficulty can always be overcome.

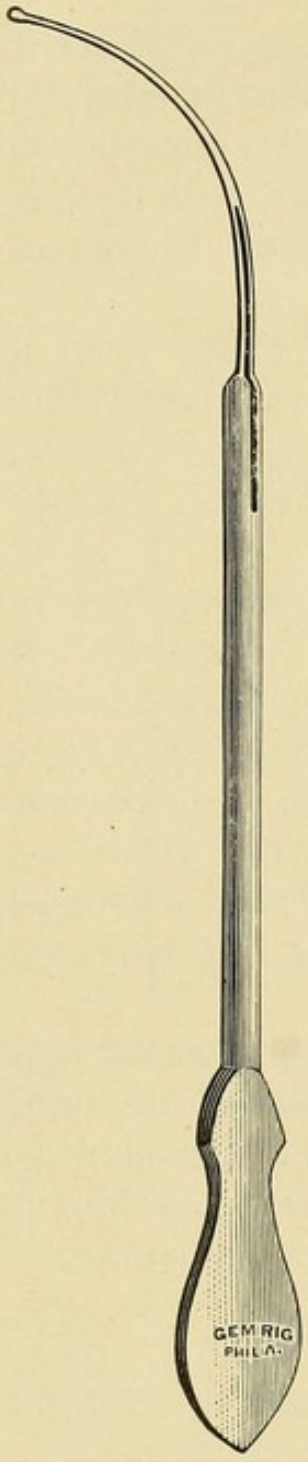


FIG. 141.—Syme's staff.

On the other hand, when no instrument whatever can be passed through the urethra the operation may be exceedingly difficult. A metal sound is carried into the urethra as far as it will go, an incision made down to its tip and the urethra opened; the edges are then drawn apart with forceps, or retracted and fastened with a thread, and the further course of the urethra sought for with a fine bougie. The effort is generally successful and the operation is then carried out as before described; it is not completed, however, until a large Nélaton or French catheter is passed into the bladder through the perineal wound and the urine flows out freely. [A perineal drainage tube may be substituted for either of these instruments, or a catheter may be passed from the meatus (Fig. 142). The introduction of a gorget (Fig. 143) into the bladder through the perineal wound will facilitate the introduction of the catheter or drainage tube. Pass the gorget in before removing the staff, then withdraw the staff and insert the catheter or drainage-tube.] If the course of the urethra cannot be determined after the distal end of the stricture has been exposed, suprapubic cystotomy may be performed as a last resort and retrograde catheterization practised. After the bladder has been opened a metal catheter or staff is inserted into the internal orifice of the urethra and carried outward until its tip appears in the perineal wound; a catheter is now passed from the external meatus and fastened onto the tip of this instrument, which is then drawn backward so that the catheter

is carried into the bladder. The catheter is carefully fastened and the bladder closed. The best instrument for this purpose is Jacques's patent catheter, which must be left in for two or three weeks.

[Orville Horwitz has devised an instrument which facilitates the performance of external urethrotomy for very tight strictures or rupture of the urethra.

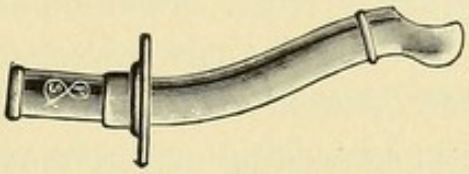


FIG. 142.—Perineal drainage tube;

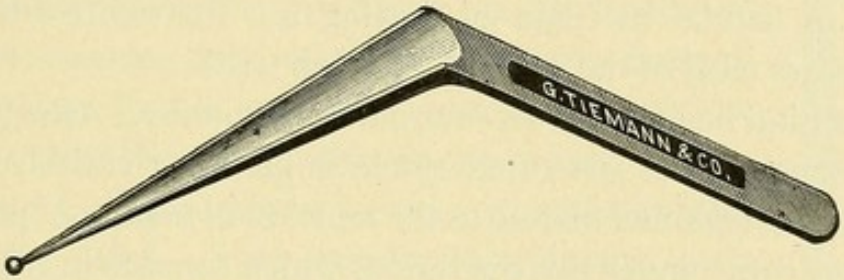


FIG. 143.—Teale's probe-gorget.

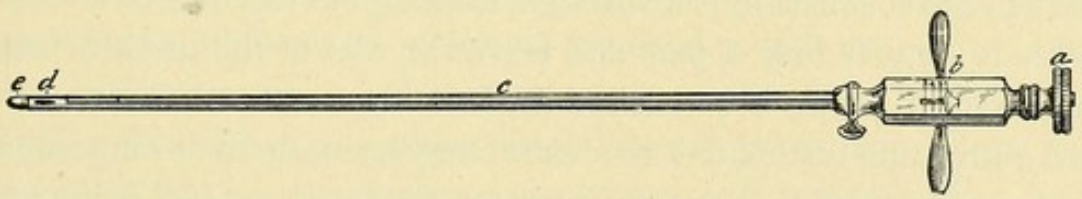


FIG. 144.—Horwitz's dilator for whip-bougie; blades closed.

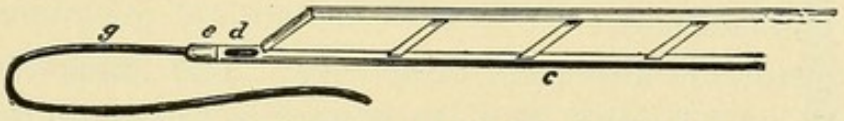


FIG. 145.—Horwitz's dilator over whip-bougie; blades separated.

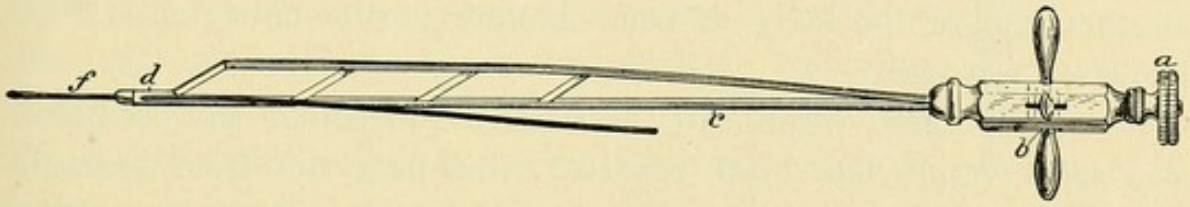


FIG. 146.—Horwitz's dilator over a filiform bougie; blades separated.

This instrument (Fig. 144) consists of two blades (c) in close approximation, which together form a smooth staff with a thumb-screw (a) at one end, by means of which the blades may be readily separated. The distal end of the staff terminates in a rounded nut (e) which can be removed and replaced by a whip filiform (Fig. 145). An opening

(d, Fig. 146) in the nut also permits the insertion of a filiform bougie, which may be used when the whip-bougie cannot be passed through the obstruction. The staff is inserted into the urethra until the obstruction is reached and the bougie is then pushed onward into the bladder. The blades of the instrument are then separated, as a result of which the urethra is fixed and also made prominent, so that it can be readily detected and opened.]

RESECTION OF THE URETHRA.

More radical than simple external urethrotomy are those procedures in which the stricture is excised. In order to prevent recurrence and the formation of fistulæ the plan of cutting out the entire stricture and uniting the free ends of the urethra has been tried.

The operation begins with an external urethrotomy. After the urethra has been exposed the strictured tissue is partly or entirely cut away. The procedures confined merely to the removal of masses of periurethral callus do not come under this operation, which consists in removing the strictured portion of the urethra itself. The entire circumference of the constricted part is usually cut through, although in some cases it may be possible to remove only a part and leave the roof of the urethra intact. After the stricture has been excised the free edges of the urethra may be united with a fine suture, or a new canal may be made by sewing some of the soft periurethral tissue over a catheter, the latter method being practised when too much of the urethra has been resected to allow the cut ends to be approximated.

Plastic operations also have been tried. The tissue covering the urethra, including the skin, have been used to supply the loss in continuity engendered by the resection, and mucous membrane from another part of the body, or from another person or an animal has likewise been used.

From all these complicated operative procedures an occasional successful result has been reported; they have not been generally adopted, however, and indeed it may be said that there is hardly any need of them as the less radical methods, including external urethrotomy, give satisfactory results.

TREATMENT OF RETENTION OF URINE DUE TO STRICTURE.

The occurrence of retention of urine requires special therapeutic consideration. We must remember in the first place that it is not always

very narrow strictures which give rise to retention, but that moderate constrictions may, if subjected to some detrimental influence, cause a total temporary occlusion of the urethra.

In numerous cases the passage of a bougie through the stricture, or even into its opening, will restore the patient's ability to urinate; there are some cases, however, in which the patient cannot urinate after the sound is withdrawn, and others in which an instrument cannot be passed into the bladder.

In the first of these two conditions, namely, when the patient cannot urinate after the withdrawal of a fine bougie which has been successfully passed into his bladder, Maisonneuve's procedure is advisable; it applies, of course, only to those strictures through which nothing but a very fine instrument can be passed, for were they permeable to one of large caliber it would be a simple matter to take a catheter and draw off the urine. Very slender instruments, even though hollow, do not allow the urine to escape. In such cases, as has just been said, Maisonneuve's method of passing a filiform to which is attached a soft or metal catheter may be followed (see page 147). It is, indeed, a divulsion, a procedure which I do not generally approve of, but in an occurrence so pressing and urgent as complete retention of urine it is permissible. [Instead of employing Maisonneuve's method, a Gouley's tunnelled catheter (Fig. 147) may be passed over a filiform. If it is impossible to get any instrument larger than a filiform through the stricture, tie in the filiform, as it will abstract some of the urine by capillary drainage, and will also cause inflammatory softening of the indurated tissue, so that another instrument can be passed within a few hours. Oftentimes Gouley's instrument can be passed at the second attempt, but in some cases it will be found necessary to insert a second filiform beside the first, and even to employ a third, before a catheter sufficiently large to draw off the urine in any considerable quantity can be introduced. If a filiform can be passed and capillary drainage secured, the imperative symptoms will be relieved; the obstruction can generally be overcome within a few days at most.]

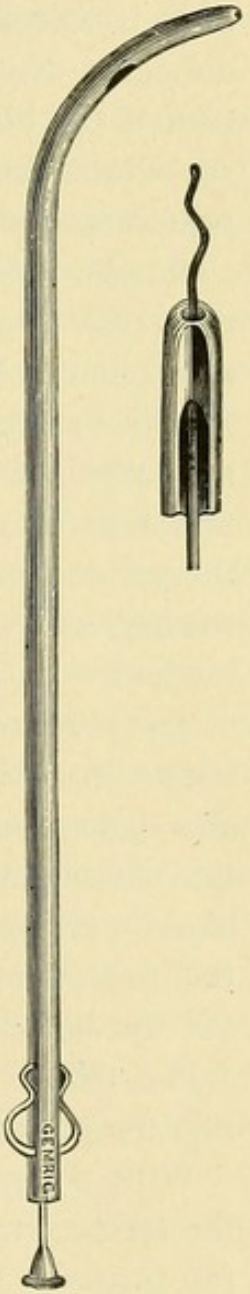


FIG. 147.—Gouley's tunnelled catheter

For those most urgent cases of complete retention in which no instrument whatsoever can be passed there are two ways which lead to the goal: either an immediate external urethrotomy is done in the manner described, or a palliative **capillary puncture of the bladder** is made.

Of the two operations I always give preference to the latter. As already stated, external urethrotomy without a guide is at times most difficult. Not infrequently urinary fistula remains as a sequel. Puncture of the bladder with a capillary trocar is the simplest and easiest procedure that there is; it confers relief very quickly and can be repeated several times without injury. The fine puncture in the bladder-wall agglutinates at once. If several have been made and the bladder thus relieved, the patient will either be able to urinate voluntarily, or a bougie can be passed and then one of the milder procedures, such as Le Fort's, employed. It must not to be forgotten that it is not altogether the narrowness of the stricture which is responsible for the retention of urine; we have often seen cases in which distortion of the periurethral masses [exudate] was the cause of the extreme narrowing, and which for this reason were readily dilatable by Le Fort's method.

To perform vesical puncture take an ordinary fine trocar somewhat longer than that used for tapping a hydrocele and, after incising the skin just above the symphysis under local anæsthesia, thrust it quickly into the bladder. The peritoneum is pushed upward by the distended bladder and remains uninjured. I have never seen harm result from this procedure. If severe cystitis with decomposition of urine is present the bladder may be irrigated through the trocar.

[To relieve urgent symptoms of impermeable stricture the urethra may be punctured at the apex of the prostate (Cock's operation).

With the patient in the lithotomy position the surgeon introduces the forefinger of his left hand into the rectum and locates the apex of the prostate. A sharp double-edged knife is then plunged into the median line of the perineum and carried toward the tip of the finger in the rectum. When the relation of the parts are thoroughly recognized and the position of the knife assured its tip is deflected a little to one side and pushed onward into the urethra. By moving the knife upwards and downwards the incision in the perineum is enlarged; a probe is then carried into the urethra and a catheter slipped over the probe.

Mr. Cock has truly stated,* "that however complicated may be the derangement of the perineum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy, often dilated, and accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate, a part which never is the seat of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator."

The operation, however, is not so simple as it appears; it should be reserved for those cases in which the stricture cannot be entered after vesical puncture has been performed several times. In urgent cases, in which the general condition of the patient is bad, it is preferable to an extensive and protracted dissection of the perineum, as by its performance the bladder can be permanently drained, and the stricture treated later, after the patient's condition becomes improved.]

As to the question of **recurrences** it may be said that there is no method free from the reproach that they may take place after its performance, for, as already stated, there can be no cure of a stricture in the anatomical sense. In general it may be said that the longer and more carefully dilatation is carried out the more lasting will be the result; no method assures against relapses unless after treatment is given. Sounds must be passed for a long time after continuous dilatation, Le Fort's procedure, and internal and external urethrotomy in order to maintain the caliber of the urethra, just as after simple dilatation. In view of these limitations the simplest method, namely, simple gradual dilatation, is the method of choice. The others are to be employed only when the special indications above described are present. External urethrotomy should be reserved for the most difficult cases, as it has the disadvantage that fistulæ, which are very hard to close, occasionally remain.

STRICTURE OF THE FEMALE URETHRA.

In woman the occurrence of urethral stricture is much rarer than in man and therefore of much less importance. Apart from the very rare congenital strictures the lesion occurs mostly as the result of cicatricial changes which occasionally arise from injury. Difficult labor, either natural or instrumental, which wounds the urethra, withdrawal of foreign bodies or calculi from the bladder, removal of

*Guy's Hospital Reports, 1866.

urethral polypi, and severe chancroidal ulceration are the causes of this scar-formation. I have never seen any instances in which chronic urethritis led to stricture as it does in man.

The symptoms are always trivial; slight difficulty in voiding urine, a somewhat longer duration of the act than normally, and a slight burning sensation are the only symptoms noticed. It is only when complications, such as cystitis, for instance, arise that the symptoms become more urgent.

The diagnosis is easily made with a bougie à boule. Treatment consists in simple dilatation with bougies. Only in extreme degrees of constriction are one or more incisions such as are used in internal urethrotomy required.

INJURIES OF THE URETHRA.

Two classes of injuries are recognized: simple traumatisms and true lacerations.

The former may be due to the passage of foreign bodies or to the improper introduction of an instrument. Very frequently slight injuries are sustained after crushing vesical calculi, when a fragment of stone remains in the lithotrite and the instrument is withdrawn without being entirely closed.

The injuries due to the introduction of catheters or bougies are generally termed **false passages.** In the healthy urethra they seldom occur, although we sometimes see cases in which fine-pointed instruments have caught in the bulb, or entered one of Morgagni's crypts, and others in which instruments having too short a curve have gone through the prostate. In a strictured urethra a false passage immediately in front of the stricture is frequently made by repeated attempts to pass an instrument. Likewise false passages are often seen around an enlarged prostate which has twisted and distorted the urethra; the false passage may go through only a small portion of the gland, or perforate it in its entirety so that the point of the catheter reaches the bladder through a channel tunnelled through the gland.

It is not always easy to determine whether one has made a false passage. Frequently the urethra gives way suddenly and the catheter passes at once into the bladder. Generally some blood flows out beside or through the catheter. The pain caused by the injury varies in intensity. If the instrument perforates the urethral wall to any extent, the tissue intervening between it and the skin covering the penis will be

felt as a thin layer. Micturition may not be at all interfered with, although if large extravasations of blood occur it will become difficult, or may be entirely arrested; these conditions may depend upon blood-clots, inflammatory swelling, or spasm of the sphincter occasioned by the injury. Not uncommonly considerable constitutional disturbance results; chills with fever of days duration are the rule.

Treatment depends upon the existing conditions. If no stricture is present, in the mildest cases, as for example those caused by the passage of a stone, nothing is necessary, as the slight tears heal without treatment. If a false passage has been made endeavor to pass a soft catheter, if necessary using a staff as a guide, and fastening the catheter into the bladder. If a stricture is present, but the patient able to urinate voluntarily, refrain from further attempts to pass a bougie; put the patient to bed and give him 1.0 [15 grains] of quinine; if he cannot urinate capillary puncture of the bladder may be made. I also advise its employment in false passages around an hypertrophied prostate (*q. v.*). The puncture may be performed several times, after which the patient generally can urinate, the false passage having healed in the meantime. Large doses of quinine, 1-2.0 [15 to 30 grains] a day, should always be administered in every injury of the urethra.

Lacerations in the penile portion of the urethra are not very common. They have been observed as a result of violent coitus, or an erection during a severe acute gonorrhœa; in the latter case the swollen mucous membrane cannot expand to accommodate itself to the distention of the penis produced by the erection, and therefore ruptures. In the flaccid condition of the organ stab-wounds, blows, crushes, and irrigation of the urethra under high pressure and without a catheter (after the method of Janet) may lead to lacerations of the mucosa.

In the perineal portion of the urethra stabs and blows, but more commonly a fall in which the perineum strikes a hard object (the edge of a chair, a stool, box or plank, etc.,) are responsible for lacerations. Less frequently they are due to fractures of the pelvis, a splinter of bone piercing the urethra.

Three degrees of laceration are recognized; in the first there is merely an extravasation of blood into the corpora cavernosa, the urethral mucosa and the outer fibrous sheath of the corpora cavernosa remaining uninjured; in the second, in addition to the extravasation of blood, the urethra is torn; in the third corpora cavernosa, urethra, and outer

fibrous envelope are all torn. In the injuries of the posterior urethra lacerations of the second and third degrees are the only ones to be considered.

Generally the tears occur immediately in front of the triangular ligament (urogenital diaphragm), in the region of the bulb, and most commonly upon the under wall; the entire urethra, however, may be torn through so that the free ends retract like a severed blood-vessel. In fracture of the pelvis it is usually the membranous urethra which is involved.

The **diagnosis** of these conditions is determined by the three cardinal symptoms of pain, hæmorrhage, and disturbance of micturition. The development of these symptoms are, however, entirely different, varying according to the extent of the injury.

In the mild cases, which we designate as of the first degree, nothing more than a momentary pain, followed by slight swelling of the penis or perineum, may be present to mark the injury. The swelling corresponds to the site of the effusion of blood. These cases usually get well rapidly; the effusion is resorbed and the urethra becomes perfectly free for the passage of the urinary stream.

In cases of the second degree urination is painful; as a result of the extravasation of blood the urine is voided slowly and is mixed with blood, and a distinct swelling is perceptible over the site of the rupture.

In the severe cases of laceration [those of the third degree] serious hæmorrhages occur; they may appear at the external meatus, or the blood may flow back into the bladder, or be poured out through the laceration and infiltrate the surrounding tissues. Even though no blood flows out of the urethra after injury do not be deceived into concluding that no laceration has taken place. The picture will soon become clearer. The patient tries to urinate, but in vain; although a few drops may have been voided at first, complete retention soon develops. Racked by violent pain the patient strains in an effort to empty his bladder, but the only result is increase in the size of the swelling in the region of the wound, which is usually in the perineum. In case the tear be in front of the bulb, swelling and redness of the penis and scrotum develop. Here we see the same picture which we drew when describing rupture of the urethra behind a stricture, that is, infiltration of urine anterior to the bulb. If the wound lies behind the urogenital diaphragm, then the infiltration extends toward the rectum and bladder.

This rapidly advancing urinary infiltration is not always the immediate result. Nothing more may occur than large accumulations of blood in the region of the laceration, but this is the exception. Therefore, if a swelling is met with after an injury, it is always better to consider it as an existing, beginning, or at least threatening infiltration originating from a laceration of the urethra than as an extravasation of blood. The case is perfectly plain if a catheter cannot be passed into the bladder and the urine withdrawn. The tip of the catheter goes only as far as the tear, the way into the bladder being destroyed. Constitutional disturbances, such as chills and high fever, are hardly ever absent.

As to **treatment,** it may be said that in rupture within the corpora cavernosa (lacerations of the first degree) it will be sufficient to confine the patient to bed, make applications to the penis [lead water and laudanum or dilute alcohol] and give from 1–2.0 [15 to 30 grains] of urotropin a day.

In lacerations of the second degree, in which the mucous membrane is also torn, it seems advisable to use the catheter and to institute continuous catheterization as soon as it can be done without great trouble. As the laceration is most frequently on the under wall of the urethra, care should be taken to pass the instrument along the upper wall, and to use a metal catheter with a pronounced curve if the urine is drawn repeatedly, or a similarly curved staff as a guide if a retention catheter is to be introduced.

In lacerations of the third degree catheterization is not appropriate and, moreover, could not be successfully performed even if attempted, because the totally severed ends of the urethra have retracted so far from one another that a passable channel is no longer present. An attempt may be made, but only on condition that the operation shall not be deemed complete when the catheter reaches the bladder and urine flows out; if this be accomplished it is still necessary to incise the tumefied tissues in order to give free outlet to the urine and its decomposition-products.

It is always best in such cases to cut externally without much attempt at catheterization. With the patient in the lithotomy position a staff is introduced into the anterior urethra and an incision made from without until the instrument appears in the wound. After removing blood and shreds of tissue the proximal end of the urethra is sought for; if found, the catheter is passed through it from the distal end and left in the

bladder. If practicable the two ends may be sutured together over the catheter.

If the proximal end cannot be found then the only measure remaining is retrograde catheterization (*q. v.*). Upon the tip of the instrument passed through the internal meatus a soft catheter is fastened and drawn back into the bladder, and the outflow of urine thus provided for. As serious as these injuries at first appear, if they are recognized and treated in the manner described, they are not only not dangerous to life, but almost always result in complete recovery. Failure to recognize the condition may, of course, be disastrous to the patient; enormous loss of substance which cannot be replaced may occur or death may be the result.

URINARY INFILTRATION AND URINARY ABSCESS.

In discussing injuries, stricture, and inflammations of the urethra we had the opportunity of mentioning that these conditions may give rise to infiltration of urine and urinary abscess.

If a larger tear occurs anywhere in the urethra, and urine collects in the lacerated parts, an infiltration may occur which is characterized by diffuse and rapid extension into the surrounding tissues. When the lesion is small and a few drops of urine trickle into it during micturition, or when there is a circumscribed inflammation in the neighborhood of the urethra in which a collection of microörganisms leads to suppuration, a urinary abscess develops. If suppuration develops rapidly the condition is spoken of as an acute abscess; if it develops slowly it is known as a cold or chronic abscess. For the development of urinary infiltration it is necessary that there be a lesion in the urethra, but urinary abscess can occur without there being any break in continuity.

We observe infiltration of urine, therefore, when a calculus in its passage through the urethra, or an instrument, as for example, the lithotrite, has produced an injury; or when, as most frequently happens, the tissue behind a stricture has become inflamed and boggy, so that the force of the impinging stream of urine tears it.

We have already carefully called attention to the importance of determining whether the infiltration orginates in front of or behind the urogenital diaphragm. Fortunately, in the majority of cases it begins in front of this structure; less commonly it comes from behind, and occasionally from both sides. If the infiltration takes place from the anterior

portion of the urethra, the phlegmonous infiltration will advance from the perineum to the scrotum, extend along the urethra, and work its way to the symphysis pubis and up the abdomen; in other cases phlegmon of the pelvic connective tissue is the result. The process has a tendency to advance towards the bladder, rectum, and peritoneum. The small swellings which at first arise grow quickly and assume an enormous size, the skin reddens, small areas become gangrenous, and if help is not soon rendered great loss of tissue occurs; the entire covering of the testicles may be destroyed, so that these organs lie entirely unprotected. Constitutional phenomena may be absent, but generally high fever and chills accompany the local disturbance.

The **termination** is usually favorable if early incision is practised, although true pyæmia may develop, which is not to be wondered at when we stop to consider that the vascular erectile tissue affords a specially favorable field for the absorption of microörganisms and their deleterious products.

The **diagnosis** of infiltration of urine never presents difficulties. The only thing it could be mistaken for is erysipelas, and the history of the case, and especially the circumstance that in erysipelas great tumefaction is usually absent, should always prevent this error.

The **treatment** consists, as has already been stated, in making free incisions at the earliest possible moment. Wherever swelling and redness are present, from the anus to high in the abdominal wall, the parts must be laid freely open and drained; the fever then falls quickly, the gangrenous tissues slough away, and the process progresses to recovery. If a stricture caused the trouble it is self-evident that it must be treated (see *Stricture*).

The conditions are different in urinary abscess. Be the cause what it may, be it that a small lesion is present, or, that owing to infection by microörganisms suppuration develops in a periurethral focus, an abscess will develop provided that the suppuration remains circumscribed and a limiting pyogenic membrane forms at its periphery as a result of adhesive inflammation.

Usually, even though its onset be acute, it produces such slight disturbance that it is seldom noticed in the beginning. Elevation of temperature, pain, and difficult micturition are absent; it is only when a perceptible tumor has formed that difficulty arises. The skin becomes red and is sensitive to pressure, and slight fever is usually present; fluctuation is hard to detect, especially in the perineum, because the

tense fascia prevents palpation of the deep tissues. Left to itself the abscess will open either into the urethra or externally, or perhaps in both directions; in the latter case a fistula is the inevitable result.

The **treatment** consists in freely opening the abscess and thoroughly curetting it, so that all its sinuous margins may be removed; it is then packed firmly in order that healing may take place from within. If the wound is allowed to heal too rapidly, and without these precautions, small fistulæ may persist.

Chronic or cold abscesses differ from the acute only in the long course of their development. They are due to the same causes, but develop very slowly owing to the circumscribed character of the infection.

Fever, redness of the skin, difficulty of micturition, and pain are all absent; upon closer examination a small tumor is felt, which is characterized by intense hardness and freedom from pain, so that one often thinks he is dealing with a solid tumor. Rarely slight sensations of pain are experienced in the urethra. The purulent liquefaction of the tissues proceeds very slowly and is often unnoticed. If the abscess becomes connected with the urethra, a sudden profuse outflow of pus will often take place during or immediately after micturition. Later, however, the abscess also breaks externally, forming urinary fistulæ with ramifying, indurated passages and ducts.

The treatment consists in laying the abscess widely open and scraping it out with the sharp curette, and also in overcoming the causative stricture or urethral inflammation.

FOREIGN BODIES IN THE URETHRA.

There are three ways in which foreign bodies can reach the urethra: through the wall of the penis, from the bladder, and through the external meatus. The first two are very rare. Foreign bodies from the bladder are exclusively stones or fragments of stones; they will receive special consideration in the next section. From the exterior of the penis only sharp-pointed bodies such as needles can gain access to the urethra.

Because of their rarity both these forms of origin are of minor importance in comparison with the third form, in which objects are introduced into the urethra through the meatus.

It sometimes happens that soft catheters or bougies break off when traction is made on their external end, the broken part remaining in the urethra. With improvement in the quality of instruments these cases

will become more rare. There remain, finally, those cases in which, generally for the purpose of masturbation, various objects, such as needles, pins, hairpins, sealing-wax, lead-pencils, tapers, fish-bones, horse-hairs, etc., are introduced. The outer end of these objects suddenly escapes from the fingers and cannot be caught again. They wander into the urethra and may proceed against the urinary stream into the bladder; they may also remain at their original site. Generally they are found in the widest portions of the canal, that is, the fossa navicularis and the bulb. The changes which they undergo depend upon their nature: they swell or become incrusted with urinary salts, or if soft become bent into the shape of the urethra.

Symptoms. Upon the entrance of a foreign body into the urethra pain, varying with the nature of the object, is generally experienced; it is usually intensified when the position of the penis is changed, when erections occur, or when manipulations are made for the purpose of locating or removing the foreign body. Hæmorrhage may be present or absent. Disturbances of urination occur only when the urethra is considerably obstructed; when this condition is present micturition is painful. The stream is small and interrupted; at times complete retention of urine develops, being due either to complete occlusion of the passage, or to spasm of the external sphincter produced by irritation.

If the foreign body remains in the urethra for any length of time, a sero-purulent or sanguinolent discharge, similar to that seen after a catheter has been retained for a considerable period, is wont to appear. Therefore, the first portion of the urine is turbid. If the inflammatory process extends to the bladder, as it usually does unless the object is removed within a few days, the urine shows evidence of the presence of cystitis, being also cloudy in its second portion. Fever need not be present. Cases have been observed in which foreign bodies have remained in the urethra for years without causing disturbance of the general health. Only when infection occurs simultaneously with the injury do the manifestions of fever arise. Under these latter circumstances a local inflammatory process is evolved, which at first is characterized by severe œdema, extending perhaps from the site of the foreign body to the meatus, and which later assumes the form of a circumscribed phlegmon, slowly spreading more and more until it possesses all the characteristics of a urinary infiltration. In these cases the urine gains access to the damaged parts, and, owing to the decomposition which it undergoes, causes the disturbances just described. If the phlegmon remains cir-

cumscribed a urinary abscess develops, from which a fistula nearly always results.

Diagnosis. From the description of the symptoms it is evident that the diagnosis can offer hardly any difficulties, although cognizance must be taken of the fact that patients, because of shame, are inclined to conceal the real state of affairs. Palpation will reveal the location of the foreign body. It can be felt in the movable part of the urethra through the perineum, [along the under surface of the penis when in the penile portion], and in the membranous portion through the rectum. If a sound or catheter be employed to confirm its location care should be taken to compress the urethra behind the foreign body with the finger, so as not to force the body further back. Occasionally the object can be seen with the urethroscope.

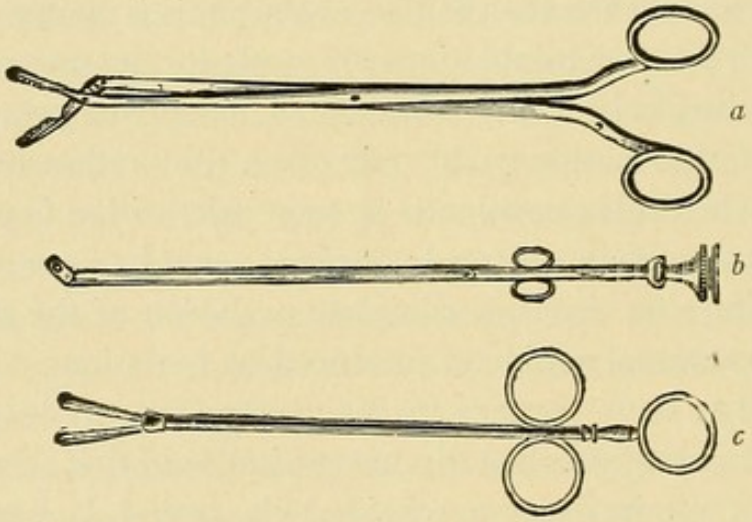


FIG. 148.—Urethral forceps of Collin (*a*), Leroy d'Etiolles (*b*), and Hunter (*c*).

Treatment. The first thing to do is to remove the foreign body from the urethra. Very rarely spontaneous expulsion occurs, but generally the object is so firmly impacted against the wall of the urethra that spontaneous expulsion by the force of the urine is not to be counted upon. Therefore an attempt should be made to seize and remove it through the urethra. For this purpose foreign-body forceps, of which many have been designed, are employed. We will mention only those of Hunter, Leroy d 'Etiolles, and Collin (Fig. 148), of which the last two are the best. The instrument of Leroy d 'Etiolles is provided with a joint. It is introduced extended, so that the lever may pass behind the foreign body; the joint is then turned to a right angle with the shaft and an effort made to draw the object out of the urethra. For the removal of broken off sounds and catheters Hunter's or Collin's forceps are better.

They are introduced closed and are opened as soon as the foreign body is reached. The catheter is prevented from being pushed into the bladder by pressing on the urethra behind it with the left hand.

If neither of the above methods prove successful two alternatives remain: the urethra may be opened at the place where the foreign body lies, the body extracted, and the urethra sutured if there be no abscess nor infiltration of urine, and drained in case either of these two conditions be present; or the foreign body may be pushed back into the bladder, exposed to view with the cystoscpe, and extracted by means of the cystoscopic forceps. The latter procedure is to be employed in all cases in which the foreign body is not firmly wedged into the urethra. With a little practice catheters, bougies, tapers, and pieces of sealing-wax can easily be removed from the bladder. I have often done this with success.

When the object cannot be pushed backward without difficulty, incision is preferable, because if force be employed to move the foreign body the urethra will be injured.

URETHRAL CALCULI.

Urethral calculi occur almost exclusively in the male sex. With few exceptions their presence is due to the fact that calculi or fragments of calculi from the upper urinary tract reach the urethra and remain there.

The rare exceptions in which a stone forms in the urethra happen when a urinary fistula exists, or when a small foreign body is retained for a long time. The latter are not true calculi, but rather incrusted foreign bodies. In fistulæ urinary crystals are occasionally deposited around a nucleus of inspissated pus.

In most cases we have to deal with vesical or renal stones which have been forced into the urethra. The latter, unless they have remained some time in the bladder, are characterized by their regular form, while the former are of different shapes. If they remain long in the urethra they undergo still further changes in form owing to the deposition of urinary salts upon their surface. The portion of the urethra in which they lie also exerts an influence upon their form; thus, when in the posterior urethra they become larger because this portion is more dilatable.

When a stone gets into the urethra it generally lodges in some narrow portion of the canal, being found most frequently just behind the meatus, and next in the beginning of the membranous portion. If a

stricture is present the stone usually lies behind it. It is evident that strictures furnish the most common cause for the retention of calculi in the urethra.

The so-called pipe-stones, part of which lie in the urethra and part in the bladder, must also be considered as urethral calculi. The two portions of the stone form an angle with one another similar to the two pieces of a pipe-head.

Those prostatic calculi the free end of which projects into the urethra also come under the head of urethral calculi. Those which are entirely surrounded by prostatic tissue are, of course, known as prostatic calculi. The existence of prostato-urethral calculi has been denied by many, but I have observed several such cases, one of which was seen post-mortem, the end of a stone projecting from a pocket in the prostate, while the body was firmly held within the pocket.

The **symptoms** of urethral calculi vary according to their nature and location and their manner of entry into the urethra.

If a stone suddenly comes into the urethra, pain is usually experienced at the place where the stone is arrested; if it happens during micturition the stream may be suddenly interrupted, or at least considerably checked, and a few drops of blood may escape with the urine. The dysuria lasts as long as the stone remains, and can lead to complete retention of urine. If it lies far back, near the neck of the bladder, slight incontinence is not infrequently present.

In other cases the stone gets into the urethra without attracting the patient's attention. As it increases in size dysuria, which may or may not be accompanied by pain, develops. Thus the stone may remain in the urethra a long time without giving rise to any alarming symptoms. Occasionally the area occupied by the stone becomes inflamed, and the inflammation may advance to ulceration, as a result of which urinary abscess or deep-seated phlegmon may form, or urinary infiltration may be produced.

This, however, is not the rule, the urethra generally being very tolerant to calculi, which may remain for months or even years without causing trouble. The results then are merely a gradual dilatation behind the stone, with inflammation of the dilated portion and extension of the suppurative process to the bladder. If its course be chronic fever is absent; if acute it is present. I have often known urethral calculi to fall back into the bladder and then be carried into the urethra again by the urinary stream.

The **diagnosis** of urethral calculi seldom presents difficulties. The symptoms enumerated point to the presence of a stone, and palpation and sounding enable us positively to determine its existence. Palpation of the urethra along the penis and in the perineum, as well as through the rectum, may deceive us insofar as other indurations may be mistaken for calculi; for this reason examination with the sound, preferably a metal instrument, should not be omitted. If a stricture is not in front of the calculus, a distinct grating will be felt as soon as the metal comes in contact with the stone.

The situation is more difficult when a stricture is present and the calculus lodges behind it, for then only slender soft instruments can be introduced, and the friction which is produced by their contact with the rough surface of the stone is very similar to that experienced in sounding indurated strictures. Accurate diagnosis can be readily made, however, if the stricture be at once dilated or cut, or if an X-ray picture be taken, the latter procedure, of course, being employed only when the stone does not lie beyond the bulb of the urethra.

As to **treatment** it is well to distinguish between calculi of the anterior and posterior urethra.

Those in the anterior urethra can be removed either through the natural passage or by means of urethrotomy; in the first method the urethral forceps, which have been described in considering the treatment of foreign bodies, are employed (see page 168).

If a stricture is present it must be overcome before extraction through the meatus can be accomplished. If the stone is near the opening meatotomy is performed; if it is further back recourse is had to internal urethrotomy as soon as a guide can be passed by it into the bladder. If this cannot be done, if internal urethrotomy is not practicable, or if urinary fever supervenes, showing that infection has taken place, then I advise external urethrotomy. In absence of inflammation and infection the wound may be entirely closed; otherwise nothing but the urethra is closed, and even it may be left open. Two methods are used for removing stones in the posterior urethra: the calculus is either pushed back into the bladder and crushed, or it is extracted by means of an external urethrotomy. The first procedure is the simpler and less dangerous, and should always be chosen when the stone is movable and can be easily carried back into the bladder. Whenever this cannot be done without difficulty, and there is danger of wounding the urethra, urethrotomy is to be preferred.

Lithotripsy either in the anterior or posterior urethra should not be practised.

Urethral calculi in the female are very rarely observed. Their development is due to bulging of the mucous membrane, as the result of which a pocket or diverticulum is formed, which is known as a urethrocele, and in which the urine may collect and decompose and its salts give rise to the formation of calculi.

The symptoms consist of more or less pain upon urination, especially at the beginning of the act, dysuria, incontinence, and an uncomfortable feeling when the patient is sitting. Palpation reveals a swelling which is hard, and the nature of which is at once manifested by the crepitation which is elicited.

Sometimes the stone can be extracted from the pocket. If recurrences take place it is advisable to excise the urethrocele and suture the urethral wound.

TUMORS OF THE URETHRA.

TUMORS OF THE MALE URETHRA.

Tumors of the urethra are very uncommon in man. Polypous or papillomatous growths, malignant tumors (carcinomata), cysts, and angiomata are met with, occurring as to frequency in the order mentioned.

The **polypi** and **papillomata** are histologically the same as condylomata. They are rarely solitary, several occurring together in the same urethra. Their site of predilection is the region of the external meatus, although they may occur anywhere in the urethra as far back as the neck of the bladder.

Their development is to be attributed to the same causes which produce condylomata on the glans penis. We know that condylomata develop not only as the result of gonorrhœal infection, but frequently as an accompaniment of balanitis. The same irritation which brings about their development on the exterior of the penis may be considered responsible for their occurrence in the urethra.

The symptoms which they make are of a very trifling character. Generally they keep up a slight serous or sero-purulent discharge, which is usually regarded as a sequel of gleet. If their number become greater and they extend nearer to the neck of the bladder, they may

perhaps give rise to phenomena resembling those caused by stricture. Occasionally they may cause slight urethral hæmorrhage.

The diagnosis, however, cannot be made from these manifestations, but requires the use of the urethroscope. If a small wart is seen at the meatus and signs of a chronic urethral discharge persist, then the suspicion that other growths are present further back in the urethra is justifiable.

Treatment is most simple. The tumors growing near the meatus are snipped off with scissors, and those deeper down in the urethra are removed through the urethroscope with a tampon-holder, a curette, or the galvano-cautery.

Carcinoma of the urethra may be primary or secondary. The former is of very rare occurrence, the growth usually being due to extension of a cancer from the rectum or prostate. In the cases of primary carcinoma observed stricture or fistula of the urethra was always present, so that a causative relation must be attributed to them.

In its early stages urethral cancer presents no characteristic signs. It may cause interference with micturition, thus simulating stricture; occasionally, too, slight pain and hæmorrhage occur, which may likewise be referred to stricture. It is only when the disease is further advanced that it becomes recognizable by the presence of a palpable tumor, dysuria, painful micturition, swelling of the inguinal glands, and general decline. Strong suspicion of a malignant growth in the urethra should be entertained when an irregular hard tumor, or even fistulæ, develop irrespective of the usual causes, namely, gonorrhœa and stricture.

Unfortunately, in the stage in which the disease is recognized it is usually too late for treatment. It consists in total removal of the tumor, together with the surrounding parts of the urethra. Resection of the urethra has been done with good results in cases in which the growth was situated in the posterior urethra; when in the anterior portion amputation of the penis is the only proper procedure.

Cysts of the urethra are to be considered as retention cysts due to occlusion of urethral glands. They may develop from the mucous glands, but generally arise from the glands of Cowper. The latter form has been studied by English.

Only a single case of echinococcus cyst has been reported, and that one was observed by Pean.

As a curiosity it may be mentioned that a few cases of **angioma** of the urethra have been observed.

TUMORS OF THE FEMALE URETHRA.

Tumors of the female urethra are much more common than those of the male. The following varieties are found: papilloma or condyloma, angioma, cysts, fibroma, sarcoma and carcinoma, elephantiasis, and, lastly, prolapse of the urethral mucous membrane simulating a tumor.

The **papillomata** occur usually in the form of condylomata around the urethral orifice. They cause neither pain nor inconvenience, and as a rule do not bleed. A conglomeration of these growths may be mistaken for a cauliflower-like tumor.

The **angiomata,** fungous excrescences sometimes known as urethral caruncle, represent areas of thickened mucous membrane in which there is an abnormal development of veins. They might rightly be called varices or hemorrhoids of the urethra. They are usually on the under wall near the meatus, and may attain the size of a raspberry. Any influence leading to congestion (standing for a long time, straining, menstruation) causes them to swell, and if a varix results therefrom true hæmatoma may develop.

The **cysts** of the female urethra are also retention cysts which develop from the glandular elements. If they project sharply from the mucous membrane a pedicle is formed, and they are then known as mucous polypi, for the reason that their walls consist solely of mucous membrane.

Fibromata, which are solid tumors, also occurring in the form of polypi, are very rare, as are also **sarcomata** and **primary carcinomata.** Of more frequent occurrence are cancerous growths due to extension of disease from neighboring organs (vagina, clitoris).

Elephantiasis occurs with the greatest rarity. A case has been recorded in which elephantiasis of the vulva invaded the urethra and destroyed it.

In general the symptoms caused by these various kinds of tumors depend upon their size and location. They frequently produce signs of irritation and itching, but they may not cause any symptoms whatever. If they obstruct the lumen of the urethra dysuria results. Dribbling of urine is observed if the internal meatus is separated by a tumor. Hæmorrhage may occur or be absent. Oftentimes the condition is discovered accidentally when an examination is being made for another purpose.

With the exception of the malignant growths, which are often characterized by rapid ulceration, these tumors may remain unchanged for years.

Treatment consists in removal of the tumor. The manner in which this is done varies according to the nature of the growth. Pedunculated benign excrescences can be removed with the cold or galvano-caustic snare, or with the scissors, and the base then cauterized. More extensive tumors are better excised with the knife, so that the incision can be carried into healthy tissue and made in the long axis of the urethra. The cut surfaces are sutured. Small multiple growths can be satisfactorily treated with the thermocautery.

The malignant growths require not only extirpation, but also, if possible, removal of the primary focus of disease.

Urethrocele (Prolapse of the Female Urethra).

Prolapse of the urethra, which sometimes assumes the form of a tumor, may easily be confounded with the new growths above described. When of slight degree they present the appearance of labiated elevations, between which the urethral orifice is included. Their cause is to be found in a relaxed condition of the urethra and vagina, such as may be produced by quickly repeated labors, rapid dilatation of the urethra by foreign bodies, the passage of calculi, masturbation, etc. If the subject of this slight prolapse is exposed to any strain, as for instance that necessitated at stool by constipation of the bowels, or that caused by strangury, the small protrusion of the urethra may be converted into a large tumor the size of a pigeon's egg, which may totally obliterate the view of the urethral orifice.

In the early stages, when the protrusion is slight, its possessor experiences practically no difficulty, and may not even know that an abnormal condition is present. If it increases in size painful and difficult micturition, as well as hæmorrhage and incontinence of urine, may ensue, and the urethra become inflamed and eroded.

Upon careful inspection, especially if the suspected growth be lifted up with forceps, it will be almost always recognized that the supposed tumor is only an extroversion of the urethral walls.

The smaller protrusions may be destroyed with the Paquelin cautery; the larger ones require removal by the knife, the edge of the wound in the mucous membrane being sutured.

TUBERCULOSIS OF THE URETHRA.

Tuberculosis of the male urethra is an exceptionally uncommon disease and is always secondary. According to my observations it occurs

only in association with tuberculosis of the bladder, prostate, and seminal vesicles. It is therefore exclusively confined to the posterior urethra.

Primary tuberculosis of the female urethra is also unknown, the disease invariably extending from contiguous organs, especially the bladder.

If lupus be considered as true tuberculosis, then it is to be stated that lupus nodules may extend from the vagina to the urethra and infiltrate its walls, as the result of which narrowing is produced, or the nodules may coalesce on the surface of the urethra and form a true ulceration of the mucosa.

MALFORMATIONS OF THE URETHRA.

1. ABSENCE OF THE URETHRA.

This malformation is exceedingly rare. One case of total absence and another of partial absence have been reported; in the first the patient urinated through the anus, in the second through an opening anterior to the anus. The penis was absent.

2. COMPLETE AND PARTIAL OBLITERATION OF THE URETHRA.

Obliteration of the urethra is a form of arrested development due to unequal growth of the three parts out of which the male urethra is formed.

In partial obliteration there is so much narrowing at the external meatus that a needle can hardly be passed into the urethra. This abnormality naturally leads to severe disturbances unless immediate relief is given by the operation of meatotomy.

In complete obliteration either the skin or the urethral mucous membrane forms the occlusion, or the entire urethra is converted into a firm cord. Occlusion of the skin reaches only a short distance into the urethra, that of the mucous membrane may extend further back; the cord-like transformation generally extends far back, and is almost always associated with occlusion of the anus. Unless an opening for the exit of urine is at once made, or unless its exit is provided for in some other way, as for example, by communication of the ureters with the rectum, or the bladder with an open urachus, the child will soon die.

3. DOUBLE URETHRA.

Various malformations have been described as double urethra which in reality are only accessory blind fissures or congenital fistulæ of the

penis. These fissures are lined with mucous membrane and are frequently the seat of disease, for instance, gonorrhœa. Very often such blind pockets are found near the external meatus, although they also occur in the deep urethra, and are to be regarded as cysts or dilatations of the crypts of Morgagni. True double urethra occurs only when a double penis is present.

4. URETHRAL DIVERTICULUM.

Localized expansion of the urethra may occur behind a construction situated far forward or may be due to an increase in size of the normal crypts and duplicatures of the urethra. Such pockets, funiculi, and valves can occasionally be seen near the meatus or brought into view by means of the urethroscope when they are situated further back in the urethra. If they cause trouble they must be divided.

5. ABNORMAL COMMUNICATION OF THE URETHRA WITH THE URETERS AND RECTUM.

Both of these malformations are very rare. Opening of the ureters directly into the urethra has been observed in cases of total or partial absence of the bladder, and communication between the rectum and urethra has been seen in cases of imperforate anus.

6. FISSURES OF THE URETHRA.

(*a*) **Hypospadias.** By hypospadias is meant a malformation in which the urethra does not open on the glans, but on the under side of the penis. If the cleft lies immediately behind the glans it is known as hypospadias glandis, if on the shaft of the penis as hypospadias penis, and if the scrotum is also cleft and the opening of the urethra is in the perineum it is spoken of as hypospadias perinealis.

The origin of this malformation may be explained by the following circumstances. The urethra is formed out of three elements: the glandular portion is an invagination of the corneal layer, and grows toward the primary urethra just as the anus grows toward the rectum; the middle portion develops from the sinus urogenitalis; the third is of primary origin. In explanation of the various degrees of hypospadias it may be assumed that one or the other of these portions undergoes an arrest of development. The condition is almost always associated with abnormalities of the penis.

In hypospadias glandis (Fig. 149,) the penis is generally short and curved downward; not uncommonly it bends downward when turgid

instead of becoming erect like the normal penis. Where the urethral orifice is found normally there is often a small hole, which is continued

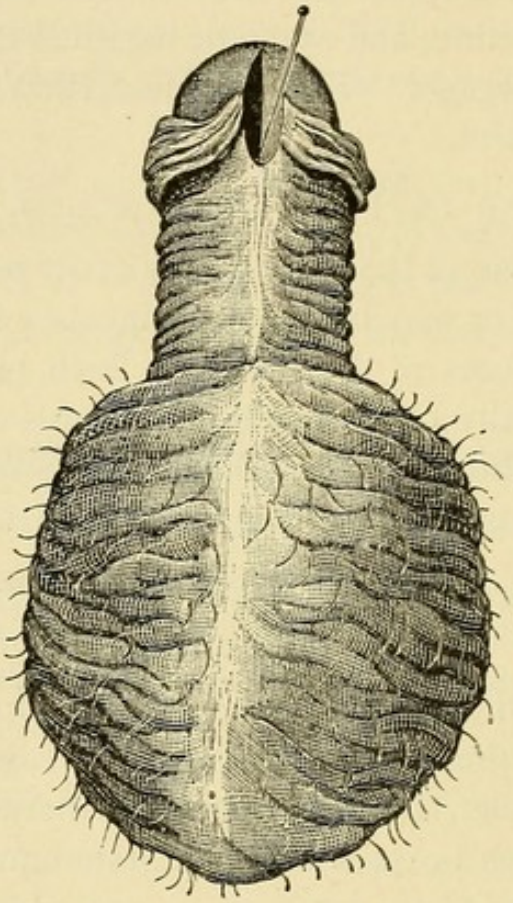


FIG. 149.—Hypospadia glandis.

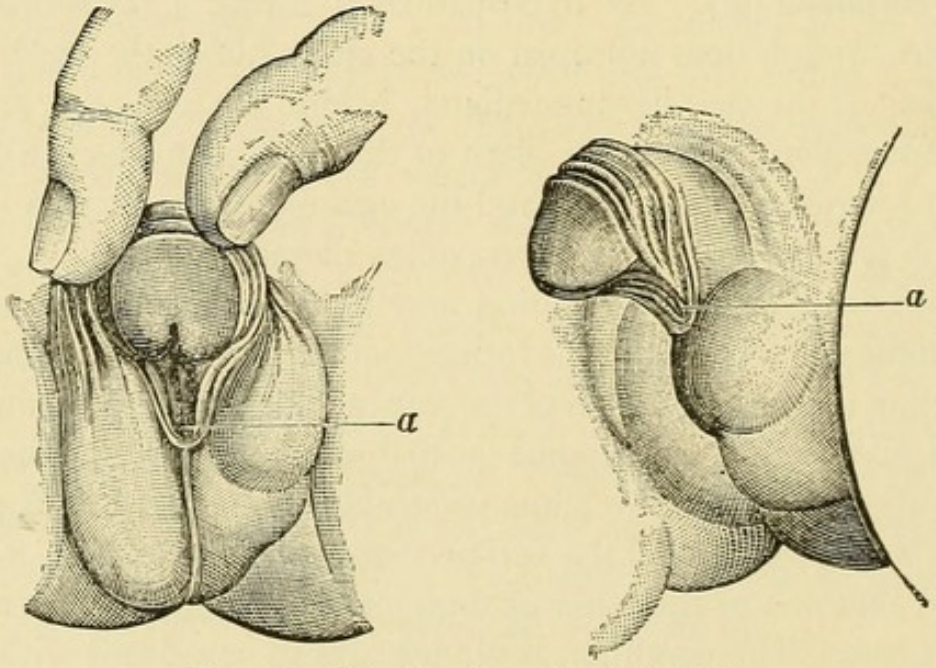


FIG. 150.—Hypospadia penis.—(Duplay).

backward as a groove and ends where the real urethral opening begins. From the latter point a slender bougie can be passed into the bladder.

In hypospadias penis the urethral opening lies between the corona glandis and the scrotum. From the orifice a furrow usually extends anteriorly, the mucous membrane being continued in it (Fig. 150).

Hypospadias perinealis, the third degree of urethral fissure, in which a deep sulcus divides the scrotum and perineum into two parts, is very rarely encountered. The urethral opening lies in the depth of this fissure behind the scrotum. In front of it a furrow extends anteriorly (Fig. 151).

In all three cases there may be a second opening into the urethra in

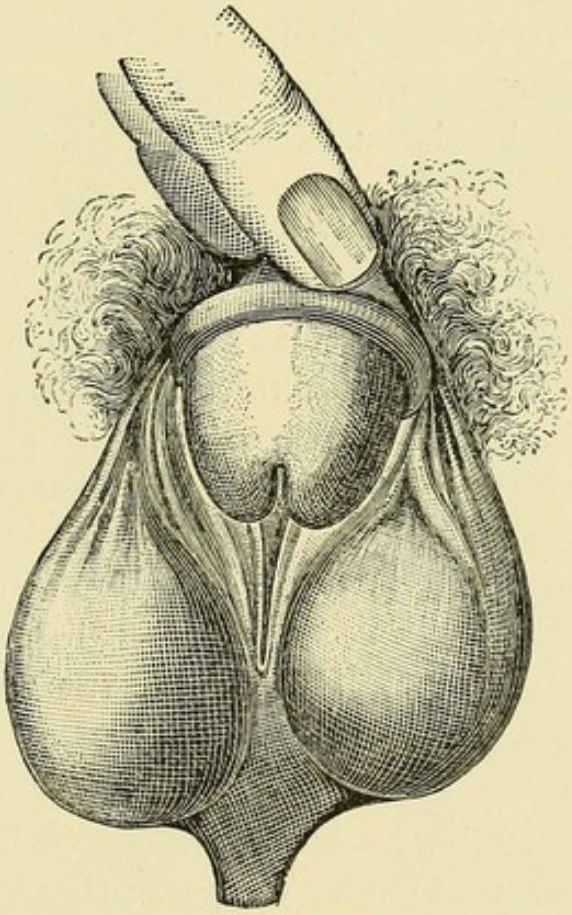


FIG. 151.—Hypospadia perinealis.

front of the true orifice, the former ending in a blind canal, which is a portion of the urethra that has not united with the part posterior to it.

Hypospadias also occurs in the female, a greater or less portion of the under wall of the urethra being replaced by a furrow.

In its milder degrees hypospadias does not generally cause any symptoms. It is only when the opening is exceedingly narrow that symptoms similar to those produced by stricture appear. The downward curvature of the penis may interfere with cohabitation. In general the subjects of hypospadias of the first degree possess the *potentia cœundi* and also the *potentia generandi*. In hypospadias peno-scrotalis and perinealis coitus

is impossible, and the unavoidable wetting of the soft parts in the area around the urethral orifice is most annoying.

The **treatment** of hypospadias is operative whenever one or more of the symptoms described necessitate treatment. In the milder degrees it is usually unnecessary to do anything.

If an enlargement of the external orifice is required, meatotomy is performed by making an incision along the under wall of the urethra; the skin and mucous membrane are then sewed together on either side.

If such a shortening of the penis exists as to cause it to curve markedly downward during erection, the organ must be straightened by making a moderately deep transverse incision severing the connecting strand between the scrotum and under surface of the penis, and then suturing the wound lengthwise.

If it is necessary to establish a new urethral opening situated more anteriorly, and the absent segment of the urethra is not too great, a large trocar may be plunged from the glans through the penis in such a manner that its point shall come out through the true urethral orifice. Through the newly formed canal a soft catheter is passed into the bladder and fastened in place; the edges of the wound are then freshened and sewed over the catheter.

In the more severe grades of hypospadias Duplay's procedure should be employed. It consists of three separate operations: 1. straightening of the penis and establishment of an external orifice; 2. formation of a true urethral canal; 3. anastomosis of the new urethra with the one already present.

[It is performed as follows: Make a transverse incision through the central portion of the band uniting the glans to the hypospadic opening, cutting through the tissue layer by layer until the fibrous envelope of the corpora cavernosa is reached, incising it together with the septum between the bodies until all incurvation of the penis is overcome.

This procedure results in the formation of a lozenge-shaped area, which should be closed by a few sutures in order to diminish the formation of scar-tissue.

Next freshen the lips of the depression representing the meatus and fasten a piece of catheter between them; or, if the depression is too slight to permit the formation of a meatus in this manner, make a median incision, or two small lateral incisions, into the substance of the glans penis and sew the catheter in. After healing has taken place the new urethra is formed in the following manner. Lift up the penis and make

two longitudinal incisions parallel to the median line and extending from the base of the glans to within 1 or ½ centimeter (⅖–⅕ of an inch) of the hypospadic opening; join each extremity of these incisions by a transverse cut, thus forming two quadrilateral flaps. Now pass a catheter through the previously formed meatus, along the denuded under surface of glans, and turn the cutaneous surface of the flaps over the catheter, bringing the raw surface outward. Next prolong the transverse incisions outward, and dissect up two new flaps sufficiently large to cover over the raw surface of the first ones, over which they are turned and sutured with fine silver wire. It is important that the external flaps

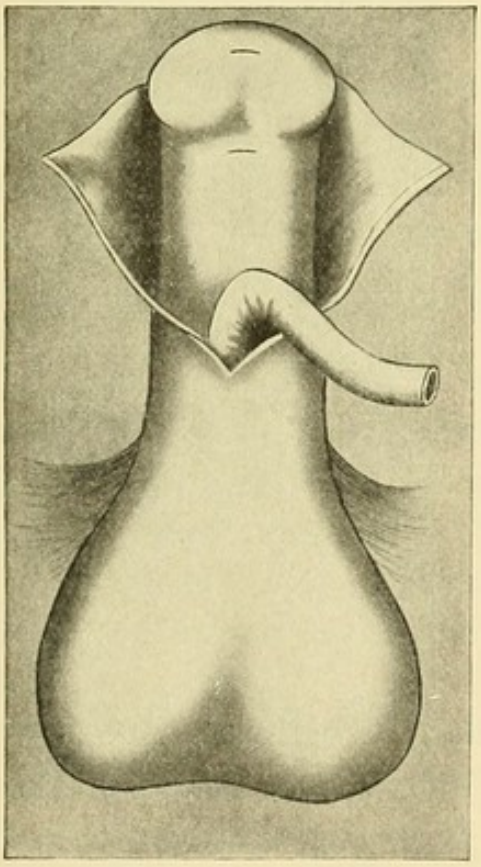


FIG. 152.—Beck's operation. (Binnie, after C. H. Mayo.)

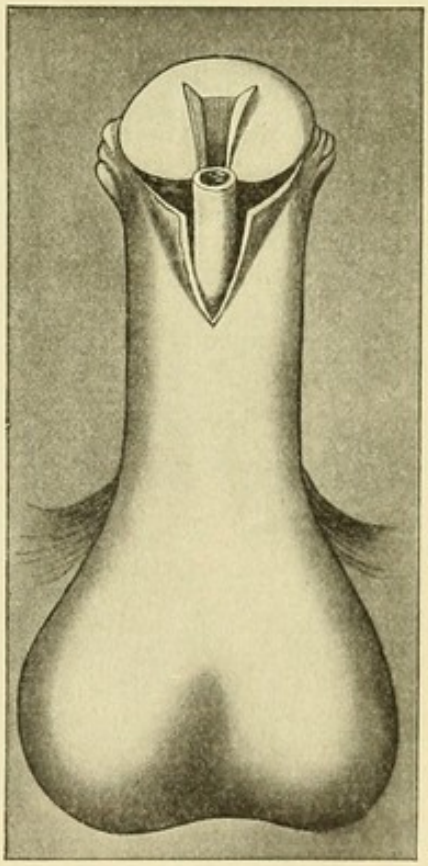


FIG. 153.—Beck's operation. (Binnie, after C. H. Mayo.)

be sufficiently large to encompass the catheter and internal flaps without making immoderate tension.

If this operation proves successful it is a simple matter to join the old and new urethra. Freshen the edges of the hypospadic opening, pass a catheter from the meatus through the canal into the bladder, and close the opening with metallic sutures.

Carl Beck, of New York, has devised an ingenious operation for the relief of balanic hypospadias, consisting in dissecting free the existing urethra and drawing it to the end of the glans penis through a channel

cut along the under surface of the glans, or tunnelled through the substance of the glans from tip to base by means of a narrow bistoury or a small trocar. Thus a new canal is not formed, but the urethra itself is made to do the service of a new passage.

Beck describes his operation practically as follows: A transverse incision is made across the lower surface of the glans, embracing the hypospadiac opening. The lower margin of the wound is pulled down so as to expose the end of the urethra and permit its separation from the adjoining tissues. A longitudinal incision is now made alongside the

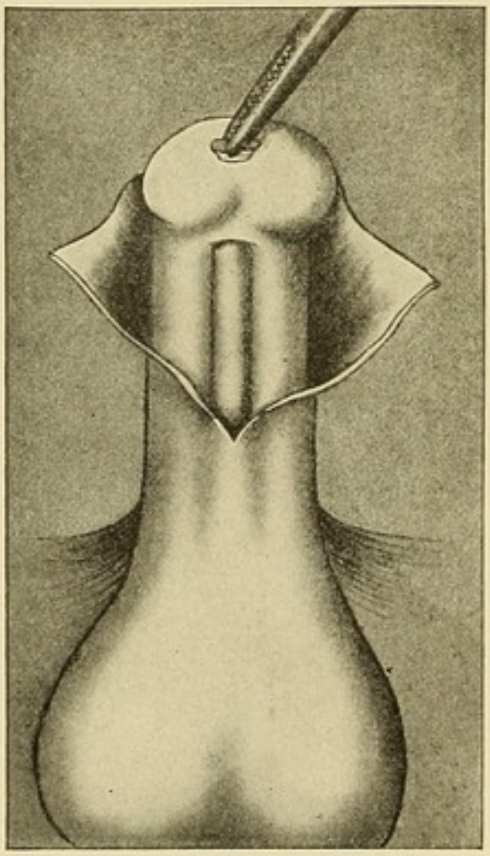


FIG. 154.—Beck's operation. (Binnie, after C. H. Mayo.)

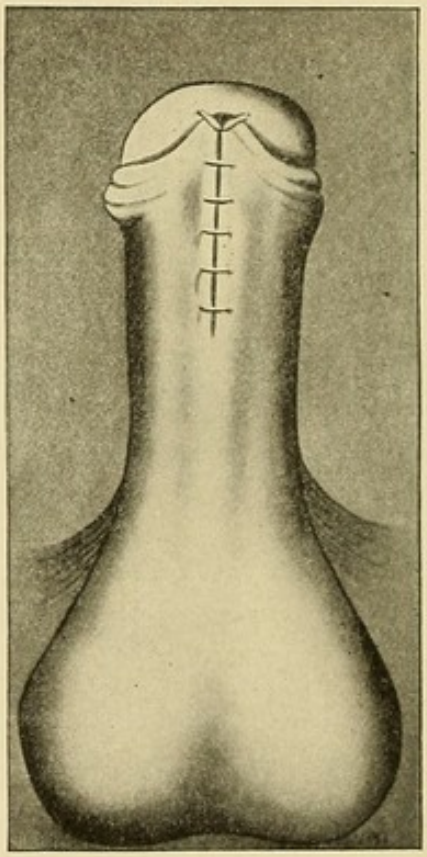


FIG. 155.—Beck's operation. (Binnie, after C. H. Mayo.)

median line of the groove. Two flaps are dissected up, one on either side, and the urethra freed still further down until it can be drawn to the extremity of the glans penis without tension. (Fig. 152.) By dissecting the edges of the hypospadiac groove two flaps are formed, which are cut off in order to give a freshened surface (Fig. 153); or a narrow bistoury is plunged into the tip of the glans penis and carried down to the site of the hypospadiac opening (Fig. 154). The urethra is now pulled through the channel thus made, whichever it may be, and sutured to its distal end. The flaps of integument are now brought together over the urethra. (Fig. 155.)

The removal of a bit of tissue from the external orifice affords a hard, firm meatus.

(*b*) **Epispadias.** Epispadias, or cleft penis, is a malformation in which the opening of the urethra is on the upper side of the penis. If the opening lies directly behind the glans the condition is known as epispadias glandis, and if between the glans and the symphysis as epispadias penis. In both conditions the upper wall of the urethra remains open, so that in its place a cleft or furrow is formed. Behind the groove where the real urethra begins there is usually a funnel-shaped dilatation called the infundibulum. If the entire urethra down to the bladder is open, so that the cleft extends directly into the bladder, we then have to do with a complete epispadias.

As in hypospadias the penis is more or less stunted and is also curved upward; other malformations or arrests of development are seldom wanting; thus, the prostate may be absent, the testicles atrophied or undescended; congenital hernia, non-union of the pubic bones, non-closure of the bladder, and even fissure or ectopia vesicæ are not unfrequent complications.

The principal symptom of epispadias is dribbling of urine, which causes a continuous moisture and an exceedingly troublesome eczema. This involuntary discharge of urine is due to faulty development of the vesical sphincter.

The treatment of epispadias is purely surgical. It consists either in directly uniting the edges of the urethral fissure or in performing a plastic operation.

The first procedure was successfully carried out several times by Dieffenbach, although at present the plastic operation devised by Thiersch, or its modification according to Duplay, is employed because it gives more certain results. Thiersch's operation is performed in the following stages: conversion of the furrow in the glans into a duct having its orifice on the extremity of the glans; transformation of the cleft in the body of the penis into a tube; union of the two, closure of the infundibulum.

FISTULÆ OF THE URETHRA.

With the exception of fistulous passages in hypospadias congenital fistulæ of the urethra are very rare. They are formed during intrauterine life to provide for the exit of urine when a portion of the urethra is obliterated.

Acquired fistulæ of the urethra in man (the condition in the female does not come under our subject) are divided, according to the locality in which their orifice is found, into urethro-rectal, perineo-scrotal, and penile fistulæ.

The urethro-rectal fistulæ develop as a result of trauma (fracture of the pelvis, injury during operation), from suppuration in a neighboring organ (prostatic abscess), and from extension of a malignant new growth or tubercle from surrounding parts (carcinoma of the rectum or prostate, or tuberculosis of these organs).

As a result of the abnormal communication either a portion or the entire quantity of urine is voided through the rectum; conversely, although it is of rare occurrence, the fæces may be expelled through the urethra.

The prognosis as to cure, except in the case of fistulæ due to prostatic abscess, is bad. Large sounds may be passed in order to make the caliber of the urethra as free as possible, and cauterization of fistulous canals with silver nitrate or zinc chlorid, or the galvano-cautery, may be tried; but these procedures give hope of only slight success. Plastic operations likewise are usually failures.

The most rational thing to do is to make a prærectal incision, separate the urethra from the rectum, freshen the edges of both openings and unite them by suture. If deemed necessary suprapubic cystotomy may be performed so as to supply another conduit for the urine while the wound is healing.

Urethral fistulæ in the perineum and scrotum are seldom of traumatic origin. In the vast majority of cases they are due to the urethra opening externally behind a stricture. Urinary abscess or infiltration are responsible for this occurrence. More rarely it is suppuration of Cowper's or other periurethral glands, prostatic abscess, tuberculous or syphilitic ulceration (disintegrating gummata), which are responsible for the development of fistulæ.

If the fistula pursues a straight course and has a small opening, or if there is no induration of the surrounding tissues, it will usually suffice to restore the caliber of the urethra (dilatation or internal urethrotomy); in dealing with cicatricial fistulæ in which the adjacent parts are scarred or indurated this procedure will not be sufficient. After the urethra has been thoroughly dilated the edges of the fistula must be freshened. For this purpose cauterization with silver nitrate or tincture of iodine, or with the galvano-cautery, should first be tried. A surer way is to split the

fistulous canal and thoroughly curette it. In cases in which there is a considerable loss of substance excise the entire wall of the fistula, forming a funnel having its apex in the urethra, separate the mucous membrane from its adjacent tissues, and suture the individual layers together. A catheter fastened into the bladder, or even a suprapubic cystotomy, to prevent the urine coming in contact with the fistula, will favor healing.

Fistulæ opening into the penile urethra are likewise formed behind strictures, and furthermore develop as the result of gunshot wounds, kicks, injuries with stones, gangrene of the penis after strangulation (paraphimosis), periurethral abscess, softening of a gumma, and also from phagedænic chancres. Cauterization, suture of the freshened edge when there is no loss of substance, and, lastly, plastic operations, generally produce a cure.

INJURIES OF THE PENIS.

Injuries of the penis are rare. They may be divided into simple contusions, fractures, and luxations. The contusions are characterized by copious extravasations of blood, which generally comes from the corpora cavernosa. After healing takes place protuberant scars called nodes remain. Treatment consists in placing the penis at rest and applying clothes wet with a solution of aluminum acetate. The effusion is resorbed.

In graver injuries due to violence the urethra is generally involved. The accompanying conditions have been discussed under injuries of the urethra, so we will merely state here that the laceration or partial fracture of the corpora cavernosa is frequently associated with retention of urine, which makes it necessary to lay the affected parts freely open, clear out the blood-clots, suture the laceration in the urethra, and fasten a catheter into the bladder to prevent the urine gaining access to the lacerated urethra and causing urinary infiltration.

In **luxation of the penis** the organ is pushed into the scrotum, under the skin of the upper portion of the thigh, or upward over the pubic bone (*Luxatio penis scrotalis, femoralis, hypogastrica*). In these cases, too, the urethra may be lacerated. The penis must be brought back to its normal position, the wound opened freely, hæmorrhage arrested by ligature or suture, according to the nature of the case, and the condition of the urethra carefully attended to, a catheter being retained if injury of any extent has been inflicted.

In order to satisfy morbid sexual impulses foreign bodies [metal or

celluloid rings, for example] are sometimes drawn over the penis, and, owing to interference with the venous outflow, remain firmly fastened behind the glans so that they cannot be removed. It is frequently impossible to free the penis without surgical intervention. The strangulation must be incised, a grooved director passed under the ring, and the latter removed with forceps, saw, or file.

BALANITIS, (BALANOPOSTHITIS,) GONORRHŒA OF THE GLANS.

Suppurative inflammation of the superficial mucous membrane covering the glans penis, the coronary sulcus, and the inner layer of the foreskin is called balanitis.

The most frequent cause of this loathsome disease is uncleanliness, the secretion from Tyson's sebaceous glands, which is very profuse, accumulating and becoming decomposed. In the uncleanly balanitis is often due to the accumulation of gonorrhœal pus beneath the prepuce. In addition to these causes the pus of a soft or hard chancre, violent coition, condylomata, herpes, eczema, in short, any form of irritation, may lead to inflammation of the mucosa of the glans. It supervenes, however, only when proper cleanliness of this part of the body is neglected. If the glans were washed twice or thrice daily there is scarcely any irritation which would produce inflammation. Persons who have no prepuce never get balanitis, their mucous membrane having been converted into epidermis.

In the beginning the patients experience an annoying sense of heat in the penis; as the disease progresses this sensation is converted into one of actual pain. Generally a glance at the organ reveals the nature of the trouble. The prepuce in the region of the corona is distended, and often so swollen that it cannot be drawn back over the glans. If it can be retracted a profuse, malodorous, purulent discharge will issue forth. After it subsides the surface of the glans is seen to be reddened in spots, prone to bleed, sensitive, eroded, and deprived of its epithelium. The whole prepuce may be swollen and œdematous, so that an inflammatory phimosis, or if the foreskin has been previously retracted, a paraphimosis, results. If either of these conditions be not relieved, gangrene can easily supervene and the necrosed parts slough away.

After frequently recurring balanitis the prepuce gradually becomes so thickened and rigid that it cannot be retracted over the glans. During

coition it becomes torn, and as the lacerations and cracks heal more and more contraction takes place.

A very unpleasant complication of balanitis is the formation of preputial calculi. They are composed of thickened smegma and deposits of urinary salts. Urethral calculi may also be deposited in the preputial sac and remain there because of the narrow orifice. Preputial calculi, then, are usually the result of balanitis, but may also be its cause when they originate from the urine. They are capable of causing great pain and may interfere with coition; therefore their removal is indicated.

For the prevention of balanitis, as already mentioned, nothing but personal cleanliness is usually required. If, despite regular bathing, the disease should begin to manifest itself, astringent washes may be prescribed in order to diminish the secretion of the glands. Potassium permanganate 1 : 3000 or aluminum acetate 2 per cent are useful.

In all developed cases, too, in which the affection is not complicated with phimosis it is best to employ cleansing, disinfectant washes. The foreskin should be drawn back and the penis immersed in one of the above mentioned solutions, or in corrosive sublimate 1 : 5000, or in lead-water, after which a pledget of cotton should be inserted between the prepuce and glans in order to keep the inflamed surfaces apart. In case the foreskin is rather too narrow to admit the cotton, the glans may be dusted with a drying powder such as tannin or dermatol [or compound stearate of zinc]. If ulcerations are present a salve containing 1–2 per cent of silver nitrate, applied after thorough cleansing, will be found best to heal them.

PHIMOSIS AND PARAPHIMOSIS.

The term **phimosis** is applied to a condition of preputial narrowing in which it is impossible to uncover the glans penis by retracting the foreskin. This constriction may be either congenital or acquired and is of different degrees. The most pronounced grades are those in which not even the end of the glans can be uncovered; in cases of milder degree retraction of the prepuce is possible if force be employed.

These latter cases, however, are easily converted into complete phimosis by the slightest venereal infection, or even by uncleanliness. If a prepuce previously normal becomes constricted by inflammation and the glans also swells, a phimosis develops although there was no predisposition present.

Such changes in the foreskin and glans penis may be occasioned by

gonorrhœa, balanitis (*q. v.*), chancroid, chancre, condylomata, new growths, and injuries. The exact cause of a particular case will often be determined only after the phimosis has been reduced.

Diagnosis of this affection is made easy by the appearance of the penis and failure to retract the foreskin.

Relief of the condition is urgently demanded, especially if the cause is not known. If neglected when sclerosis or a serpiginous soft sore, for example, is the cause, great deformity of the penis, and also fistulæ, may result.

As to treatment, an attempt may first be made to secure relief by cleanliness and the use of antiphlogistics. The penis should be soaked in antiseptic solutions such as lead-water, corrosive sublimate 1: 5000, acetate of aluminum 2 per cent, and some of the fluid injected between the foreskin and the glans; the penis should also be bound to the abdomen, rest ordered, and clothes wet with aluminum acetate solution applied. If these measures fail, and if the phimosis is of long duration, so that there is no prospect of their proving successful, recourse should be had to operation.

The operation for phimosis is easy and free from danger, and can be done under Schleich's infiltration anæsthesia. A dorsal incision dividing both layers of the foreskin is made with knife or scissors, using a grooved director as a guide, and sutures introduced on both sides. If the prepuce is very long a triangular flap may be removed from each side, the apex of the triangle being toward the corona, and enough sutures introduced to control hæmorrhage and keep the edges of the wound apart.

Another method is **circumcision,** or complete removal of the foreskin. The foreskin is drawn well over the glans, forceps applied, and the portion anterior to the blades of the instrument cut off with scissors or knife. The mucous membrane is then divided and trimmed around the corona, and the two layers sutured together.

[In adults this operation can be satisfactorily performed under local anæsthesia, both the cutaneous and mucous layer of the prepuce being infiltrated with a few drops of a one or two per cent solution of cocain. Adrenalin should not be used in conjunction with cocain, for although it renders the operation practically bloodless, severe reactionary hæmorrhage may follow its use. I have had one such case in my own practice and know of two others in the practice of a colleague.

In children a general anæsthetic should be used.

After the parts have been thoroughly washed with hot water and green soap, followed by weak bichloride of mercury solution (1–6000), which in turn is washed away with sterile water, the position of the corona glandis is outlined on the foreskin with tincture of iodine or potassium permanganate solution, applied by means of a sterile applicator.

The foreskin is now caught at the preputial opening with a pair of

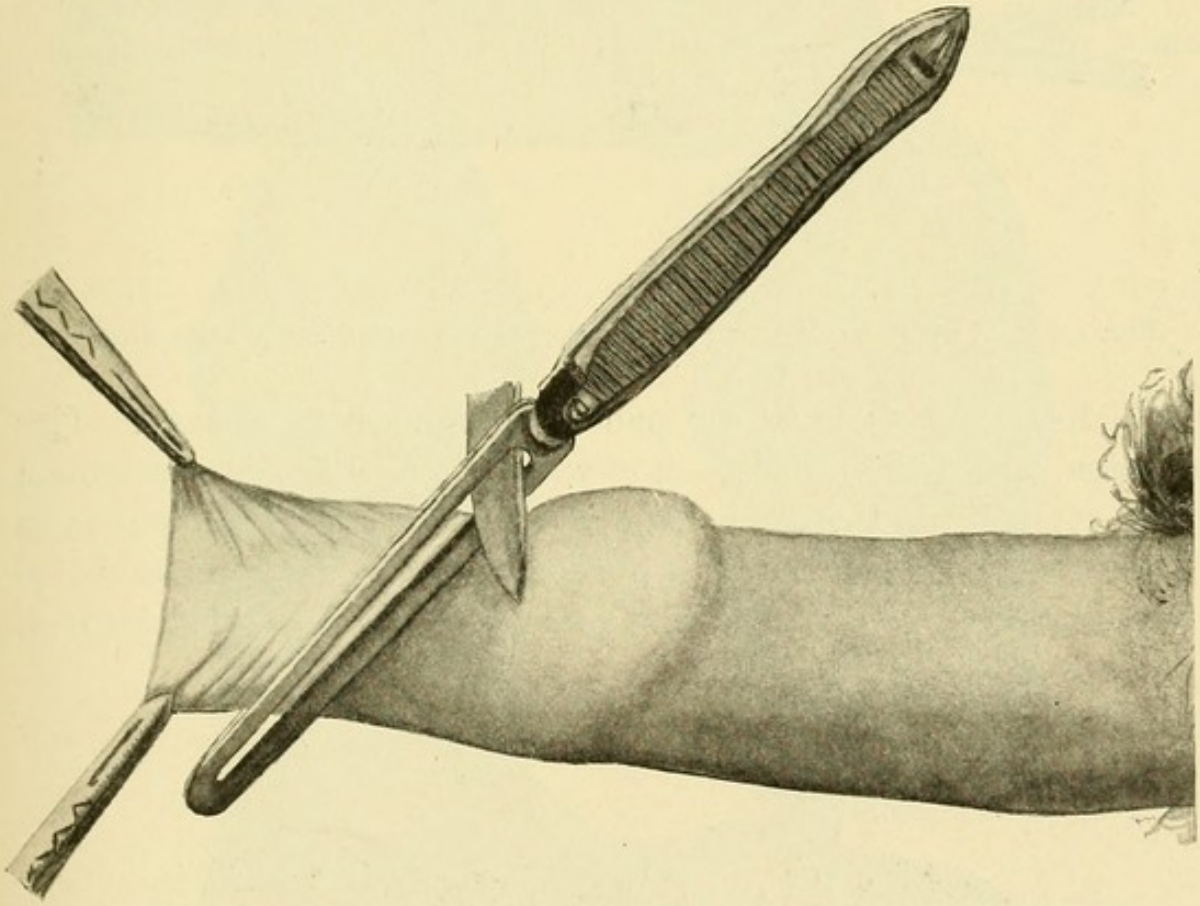


FIG. 156.—The prepuce has been drawn forwards and the circumcision forceps applied The skin incision is about to be made.

hæmostatic forceps, one above and one below, and while traction is being made upon them, either by an assistant or by the left hand of the operator himself, the circumcision forceps is applied obliquely from above downward exactly along the line of the corona, which has previously been marked out in the manner above described. This method of application results in more skin being taken from the superior aspect of the penis than from the inferior (Fig. 156). When the fenestrated forceps shown in the illustration is used, the line of the corona should correspond to the fenestra.

The forceps being firmly held with the left hand, the foreskin is

severed with a quick, sharp stroke of the scalpel. It is now removed, together with the circumcision forceps and the hæmostatic forceps which grasped the margins of the preputial orifice. The mucous layer of the prepuce, which still covers the glans penis, is next divided

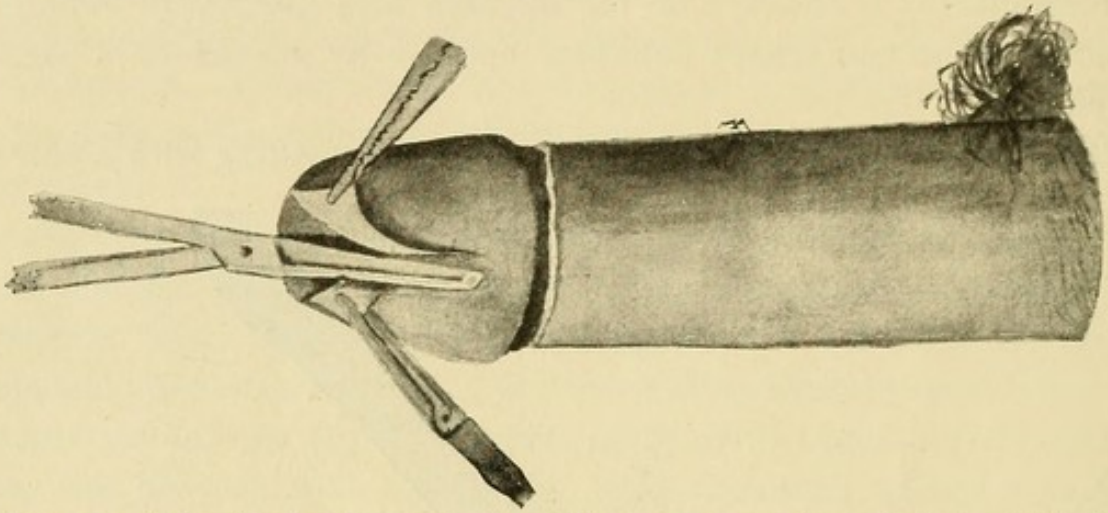


FIG. 157.—The skin has been cut off and the mucous membrane is being divided.

by a dorsal slit made with a pair of straight sharp scissors. This division should be carried back to within $\frac{1}{8}$ of an inch of the corona (Fig. 157). If, as frequently happens in congenital cases, the mucosa is adherent to the glans, it must be separated; and if adhesions due to ulceration are present they must also be broken up. The flaps of

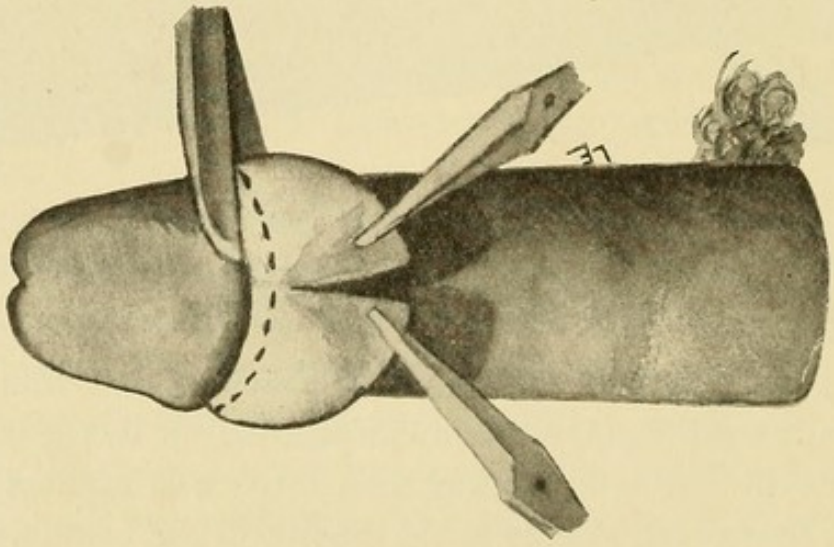


FIG. 158.—The flaps of mucous membrane are about to be trimmed off. The longitudinal incision should extend down as far as the dotted line.

mucous membrane thus formed are trimmed off with scissors, the line of the cut following the corona. It is important not to leave too much tissue at the frænum, lest there result an unsightly and sometimes troublesome induration in this locality when healing and con-

traction shall have taken place. (Fig. 158). If these directions are followed there will be a narrow band of mucous membrane encircling the corona. The appearance of the parts is shown in Fig. 159. An area of loose cellular tissue is seen between the mucous membrane and the retracted cut margin of the skin. After complete hæmostasis has been secured, the cutaneous and mucous layers are united by a series of interrupted sutures of No. 00 catgut. Care should be taken not to include in the suture any of the loose cellular tissue between the two layers (Fig. 160).

A wet dressing is the best for forty-eight or seventy-two hours.

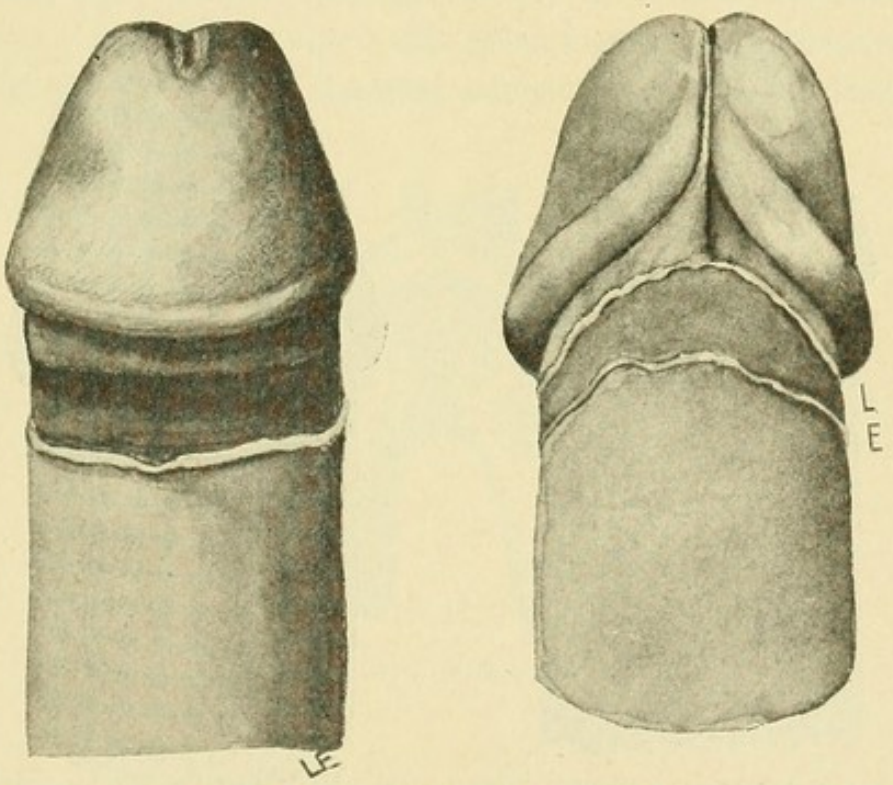


FIG. 159.—Appearance of the parts anteriorly and posteriorly after skin and mucous membrane have been removed.

Either weak lead-water and laudanum or a saturated solution of boric acid will be found satisfactory. I generally use the former.* As soreness and swelling subside a dusting powder may be substituted. Some surgeons employ a dry dressing from the beginning. I have tried both methods and state unhesitatingly that the wet dressing is better. Bransford Lewis recommends a dressing composed of cotton enclosed in gauze and saturated with compound tincture of benzoin, which is applied with a medicine dropper. This dressing becomes firm upon drying and affords good protection to the raw surfaces. It is renewed

*Objections to the use of lead-water on a small raw surface are entirely theoretical. It has been used by Jefferson College men since the days of S. D. Gross.

after four or five days. As a rule, the wound is entirely healed in a week or ten days.

Should hæmorrhage occur after the operation, the sutures must be removed, the clot turned out, and the bleeding vessels tied. To prevent such an accident all bleeding points of any size should be tied with fine catgut during the operation. This precaution will save trouble.]

Still another complication is occasionally observed in congenital phimosis, namely, too short a frænum. In later years this abnormality leads to imperfect erections of the penis. The frænum pulls the glans

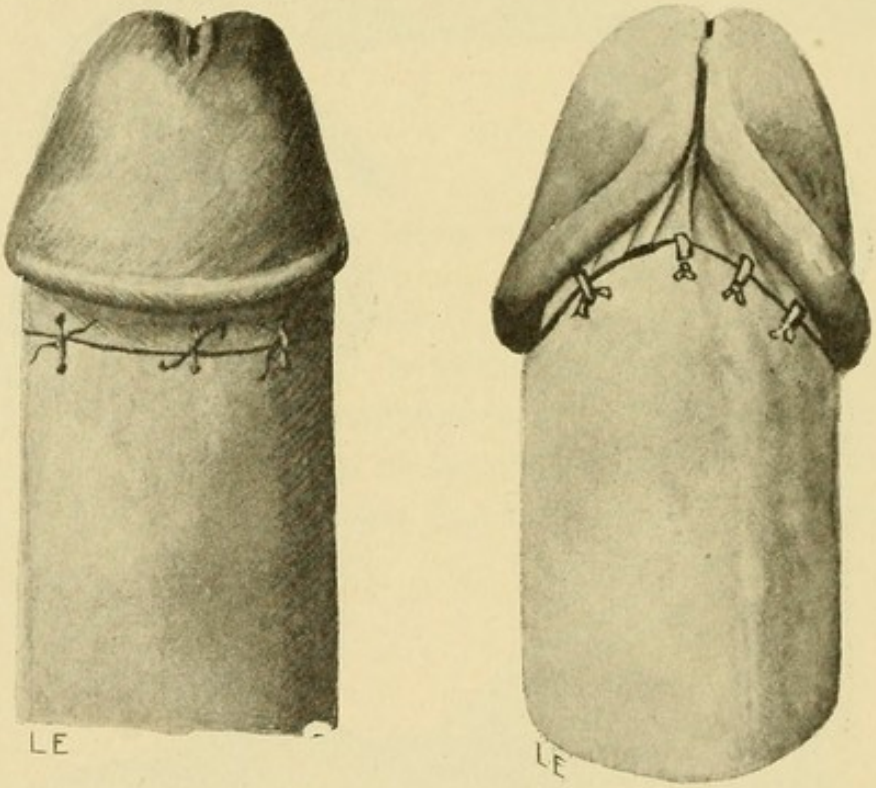


FIG. 160.—Appearance of the parts anteriorly and posteriorly after skin and mucous membrane have been united.

downward and the former is then easily torn during coition. Simple division with the knife or with the Paquelin cautery generally is sufficient to relieve this slight, though as to its results, important, abnormality.

Paraphimosis is a condition in which the prepuce is retracted and fixed behind the glans penis in such a manner that it cannot be drawn forward. It is often caused by drawing a tight foreskin back for the purpose of washing the glans. The result is an annular constriction around the glans which causes circulatory disturbances, namely, œdema of the glans itself and of the preputial mucosa, producing a collar-like swelling around the glans. If this condition is allowed to continue, in-

flammation and gangrene of the parts anterior to the constricting band can easily supervene, but as a rule gangrene is confined to the strangulating ring itself, as a result of which it sloughs and thus relieves the paraphimosis.

In every case of paraphimosis reduction must be attempted at once in order to prevent more serious injury. [Several methods of reduction have been devised. In many cases œdema of the parts is the chief obstacle to reduction. In such cases multiple punctures with a fine-pointed bistoury or large needle, followed by elevation of the penis and the use of hot moist applications for a short time, will so relieve the swelling that the prepuce can readily be drawn forward over the glans penis. In cases in which this procedure proves unsuccessful or in those in which it is not deemed advisable to try it, reduction may

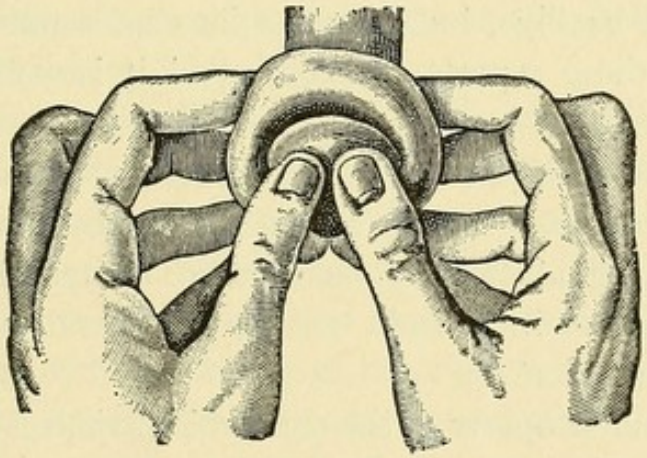


FIG. 161.—Reduction of paraphimosis. (Hirsch.)

often be effected by encircling the penis behind the constriction with the thumb and one or two fingers of the left hand, at the same time grasping the glans with the thumb and fingers of the right hand, and then simultaneously drawing the swollen constricted prepuce forward and pressing the glans backward (Fig. 161). Before beginning this manipulation it is well to dust the parts with talcum powder or pulverized starch. Local or general anæsthesia may be required. Children usually require a general anæsthetic. If this does not succeed the constricting ring must be divided in one or more places until the glans slips back under the skin. After-treatment consists in confining the patient to bed, elevating the penis and applying wet antiseptic dressings. In cases complicated with chancroids these lesions must receive proper treatment.]

CHANCROID (ULCUS MOLLE).

Although in the earliest times an ulcer of the genital organs characterized by purely local manifestations was recognized, the doctrine that the soft chancre and the syphilitic sore are identical was propagated at the time of the great epidemic of syphilis at the end of the fifteenth century. Basseran, a pupil of Ricord, was the founder of the presently accepted and correct **theory of duality,** which holds that the soft and hard sores are due to two distinct poisons. The existence of a **mixed chancre,** a sore which represents both infections, is also acknowledged.

The virus of chancroid, although probably due to a microörganism, has as yet not been discovered. It is possible that the bacillus of Ducrey, or the streptobacillus of Unna, may be the specific cause, although the question does not seem to have been decided beyond all doubt. Lenglet states that he has reproduced the disease by inoculating with cultures of this bacillus, but his assertions have not been sufficiently tested. Until these reports are confirmed it is well to speak of the *virus* of chancroid.

Infection occurs almost always by direct contact during sexual intercourse; indirect conveyance of the disease by clothing, linen, the finger, etc., taking place with the greatest rarity. Breaches of continuity, such as small wounds, excoriations, and ruptured herpetic vesicles favor infection.

A characteristic property of the chancroidal virus is its power to produce new and typical sores if the purulent secretion of the ulcer is inoculated into another part of the body or transferred to a healthy person. After the chancroid has become healthy and is granulating this property is lost and no inoculation sores can be produced. The action of the virus is always local; systemic infection never occurs. According to some authors it differs from the syphilitic virus in that it is communicable to animals (rabbits, cats, apes), while as is well-known animals are not susceptible to lues. [Recent experiments have proved that certain anthropoid apes are susceptible to the syphilitic virus.] According to others the chancroidal virus cannot be transmitted to animals.

Symptoms. The incubation period, or time between the occurrence of infection and the outbreak of the sore, is very brief. Even within twenty-four hours an itching sensation may be felt and a reddened spot be found upon examination; the latter soon becomes transformed into a papule with reddened edges, and then rapidly develops into a pustule. As soon as the pustule ruptures an ulcer is formed.

The whole occurrence takes about three or four days. The ulcer is usually of a round or oval form, with sharply defined edges, so that in the beginning it looks as though it had been cut out with a punch. Its base soon becomes covered with discolored necrotic tissue, the surface being slimy yellow and the undermined edges red and inflamed. We generally first see the disease in this stage, as the nodular and pustular stages often pass unnoticed by the patient.

The ulcers are confined to certain areas; namely, those parts which are subjected to the greatest friction during coition, those where tears or breaks in continuity of tissue take place, and those where the penis is covered only by mucous membrane or thin skin. Therefore they are frequently found on the frænum and in the depression on either side of it, in the coronary sulcus, on the free edge of the prepuce, and at the orifice of the urethra. They seldom occur any distance back in the urethra. Occasionally they are observed on the shaft of the penis and even on the scrotum or thigh.

The soft chancre is characterized by its multiplicity. The ulcers frequently coalesce and cause wide-spread destruction of tissue, undermining the frænum and completely perforating it. If the frænal artery is eroded severe hæmorrhage occurs. The virus being autoinoculable new sores are frequently formed on contiguous parts.

In conformity with the nature of its progression, its tendency to heal or to spread, the chancroid is designated as atonic, inflammatory, phagedænic, serpiginous, and gangrenous.

The atonic chancroid shows neither an inclination to heal nor a tendency to spread, remaining in the same condition and of the same size for weeks or months.

The inflamed chancroid is surrounded by a reddened, œdematous zone; as a result of the accompanying swelling phimosis can easily develop.

In phagedænic chancroid there is a gradual and steadily progressive molecular destruction of tissue which may last for many weeks. The ulcer has no inclination to heal, but instead shows a proclivity to spread over the surface of the tissues; it does not, however, invade their depths.

Serpiginous chancroids are those in which the sloughing advances in a certain direction, the surface previously affected healing as the process advances, repair thus following disintegration.

A gangrenous chancroid is one in which the affected tissue rapidly undergoes mortification. The base is covered with a black or grayish-

black eschar. The gangrenous process extends deeply so that serious mutilation of the penis, as well as hæmorrhages, may result. This form of gangrene is not to be confused with that due to circulatory disturbance such as is caused by phimosis and paraphimosis.

Diagnosis. The presence of a sore on the penis can of course be determined by inspection; it is to be differentiated from other affections occurring on the same parts, and above all from the primary lesion of syphilis.

From a practical point of view the differentiation is not so important, because if the sore be syphilitic its recognition will in no way alter the inevitable result, namely, the development of constitutional syphilis. So, too, the question is generally not of great significance as concerns treatment, for both soft and hard sores are accustomed to heal under the same threapeutic measures. There are cases, however, in which it is of value in respect to treatment to make a differential diagnosis, and this is especially desirable in reference to prognosis and the certainty demanded by patients concerning the nature of their malady.

The following criteria enable us almost always to determine whether we are dealing with a chancroid or a syphilitic chancre.

The incubation period of the syphilitic sore is much the longer, the first manifestations not occurring before the fourteenth day after infection. [The average period intervening between inoculation and the time at which the patient's attention is attracted to a lesion on his genitals may be stated as twenty-one days. In many instances there is no doubt that examination by a careful observer would reveal the presence of an incipient sore several days earlier.] It must be remembered, however, that a chancre may begin as a soft sore and afterwards assume its specific character (mixed chancre).

The primary lesion of syphilis is harder than the chancroid, although if the latter has been cauterized repeatedly it may become indurated; there are, moreover, soft sores which are subsequently followed by syphilis.

Chancroids have a more abundant secretion than chancres, producing pus very freely; they are multiple, in contradistinction to the primary lesion of syphilis, which is single; the glandular swelling which accompanies the chancroid is painful [has a tendency to suppurate], and is generally unilateral, while that associated with syphilis is indolent and usually affects both sides.

Oftentimes disintegrating gummata present the appearance of fresh

soft sores. If they fail to yield to ordinary treatment, mercury or potassium iodide should be tried, as under their use gummata readily heal, but chancroids are not influenced.

Tuberculous and lupoid ulcers should be differentiated from the chancroid by the history of the case. Disintegrating carcinomata hardly enter into the question, although their separation from syphilitic ulcerations is not always easy; indeed, I have seen one case in which amputation of the penis was advised on account of a supposed carcinoma heal rapidly under large doses of potassium iodide, and thus manifest its syphilitic nature.

Lastly herpes progenitalis must be mentioned. It is a harmless affection characterized by an eruption of groups of vesicles, which soon burst and form small superficial erosions. They heal spontaneously in a few days.

Prognosis. The prognosis of chancroid is almost without exception favorable. Only the serpiginous, phagedænic and gangrenous form can cause extensive destruction of the penis, and thus alarm both patient and surgeon. Generally, however, even these severe forms can be subdued.

Treatment. Abortive treatment of chancroid can be recommended only when the patient comes under observation very early in his disease; then the sore may be touched with zinc chloride or copper sulphate, or a concentrated solution of these salts applied on a pledget of cotton or lint. In rare cases this method will prevent further development of the ulcer, but, on the other hand, there is danger of its causing inflammation and œdematous swelling of the neighboring parts. For this reason the slower and more certain antiseptic, disinfectant treatment, which is free from danger, is to be preferred.

Bichloride of mercury 1:5000 and copper sulphate 1:100 are most useful applications. The penis, with the foreskin well retracted, should be soaked four times daily in one of these solutions, and if there is sufficient space between foreskin and glans, a fine pledget of cotton wet in the solution should be inserted. Under this medication the ulcers become clean and rapidly heal.

If, by reason of his occupation or other circumstances, the patient cannot practice this regimen, we must be content to let him use the bichloride solution morning and evening, and after drying the sores dust them with iodoform, dermatol, or europhen. Of these drugs iodoform still remains the best. It is somewhat deodorized by cumarin.

If the frænum is undermined it should be cut through; if constrictions of the foreskin are present the best and quickest way to overcome them is by division. Often, however, cleanliness, rest, and the use of antiphlogistics will suffice. Indolent ulcers should be frequently painted with tincture of iodine, and serpiginous sores cauterized with chloride of zinc, or scraped with a sharp curette, burned with the thermocautery, and dressed with alcohol and iodoform. Unna's mercurial and salicylic acid plaster is sometimes of service.

NEW GROWTHS OF THE PENIS.

Lipoma, fibroma and sarcoma may develop in the skin and connective tissue of the penis; the first two are exceedingly rare and the last does not occur very often. The sarcomata grow from the fibrous septum between the corpora cavernosa. Cysts in the skin of the penis, athereroma, enchondroma, and a form of osteoma proceeding from the fibrous layer of the corpora cavernosa, have also been observed.

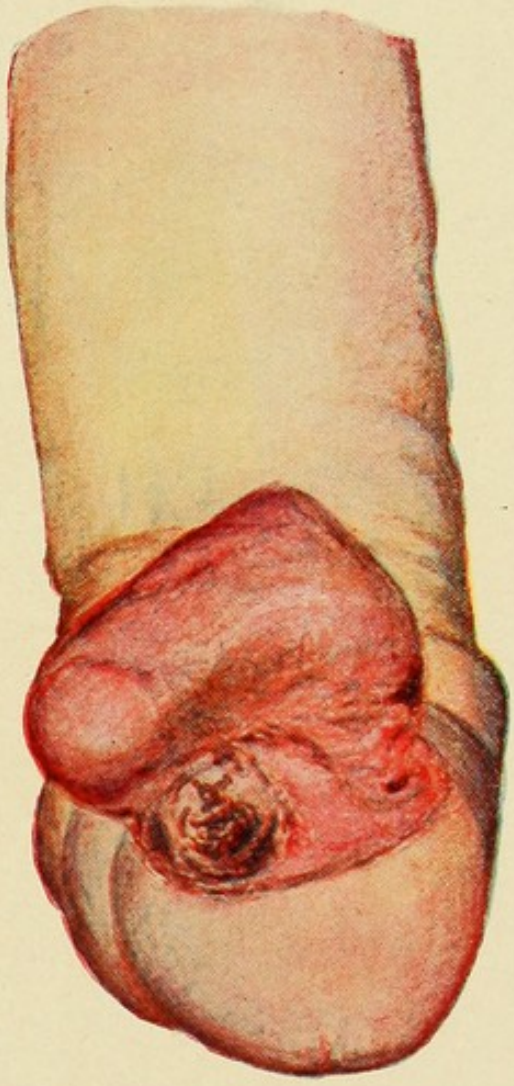
All of these tumors, however, are of much less frequent occurrence than **condyloma** and **carcinoma.**

When **condylomata** are isolated or arranged in small clusters they do not offer any difficulties as regards diagnosis and treatment. They are easily recognized as fine papillary excrescences, and should be removed and the base treated with 5 per cent resorcin in order to prevent recurrence.

In other cases the disease is so neglected that large tumors develop, resembling malignant cauliflower excrescences, and covering the entire glans or even the shaft of the penis. They disintegrate, decompose, and form ichorous, stinking masses, thus giving rise to a condition which often leads one to doubt whether he is not dealing with a true carcinoma. To differentiate in these doubtful cases cut off a few of the tumors; whereupon, if the condition is benign, normal, though perhaps atrophied skin, will be found on the glans, the atrophy being due to long-continued pressure by the tumor. [If deemed desirable a small mass may be cut away and examined microscopically.]

Papillary excrescences perforating the epidermis and extending into the deep tissues are to be considered as **carcinomata.** Their most frequent form is the squamous-celled epithelioma, which, owing to the formation of multiple papillary excrescences, together with disintegration and generation of foul secretion, soon assumes a large and formidable aspect, and gradually invades the deep portions, extending to the cor-

PLATE I



CARCINOMA OF THE PENIS (RODMAN.)

pora cavernosa and sometimes even penetrating the urethra. Of more seldom occurrence is the soft form of cancer, the medullary carcinoma, which in its incipiency appears as circumscribed nodules; these soon disintegrate and form sanious ulcerations, which horribly disfigure and mutilate the penis.

The **prognosis** of carcinoma of the penis depends entirely upon the stage in which the patient comes under treatment. If no metastases are present a remarkably large number of patients can be permanently cured. Unfortunately the cases are seldom seen early enough. Generally metastases are present, which first affect the inguinal glands, later the glands of the pelvis and those along the iliac vein.

The **treatment** of new growths of the penis is entirely surgical. In the case of fibromata, myomata, cysts, and osteomata the tumors should be removed, as much of the penis as possible being spared.

Condylomata which have attained large size must be removed. By proceeding cautiously it will generally be possible to preserve the penis intact.

In dealing with carcinoma conservative procedures cannot be practised, amputation of the penis being necessary, and the line of incision being carried into healthy tissue whenever practicable; indeed, if the latter requisite be impossible, operation might better be left undone. Before deciding upon operation it is well to recall the fact that syphilis may, under certain conditions, cause large tumor-like ulcerations on the penis, and if doubt exists to give energetic doses of potassium iodide. [Here again microscopic examination of a small piece of tissue is of value.]

Amputation of the penis is performed in two ways, according as the organ must be removed in its mobile portion or from the roots.

To amputate in the mobile portion draw the skin well back and sever the organ with one or two sweeps of the scalpel, cutting well back in the healthy tissue behind the tumor. Catch the spurting vessels, especially the dorsal artery of the penis above and the artery of the urethra below, with hæmostatic forceps and tie them, draw the end of the urethra somewhat forward, notch it at two opposite points, and join it to the skin of the penis by a few sutures made to include the corpora cavernosa. A short catheter should be introduced into the urethra and fastened there so as to keep the wound from being contaminated with urine. [If desired, the corpus spongiosum may be separated from the corpora cavernosa and divided a little anterior to the line where the latter are

cut. This procedure makes the urethra somewhat longer and reduces the liability of retraction.

The results obtained by the usual operative procedures are frequently unsatisfactory as regards their cosmetic effect, and, moreover, the patient is often annoyed by dribbling of urine upon the scrotum and thighs.

In order to avoid these unpleasant features Witzel has devised the following ingenious operation.

An extensive oval incision is made through the skin on the dorsal surface of the penis, a flap dissected up and turned back, the dorsal vessels ligated, and the corpora cavernosa cut through down to the urethra, which is then divided a centimeter anterior to them. Each corpus cavernosum is now closed by a row of vertical sutures passed through their fibrous capsule, the resulting line of suture thus being horizontal. This manner of suturing draws the urethra somewhat upwards, but in order to carry it still further up over the stump a buried silk suture is passed through its anterior end. The suture is made to traverse the fibrous capsule of the corpora cavernosa, the periurethral tissue, and the superficial portion of the wall of the urethra, although it does not encroach upon the mucous membrane. The orifice of the urethral stump now lies at the base of the flap. A slit $\frac{3}{4}$ of a centimeter long is made in the flap and the urethra drawn through it. The posterior surface of the urethra is now divided for the distance of $\frac{1}{2}$ centimeter, and the new external urethral orifice formed by suturing the edges to the skin. The flap is then drawn down, trimmed if necessary, and sutured to the skin on the under side of the penis. Only a few sutures are required.

The scar is on the under side of the stump, so that the urine is discharged in the normal manner. By properly trimming and adjusting the dorsal flap all unsightly folds of skin are done away with.]

If the penis has to be removed at its root, the stump should not be left in the natural place because excoriations, eczema, etc., will be produced by the inevitable wetting which results. Thiersch's method of making a longitudinal incision in the midline of the perineum, freeing the root of the penis from its surrounding tissue, severing it, drawing the stump into the incision and suturing it there should be adopted. The urethral opening will then lie just in front of the anus.

The operation for carcinoma of the penis cannot be considered complete unless all diseased inguinal glands are removed. The field of operation is reached by making a large incision parallel to Poupart's liga-

ment, and a second perpendicular to the first, following the course of the femoral vein. The skin-flaps thus formed are dissected up and a careful enucleation of the glands made. The glands are situated alongside the vein and often grow around it. In some cases it is possible to spare the vein, but in others it has to be ligated. This part of the operation is much more difficult than the simple amputation of the penis above described.

ELEPHANTIASIS.

This disease is rare and is observed after gonorrhœa, stricture or injury, and also, as König has demonstrated, in persons from tropical countries in whom there is no recognizable cause for its development. The elephantine masses attain their characteristic form as the result of repeated inflammation of the lymphatic vessels. The tumor, which most frequently originates from the prepuce, soon invades the skin of the penis, and may assume enormous dimensions, sometimes reaching below the knees. The penis itself may not be damaged, so that much of it can be preserved when the growth is removed.

Before operating a cord should be tied around the root of the penis. After splitting the penis on its dorsal surface it can be learned whether the prepuce alone or the penis itself is affected. The amount of tissue which can be saved will be determined by the superficial and deep extent of the tumor. In desperate cases amputation of the penis is necessary.

CAVERNOUS INFILTRATION AND INDURATION OF THE PENIS.

If urethritis extends into the urethral follicles, inflammation, or **folliculitis,** results. The follicles can be felt as small nodules about the size of millet-seeds. These follicular infiltrations generally undergo resolution, but they may proceed to suppuration and discharge into the urethra.

Folliculitis may, however, extend beyond the follicles and involve the perifollicular tissue. With the exception of those in the fossa navicularis the follicles of the urethra are imbedded in the tissues of the corpora cavernosa. If the inflammation goes beyond the follicles and perifollicular tissue **cavernous infiltration** is the result. These infiltrates, which are now in relation with both the urethra and the penis, may develop into nodular protuberances which terminate in resolution

just as the follicles do, or rupture into the urethra, break externally, or even empty themselves in both directions. In addition to these circumscribed cavernous infiltrates, diffuse inflammation of the corpora cavernosa also occurs. If the process is acute it may undergo resolution or proceed to suppuration.

Instead or terminating in either of these ways it may become chronic and cause induration and formation of fibrous tissue, as a result of which permanent interference with erection, which may be sufficient to cause impotence, is produced. All these conditions—folliculitis, acute, circumscribed, and diffuse cavernitis—may begin during any stage of urethritis from the acute to the chronic, and also during the development of a stricture. The degree of alteration produced in the urethra depends upon the extent of the induration. The slowly developing, painless, chronic thickening of the corpora cavernosa may become so large as to extend completely around the entire circumference of both bodies and thus cause flexion of the penis during erection. The thickening may occur either as one or more nodules or as a lamina. It may be limited to one corpus cavernosum, but in many instances it affects both.

In making the diagnosis lues must be thought of, as in this disease gummata may be present in the corpora cavernosa. Differentiation is important in respect to treatment. The gummata yield readily to antisyphilitic treatment, while induration of the cavernous bodies due to chronic circumscribed or diffuse inflammation is not influenced by it. Inunctions of mercurial ointment or applications of mercurial plaster, moist compresses, electricity, and the use of large sounds may be tried in an effort to bring about resorption, although the result obtained by these measures is slight.

LYMPHANGITIS.

Inflammation of the lymphatics of the penis usually follows gonorrhœa or chancroid; in rare instances it results from some other cause, being due to injury, herpes, or balanitis. The infecting organisms generally pass through the lymphatics without producing any disturbance, just as the gonococcus passes through the vas deferens without infecting it, the inflammation first manifesting itself in the epididymis. In exceptional cases, however, in which the lymphatic vessels are inflamed, one or two sensitive, cord-like swellings, varying in size from a thread to a lead-pencil and presenting nodular enlargements unequally distant

from one another, can be felt and seen along the dorsum of the penis. The skin over these cords is generally somewhat infiltrated and reddened. Under appropriate treatment the process almost always undergoes resolution, the hard cords becoming gradually softer and smaller and the entire infiltrate becoming absorbed. It is very unusual for suppuration to ensue. When it occurs it is confined to the little intumescences, which become converted into small abscesses about the size of a bean.

Treatment consists in rest and elevation of the penis. It should be bound to the abdomen and cloths wet with aluminum acetate applied; at night an application of mercurial ointment may be made. If an abscess breaks it is treated according to general principles, being cleansed with sublimate solution and dusted with iodoform.

LYMPHADENITIS.

If pathogenic microörganisms invade the lymph glands as a result of injury (excoriations, herpes, scratches), or infection (gonorrhœa, ulcers), they may give rise to an inflammatory and infectious process. Especially in chancroid is this the case, the glands becoming enlarged and painful and showing a tendency to suppurate. In gonorrhœa this complication is much rarer, and when it does occur usually remains stationary, seldom progressing to pus-formation. In syphilis it is still rarer, the virus establishing itself in certain glands and producing only insignificant swelling. Therefore it is as a complication of chancroid that we most frequently see glandular swellings of considerable size; they are generally unilateral, rarely bilateral. In gonorrhœa the enlargement is not so pronounced, affects both sides, and as a rule remains stationary, while in syphilis it manifests itself as a chain of small isolated glands, which are like a string of pearls imbedded beneath the skin.

These glandular tumors are situated in the groin for the reason that the lymphatic vessels of the penis empty into the inguinal glands.

As long as the inflammatory process is confined to the glands themselves, the latter are freely movable under the skin. They vary in size, some being as small as a pea, others as large as a hazel-nut. If the periglandular connective tissue becomes involved the whole picture becomes changed. The tumor is no longer movable, being replaced by an indurated, painful swelling which makes it impossible to detect individual glands. If the inflammation advances liquefaction of the

tissues occurs, the pain increases, and movement of the thigh becomes difficult; notwithstanding this, however, fluctuation is not detectable, because the pus lies too deep in the tissues. It works its way to the surface slowly, causing the skin over the tumor to become tense and reddened, and making it gradually thinner and thinner, so that if the abscess is not opened it breaks externally of its own accord. It is rare for only a single gland to be thus affected; generally several are involved, although it may be impossible to isolate them, as the abscesses which they produce become confluent.

If these suppurating buboes are not operated upon considerable damage to the groin may result. The entire skin down to the thigh may be undermined. After spontaneous rupture and discharge of the nectrotic tissue, fistulous tracts often persist after healing has taken place. When due to chancroid the suppurating bubo may assume a specific character, as it is infected with the chancroidal virus. The lesion is then known as inguinal chancroid. It may become serpiginous, phagedænic, or gangrenous exactly the same as simple chancroid.

The diagnosis of inguinal bubo presents no difficulties. Its differentiation from hernia might possibly arise, but the soft elastic character of the latter tumor, its alteration in size when the patient coughs and likewise when he changes from the upright to the recumbent posture, the reducibleness of the tumor, or if it be irreducible, the tympanitic note which it emits upon percussion, and finally, if it be strangulated, the phenomena of intestinal obstruction and the small frequent pulse, assure a correct differential diagnosis.

The prognosis of inguinal bubo is always favorable.

Treatment is governed by the nature of the causative ailment and by the stage in which the disease comes under observation. Enlarged lymphatic glands caused by syphilis require no other treatment than rest and inunctions of mercurial ointment or the application of Unna's mercurial plaster.

Similar treatment is suitable for gonorrhœal bubo. Rest, applications of ice-water to which a little acetate of lead or aluminum has been added, together with the nightly application of mercurial ointment or plaster as long any danger of suppuration is feared, are appropriate therapeutic measures. In the later stages, when the glands remain chronically enlarged, inunctions of iodine-vasogen or potassium iodide ointment may be tried, or the glands may be painted with tincture of iodine.

These antiphlogistic measures are also indicated in bubo of chan-

croidal origin provided the process is not so far advanced that suppuration already exists in the deep tissues. In the latter case, and also if tenseness and discoloration of the skin reveal the presence of pus in the superficial tissues, these measures are ineffective, and incision must be practised. A long deep cut is made over the tumor parallel to Poupart's ligament, the pus liberated and the abscess cavity tamponed with iodoform gauze. Pockets in the abscess must be sought out and opened, and necrotic cutaneous borders cut away; it is also a good practice to scrape out the abscess with a sharp curette. If these procedures are omitted fistulæ may result. Any fistulæ present must be split open and curetted. In phagedænic and gangrenous buboes the base of the wound should be powdered with iodoform.

Excision of the glands before the occurrence of suppuration, or in the beginning of suppuration before the pus has broken through the glandular capsule, is being practised less and less. The lymph-glands act as protectors to the organism and removal should not be countenanced unless it is actually demanded. If a part of them can be preserved extirpation is not appropriate, for it occasionally happens that glands which have undergone partial suppuration become restored without operation, the pus in them being resorbed.

In beginning suppuration the abortive treatment of Lang or Welander may be tried. After puncture and evacuation of the pus Lang makes repeated injections of a small quantity of a ½ per cent silver solution into the tumor with a Pravaz syringe and applies a moist dressing, which is later substituted by a firm compress. Welander uses a 1 per cent solution of benzoate of mercury.

[M. K. Taylor injects from 10 to 40 minims of carbolic acid solution of the strength of ten grains to the ounce.

Iodoform injections in the treatment of suppurating bubo were first recommended by Helme. The method was somewhat modified by James R. Hayden, of New York, and has been extensively practised by Orville Horwitz, of Philadelphia.

The field of operation is rendered surgically clean and cocain solution injected over the bubo. A sharp bistoury is then plunged into the abscess, the pus forced out by firm pressure, the abscess-cavity irrigated first with hydrogen peroxide and then with bichloride of mercury 1:5000; when it has been thoroughly emptied a syringeful of 10 per cent iodoform emulsion is injected, a cool compress applied and a firm spica bandage put on. The patient is kept quiet for a day or two.]

DISEASES OF THE URINARY BLADDER.

ANATOMY AND PHYSIOLOGY.

The urinary bladder lies in the true pelvis behind the symphysis pubis, being bounded posteriorly and laterally by the peritoneum and the obliterated umbilical arteries, superiorly by the urachus, and inferiorly by the prostate and pelvic fascia. Its size, form and position vary with its degree of fulness. In the form of a triangle when empty, it assumes an ovoid shape when full, its shortest diameter extending from before backwards and its longest running from above downwards. Its capacity in adults varies from 300 to 600 cc. [10 to 20 fluid ounces].

The anterior surface of the bladder is entirely free from peritoneum, being connected to the abdominal wall by a thick layer of loose connective tissue. Further down it is fastened to the symphysis by bands of firmer connective tissue called pubo-vesical ligaments. The space in front of the bladder filled with loose connective tissue is known as the prevesical space or the space of Retzius. The posterior surface is entirely covered with peritoneum, which separates it from the rectum in the male and from the uterus and broad ligaments in the female. The superior surface is likewise covered with peritoneum. The inferior surface is in relation with the rectum, the prostate, the seminal vesicles, and the vasa deferentia.

In the interior of the bladder, on its inferior surface, the trigonum of Lieutaud is seen, which is bounded by the ureteral orifices and the internal orifice of the urethra. The muscular fasciculi covered with mucous membrane which are seen projecting from the inner surface of the bladder are continuations of the ureteral musculature and are known as the *ligamentum inter-uretericum.*

That portion of the bladder in which the urethra commences is called the neck. It is encircled by the internal sphincter muscle, which is formed by the circular muscular fibers of the bladder.

The bladder-wall is composed of a serous, muscular, and mucous coat. The nature of the serosa, which is identical with the peritoneum covering the bladder, has already been described.

The muscularis is composed of longitudinal and transverse fibers which cross one another, and when more fully developed form a trabe-

cular reticulum which has given the name of trabecular bladder or *vessie à colonnes* to those bladders in which it is present.

The mucosa is pale, being somewhat more vascular near the neck than elsewhere. It has no villi and when the bladder is full no plications. The existence of glands has been denied by Sappey, but others have demonstrated the presence of small rudimentary mucous follicles, especially in the region of the neck. The epithelium of the mucosa is cuboid and cylindric in the deep layers, then of the pavement variety, while the most superficial portion consists of large squamous cells.

The arteries of the bladder are derived from the hypogastric, some coming direct and others being given off by branches of the internal iliac. [The superior vesical artery is really the unobliterated portion of the hypogastric artery; the middle vesical is either derived directly from the hypogastric or is given off from the superior vesical; the inferior vesical is a branch of the internal iliac. In the female the uterine and vaginal arteries also send a few twigs to the bladder.] They anastomose on the outer surface of the bladder, penetrate its wall, and form a vascular net-work beneath the mucosa.

The numerous veins form a triple net-work, one set, which is especially large, being under the mucosa, the second intermuscular, and the third subperitoneal. All these vessels unite with the dorsal veins of the penis and the plexus of Santorini and eventually empty into the iliac. This venous system is slightly developed in youth, becomes well-developed in middle life, and in old age sometimes grows so large as to form well-marked glomeruli.

The lymphatic vessels, the existence of which has been denied, empty into the lymphatic glands of the pelvis.

The nerves are derived from the hypogastric plexus and from the anterior branches of the third and fourth sacral nerves.

The sensibility of the body of the bladder to touch is not great.

The vesical neck is much more sensitive. When it is touched with a foreign body, such as a sound for example, considerable pain, or at least a desire to urinate, is generally experienced. In diseased, inflamed bladders this sensibility is increased.

The sensibility of the bladder to distention is considerable. Whenever a certain quantity of urine, which in healthy persons varies from 300 to 500 cc. [10 to 15 fluid ounces] accumulates, a desire to urinate is felt, which becomes greater and greater and increases to a distinct feeling of pain if the bladder is not emptied. In disease this sensibility is

much greater. There are inflammations of the mucous membrane or of the entire bladder-wall in which even a minimum quantity of urine gives rise to acute pain.

In response to this irritability of distention the bladder contracts. The thicker its walls, the greater its power of resistance. Under normal conditions it seldom ruptures, but if deep ulcerations or diverticula are present tears of the bladder may easily result from pressure, especially pressure exerted from without.

Micturition is an act under the control of the will. The theory that the vesical contractions producing it are caused by impingement of a few drops of urine upon the prostatic urethra is erroneous, as they result from distention of the entire vesical wall.

So, too, the prevalent idea that the vesical mucous membrane does not absorb is erroneous and not to be accepted. It is true that absorption takes place slowly and with difficulty in a healthy bladder, but yet it does take place to a certain extent. An inflamed, hyperæmic, or even an ulcerated bladder absorbs more readily than one which is not diseased. These facts must be considered in cocainizing the bladder.

CYSTITIS.

At present we understand by the term cystitis an inflammation of the bladder due exclusively to **infection.** The bacteria in the bladder cause suppuration. Therefore in every case of cystitis pus and microorganisms are found in the urine. Whenever pus is present in the bladder bacteria are also present; bacteria, however, may be present without producing suppuration. In such cases we have a condition known as bacteriuria.

Certain bacteria occasion cystitis, although certain conditions must be present to prepare a favorable soil for their reception and growth. Such predisposing causes are **trauma, congestion, retention of urine,** or a combination of these conditions. Experiments have shown that under certain conditions pathogenic microörganisms can be introduced into the bladder without giving rise to a cystitis; if injury be inflicted, however, or congestion produced, as for example, by occluding the urethra, then a cystitis develops.

When cystitis occurs after catheterization or the passage of a stone, its evolution is to be explained by the fact that some injury, however slight it may have been, was inflicted at the same time the microörganisms gained entrance to the bladder.

The cystitis which supervenes after ingestion of cantharides, or after exposure to cold, may be accounted for by supposing that the congestion, which, as is well-known, follows the use of this drug, and which may also be caused by cold, prepares a suitable ground for microörganisms already present. Repeated violent copulation, masturbation, constipation or hemorrhoids may also lead to congestion of the bladder.

Old people, especially prostatics, are more subject to cystitis, because they do not completely empty their bladder, so that a partial retention of urine results which makes it possible for microbes to take up their abode and propagate.

Which bacteria are to blame? A large number have been found or named, some by one investigator and some by another. We will not mention them all, but will name only those which have been most frequently observed. The following microörganisms, named in the order of frequency with which they are present, are to be considered as the cause of cystitis: bacterium coli communis, streptococcus, proteus Hauser, bacillus tuberculosis, displococcus ureæ liquefaciens, staphylococcus ureæ liquefaciens, streptobacillus anthracoides, gonococcus, and bacillus typhosus.

The formerly prevalent theory that the presence of a ferment which converts urea into ammonium carbonate was necessary for the development of cystitis has now been abandoned. Rovsing maintained that only such bacteria as generated this ferment could cause cystitis. We know, however, that most cases of the disease are associated with acid urine, a condition which precludes the possibility of decomposition taking place. In other cases it may and does happen, but its occurrence is secondary; as a primary cause of cystitis it does not exist.

The question as to how the bacteria reach the bladder now presents itself to our consideration, and in answer thereto it may be stated that they gain access by four routes, namely, through the urethra, the kidneys, the blood, and the wall of the bladder itself.

First, as concerns the urethra, it is to be borne in mind that a whole series of microörganisms inhabit the healthy urethra of both sexes, where they are not pathogenic, or at least remain latent, although they may become virulent if they get into the bladder, and thus supply the requisites for the development of disease. In this manner many cases of cystitis in persons who have never been catheterized are explained. If urethritis, gonorrhœa, or in the female, leucorrhœa, is present, the extension of the infectious process is readily understood.

That the kidneys sometimes discharge microörganisms into the bladder and thereby cause cystitis is clearly demonstrated in tuberculosis. With the cystoscope it can be seen that the primary lesion of tuberculous cystitis begins around the orifice of a ureter communicating with a tuberculous kidney. Like conditions due to other organisms can be demonstrated experimentally. Thus the colon bacillus may be excreted by the kidneys and pass into the bladder. According as the bladder is or is not in a condition of receptivity, a cystitis develops or the bacilli are carried out by the urine without doing any damage. It may also be assumed that microörganisms are in like manner brought to the bladder through the blood-stream or lymph-channels and give rise to cystitis if favorable conditions for their development are present.

Finally in regard to a path of infection through the wall of the bladder, it may be said that such an occurrence, though not yet certain, is nevertheless most probable. Wreden, Posner, and Reymond have endeavored to prove it experimentally, but their conclusions have not remained undisputed. I am of the opinion that bacteria inhabiting the intestines, such as the colon bacillus, may, under favorable conditions, —as for example, a slight lesion of the intestinal wall, or congestion— penetrate the intestine and the wall of the bladder, reach the interior of the viscus and give rise to a cystitis provided the conditions necessary for its development are present.

Proceeding from the point of view that every cystitis is infectious, and furthermore that a condition favoring the occurrence of infection, be it congestion, trauma, or retention of urine, must be present, we can make the following classification:

1. Cystitis due to extension of infection from neighboring parts. To this class belong gonorrhœal cystitis and that form of cystitis so common in puerperal women.

2. Cystitis formerly known as cryptogenetic or idiopathic, and which we must assume to be due to the passage of infectious germs to the bladder through the intestines, the blood, or the kidneys. Under this form are included cystitis due to cold and to irritating drugs.

3. Traumatic cystitis (caused by calculi or foreign bodies).

4. Cystitis with retention (caused by stricture, hypertrophy of the prostate, paralysis of the bladder of central origin, tabes, myelitis, etc., arteriosclerotic degeneration of the vesical musculature).

5. Neoplastic cystitis.

6. Tuberculous cystitis.

7. Symptomatic cystitis, a form in which the vesical condition is merely a symptom of some constitutional disease, such as pyæmia, typhoid fever, etc.

From a practical point of view we also distinguish between acute and chronic cystitis, cystitis localized at the neck of the bladder in contradistinction to that affecting the body of the viscus, and the circumscribed and diffuse forms of the disease. We no longer speak of catarrhal, purulent, and hæmorrhagic cystitis because the products of inflammation, now mucus, now pus, now blood, or indeed a mixture of the three, represent nothing essential to the disease.

PATHOLOGICAL ANATOMY.

In acute cystitis there is a more marked vascularization and distention of vessels than in health. This is seen especially near the neck of the bladder, the trigonum, and the base. The mucous membrane is œdematous, hyperæmic, and in certain areas spots of ecchymosis are present. The epithelium is swollen, and is soon cast off and passed with the urine. In more severe grades of inflammation the disease extends into the deep tissue and small-celled infiltration of the mucosa and muscularis results.

In chronic cystitis the principal changes likewise affect the trigonum and neck of the bladder. The mucous membrane is gray in color, and is swollen, thickened, and secretes freely; its various strata, which in health are closely adherent, are now almost separated from one another. It is deprived of superficial epithelium, while in the deeper strata of epithelia and in the submucosa a small-celled infiltration is present. In some cases typical granulations are seen on the mucous membrane, and when extensive form a number of small round excressences; in other cases the mucous membrane presents villous elongations and protuberances, which may be mistaken in the cystoscopic picture for papillomata (cystitis vegetans). (Fig. 162.) The process generally invades the deep tissues and infiltrates the muscularis with small-cells; it is unusual for it to extend beyond the muscular coat and lead to a pericystitis. In very severe grades of cystitis true ulcerations occur, circumscribed areas of the epithelium and submucosa becoming gangrenous and sloughing away.

SYMPTOMS AND DIAGNOSIS.

The symptoms of acute and chronic cystitis differ from one another only in intensity, one form frequently merging into the other. In gen-

eral the disease is characterized by three cardinal symptoms: **Strangury, pain,** and **pus in the urine.** The more acute the inflammation the more pronounced are the first two symptoms, while the more chronic it becomes the less marked they are, so that in many cases of chronic cystitis they fail entirely. Pus, however, is invariably present in the urine. **There is no cystitis without pus.** This declaration still holds good, although cystoscopy has taught us that we must make a little

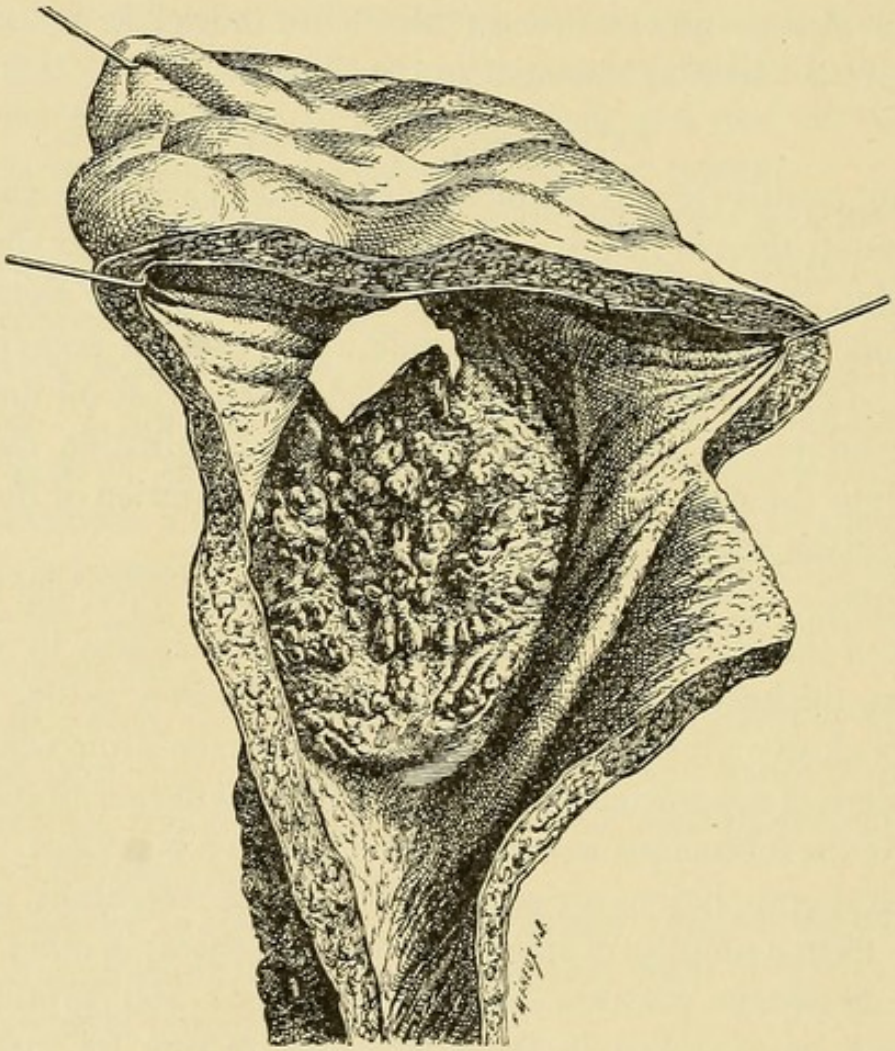


FIG. 162.—Cystitis vegetans with papillary excrescences.

concession, for it has shown that slight grades of inflammation characterized by hyperæmia of the mucous membrane may exist without there being any pus in the urine. These processes are to be considered rather as the precursors of cystitis than as cystitis itself.

Let us consider the special symptoms more accurately. The **strangury** is characterized by the patients urinating very frequently without the quantity of urine being increased. Often the voiding of a few teaspoonfuls of urine quells the desire to urinate. It is very

characteristic of cystitis that the urgency of urination persists day and night, although it is not so severe at night as during the day. In this respect it differs from the urgency of nervous origin, which causes a desire to urinate only at intervals during the day and not at all at night. The strangury is due to the inability of the swollen mucous membrane to expand in response to accumulation of urine. For this reason it is most severe in acute cystitis.

So, too, **pain** is chiefly a symptom of the acute form. It arises before, during, or at the end of micturition. In very acute cases it is most intense before the act, subsiding as soon as the distention of the bladder is relieved. In other cases, especially those in which the inflammation is localized at the neck of the bladder, the pain is most severe at the end of urination. The location of the pain varies, it being felt above the symphysis, in the perineum, and especially in the end of the penis. It may supervene irrespective of micturition upon violent physical exertion, riding over rough roads, etc.

The third and most constant symptom of cystitis is **purulent urine.** The quantity of pus varies exceedingly. The more diffuse the inflammatory process, the more copious the amount of pus. If the patient urinates in several glasses the urine in the last glass will be the most turbid, because it contains the pus which sinks to the bottom of the bladder and is voided last. In this respect it differs from the urine of posterior urethritis and urethrocystitis (*quod vide*).

Blood may or may not be present in the urine. It is not a constant symptom; in general it may be stated that its presence is exceptional. Reference will be made to it again when considering the particular forms of cystitis.

It has already been stated that in the majority of cases the urine is acid. The idea that the urine is always ammoniacal has been entirely abandoned. There are cases— usually those which have been neglected—in which the urea has been decomposed and ammonium carbonate formed, and in which triple phosphates (ammonio-magnesium phosphate) are always found upon microscopic examination, but this condition does not belong essentially to cystitis. Oftentimes the microscope reveals nothing but pus.

In the beginning of the disease, especially in children, it is not unusual for a slight rise of temperature to occur, but as the disease advances the temperature becomes normal again. In subacute and chronic cystitis the temperature is almost always normal, and any eleva-

tions which take place are to be attributed to exacerbations or complications.

As some of the previously mentioned forms of cystitis present peculiarities of symptomatology, and also vary as to their prognosis, they should be accorded further consideration.

Gonorrhœal cystitis is decidedly benign. It may supervene during any stage of acute or chronic gonorrhœa; indeed, even when nothing but a simple urethral catarrh is present, that is, one in which gonococci no longer exist, a cystitis may suddenly develop. It is to be considered as an extension of the urethral inflammation due to bacteria present in the urethra after the subsidence of the specific infection.

The symptoms of acute gonorrhœal cystitis are entirely different than those of the chronic form.

The acute form appears as a **cystitis colli** or cystocollitis: severe strangury, excruciating pain, especially at the end of micturition, pus in the urine, and usually blood also, constitute the typical picture of the disease. The strangury is of the most severe type; it manifests itself every five or ten minutes, and because of the pain associated with micturition it becomes unendurable. It robs the patient of rest and sleep and soon undermines his general health. If the urine be collected in several glasses the first portion will be found the most turbid, because it contains the pus from the bladder in addition to that from the urethra. At the conclusion of micturition a few drops of pure blood or bloody urine are voided; the latter, however, may be absent. This so-called terminal hæmorrhage is characteristic of inflammatory disease at the neck of the bladder.

As the inflammatory process becomes chronic urgency of urination and pain abate, or finally subside altogether, leaving nothing but the purulent urine, which when collected in separate portions is found gradually to assume the character of the urine of cystitis corporis as the inflammation extends more and more from the neck to the body of the bladder. Occasionally the clinical picture is different. All signs of hæmorrhage may be absent, or severe bleeding, such as characterizes vesical tumors, may occur. This fact must be remembered in order to guard against error. This form of gonorrhœal cystitis with profuse hæmorrhage may lead the physician to think that he is dealing with a very grave malady; especially is this the case when a history of gonorrhœa is not obtainable. It must not be forgotten that careless persons are often unaware of the existence of a slight chronic urethritis, which

when it undergoes an exacerbation may extend to the neck of the bladder and cause the above mentioned form of cystitis. Furthermore the favorable effects of treatment upon gonorrhœal or post-gonorrhœal cystitis serve to prevent confusion; it is plain that strangury and hæmorrhage from other causes, as for instance from tumors, are not so easily subdued.

Cystitis feminæ. The ordinary forms of cystitis, such as those due to gonorrhœal infection, calculi, foreign bodies, etc., naturally occur in woman as well as in man. Here, however, it is our purpose to consider that form which occurs especially in women without the presence of a distinct assignable cause. This idiopathic cystitis is much more common in females than in males, and is probably due to the shortness of the female urethra, as a result of which pathogenic microörganisms more readily gain access to the bladder. This form is especially common during pregnancy and the puerperium, periods in which the disturbed circulatory relations offer exceptionally favorable conditions for the development of cystitis.

Its symptoms and course do not differ much from those of the other forms. It is benign in nature and yields readily to appropriate treatment. Generally urgency of urination, pain, and pus in the urine form the symptom-complex; blood is seldom voided.

Cystitis arising from **exposure to cold** or ingestion of **cantharides** likewise pursues a benign course. It presents no peculiarity of symptoms.

Traumatic cystitis, by which is meant those forms due to injury produced by calculi or foreign bodies, is also of favorable prognosis. Special stress is to be laid upon the circumstance that in this form oftener than in others exacerbations associated with great pain follow exercise and exertion. Especially in many cases of cystitis due to stone, the so-called vesical spasms, a condition in which the patient is seized with attacks of violent convulsive pain in the hypogastrium, manifest themselves. These spasms of the bladder are difficult to control by internal treatment. On the other hand, if the source of the evil can be removed—the stone or foreign body got out of the bladder—they usually subside very quickly.

Cystitis accompanied by retention of urine generally pursues a chronic course; the fact must never be lost sight of, however, that every chronic cystitis may suddenly become acute. Any baleful influence, such as exposure to cold or excess in drinking, may cause a

chronic and absolutely painless cystitis to assume an acute form. It may then be exactly like a first attack, being accompanied by severe pain, spasm of the bladder, etc.

The prognosis of cystitis associated with retention of urine depends upon whether it is possible to relieve the retention. We have come to recognize that retention is one of the conditions which favor the development of vesical infection. It is self-evident then that it will be especially prone to cause the persistence of an already existing cystitis. Thus it is found that those cases in which retention can be overcome have a decidedly favorable course, while those in which retention persists are obstinate.

Cystitis due to stricture of the urethra almost always gets well after the stricture has been sufficiently dilated. Prostatics are relieved of their vesical catarrh—as we are wont to call the chronic cystitis from which they suffer—by simple treatment as soon as the congestion and engorgement of the prostate, and with it the retention of urine, are subdued. The same thing is true of the forms dependent upon disease of the central nervous system in which the residual urine can be reduced or done away with. This is not uncommonly the case in tabes, in chronic myelitis, and, according to my own experience, most frequently of all in spastic spinal paralysis. When the retention persists, as for example in advanced cases of paresis, or when the residual urine of prostatics cannot be diminished, then the cystitis may equal it in persistency. It can be ameliorated, but seldom cured. The course of this form presents some peculiarities. Its excessive chronicity has already been mentioned. Furthermore it is worthy of notice that in these cases there is usually a considerable degree of suppuration, and that decomposition of the urine takes place, the urea being changed into ammonium carbonate. The urine has an alkaline reaction and free alkali in the form of triple phosphate is found.

If we remember that in these forms the bladder is generally trabecular, its walls being filled with recesses and pockets and its mucous membrane being invaginated between projecting columns, so that the surface is greatly increased, it will be readily understood that large quantities of pus can collect; moreover, it will be apparent that such cases are very hard to cure, for the reason that the bacteria-laden urine remains in the diverticula, from which it is not easily removed by even the most thorough irrigations.

It is also important for a complete understanding of these forms to

remember that in the vast majority of cases the bladder has undergone enormous dilatation. This is a result of constant pressure exerted by the retained urine upon the bladder wall. The degree of distention may be exceedingly great. I have seen patients whose bladder could hold two liters [about two quarts] of urine without causing them material uneasiness. As the result of pressure pouches are formed which are often larger than the bladder itself.

On the other hand, instead of being dilated and distended the cavity of the bladder may be compressed. When the morbid process extends to the musculature and the latter becomes markedly hypertrophied the cavity of the bladder may become so small that it cannot hold more than 30 to 50 cc. [1 to $1\frac{2}{3}$ fluid ounces]. Fortunately this so-called **concentric hypertrophy** of the bladder wall is exceptional in the forms of cystitis already described. We shall refer to these cicatricial and contracted bladders again in our article on vesical tuberculosis.

The cystitis **due to tumors of the bladder** varies greatly in its manifestations, according as it depends upon a benign or malignant growth. In the first place we know that neoplasms may be present in the bladder without producing cystitis. If they give rise to hæmorrhage, however, cystitis usually develops. The growth of a tumor in the wall of the bladder causes circulatory disturbances which favor the development of infection.

While the cystitis which arises as a result of benign polypi is of a decidedly mild character, that which accompanies malignant growths is difficult or impossible to control. In the former class only slight pain and scarcely any urgency of micturition are experienced; the frequent hæmorrhages are due to the tumor and not to the cystitis. When the tumors are removed the bladder quickly heals. Even though the tumor remains the symptoms of cystitis soon disappear under appropriate irrigations, but relapses are prone to take place.

The malignant growths, carcinoma and sarcoma, tend to disintegrate. The products of disintegration are retained in the bladder and supply an unfailing source of infection. Even though the symptoms improve exacerbations due to the same cause are not long deferred.

We will not enter upon a discussion of **tuberculosis** in this place, because we shall consider it under tuberculosis of the bladder (*quod vide*). We merely state here that it is the most pernicious of all forms, that it is characterized by unconquerable pain, tenesmus, hæmorrhage, and an almost invariable contraction of the bladder which

greatly diminishes its capacity. It is upon this form that all our therapeutic efforts are often wrecked—efforts, too, which in nearly all other forms of cystitis are crowned with more or less success.

The French school has made a still more minute classification of cystitis, having described what they term **painful** and **membranous** forms (*cystite douloureuse*, *cystite membraneuse*). The first is characterized by excessive pain which cannot be controlled by the ordinary therapeutic measures. I deem it unwise to separate this form from the others for the reason that any cystitis may suddenly become very painful. Many of these cases are probably tuberculous, but the diagnosis is not made because the presence of bacilli cannot be demonstrated. Some believe that in many such cases there has been a pericystitis, and that the adhesions on the exterior of the bladder are responsible for the pain.

Membranous cystitis is peculiar in that large shreds or masses of mucous membrane are discharged. The same thing is known to take place in inflammation of other organs, large pieces of ephithelium being cast off. This form of cystitis presents no other peculiarities.

In conclusion it should be mentioned that cystitis also occurs in very young children. I have seen gonorrhœal cystitis in a boy of two. Cystitis is more common in girls, in whom it is evident that infection occurs through the vulva.

The **diagnosis** of cystitis is exceptionally easy, there being scarcely any disease which can be more readily and surely recognized. If strangury and painful micturition exist, and pus derived from the bladder is present in the urine, the diagnosis is assured. A careful anamnesis, together with a more complete examination, either with the sound or the cystoscope, or by means of digital palpation, will then enable us to determine with which form of the disease we have to do.

The only question which can cause difficulty is whether the pus comes from the bladder. May it not come from the urethra, the prostate, the pelvis of the kidney? For the solution of this problem the urine should always be collected in glasses, as other vessels do not permit the detection of slight turbidity. Always have the patient urinate in two glasses. The first portion in the second glass will represent the urine from the bladder, the last portion that from the bladder and kidneys. If pus is present only in the first glass it is surely from the urethra or its neighboring glands, such as the prostate.

But if the urine in the second glass is cloudy, then the source of pus

can be only from the bladder or kidneys, or perhaps from both. The differential diagnosis between cystitis and pyelitis may be exceedingly difficult. We shall refer to this matter again in our article on pyelitis. Here we shall merely emphasize the fact that painful micturition, strangury, and alkaline urine containing but little albumen point to cystitis. It must not be forgotten, however, that in most cases of cystitis the urine is acid, so that the teaching which formerly prevailed to the effect that the reaction of the urine—it being acid in pyelitis and alkaline in cystitis—furnished an infallible means of differentation can no longer be accepted. Very little can be determined from miscroscopic examination of the urinary sediment, for in pyelitis nothing but pus-cells may be present, as is the case in cystitis; in cystitis, too, all forms of epithelium may be observed, and those derived from the deep layers of the urethra and bladder were formerly supposed to be the characteristic type of cells from the renal pelvis.

I consider that great help is derived from the effect produced by treatment. Every form of cystitis, with the exception of those caused by tuberculosis and malignant growths, is benefited by irrigation of the bladder, but this treatment has no effect upon suppurative disease of the renal pelvis. Finally cystoscopy and catheterization of the ureters offer the most important and trustworthy means of diagnosticating between the two affections. Both will be discussed under pyelitis.

TREATMENT.

The treatment of cystitis is a very gratifying task, because the disease is one which is always susceptible of amelioration and one which can often be entirely cured. I premise that all treatment must first of all be directed to removal of the underlying cause. Strictures must be dilated, stones or foreign bodies removed. If a suppurating kidney is the source of the disease, cure will never be obtained until the renal disease is mastered. If a large amount of residual urine is present, or if paralysis of the bladder exists, regular catheterization is the prerequisite to a possible cure.

Here, too, as in general medicine, prevention must not be underrated. As we know that infection is the cause of cystitis we must be on the alert to prevent its occurrence. Careful washing of the genital organs, especially in woman, but also in man, and the most scrupulous asepsis in catheterization should be practised.

There are four principal therapeutic measures at our disposal in the treatment of cystitis; namely, hygienic, internal, local, and operative.

In the treatment of acute cystitis only the first three are employed. The hygienic measures resorted to in acute cystitis comprise baths, applications, diet, and rest. It has long been known that warmth exerts an exceptionally favorable effect upon the bladder. We use it, therefore, in all conceivable forms; warm full baths, hot sitz-baths, hot cataplasms, or better still the thermophore applied over the bladder, usually relieve pain and strangury. In addition a restricted diet should be prescribed; all highly seasoned food, mustard, cheese, radishes, pungent sauces, etc., and all alcoholic beverages, should be interdicted. It is better for the patient to keep his bed in the beginning of an acute cystitis. As the symptoms abate and the temperature becomes normal he may be allowed to sit up, but should still remain in his room.

Of remedies administered internally the narcotics hold first rank. They lessen the sensibility of the bladder, thereby diminishing the number of painful contractions, and thus, by tranquillizing the bladder, exert an indirect curative effect. Morphine, opium, or belladonna should be ordered in pills, powders, or suppositories. The dose is determined according to the general rules of practice. When given in the form of suppositories a somewhat larger quantity should be used than otherwise, because all the drug is not absorbed. As an internal initial dose 0.015 [$\frac{1}{4}$ grain] of morphine or 0.005 [$\frac{1}{12}$ grain] of heroin may be given, and the amount increased as necessary. The following combination injected into the rectum by means of a small glycerine-syringe is very efficacious in relieving pain: antipyrin 1.0 [15 grains] or pyramidon 0.25 [$3\frac{3}{4}$ grains], water 5.0 [$1\frac{1}{2}$ fluid drachms] laudanum 10 to 20 drops.

Urinary antiseptics and diluents should be ordered at the same time. We shall refer to them again under the treatment of chronic cystitis.

As to local treatment, that is, irrigation of the bladder, it may be stated that it is generally contraindicated in acute cystitis. The remedies just mentioned usually suffice to relieve the acute symptoms to such an extent that the strangury and pain become insignificant, the only essential characteristic of the disease which remains being pyuria. When this condition obtains local treatment is appropriate.

An exception to the rule is constituted by gonorrhœal cystitis. This form may be so severe and obstinate that all the hygienic measures and internal treatment above mentioned fail to relieve the pain. Even large

doses of morphine are of no avail. Such cases should be treated during the acute stage by irrigating the neck of the bladder with a solution of nitrate of silver after the method of Diday, which was described in the article on *cystitis colli gonorrhœica* (*quod vide*). This treatment is more effective than all other measures combined. A few irrigations suffice to relieve the pain and considerably reduce the suppuration.

In all other forms of cystitis excepting the tuberculous, local measures are to be employed during the stage of severe pain and strangury only after hygienic measures and internal treatment have failed.

In the treatment of chronic cystitis the same hygienic rules advised for acute cystitis should be followed. Restricted diet and hot baths are especially indicated for the exacerbations which so often occur as the result of exposure to cold or excess in eating.

Of the remedies administered internally the narcotics, as in acute cystitis, cannot be dispensed with, because throughout its protracted course exacerbations are constantly occurring. Whenever pain and strangury are absent there is, of course, no indication for their administration.

Drugs which have the reputation of disinfecting the bladder and lessening suppuration therein have long played an important rôle in the treatment of cystitis. None of them fully accomplish this purpose, but there is, however, a difference in their value.

The balsamics—oil of sandal-wood, balsam of copaiba, oil of turpentine—are to be avoided as a rule, because they are badly borne by the digestive tract. I consider their administration advisable only in gonorrhœal cystitis, in which they are in some measure beneficial. If it be desired to try them in the other forms they should be given only in moderate doses, say 40 drops a day, and only for a short time.

A very old and highly esteemed class of drugs used in the treatment of cystitis is composed of certain vegetable substances, such as buchu leaves, couch-grass, pareira brava, corn-silk, uva ursa, alchemilla and others. The best of these is buchu, which certainly exerts a soothing influence.

These herbs may be taken in the form of tea, several being mixed together and two teaspoonfuls allowed to each cup of water. The patient should drink three or four cupfuls a day. Although some of the good effect produced may be due to the fact that the urine is diluted by the free ingestion of fluid, these medicinal teas seem to exert a specific sedative and astringent action which is not produced by simple

diluents. Care should be taken to have the tea actually boil for a few minutes and not merely simmer, as by the former process the active principles of the herbs are withdrawn.

In the treatment of cystitis diluent drinks hold a rank of considerable importance. It is evident that if the urine is well diluted accumulations of pus will be broken up and more easily expelled. We may prescribe diuretics either alone or in combination with the decoctions above mentioned, or administer diuretin in doses of 0.5 [7½ grains] three or four times a day; if preferred certain of the mineral waters may be given. The waters of the George Victor and Helena springs at Wildungen, Wernarz spring at Brückenau, Obersalz, Salvator, Fachinger, Offenbach, and Ems are alkaline, and when drunk in large quantities render acid urine alkaline, and make alkaline urine more strongly alkaline. They have a decidedly favorable influence on chronic catarrh. The greater part of their action is due to their diluent effect, but some may be due to the specific properties of the waters themselves. As these spring-waters are expensive, Dr. Sandow's artificially prepared salts, which are of the same composition as those of the natural waters, may be ordered for patients in moderate circumstances.

A large number of drugs, among which may be mentioned salicylic, benzoic, camphoric, carbolic, and boric acid, potassium chlorate and nitrate, the balsamics, arbutin (the active principle of uva ursa), salol, urotropin and helmitol, have been recommended as effective urinary antiseptics. All were reputed to possess the property of destroying bacteria in the urine, of making it aseptic, and thereby removing the cause upon which the continuance of cystitis depended. The first thing to be remembered about them is that none of them fulfilled that which was expected and desired of them. Some of them, however, have a decided influence upon the bacteria in the urine, and thus exert some action upon the catarrh. Even though they cannot kill the bacteria, they inhibit their development and prevent increase of their number.

According to my experience this very desirable property is possessed solely by urotropin, which is the best urinary antiseptic at our disposal. It may be given in powder, tablets, or solution in the dose of 1–3.0 [15 to 45 grains] a day. Chemically it is hexamethylene-tetramin, under which name it is now on the market. It works, as I have proved, by liberating formalin in the urine. It is well borne and only rarely produces unpleasant after-effects. Burning in the urethra or bladder, and occasionally the appearance of blood, have been caused by its use, but

their occurrence is most exceptional; generally the patients experience no untoward effects from the drug, being able to tolerate it for months at a time. When these ill-effects manifest themselves, the drug should, of course, be discontinued for a shorter or longer time, as the exigencies of the case demand.

The next drug to be alluded to is salol, which is given in doses of 2–4.0 [½ to 1 drachm] a day, and which is eliminated in the urine as carbolic and salicylic acid. It is not borne very well by the stomach. It should be discontinued at once if the urine shows the presence of carbolic acid.

Chlorate of potassium acts well now and then, but it should not be used because of its poisonous properties. One patient can take large doses, another not even the smallest. Unfortunately we cannot tell which patients will tolerate it and which will not.

I have seldom seen any good follow the use of any of the other drugs mentioned. Salicylic and camphoric acid, the first in the dose of 2.0 [30 grains], the second in the dose of 4.0 [60 grains] daily may occasionally be used with advantage. Sufficient evidence concerning the value of the recently recommended helmitol has not yet been gathered.

In isolated cases, especially those in which the infection is not severe and the formation of pus in the bladder is slight, the previously mentioned hygienic measures and internal medication are all that is necessary. If the character of the urine does not soon change, if its turbidity does not materially diminish, then no time should be lost in resorting to local treatment, which, when properly conducted, gives most admirable results. I refer almost exclusively to irrigation of the bladder with large quantities of fluid. The instillation of a few drops of fluid is hardly ever practised.

Irrigation of the bladder has a twofold object: it is intended simultaneously to cleanse the bladder of bacteria and accretions of pus adherent to its walls, and to stimulate the superficial layer of the vesical wall to exfoliation, so that a healthy surface from which regeneration of the tissue shall take place may remain. As for internal medication, so likewise for this purpose a number of substances have been recommended, among which are permanganate of potassium, permanganate of zinc, sulphate of copper, carbolic and salicylic acid, potassium chlorate, ichthyol, lysol, oxycyanate of mercury, bichloride of mercury, and nitrate of silver.

The last two drugs are the most effective. Bichloride is used only

in exceptional cases. The remedy *par excellence* is **silver nitrate.** It is used in solution in the strength of 1:5000–1:500. The best solution for general use is 1:1000. After the bladder has been emptied by means of a catheter it is filled with the silver solution, as much being allowed to flow in through an irrigator or injected with a syringe as the bladder will tolerate. Undue distention of the organ should be avoided. For very sensitive bladders it is better to use a hand syringe, but for large dilated ones the irrigator is to be preferred. It is important that the bladder be completely filled. The custom of using small quantities of fluid, from 50 to 100 cc. [1½ to 3 fluid ounces] is in the majority of cases incorrect; as the silver nitrate must come in contact with all parts of the bladder in order to disinfect it, the solution must therefore be forced between all duplicatures and into all recesses and diverticula.

These silver irrigations are somewhat painful and also produce more or less strangury. Therefore is is not wise to employ them daily. I seldom use them oftener than every second day. It is well to change the solutions, using the silver on one occasion and a milder irrigation on the next. Of the latter oxycyanate of mercury and boric acid are the best, the first being used in 1:5000 solution, the second in a 3 per cent solution. Their general effect is to cleanse the bladder; curative action has not been observed. All the other drugs mentioned, excepting bichloride, may be stricken from the list, as they do not equal the silver.

The bichloride is an unusually active remedy in vesical catarrh, being exceedingly valuable for securing thorough disinfection. It is not entirely free from danger and, moreover, is so painful that it should be used as an irrigation only in exceptional cases. It is employed in the strength of from 1:10000 to 1:3000.

It has rendered me excellent service in the treatment of bacteriuria, that condition in which bacteria alone, without cellular elements or pus, are found in the urine. If the bacteria come from the kidneys, an occurrence which I have repeatedly seen, then the employment of sublimate irrigations is manifestly irrational. In such cases we must limit our therapy to the internal administration of urotropin.

Instillations of bichloride, as well as of silver nitrate, have often been recommended for general diffuse cystitis. This is the same method we referred to under the treatment of gonorrhœa, a few drops of a 2 per cent silver solution, or a 1:1000 bichloride solution, being instilled into

the fundus of the bladder. I have seen good results from this method only when the inflammation was localized to the fundus, that is, in cases of tuberculous and gonorrhœal cystitis. In all forms in which the body of the bladder is involved—and it soon becomes affected in gonorrhœal cystitis—I recommend irrigations instead of instillations.

As already stated there are few cases of cystitis which do not improve under rationally conducted irrigation. Even the severe catarrh of long duration which is associated with diverticula of the bladder becomes less. If a case proves exceptionally obstinate and the usual measures do not succeed, then I advise that a soft catheter be fastened into the bladder and the viscus irrigated every one or two hours, one irrigation with 400 c.c. [13 fluid ounces] of silver solution being given once during the day, and boric acid, mercury oxycyanate, or merely sterile water being used for the others. More frequent use of the silver is too irritating. This treatment is extraordinarily effective. Unfortunately, though, the patients often do not bear the catheter well; it causes them pain and they desire its removal. The administration of morphine during its retention may serve to make it tolerable. Some instructions concerning this permanent catheter may not come amiss. Its outer end should be placed in a vessel containing 5 per cent carbolic acid or 1 per cent bichloride, so that the urine may be disinfected and new infection prevented from taking place from without. This is the more important because whenever a catheter is allowed to remain in the urethra for any length of time urethritis develops. Pezzer's catheter, or the self-retaining catheter designed by me, are appropriate instruments for use. In treating old, debilitated men care should be taken to have the upper part of the body raised as high as possible, so as to guard as much as possible against the development of hypostasis.

In case all of these measures—the hygienic, the internal, and the local—do not succeed, then we possess as a last expedient certain operative procedures. These consist either in opening the bladder and draining it for awhile, or in addition thereto in curetting the mucous membrane.

Formerly the practice of rapidly dilating the sphincter of the bladder in the female by means of Simon's speculum was thought well of for the purpose of securing drainage. I have never seen any great advantage result from this procedure, and, moreover, think that there is danger of its producing incontinence of urine.

In the female the bladder is now drained by a colpocystotomy, the

mucous membrane of the bladder and vagina being sutured together so as to establish a fistula, through which a permanent catheter is introduced and the bladder energetically irrigated.

In man either the boutonnière opening (external urethrotomy) is made or suprapubic cystotomy performed. A catheter is fastened into the wound and the bladder washed out with the medicated fluids already mentioned.

As to curettage it can be performed in the female through the urethra without opening the bladder. In the male either a suprapubic or perineal cystotomy has to be done. The bladder, chiefly in the region of the neck and fundus, is freed from its fungosities by scraping with the curette. It is only when a suprapubic opening is made that the other parts of the bladder are accessible; the posterior wall cannot safely be reached through a perineal incision nor through the female urethra.

My opinion of these various procedures is that in the most exceptional cases drainage may be indicated. In man it should be made through the perineum, in woman through the vagina. A suprapubic fistula drains the bladder badly because it lies too high. These artificial openings sometimes give good results, and are at least not dangerous. The bladder can be more thoroughly cleansed through them than through the urethra. Notwithstanding this, however, they should be reserved for the most urgent cases, as for example, those which are exceedingly painful and fail absolutely to be influenced by other measures.

Curettage of the bladder has as yet been too little practised to permit it being recommended as an assured method of treatment. Should its performance be deemed advisable the suprapubic route is the one of choice.

TUBERCULOSIS OF THE BLADDER.

A disease of extraordinary importance and frequency, and one which for a long time received too little attention, is tuberculosis of the bladder. Observations made within the last five or ten years have showed that it is much more common than formerly was thought. A large number of the obscure so-called cryptogenetic cases of painful cystitis are in reality tuberculous, and their accurate recognition is important because many cases can be cured if diagnosticated early, and in others the patient can be materially benefited and his existence rendered tolerable once the nature of his malady is recognized.

ETIOLOGY.

As to the etiology of this disease it may be stated that the cause producing it is the same as that which gives rise to tuberculosis in general, namely, infection with the tubercle bacillus. The fact must be emphasized, however, that the mere passage of tubercle bacilli through the bladder does not suffice to produce infection. To be sure, there is a form of excretory vesical tuberculosis caused by the passage of tubercle bacilli through healthy kidneys into the bladder. On the other hand, there are cases in which the organisms pass from the kidneys to the bladder for considerable periods of time without the latter organ becoming diseased. Therefore it would seem that the assumption of a certain predisposition to infection is necessary for the explanation of the development of this malady. We must also refer again to a statement made in a preceding section concerning the etiology of cystitis, namely, that trauma, congestion, and retention of urine are predisposing factors.

Another opinion prevails among strictly orthodox bacteriologists, according to whose ideas bacteria move with the celerity of bullets and, like them, stop wherever they strike. To these gentlemen predisposition and exposure are synonymous terms. In our following consideration of tuberculosis of the bladder we shall prove that this theory is not tenable, and shall show, moreover, that the development of all forms of the disease may readily be explained by the hypothesis of susceptibility to infection.

In the first place tuberculosis of the bladder is a symptomatic affection, that is, it may be a symptom of generalized tuberculosis; and just here it may not be amiss to take notice of the fact that by choice tuberculosis attacks more than one organ.

Tuberculosis of the lungs is the most common form of the infection. That the vesical form is not more frequently observed in the subjects of phthisis is due to the fact that many die before the bladder becomes involved, and others have their attention concentrated upon their pulmonary symptoms to the exclusion of other manifestations of their disease. Yet, after all, such patients presenting vesical symptoms are not rare.

Next to tuberculosis of the lungs tuberculosis of the kidneys is the form with which vesical involvement is most frequently associated. In these cases infection occurs in one of two ways: infectious material is either brought directly from the kidneys to the bladder through the

ureters, or else renal and vesical infection takes place independently from a primary focus in the lungs by way of the blood or lymph-stream. In their clinical manifestations these forms differ essentially from one another, as will be shown later.

Another form of tuberculosis of the bladder results from tuberculous lesions of the genital organs unassociated with any other foci of infection. Thus, tuberculous processes may extend to the bladder directly from the seminal vesicle, the testicles, the epididymis, or the prostate. This form of development is easily recognized because tuberculous lesions of the above mentioned organs are, as a rule, distinctly palpable, the seminal vesicles being the only structures not readily accessible to the examining finger. Very often these affections exist simultaneously with tuberculosis of the lungs.

In contradistinction to these more common and generally recognized forms we now come to the consideration of primary tuberculosis of the bladder, the existence of which, however, is not undisputed. If the existence of primary tuberculosis of the bladder is conceded, it is necessary to exclude the presence of any other tuberculous focus within the body, a thing which it will often be exceedingly difficult, if not actually impossible, to do.

Due weight must be given to the fact that a tuberculous process may remain latent in certain organs for years without producing the slightest morbid phenomena. I have known men to suffer from ill-defined urinary disorders for a long time without being able to demonstrate any objective source of their trouble, until finally the signs of vesical tuberculosis manifested themselves, and later tubercles of the prostate developed. In these instances it is probable that a focus previously existed on some part of the prostate not accessible to palpation. It has been a not uncommon experience with me to have tuberculosis of the prostate run a symptomless course and only be discovered after it has extended to the urinary tract.

Doubtless there are cases also in which the bladder is the only organ attacked. Such cases I have seen especially in women who for years presented no apparent abnormality except the lesions of the bladder. These cases are not well understood because we do not know the reason why the tubercle bacilli, which we believe are harbored by a large proportion of mankind, take up their abode in the bladder and become virulent.

It is much easier to offer a plausible explanation of those cases in

which some cause can be assigned. Of such causes I wish especially to direct attention to gonorrhœa, because the relation existing between gonorrhœa and tuberculosis is not sufficiently understood. I believe that gonorrhœa, especially when it affects the bladder, acts similarly to a traumatism, and that it prepares a favorable soil for the development of tuberculosis.

The question also arises as to whether infection of the urinary or genital organs can result from cohabitation with a tuberculous person. Such a case has not yet been proved. Cornet believes that infection during intercourse more likely takes place from without, and remarks that the genitals are often wet with spittle to facilitate performance of the sexual act. He is of the opinion that the bacilli pass through the urethra, which is only slightly susceptible to their action, and take up their abode in the bladder, just as they pass through the mouth, nose, and throat without doing damage and yet disseminate disease in the lungs.

PATHOLOGICAL ANATOMY.

The development of tuberculosis in the bladder is the same as in any other organ. In the earliest stage small gray nodules are observed, some of them being so small that they cannot be observed with the naked eye, while the largest are about the size of a hemp-seed. They are more or less numerous and occur either singly or in masses, which, projecting over the surface of the bladder, give it the appearance of being studded with follicles. These tubercles are of firm consistence and impart a feeling of roughness to the finger when it is passed over the surface of the bladder.

In comparison with later stages of the disease this early stage is rarely seen at autopsy. In order to illustrate it two plates are inserted, one of which (Fig. 163), taken from Guterbock's work, shows a fresh eruption of tubercles at the ureteral orifice, while the other (Figs. 66 and 67), taken from the living subject by means of intravesical photography, shows tubercles in two stages of evolution.

As in all other organs tubercle in the bladder undergoes retrograde metamorphosis. The center of the gray nodule gradually becomes paler and more opaque and the whole mass soon assumes a yellowish white color, a phenomenon which represents destruction of the cellular elements. The nuclei first shrivel and then disintergrate, the protoplasm disappears, and the cell detritus gradually loses its color; flakes of hyaline material now appear, and finally a tolerably homogeneous

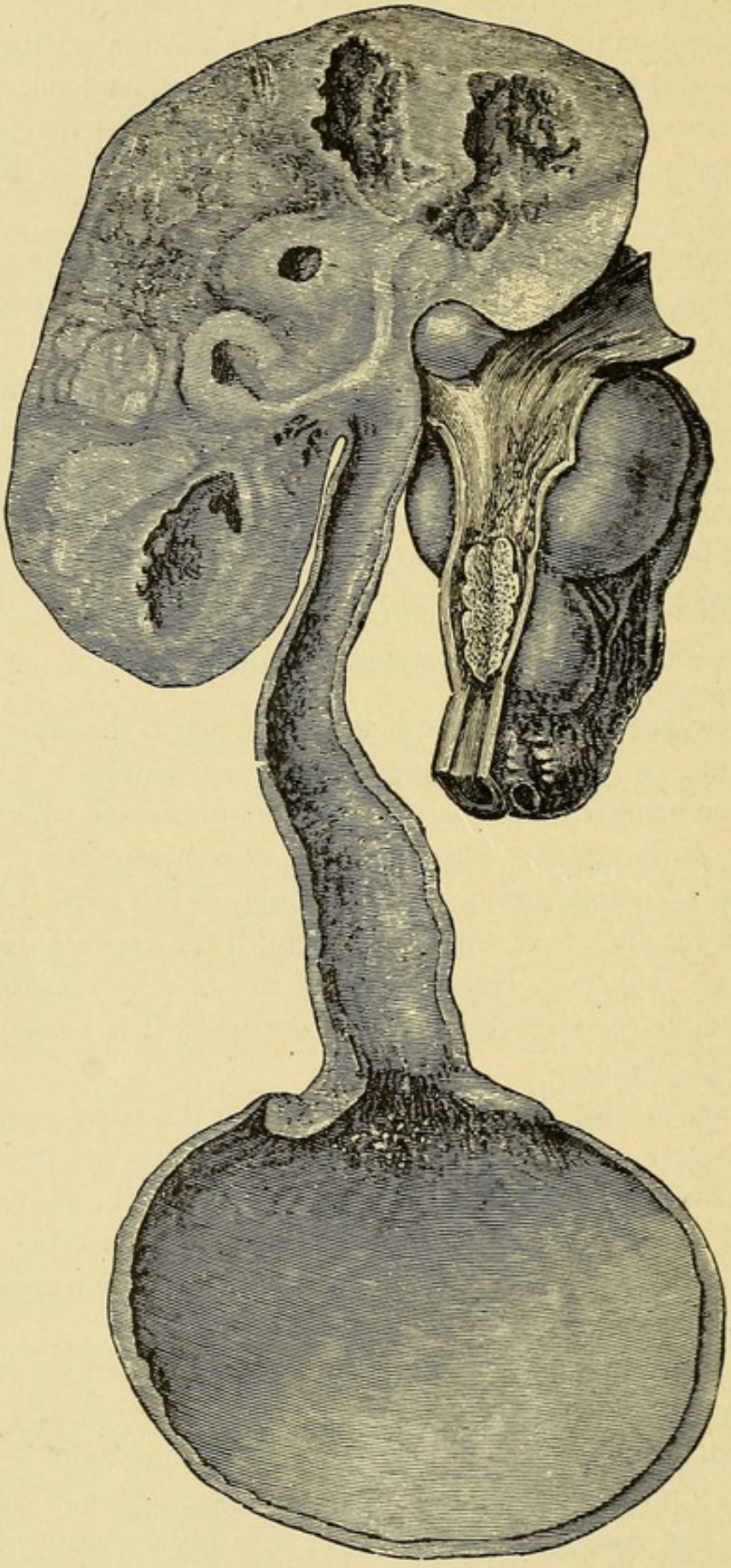


FIG. 163.—Fresh tuberculous eruption at the ureteral orifices.

mass is formed containing a variable number of fat cells, which impart the opaque yellowish white appearance above mentioned.

Later complete softening of the tubercle takes place, the destroyed cellular elements being converted into a thick, slimy, caseous mass. If this process of softening extends to the surface, the cheesy masses become partly excavated and a tuberculous ulcer results. If the areas of softening are small the ulcers are small and localized, whereas if several areas coalesce large ulcers with irregular borders are formed.

Ulcers the size of a three-mark piece are sometimes observed. These are generally superficial, although at times they invade the muscular coat of the bladder and even extend beyond it.

When the disease has made such inroads as this, and generally even much earlier in its progress, changes in the mucous membrane of the bladder take place which lead to the development of a tuberculous cystitis. Inflammatory areas not differing from those seen in other forms of cystitis develop around the tubercles. The surface of the bladder is discolored, varying from gray to red in hue, is well vascularized in places and may even present areas of ecchymosis. On the whole the mucous membrane of the bladder, which is infiltrated with blood and sanguino-purulent mucus, appears swollen, ulcerated, thickened, and covered with a layer of pus.

In advanced cases the morbid process generally penetrates to the deeper layers. When this occurs the musculature of the bladder is thickened and contracted, often to such an extent that the organ is no larger than an egg. The prevesical tissue is also occasionally involved, and becomes changed into a thick layer which is scarcely separable from the bladder itself. Very rarely a phlegmon forms here; it may rupture into the rectum or vagina, break into the perineum, or discharge its contents into the space of Retzius. Such a condition may leave fistulous tracts after partial repair has taken place.

These different stages of tuberculosis, together with the various lesions, namely, gray tubercles, yellow tubercles, minute areas of softening, large confluent ulcerations, and secondary inflammation of the mucosa and muscularis, are occasionally observed together at autopsy, but more commonly death comes earlier in the disease from some intercurrent affection and only a few of these pathic changes are seen. Thus, merely isolated tubercles may be observed, or tubercles and ulcerations, ulcerations and areas of inflammation, may be present side by side.

From a clinical standpoint it is of great importance to determine the exact localization of these lesions.

In the **descending form** of the disease minute tubercles will be found in the region of the urethral orifice, occurring on a line which corresponds to the direction in which the urine is discharged from the ureters. Small ulcers may also be recognized here. All in all, however, the morbid process in this form of the malady is not much advanced; the lesions are apt to be localized and the bladder as a whole is not much impaired.

If this descending form exists in the bladder for a long time, then, of course, the above depicted condition becomes converted into one of general vesical tuberculosis, or more correctly speaking, into tuberculous cystitis. The trigonum of Lieutaud, that is, the area between the urethral opening and the neck of the bladder, is the seat of predilection for the alterations, though an eruption of tubercles may occur on the lateral walls, on the anterior wall, or upon the summit of the bladder. In such cases tuberculous ulcers surrounded by an inflammatory zone, and also a suppurating lardaceous coating on the base of the bladder, are found to be associated with the growth of tubercles.

The disease often extends from the bladder to neighboring parts, such as the posterior urethra, the ureters, and the pelvis of the kidneys. It seldom or never reaches the anterior urethra, because generally it is so far advanced when it invades the posterior urethra that it causes rapid termination of life.

SYMPTOMS, CLINICAL COURSE, AND DIAGNOSIS.

In conformity with the pathologic division which we have made separating isolated, discrete tuberculous nodules unassociated with secondary inflammatory phenomena from true tuberculous cystitis with its severe generalized lesions, involving especially the base of the bladder, we may divide the clinical manifestations of vesical tuberculosis into an initial stage and a fully developed stage of inflammation.

In the initial stage, which we meet with when the tuberculous process has just begun to descend from the kidneys and establish itself in the ureters, or when during the course of phthisis a few foci appear in the bladder, or more rarely in the beginning of primary vesical tuberculosis, only two well-defined symptoms are to be observed, namely, **increased frequency of micturition and hæmaturia.**

The frequency of urination is not very great, but yet the patients are

obliged to pass their water oftener during the day than a healthy person, and are also forced to urinate in the night. Micturition is not really painful, although at the end of the act an uncomfortable feeling akin to pain is experienced. This discomfort may be alleviated and at times removed by narcotics, although the frequency of urination is scarcely affected by their use.

While the urine passed during this period is usually clear there occurs at times a hæmaturia which is characterized by short duration and by the fact that it almost always begins after micturation. The blood, however, may be mixed with the urine. Neither activity nor rest exerts any influence whatever upon the hæmorrhage, in which respect it resembles that due to tumor of the bladder, although the quantity of blood lost is materially less than in hæmorrhage due to new growths, being often so slight as to be demonstrable only by means of the microscope.

If the vesical tuberculosis thus developing from single circumscribed areas produces a tuberculous cystitis—and it has been my experience that it does in course of a few months—then the aspect of the case is essentially different.

In general it may be said that the symptoms of tuberculous cystitis are the same as those of other forms, namely, strangury, painful micturition, and the presence of pus or blood in the urine; in tuberculous cystitis, however, these symptoms are of special significance.

The **strangury** dominates the entire symptom-complex. Although this symptom is observed in numerous other diseases of the bladder and kidneys, it is not so severe, so constant, so distressing, so little influenced by treatment as in this affection. It is in the descending form of the malady, in which the process is located at the ureteral orifice, that this symptom least troubles the patient. When the disease advances to the trigonum and comes nearer to the neck of the bladder then the pain becomes unendurable, and though hot sitz-baths and powerful narcotics afford transitory relief they produce no permanent effect. Repeated attacks take place in which the patients are forced to urinate every five or ten minutes.

Their torment is increased, moreover, by the **pain** which is associated with each and every act of micturition, and which is especially severe at the end of the act. If an attempt be made to hold the urine the slight distention resulting therefrom causes increased desire to urinate; if the patient seeks to escape from this discomfort by voiding his water the slight relief experienced during its passage through the urethra is

followed by a violent burning which localizes itself at the end of the penis. Scarcely does this painful paroxysm cease when contractions of the bladder, together with tenesmus ensue, giving rise to stinging pain which extends even to the rectum. Often the penis becomes turgid, the face suffused with blood, and the whole body covered with a cold sweat. At last the agony diminishes, and the patient becomes calm, although in the intervals he is still beset with a feeling of heaviness and burning which radiates to the rectum and anus.

It is self-evident that the degree of pain does not always reach the height just described, but that more commonly it shows considerable diversity of gradation. Whenever the patient sustains any injury, however, be it increase of inflammation resulting from excesses or exposure to cold, be it traumatism due to improper local treatment, then the above depicted lamentable condition almost always supervenes.

We now come to the consideration of the third symptom, **the presence of pus and blood in the urine;** and in regard to the character of the urine I desire to state that although it is acid in the majority of cases of cystitis, in tuberculous cystitis it rarely possesses this property.

The amount of pus varies greatly, being dependent upon the extent and intensity of the disease. As a rule the quantity is much greater than in other forms of cystitis. This is due to the fact that in tuberculous cystitis there is present in addition to the ulcers and tubercles a diffuse inflammation involving almost the entire bladder, whereas in many other forms, as the gonorrhœal, for example, the morbid process is circumscribed and more closely confined to the neck of the bladder. The presence of a large quantity of pus is not of great importance, for it occurs in other forms, as for example, those associated with paralysis and diverticula of the bladder.

An occurrence of more gravity is **admixture of blood with the urine.** While it is true that blood is found in the urine in other forms of cystitis, as for example, the calculous, and also in gonorrhœal inflammation of the neck of the bladder, the onset and course of these affections distinguish them from tuberculosis. Moreover, hæmorrhages occur only rarely in these other forms, while in tuberculosis their occurrence is the rule. Of course under the term hæmorrhage are included losses of blood so slight as to be demonstrable only by the microscope. In my experience these minute hæmorrhages occur in almost every case

of vesical tuberculosis; during exacebations they become more severe and are often apparent to the naked eye.

The albumen-content of the urine is in no wise characteristic. In cases of simple tuberculosis of the bladder without associated renal disease, the quantity present depends upon the amount of pus or blood in the urine. If in addition to the disease of the bladder the kidneys also are tuberculous then there is a greater quantity of albumen present. Thus it will be understood that the intrinsic conditions of every case, whether merely vesical or both vesical and renal, influence the production of albumen, and that the presence of this substance is not idiocratic to tuberculosis, and that it is not to be considered as a special symptom of the malady.

The discovery of tubercle bacilli in the urine is of decided significance. A few years ago I was of the opinion that these microorganisms were found in only about 50 per cent of the cases of vesical tuberculosis. As a result of increased experience, however, I have come to the conclusion that with our present methods of examination they are found in 80 per cent of all cases.

The method of examining for the bacilli is as follows: a large quantity of urine, preferably the entire quantity voided in twenty-four hours, is collected, and a little of the sediment, together with a small quantity of the urine itself, is taken and placed in a small flask; the flask is well shaken and the contents then centrifuged vigorously from three to five minutes. After pouring off the supernatant fluid a little of the sediment is spread upon a slide, stained with carbol-fuchsin, decolorized with 3 per cent hydrochloric acid-alcohol and then counterstained with methylene blue. If tubercle bacilli are present accurate examination will reveal them. Examination is not a matter of a few minutes, but often requires a half hour.

In case only the red, acid-fast, slightly curved rods are found, there arises, in the opinion of many at least, the question whether they are really tubercle bacilli, and not **smegma bacilli,** with which the former organism may readily be confounded. We must confess that in reality this difficulty does not exist. In the first place the tubercle bacillus has a different appearance than the smegma bacillus, the latter organism being almost always thicker than the former, although it must be admitted that there are thick tubercle bacilli. The smegma bacillus is not of such a bright red color as the tubercle bacillus, which tends to prove that the former organism parts with some of the red

stain when subjected to the action of acid and afterward takes up some of the blue stain; in fact smegma bacilli are almost always bluish red.

Moreover, the smegma bacilli are scattered throughout the whole field, while the tubercle bacilli appear thickly grouped in either small or large clusters, and it frequently will require an examination of several different fields before they can be found. The smegma bacilli are symmetrical thick rods, the tubercle bacilli as found in the urine are generally fringed or fibrillated, a condition produced by the action of the urine.

It is an erroneous belief that the use of absolute alcohol affords a means of differentiating the two organisms. I have subjected smegma bacilli to the action of this substance for fifteen minutes or longer without observing any more loss of color to result therefrom than in case of tubercle bacilli. A very valuable point of differentation is the fact that the smegma bacillus is invariably associated with other organisms, whilst the tubercle bacillus generally is found by itself.

Further investigation has proved that culture methods do not constitute a reliable means of differentiating the organisms. Karl Fraenkel has shown that the microörganisms cultivated by Lazer and Czaplewski and thought by them to be smegma bacilli were in reality pseudodiphtheria bacilli, organisms which almost always are present in smegma. He states that culture of the true smegma bacillus has not yet been successful.

Owing to the ever-present possibility of mistaking the one organism for the other, it is desirable that the specimen of urine be drawn with the catheter in order to prevent contamination with smegma. Even after this precaution has been taken there still remains the possibility of contamination by migration of the smegma bacillus to the bladder, although such an occurrence is hardly probable, for if it were, we certainly would find the organism in the urine of healthy persons, or in that of patients suffering with other maladies, much more frequently than is the case.

Finally it may be stated that when a person shows the symptoms of vesical tuberculosis and acid fast bacilli are found in the urine, it is presumptuous to call them smegma bacilli. The correctness of this statement will become more apparent if it be borne in mind that smegma bacilli are sometimes found in the urine of those who show no vesical symptoms.

Therefore whenever acid fast bacilli are found I believe the decision easy to make. Much more difficult to determine are those cases in which, despite repeated careful examination, no such organisms are revealed. When dealing with such cases it must be remembered that the absence of all bacteria from the urine of cystitis is highly suspicious. We have already said that in the presence of tubercle bacilli other organisms are usually absent. Tuberculous urine in which no tubercle bacilli are present may only be recognized by the fact that often, though not always, no other organisms whatsoever are contained in it. Here the same rule which obtains in the case of pleural effusion is to be followed, that is, if no tubercle bacilli nor other microörganisms are present, it is generally tuberculous.

Such a finding should always arouse suspicion and lead us to employ still another means of elucidation, namely, **inoculation,** which may be made either in the anterior chamber of a rabbit's eye, or better still, because of the panophthalmia which this method may produce, into the peritoneal cavity of a guinea pig, the centrifuged sediment being injected with a small syringe after the skin of the abdomen has been carefully washed.

If the result is positive there is no cause for doubting the nature of the injected pus; if it is negative the possibility of tuberculosis is by no means excluded, for sometimes the inoculation does not take, and then again the bladder-wall may be tuberculous and yet no bacilli be passed in the urine. I have with the utmost certainty pronounced cases to be tuberculosis in which no tubercle bacilli were found in the urine and in which inoculation was negative, and have seen the course of the case verify the correctness of my diagnosis.

This certainty of diagnosis may be attained if a few facts which clinical observation and our present highly perfected methods of research teach us be borne in mind.

It is to be remembered that, in contradistinction to other forms of cystitis, often no cause for the inception of the malady can be assigned.

Gonorrhœa, calculus, tumors, foreign bodies in the bladder, stricture of the urethra—any of these may offer plausible explanation for the development of inflammation; but tuberculosis of the bladder generally exists without us being able to impute its development to any causative factors, and, indeed, its insidious onset must be considered as of considerable diagnostic value.

Excessive tenderness of the bladder is one of the characteristic

features of tuberculous cystitis. Palpation through the vagina in the female, and through the rectum in the male, is painful, and if the viscus be disturbed by the energetic use of metal instruments the pain becomes unbearable. Flexible instruments are tolerated if used gently, but sounding with hard catheters or touching the wall of the bladder gives rise to great pain and even to vesical spasm.

Not less significant is intolerance of the bladder to distention. When discussing the pathological anatomy we stated that in many cases, and especially in advanced ones, the morbid process extended deep into the bladder-wall and caused thickening and rigidity, thus rendering any considerable degree of distention impossible. If an attempt be made to distend the organ by the injection of fluid, hæmorrhage and intense pain are produced, which last for days.

The lessened capacity of the bladder does not always depend upon contraction of the organ, but is often due to vesical spasm, which in turn is produced by inflammation of the vesical mucous membrane. The membrane being swollen, and having lost its elasticity, cannot expand when the bladder becomes distended. That this is true is shown by the fact that many persons thus affected improve and occasionally regain the normal capacity of the bladder.

This state of vesical spasm does not necessarily mean that the whole vesical mucous membrane is diseased, for if a single area be affected this alone may suffice for its production. Thus, diminution in capacity occurs in the **descending renal form,** in which often only the region around the ureteral orifice is affected. The **contracted or cicatricial bladder,** which is incurable and generally not even susceptible to palliation, develops more rapidly in those cases which are due to extension of disease from the neighboring sexual organs or in which tubercles develop primarily in the bladder.

In regard to treatment it is of great importance to distinguish these two principal forms, and for this purpose the cystoscope renders valuable service.

In general, tuberculosis of the bladder does not present a specific cystoscopic picture: besides diffuse swelling and redness there are observed at times deeply congested localized areas clearly separated from apparently healthy tissue, while again ulcerations which, however, have nothing distinctive about them, are seen; tubercles are very seldom found. From this description it will be seen that, as just stated, there is little characteristic in the picture, although of course exceptions do

occur; nevertheless the location of the morbid changes as revealed by the cystoscope gives us information concerning the nature of the infection. Thus, while the morbid process in primary cases shows an affinity for the posterior wall of the bladder, and in those cases due to infection from the genitalia extends from the fundus well up toward the sphincter, and involves in greater or less degree the lateral walls as well, the descending form confines itself to the region of the ureteral orifice. In many of my cases I have observed ulcerations in a region corresponding to a continuation of the course of the ureters. In others I found tubercles below the ureters toward the sphincter, and finally I saw that which I consider to be especially typical, namely, a **bullous œdema** around the orifice of the ureter, there being present small translucent vesicles which often so encroach upon the ureter that its orifice is apparent only when contractions take place, or more commonly is totally concealed.

These differences, however, can be made out only when the disease is in its beginning; when it is at all advanced they become more and more merged with one another.

When the diagnosis has already been determined cystoscopy should not be resorted to, for it necessitates distention of the bladder, which is very painful and at times even injurious. Its injudicious employment may produce a temporary exacerbation, or even give rise to extension of the disease.

While this permanent lessening of vesical distensibility in chronic cases is suspicious, further and valuable information as to the nature of the malady may be derived by watching the effects of treatment; for those cases which present the symptoms of tuberculosis, but in which no tubercle bacilli are found—concerning which the French are wont to say, "*ils sentent la tuberculose*"—are highly suspicious if they do not improve, or even grow worse, under the therapeutic regimen usually applied to cystitis.

With the exception of malignant forms, which are complicated with tumor formation, nearly all cases of cystitis, including those occurring in the aged, are benefited by appropriate irrigations; even in those due to diverticula of the bladder, in which the numerous pockets and duplications within the organ are filled with thick, ropy pus, the urine becomes somewhat clearer under irrigation treatment. If improvement does follow such treatment, or if the condition becomes worse—and we very often see cystitis aggravated by nitrate of silver

irrigations—it has long been my custom to consider the case not as one of simple cystitis, but either as cystitis complicated with pyonephrosis or as tuberculosis.

As the former condition can almost invariably be diagnosticated by means of ureteral catherization, we gain a diagnostic point in the manner above described *ex juvantibus*. Our diagnosis may be confirmed by application of the specific therapeutic measure about to be mentioned, because it is almost invariably the case that vesical tuberculosis is benefited by these measures after having failed to yield to the remedies used in the treatment of simple cystitis.

After all I believe that the diagnosis of tuberculosis of the bladder will not be very difficult. If it be borne in mind that it occurs much more frequently than was formerly thought; that an assignable cause for its existence is often wanting; that the symptoms of cystitis, namely, strangury, pain and admixture of pus and blood in the urine are present in intensified degree; that an enormous thickening of the bladder with resulting diminution in its capacity occurs;—if these facts be remembered, I say, and if to them be added the equally important one that the ordinary therapy of cystitis is often totally ineffective, or even aggravates the symptoms, the diagnosis of tuberculosis can be correctly made whether tubercle bacilli are or are not found.

TREATMENT.

In order to employ a fruitful, or at least a reasonably satisfactory therapy, in tuberculosis of the bladder, it is indispensable for the physician to possess knowledge of the nature of the malady, its extent, dissemination, and relation to other organs of the body.

If the patient has a unilateral renal tuberculosis, as a result of which the bladder has become infected, it is evident that we must attack the root of the evil and remove the diseased kidney. Experience has taught that even severe tuberculous disease of the bladder, when of the descending form, is benefited and even completely cured by removal of the primary tuberculous focus. It is often not necessary to treat the vesical lesion at all, for it heals of itself after the operation on the kidney.

This preliminary statement will be obvious to every scientific physician without further elucidation, so we may now proceed to a discussion of the ends to be sought in the treatment of vesical tuberculosis, and the means by which these ends are to be accomplished.

Our task is a two-fold one, varying with the condition of the patient; it consists either in restoring him to health, or, if this be impossible owing to the severity of his condition, in ameliorating his suffering and conserving his strength.

Take for example a person suffering from phthisis who becomes infected with a vesical tuberculosis of such intensity as to overshadow the pulmonary symptoms because of the strangury and painful micturition it produces. In such a case cure of the vesical lesion is out of the question, but yet we must make the diseased bladder the object of our therapeutic effort.

In general it may be stated that we possess four measures for the fulfillment of our task; namely, a **hygienic-dietetic regimen, internal medication, local applications, and operative procedures.** A combination of these methods is often resorted to.

As we have already stated, in a large number of cases tuberculosis of the bladder is associated with tuberculous infection of other organs, and even when this is not the case the vesical disease itself exposes the patient to the danger of further infection; therefore it is self-evident that in every case a roborant, supporting, dietetic-hygienic treatment identical with that employed in other forms of tuberculosis is indicated.

In regard to these measures it will suffice to say that they are of the utmost importance, and that I have seen many patients, some of whom showed signs of tuberculous disease of other organs, materially benefited by several years residence in a **southern climate,** such as that of Italy and Egypt. In none of these cases did the urine become entirely free from pus, but the subjective symptoms—violent tenesmus and painful micturition—became much lessened under the influence of the warm climate.

Warmth in the form of baths or compresses likewise does these patients good, and affords us a valuable agent in overcoming tensemus, pain, vesical spasm, and especially the acute exacerbations of the malady. I order hot sitz-baths to be taken several times a day, having the patient sit in water of 35° C. [93° F.] and gradually increasing the temperature to 40° C. [102° F.] or higher by the addition of hot water. As a rule the bath is to be made as hot as the patient can endure, provided of course that no contraindication be present. These local baths are well borne by nearly all patients, and generally produce great relief.

At night I have a thermophore [hot-water bag] put over the suprapubic region and fastened by a bandage. In many cases its action is beneficial. In short, warmth may be applied in every conceivable form.

As to **internal medication** three classes of drugs deserve our consideration; namely, **tonics, sedatives, and those which are reputed to exert a beneficial effect upon the tuberculous process.**

The tonics employed are the same as those used in all forms of debility: quinine, iron, arsenic, etc.

Of the sedatives I prefer morphine above all others as being the most reliable and certain. I place great value upon this drug because it not only quiets pain, but also actually exerts a curative effect upon the diseased bladder, a fact which I here desire to emphasize. A bladder which is exceedingly sensitive and in a condition of the greatest irritability must be quieted as much as possible, for the incessant contractions resulting from such a state constitute a great hindrance to the relief of inflammation; as morphine controls these conditions the really wonderful results sometimes obtained by its use are easily explained. It should be administered freely, the dose being determined by the needs of the individual case. Subcutaneous injections of 0.01 to 0.05 [approximately $\frac{1}{6}$ to $\frac{3}{4}$ grain] are the most effectual. Next in value are suppositories, in which form the dose should not be less than 0.015 [$\frac{1}{4}$ grain]. In selected cases heroin may be used instead of morphine. Powders or pills containing from 0.004 to 0.006 [$\frac{1}{1\,6}$ to $\frac{1}{1\,0}$ grain] given several times daily render good service.

Next to these preparations belladonna is the most valuable. Pills or suppositories containing as much as 0.05 [about 1 grain] will be found especially useful if given alternately with morphine, and also as a substitute for morphine if it be desired to discontinue the latter drug. Belladonna possesses the special property of diminishing vesical irritability.

I cannot praise opium so highly. It does not work so promptly upon the bladder as upon the intestines, but yet we could not always dispense with it.

If we now proceed to consider those remedies which are supposed to exert a favorable influence upon the tuberculous disease itself, I am unfortunately not able to say much in their favor. Those medicaments which render good service in other forms of cystitis, as for example, urotropin (hexamethylen-tetramin), helmitol, salol, camphoric acid, and salicylic

acid fail entirely in tuberculosis. I have never seen them produce any effect worthy of mention. They are indicated only when the microscope shows that organisms other than the tubercle bacilli play a rôle in the case, that is, when the so-called mixed infection manifests itself.

The same statement may be made as to the value of the mineral waters which are usually prescribed for cystitis. They are not entirely useless as they dilute the urine and thin the pus, thereby making micturition less painful. Vichy, Salvator, Wernarz, or Obersalzbrunner may be used.

Balsamics are useless and injurious. Oil of sandal-wood certainly has some effect upon gonorrhœal cystitis, but it is utterly worthless in tuberculous cystitis, and, moreover, as it is likely to disorder the stomach or irritate the kidneys I consider it to be contraindicated.

The only internal remedies which it appears rational to administer are creosote, guaiacol carbonate, and ichthyol. I allow them to be given without restriction as to quantity for as long a time as the patients tolerate them. Ichthyol is best administered with water, as in the following prescription:

℞ **Ichthyol sulpho-ammoniac.**
Aquæ destillatæ **aa 30.0 [℥j]**
m

Sig. Begin with 10 drops three times a day and increase gradually to half a teaspoonful.

It is still better to give these drugs, which are at best unpalatable, in the form of oil injections, mixing 30 grams [1 fluid ounce] with 200 grams [7 fluid ounces] of olive oil and injecting a small glycerine-syringeful into the rectum twice daily.

It is impossible to state whether they exert a beneficial and curative effect upon the disease itself; the most that can be said is that they apparently do some good.

When we come to consider the local treatment **of vesical tuberculosis** the question arises as to whether it is altogether judicious to combine local measures with general hygienic and internal treatment, and if so what shall be the nature of the same, in what cases shall it be applied, and what results are to be expected from it.

There are many who would do away with local procedures and attempt to control the often intolerable pain by means of narcotics, baths, and other measures.

My observations have led me to abandon this view, which I also

formerly held, for I am convinced that judiciously conducted local treatment often does great good, and that it may even effect a cure in a few cases. Many patients cannot be relieved of their suffering by the most powerful narcotics. In spite of large doses of morphine, the severe pain incident to urination, together with the harrowing tenesmus which forces the patients to pass their urine every fifteen minutes or oftener, remains unrelieved.

To these unfortunate sufferers local treatment is advantageous; though it may not cure them it will materially alleviate their distress.

The first principle of local treatment is never to distend the bladder by means of irrigations as is done in other forms of cystitis. Guyon goes so far as to forbid flushing with a syringe or even with an irrigator, permitting only the instillation of a few drops of fluid. Provided that not enough be injected to produce a sensation of fullness or to cause pain, I have found weak solutions to work better and produce a more lasting effect than concentrated instillations. The use of soft instruments is recommended, for as already mentioned the tuberculous bladder is exceptionally sensitive to metal instruments.

Of the multitudinous drugs which have been recommended for the local treatment of vesical tuberculosis, among which may be mentioned iodoform, ichthyol, guaiacol, and orthoform, I have seen only two, namely, **lactic acid and bichloride of mercury,** which produce any real result; nitrate of silver, incontestably the best remedy in other forms of cystitis, has a detrimental influence and increases the pain. This observation, to which Guyon first called attention, was corroborated by Goldman and myself. Indeed, it may be said that, with few exceptions, all cases of cystitis which without apparent cause become worse under silver treatment are most likely tuberculous even though no tubercle bacilli have been found.

Lactic acid, which was recommended by Witzack, and which I have used in very strong solution (20%) in form of instillations, undoubtedly has a good effect, but the pain it produces, even though cocain be used, is so intense and lasting that I have ceased to employ it. Indeed, true heroism is required to endure an application of this drug!

I now use **bichloride of mercury,** a sovereign remedy, for the knowledge of which we are indebted to Guyon. I have tried it in innumerable cases; in many benefit was derived, in a few a cure, while in some no improvement was obtained. In the beginning I use instillations of a strength of from 1 : 10000 to 1 : 1000. As the condition improves,

as shown by subsidence of tenesmus, less frequent micturition, and abatement of pain, I increase the quantity of solution, making it weaker at the same time, until finally 50 cc. of a solution varying in strength from 1: 10000 to 1: 5000 (seldom stronger) are used. The patients retain the fluid as long as they can without it causing them great pain. Enough should never be injected to cause distention of the bladder, and the application should not be made oftener than twice a week.

As the bichloride produces a painful reaction, which naturally leads patients to think that their condition is becoming worse, it is well to warn them of the primary effect of the treatment; or, as I am in the habit of doing, keep them under morphine for the first two days. The dose of morphine required depends entirely upon the condition of the individual patient.

[Rovsing, of Copenhagen, has recently reported good results from the use of carbolic acid. After washing the bladder out he injects 50 cc. of a 6 per cent solution. This is left in the bladder for three or four minutes. The injection is repeated until the fluid returns clear. At first the treatment is used every two days, then at longer intervals, and finally only once in two weeks, three weeks and a month, according to the cystoscopic appearance of the bladder. This treatment is very painful at first, and morphia has to be given after it is employed. Rovsing gives it in the form of rectal suppositories.]

If it be asked when and under what circumstances local treatment should be instituted, the first thing I desire to say in answer is that I have never seen any toxic effects result from the sublimate treatment administered as above described; moreover, one can soon tell whether a case is appropriate for the treatment. If sublimate is going to do good its effects will be manifest after the first few instillations. If no result is experienced after three or four applications the treatment should be discontinued.

The most apparent effect after the reaction period is subsidence or complete cessation of pain. Strangury does not subside so promptly. While micturition becomes less frequent under the influence of sublimate treatment it is not affected so quickly and regularly as is pain. It will be evident, then, that this treatment is especially indicated in cases in which there is persistent, painful vesical, and also often rectal tenesmus which cannot be subdued by other means. It is also valuable in cases which have not advanced so far, especially as painful after-effects do not occur in this class of cases.

On the other hand, it is desirable to proceed with the greatest caution, endeavoring to improve the general condition of the exhausted and suffering patients, because local treatment, if not carefully conducted, may add to their distress. It may be necessary to allow from two to four weeks to elapse between the applications.

No hesitancy should be shown in giving highly nutritious food and also wine. The ill-founded fear of irritating the urinary organs must cede to the great desideratum of improving the general condition of the patient. If this indication can be fulfilled material results may be expected from our efforts to alleviate or cure the local disease. Tuberculosis no longer seems to be such a malignant disease as it formerly was thought to be; we know that it can be cured when affecting the bladder the same as it is when affecting other organs. Villard has shown in a most admirable work that tuberculosis of the genital organs is relatively benign as long as systemic infection can be prevented. Series of examples of cure are contained in the literature of the subject. (Guyon, Motz, *et. al.*)

All forms of local treatment except the one above described are to be discarded. I refer especially to the measures undertaken by means of operation through the cystoscope. Attempts have been made to remove intravesical ulcerations with the galvano-cautery or with caustics. I consider such treatment not only useless, but actually harmful. Enough has already been said concerning the sensitiveness of the bladder to show that such extensive instrumentation as is necessary for the performance of these manipulations would increase inflammation and lead to propagation of the tuberculous process instead of conducing to its cure. The same is true of iodoform-gauze tampons. If one believes in the efficacy of iodoform—but I have never seen any results from its use—it may be employed as an emulsion injected into the bladder through a soft catheter. For the reason just stated I strongly oppose these methods of treatment.

[The Finsen light has been tried, but the results obtained have been entirely unsatisfactory. In some cases the patients were made worse.]

Concerning the value of **surgical procedures** in the treatment of tuberculosis of the bladder, I can express myself only with great reserve, although series of cases have been reported as cured by operation.

The operations consist in opening the bladder either through the

perineum or above the symphysis. Some content themselves with establishing a vesical fistula, operating merely for the purpose of relieving the distressing tenesmus and draining the bladder, but others practise curettement or cauterization of the vesical mucous membrane; there are still others who are not satisfied with curetting, but practise partial or complete ablation of the mucous membrane.

What I have learned from my own experience and from the work and writings of others does not enable me to speak very encouragingly in favor of operation, for judging therefrom it seems that the prospect of bringing about a cure by means of operation is very slight. Only those cases in which it is certain that there are but few localized lesions are suitable for operation. It must always be remembered that recurrence may take place, and that even if we succeed in arresting the vesical disease tuberculous infection of other parts of the genito-urinary system is probable.

Curettage of the bladder is not out of the question, but if it be resorted to care must be taken lest the disease be carried deeper into the tissues, or become disseminated and cause general infection. It will be necessary to gain further experience, as the procedure is yet too young to permit the expression of a definitive conclusion regarding its value. In selected cases which fail to yield to other forms of treatment it may be justifiable to try it.

After cystotomy fistula often persists, rendering the condition of the patient highly uncomfortable if not actually tormenting. Therefore it is better to feed the patient on morphine than to add to his already lamentable condition a permanent tuberculous fistula.

After what has been said it becomes evident that operative procedures are permissible only when it is certain that the tuberculous process is confined to a few circumscribed areas. Even in this class of cases exceptions must be made when tuberculous foci exist in other organs, and also when the vesical disease is dependent upon descending infection from the kidneys. In regard to the last class of cases it has already been stated that the vesical ulcerations often undergo spontaneous healing or yield to local treatment after extirpation of the diseased kidney.

In conclusion a few words must be said concerning the worth of tuberculin. The administration of this preparation in general tuberculosis has undergone many fluctuations. At first lauded to the skies, it was later abandoned, only to be recently received with favor again

in certain quarters. I have treated a few cases of vesical tuberculosis with it, and also have observed others treated by some of my colleagues, and as a result of these observations, together with a study of the literature of the subject, the only conclusion I can derive is that at present we are not in a position to pronounce judgment as to its value.

Tuberculin T. R. is the preparation used, it being given in ascending doses of from 1 to 1000 milligrammes. The injection is repeated when the reaction subsides, and the dose is increased whenever the quantity employed ceases to produce a reaction. I have never seen any untoward effect from its use. In some cases subjective amelioration seems to take place, in others the same failure results as was experienced with the other therapeutic measures employed. Some clinicians state that they have obtained more favorable results than I have.

It is yet too early to speak positively for or against this treatment, as the number of careful observations thus far made do not warrant such a course.

I do not consider it justifiable to condemn it. I mean that it must be cautiously tested. A disease such as vesical tuberculosis, which produces intense pain and makes life a burden, a disease over which, it is true, we do have some but by no means enough control, justifies an effort to secure better and more effectual remedies, our knowledge of which must depend upon objective evidence derived from their use.

FOREIGN BODIES IN THE BLADDER.

It is rare for foreign bodies to get into the bladder and remain there. By far the greater majority of them are broken off catheters or bougies, while next in frequency come silk ligatures, which either find their way from neighboring parts or are brought into the bladder during operation.

Occasionally an object introduced into the urethra with erotic intent passes on into the bladder. After injury, or rupture of an abscess, sequestra may get into the bladder, although such an occurrence is rare. Finally gunshot wounds sometimes carry pieces of clothing into the bladder.

Although in the beginning the bladder is very tolerant—there is usually little pain—inflammation, difficulty of micturition, and infection soon develop. Cystitis is almost inevitable. The urine becomes turbid, in many cases bloody. The lesions produced depend upon

the character of the foreign body, upon whether it has a sharp point or edges. In a very short time the urinary salts are deposited upon the object and it becomes encrusted with phosphates and urates.

The diagnosis offers no difficulties. Generally the history will reveal the trouble. If not we at present possess a sovereign means of diagnosis in the cystoscope. Formerly all kinds of sounds and instruments which made a noise when the foreign body was grasped between their blades were employed. Today one glance through the cystoscope enables us to detect the presence of a foreign body and determine its nature.

Metal objects are easily revealed by the X-ray.

The cystoscope is also used to facilitate the removal of foreign bodies. An attempt may be made to seize the object with the lithotrite, but if it is not successful it should be abandoned at once. Spontaneous expulsion of the body must never be reckoned on.

It is practically out of the question, for as already stated incrustation soon occurs and the object becomes so large that it is impossible for it to pass through the urethra.

If the lithotrite fails, the cystoscopic forceps, an instrument I have had made by Hirschmann, should be used. Its branches come asunder and its shaft is hollow so that a cystoscope can be passed through it. The foreign body can usually be seen with the greatest distinctness and can be seized and drawn out under the guidance of the eye. In this way I have repeatedly removed catheters, bougies, and threads.

This procedure is contraindicated when the object is firmly incrusted with salt and has become so big that there is danger of its materially injuring the urethra. Suprapubic cystotomy then becomes the proper procedure, for although it causes the patient a greater loss of time, it saves him from permanent injuries, such as would follow the forcible extraction of a large foreign body through the urethra. In the latter instance traumatic stricture would be the result.

It is not uncommon to meet with foreign bodies in the bladder of persons who have a narrow urethra, because such persons have to have catheters or bougies passed. In such cases the cystoscope cannot be immediately resorted to. Either suprapubic cystotomy must be performed and the foreign body removed through the incision, or the stricture dilated and the cystoscope then used. As the bladder would be injured by retention of the foreign body for any length of time its early removal is desirable; therefore operation has to be con-

sidered. To expedite matters I have repeatedly performed internal urethrotomy and then immediately removed the foreign body with the cystoscopic forceps. This procedure seems the more rational, too, for the reason that it always overcomes the stricture, which is really the cause of the trouble. Whether internal or external urethrotomy should be done in a given case is to be determined by the principles laid down in the article on stricutre.

VESICAL CALCULUS.

Stone in the bladder is a disease which has been known and studied for hundreds of years. Notwithstanding this the causes of its development are not yet fully understood. According as the calculi descend from the kidney and remain in the bladder, or are themselves formed in the bladder, we differentiate between primary and secondary calculus.

Primary calculi, composed of uric acid, oxalate of lime, or xanthin, åre formed in the kidneys either because these normal elements of the urine are excreted in excess, or because the capacity of the urine for holding them in solution has become diminished. For example, the smaller the quantity of sodium chloride in the urine, the smaller the amount of urates which it will dissolve at a given temperature. According to one theory these primary stones develop only as a result of precipitation of salts caused by increased crystallization, while another view is that stone formation occurs only when a connecting member, an animal frame-work, so to speak, in the form of mucus or colloid substance, is present.

What cause is responsible for the increased precipitation of salts is known only empirically. It has been assumed that in the case of **uric acid stones** there is insufficient combustion of the products of metabolism. Gout and uric acid stones stand in close relation to one another. Immoderate ingestion of meat associated with insufficient exercise has been regarded as a cause of faulty oxidation.

Overloading the body with vegetable food, especially asparagus, tomatoes, celery, apples, and pears are said to favor the formation of **oxalate calculi.** These are merely hypotheses. We only know that heredity plays a rôle in the evolution of vesical calculi; that primary stone is more frequent in man than in woman; that the disease is especially common in childern and old people, being more seldom encountered in persons of middle life. The oxalate stones are common in

poor children, while those composed of urates occur in rich old persons who are high livers.

There are noteworthy differences in regard to the geographical distribution of this disease. It is very frequent in Russia, Asia Minor, the east of England, northwest Germany, Holland, Hungary, Persia, Egypt, and India. We must assume that climate plays no rôle in its production, but that diet and regimen of living are more important causative factors. The influence of meat diet in the production of urates, and vegetable diet on the formation of oxalates has already been mentioned. Nothing is known concerning the influence of drinking water, although we have knowledge of the effect of certain wines. The heavy burgundies favor the development of urate stones, the sparkling wines (champagne) and Rhine wines predispose to the formation of the oxalates.

The formation of **secondary calculi,** those composed of phosphates and carbonate of lime, is much easier understood. Their evolution depends entirely upon the presence of catarrh, or a foreign body in the bladder. In catarrh mucus, pus and blood act as foreign bodies; upon them is deposited the sediment of cystitic urine, the most common being ammonio-magnesium phosphate and carbonate and phosphate of lime. If the urine becomes alkaline owing to decomposition of urea, the pus assumes a thick, ropy character which makes its expulsion difficult, as it adheres firmly to the wall of the bladder. It will be readily understood that these masses are especially favorable for the reception of precipitated urinary salts.

Pus, mucus, blood, and parasites (distoma hematobium) may also afford an opportunity for the precipitation of urates. This happens when the urine is still acid. If it subsequently becomes alkaline phosphates are deposited around the nucleus of urates. In this manner the formation of **mixed calculi** may be explained.

I do not hold it as fully proved, however, that pure phosphatic stones develop in a healthy bladder, and that they are the expression of a phosphatic diathesis, in the same manner that urate stones have their origin in the uric acid diathesis. The possibility of this occurrence can be conceded only as a very rare exception, for I know of innumerable cases of phosphaturia of years duration in which no formation of calculi took place. It is altogether different when phosphatic concretions are formed in a diseased renal pelvis and pass down into the bladder. They may then become encrusted with urates and phosphates.

The number of stones found in the bladder varies exceedingly. There may be few or many; more than a hundred have been removed from a single individual. Likewise they vary extraordinarily as to size, some being as small as a pea, others as large as a hen's egg. The larger the number the smaller, as a rule, is the size of the calculi.

Their weight ranges from 3 to 60 g. [45 to 900 grains]. In shape they are generally round or oval. When many are present their surfaces are generally flat and smooth. Those composed of urates are finely granular on their upper surface, and have a yellow or yellowish-red color. Those composed of oxalates are round, rough, and provided with pointed projections and spines. This attribute, together with their deep brown or grayish-black color, has given them the name of mulberry calculi. Phosphatic stones, being usually multiple, present several surfaces; they are smooth and of a light gray color.

As to consistence the oxalate stones are the hardest, oxalate of lime being a substance which it is sometimes impossible to crush. Next come the urate calculi, which also may be very hard, but which seldom withstand crushing. The phosphatic stones are soft and can be easily reduced to powder. The rare cystin stones are soft; those composed of xanthin have about the same consistence as those formed of urates.

Mixed stones present the most multifold combinations. They are most frequently composed of phosphates with a nucleus of urates, urates with an oxalate nucleus, or, conversely, oxalate with a urate nucleus. But irrespective of the nucleus, which may also be a foreign body, such as a needle, a thread, or a parasite, the calculus itself may consist of concentric layers of various substances, so that urates and phosphates, phosphates and lime salts, alternate with one another.

The chemical examination of the stone may be undertaken in accordance with the following scheme. Fragments of the calculus are heated in a platinum spoon over a Bunsen burner.

Combustible.	Without flame and smoke.	Urates.	Uric acid, Urate of sodium, potassium and ammonium.
	With flame and smoke.	Yellow flame, uriniferous odor.	Incrusted albuminoid body.
		Pale blue flame (sulphur) Odor of asafœtida.	Cystin.

Non-combustible.	Pulverized stone foams with HCl.	Carbonate of lime.	
	Pulverized stone does not foam with HCl.	The red-hot powdered stone foams with HCl.	Oxalate of lime.
		The red-hot powdered stone does not foam with HCl.	Earthy phosphates. (lime, magnesia.)

The position of stones in the bladder is usually the same. They follow the law of gravity, and generally lie in the deepest part of the bladder, which of course varies with the position of the individual.

From these freely movable stones we must differentiate those which are fixed in a given part of the bladder. The latter occur as the result of incrustation of threads, which I have observed especially on the upper wall of the bladder, and may also occur from the incrustation of tumors.

Calculi are also found in diverticula, being so situated that they may either fall out and then slip back again as the patient changes his position, or else being firmly incarcerated, having gradually become larger and larger until they have reached a size greater than the opening of the diverticulum. Their exit is then impossible. They are then truly **encapsulated stones,** which are very seldom met with. More frequently I have observed those which lie first within the diverticulum and then without it. These cases explain the apparently unaccountable disappearance of calculi whose presence had been previously determined.

Finally there remain to be mentioned the so-called **pipe-stones** which we referred to when considering urethral calculi. A portion of the stone lies in the posterior urethra, another part in the bladder. In such cases the sphincter is usually somewhat separated, forming a sort of tunnel between the walls of which the stone is held.

What now are the effects of calculi upon the bladder? In many cases none whatever. The bladder often tolerates stones so well that not only does the individual fail to recognize their presence, but the anatomical relations of the bladder remain entirely normal. This may continue as long as no infection takes place. As the moving of the stone back and forth produces lesions, very slight it may be, but yet nevertheless disposed to favor infection, it cannot continue

very long. Hence it follows that cystitis is not a symptom of stone in the bladder, but a complication, a result thereof.

The condition of the bladder is therefore the same as in cystitis. Well-formed trabeculæ are not uncommon. They are due to hypertrophy resulting from increased work. As a bladder containing calculi contracts very often, as the outflow of urine is frequently impeded, and as there is frequently repeated irritation of the vesical mucosa, muscular hypertrophy naturally results, and produces the so-called trabecular bladder, or *vessie à colonnes*. Hyperæmia or hæmorrhage affecting the mucous membrane may be present or absent. A very rare occurrence is ulceration due to pressure of the stone. When of long duration calculous cystitis may ascend the same as any other cystitis and cause pyelonephritis.

SYMPTOMS, DIAGNOSIS, COURSE, AND PROGNOSIS.

Vesical calculus has three cardinal symptoms: pain, disturbance of micturition, and changes in the urine.

The **pain** is only exceptionally spontaneous and lasting; generally it is produced by some definite cause. If the patient moves much, or if he rides much over a rough road, or in a rickety conveyance, he experiences a painful sensation in the region of the bladder, in the perineum, and particularly at the end of the penis. At times this pain becomes so great that it prevents the patient making any considerable movement or effort. As soon as the patient lies down, and especially during the night, he is free from pain.

This pain, which is due to the stone falling back and forth when the body is in motion, is different than that produced by contraction of the bladder. As soon as the bladder is emptied there comes a moment just at the close of micturition when the mucous membrane contracts upon the rough surface of the stone. This makes a lancinating pain which radiates to the end of the penis. As soon as urine collects again in the bladder and separates its walls from the stone the pain subsides. Contraction of the bladder due entirely to the irritation produced by movements of the stone may occur irrespective of micturition, and give rise to sharp pain much like that of vesical spasm.

As the bladder is particularly sensitive in the region of the neck, those cases in which the stone is relatively small and the bladder not too large, so that the calculus is forced to the neck when contractions occur, are the most painful. For this reason children and young

people suffer more than old persons with large dilated bladders, in some pockets of which the stone is more or less firmly fixed. Under certain conditions pain may be entirely wanting. I have often let patients having stone jump from a high chair without causing them any pain.

The **disturbances of micturition** consist in frequent passing of water and in occasional sudden interruption of the stream. Here again it is the movements of the body which are responsible for the frequent urination. Therefore it points strongly to stone if the patient states that he experiences urgency of urination only during the day, and particularly when walking and driving, and that he is little troubled by it at night. Many patients sleep all night without emptying their bladder. It should, however, be mentioned that this symptom of frequent micturition may fail entirely. Particularly in old persons with dilated bladders, which often hold over a liter [1 quart] without inducing urgency of urination, have I found this symptom absent.

The other sign, **sudden interruption of the stream,** is even more irregular. It occurs, as would naturally be expected, when a small calculus is forced to the neck of the bladder by vesical contractions and is made to occlude the urethral opening in a manner similar to that in which a glass ball might close the neck of a bottle. If the patient assumes another position, especially one approaching the horizontal posture, the stone sinks back into the fundus and the patient can urinate again.

It is very rare for **complete retention of urine** to be caused solely by stone. When a prostatic who also has a vesical calculus is seized with retention the latter condition is to be attributed to the enlarged prostate and not to the calculus. It is constantly observed, and is due to reflex spasm of the external sphincter engendered by the irritation present in the bladder.

As a third symptom **changes in the urine** have been mentioned. The most important peculiarity is admixture of blood. In this respect we must differentiate between the macroscopic and microscopic detection of hæmorrhage. Only the first is commonly so designated and recognized as such by the laity. In general it may be stated that these hæmorrhages are the rule in vesical calculus. They occur occasionally, and as is the case with pain and increased frequency of urination, are called forth by forced movements, walking, riding, etc. It is seldom that they occur spontaneously without one of these causes being present.

They are characterized, furthermore, by the fact that they are usually not profuse and soon disappear if the patient keeps quiet or goes to bed. Under such circumstances the blood may be voided with the urine, or appear at the end of micturition with the last drops of urine, assuming the form of terminal hæmorrhage. The latter occurrence is probably caused by the stone being forced against the sphincter at the close of the act and thus producing a slight lesion. This form of terminal hæmorrhage, is not due, therefore, to movement and straining. Here again it must not be omitted to state that both forms of hæmorrhage may be absent. I have seen patients who have suffered with stones for years without having any hæmorrhage whatever.

A sign which, according to my observation, hardly ever fails, and upon which sufficient stress has heretofore not been laid, is the presence of **blood-cells in the urine.** Their presence can be demonstrated only by the microscope. It is with the greatest rarity that I have failed to find them. Where a stone is present in the bladder there also will be blood-cells present, even though they are nothing more than a few of the so-called shadows, or red corpuscles from which the coloring matter has been extracted.

As to the other changes in the urine which take place in vesical calculus, it may be said that they consist in admixture of mucus and pus, conditions which are not characteristic of calculous disease, but which are due to the accompanying cystitis. The excretion of a certain amount of salts is the expression of the general diathesis, and at times may be of value from a therapeutic standpoint.

From this consideration of the symptoms it will be seen that a positive diagnosis of vesical calculus cannot be made from them. If they are present singly or collectively we may suspect the existence of a stone. Certainty, however, is to be obtained solely by physical examination consisting of palpation, the introduction of a stone-sound, and illumination of the bladder.

Palpation and sounding have been relegated to an unimportant place by cystoscopy, but notwithstanding this they should not be abandoned, for there are cases in which the practice of cystoscopy is technically impossible. An attempt should always be made to palpate the bladder, first through the rectum and then, in the female through the vagina, and also bimanually. With children this often suffices, which is the more important because cystoscopy is difficult in them and requires the use of specially constructed instruments.

If an instrument can be introduced into the bladder the use of the stone-sound is proper. The patient lies on his back with his buttocks elevated and the bladder empty or only slightly filled. When the tip of the sound reaches the bladder it is carried by a slight backward and forward movement to the posterior wall drawn back toward the right, then carried to the left, and finally with its beak directed downwards brought to the neck of the bladder again.

If a stone is present it will be recognized either by its striking perceptibly upon the metal sound or by the tip of the instrument touching a hard object. It must be realized, however, that this examination is not reliable in all cases. It is to be borne in mind, too, that the sound striking a firm trabecula (muscle) of the bladder may impart a sensation, especially to those of little experience, of striking a stone. It is more important to realize that if the examination is negative the absence of a stone is not proved. The stone may lie in a diverticulum or in a dilatation behind the prostate; it may be hidden by contractions of the bladder induced by the sound itself; and it may, especially in women, who have a very much dilated, distorted and irregular bladder, easily escape the sound.

Our object is obtained much more surely and quickly with the cystoscope. In the great majority of cases a glance is sufficient. It not only shows us that stone is present, but it informs us also whether there are several, how large they are, what color they have, and conveys probable though not absolute knowledge as to their nature. A stone which is yellow externally, and therefore probably composed of urates, may have an oxalate nucleus; a white phosphatic covering may conceal a mass of urates, and so on. Furthermore we get information in regard to the position of the stone, whether it is free or movable, whether it lies in a diverticulum. Naturally cystoscopy may also fail. The bladder may be so foul that it is utterly impossible to see anything, although such a condition, it is true, is exceedingly rare. With but one exception I have always succeeded in discovering the stone. It has happened more frequently that an encapsulated stone escaped the eye.

In such difficult cases the most modern method of examination, to wit, **radioscopy,** may be resorted to. Unfortunately, however, it must be stated that this method does not furnish reliable results. Conditions must be very favorable in order for a trustworthy picture of the calculus to be obtained. The most common primary calculi,

those composed of urates, allow the rays to pass through so well that their contour is seldom plainly given.

The method is usually satisfactory in children, in whom it is particularly desirable, for the reason that the introduction of the cystoscope is beset with technical difficulties; for very small children it is impracticable. Figure 164 shows an X-ray picture of a vesical calculus in a child seven years old.

For these reasons we should not confine ourselves to a single method of examination, but should use all if it be necessary. It may well

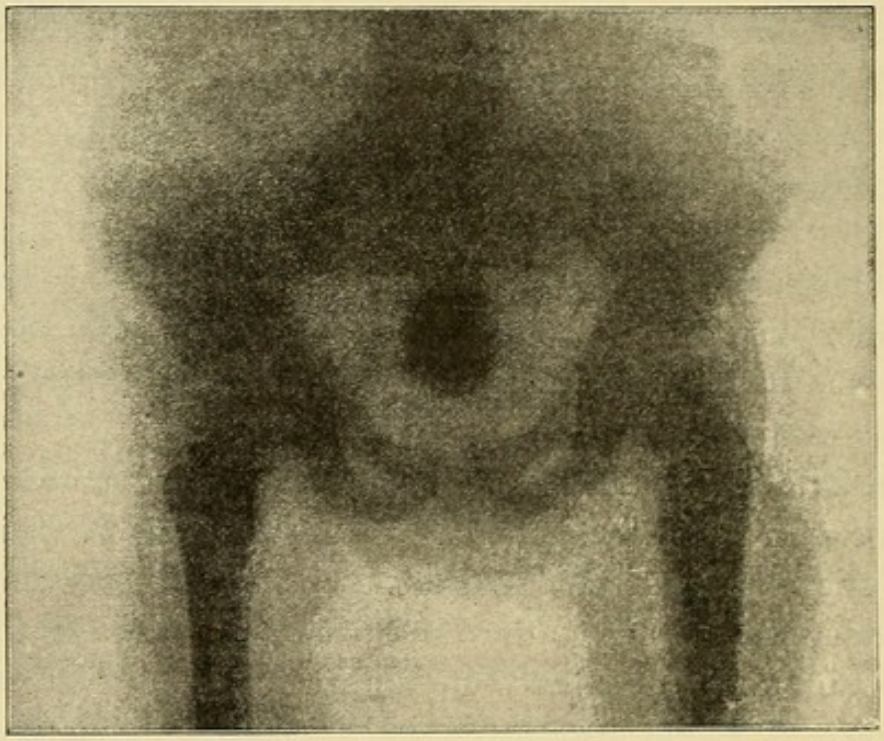


FIG. 164.—X-ray picture of a vesical calculus in a child seven years old.

be said that there are few diseases which require such certainty and precision in diagnosis as stone in the bladder.

The course, duration and termination of the disease are most variable. A stone may be present for years or tens of years without causing any material disturbance. Therefore many old persons prefer not to be operated on, and carry the calculus, which burdens them little or not at all, as long as they live.

Others have severe pain, urgency of micturition, and cystitis, so that interference is demanded. As a rule the annoyance depends more upon the accompanying symptoms, particularly cystitis, than upon the stone itself. The cystitis is characterized by hæmorrhage and pain, which appears especially in the form of exacerbations or attacks of

vesical spasm. Very rarely the stone gets wedged into the neck of the bladder; it then causes most violent pain, the patient urinating drop by drop and experiencing great distress. Under these circumstances hæmorrhage is hardly ever absent.

The general health remains good for a long time, especially while the bladder remains uninfected. If cystitis or an ascending pyelonephritis develops, then, of course, the symptoms of these maladies manifest themselves. Irrespective of these complications there occasionally occurs a condition which may be designated as urinary intoxication, a condition which is characterized by loss of appetite, want of strength, thirst, and slight elevation of temperature. This may be attributed to absorption of toxins of the urine through the lesions in the bladder produced by the calculus.

As to the cystitis, it must be ascertained whether it is primary or secondary, that is, whether it developed as a result of the calculus, or whether it is responsible for the formation of the latter. The first form is easy to cure, the second difficult.

The prognosis of stone in the bladder is usually favorable. Spontaneous expulsion is not to be counted upon except in the case of very small calculi. It occurs most frequently in women, who have a short and wide urethra.

Spontaneous fragmentation of the stone is even less common, although a few examples are on record. In such cases it is probable that the inner layers of the calculus, being no longer in contact with the urine, become dry, so that cleavage takes place, and that the latter occurrence, in conjunction with contraction of the bladder, leads to spontaneous crumbling of the stone. It hardly need be said that primary calculus unassociated with complications offers a better prognosis than do the secondary forms which were preceded by cystitis. The most unfavorable cases of all are those complicated by pyelonephritis.

TREATMENT.

The object of treatment in vesical calculus is twofold, namely, to remove the stone which is present, and to prevent the formation of others. The first can be attained only by operation.

There was a time when it was considered possible to dissolve the stone by the internal administration of drugs, but we no longer believe in such a wonder. A series of operations for the removal of stone have

been recommended and practised. We cannot enter into an historical account of these operations, but will merely engage in a discussion of those which in the present state of our knowledge seem to be

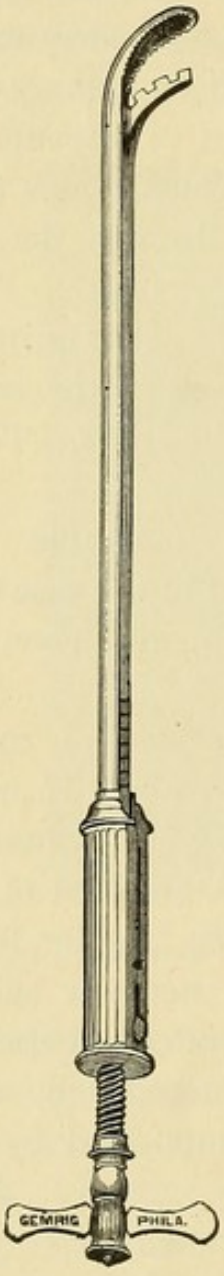


Fig. 165.—Thompson's lithotrite.

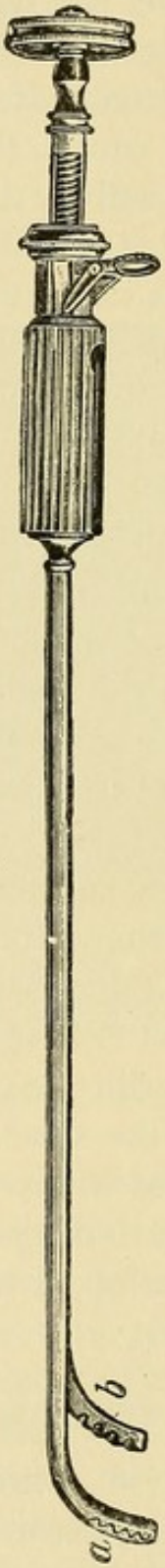


Fig. 166.—Guyon's lithotrite.



Fig. 167.—Guyon's small lithotrite. (Ramasseur.)

the most rational. As a rule, the choice lies between cutting operations and crushing.

Crushing (lithotripsy, litholapaxy).—In the writings of Hippoc-

rates, Ambrose Paré, and others the idea of crushing stone within the bladder was mentioned, but Civiale, who in 1824 first successfully put it into practice, was the founder of the operation. Although Heurteloup and Charrière improved the instruments, modern lithotripsy began with Bigelow. In 1875 he invented his aspirator, which made it possible to crush the stone and remove the fragments at one sitting. He named this operation litholapaxy. Next to him the greatest master of this procedure was Sir Henry Thompson, of London. In France Felix Guyon became the best advocate of the method, and has brought it to a high degree of perfection.

For the performance of litholapaxy lithotrites, an evacuator, and catheters of large caliber are required. The lithotrite consists of male and female blades, shaft and handle. The handle is provided with a mechanism which locks and unlocks the jaws of the blades. I prefer the instruments of Thompson and Guyon (Figs. 165, 166 and 167).

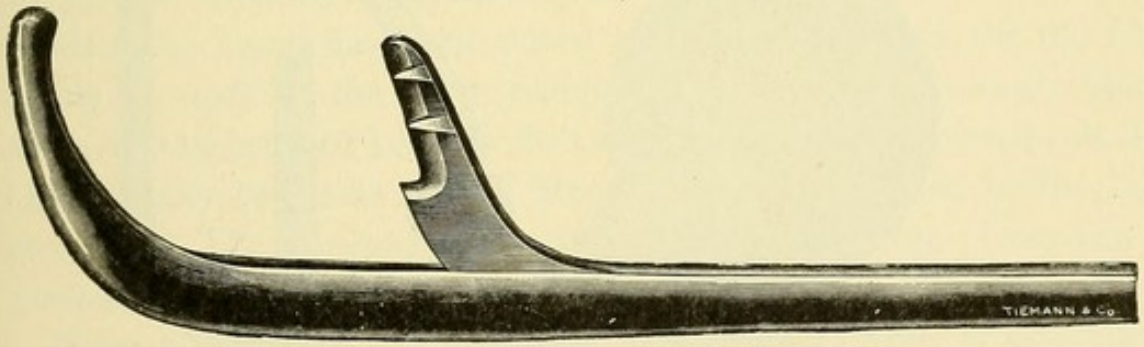


Fig. 168.—Forbes's lithotrite.

It is indispensable that the instruments be made of the best and hardest steel, and that their strength be tested. The jaw of the female blade (a) of Guyon's instrument is indentated so that the teeth of the male blade (b) fit into it. This mechanism is of the utmost importance, as by it the fragments of stone can be forced through the apertures. If any considerable number of the fragments remained in the jaws, the lithotrite could not be entirely closed, and its removal would be very difficult. The more slender instrument (Fig. 167) is used at the end of the operation to remove the last small fragments of stone. Because of the shortness of its beak it can be turned in all directions and even carried downward in the bladder. [The late Dr. Wm. S. Forbes, of Philadelphia, constructed a lithotrite (Fig. 168) of prodigious strength which seems to conform better to the laws of mechanics than any instrument previously devised. It also contains a power-recording mechanism in the screw handle which measures the strain on the

lithotrite and the crushing resistance of the calculus. A complete description of this lithotrite is contained in the *Transactions of the American Surgical Association*, 1894, to which the reader is referred.]

Fig. 169 shows Bigelow's latest evacuator. It consists of a large rubber bulb and a glass receiver. The stop-cock in the bulb permits the bulb to be filled with fluid and the one below gives attachment to the evacuating tube. Pressure upon the bulb forces the fluid into the bladder. When the pressure is relaxed the bulb reassumes its normal shape, a vacuum is created within it, and the water rushes back out

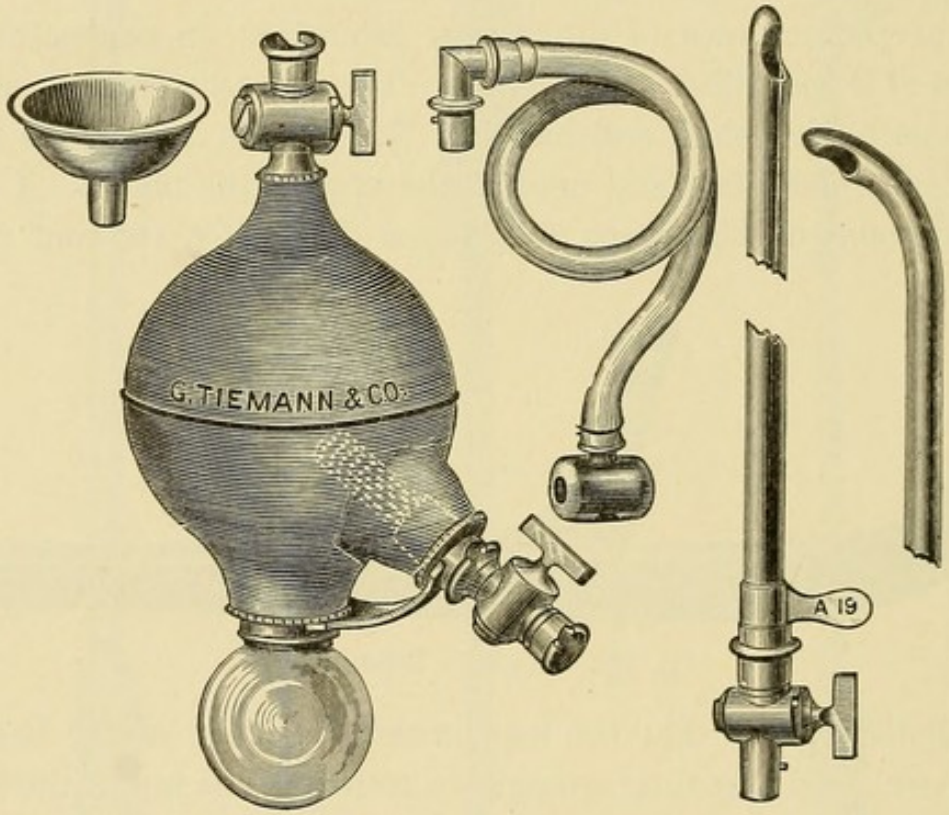


Fig. 169.—Bigelow's latest evacuator.

of the bladder into the receiver bringing the débris of the calculus with it.

The whole instrument except the rubber bulb can be boiled; the bulb is sterilized by filling it with 1% solution of bichloride or oxycyanate of mercury twenty-four hours before it is to be used. If the patient has cystitis his bladder should be cleansed by a preliminary irrigation of silver nitrate solution 1:1000. For crushing large stones I always use a general anæsthetic. It is only when the calculi are small and their crushing requires but a short time that it can be dispensed with.

I could never resolve to **cocainize the bladder,** as several fatalities

resulting from this procedure have been reported. We do not know to what extent the bladder absorbs nor how much cocain the patient will tolerate. On the other hand, insensibility of the bladder during operation is indispensable, for unless it be obtained the bladder will contract so that some part of its lining will be drawn over the stone. In such a case it will be very difficult to avoid injuring the bladder-wall.

The patient is placed on the table with the buttocks elevated and the head lowered, as in this position the stone is removed from the neck of the bladder and the operation thus made more easy. If the lithotrite be now introduced, it will often be merely necessary, while the beak of the instrument is directed **upwards,** to open and close the blades, whereupon the stone will be found in their grasp. Crushing can then be easily done, unless, as very rarely happens, the stone is of such exceptional hardness that a hammer has to be used to break it. There are cases in which the stone even resists the latter manipulation. In such instances litholapaxy is not practicable.

After the stone has been seized and crushed search for the fragments is made in the same region. They are usually easily found, and are to be crushed again in the same manner as the original calculus. Occasionally the beak of the lithotrite must be turned to the right and left. The crushing is continued as long as large pieces can be grasped between the blades.

When no more can be found the evacuating catheter is introduced, the pump attached, and evacuation begun. This procedure removes all fragments small enough to pass through the catheter. To complete the operation the small short-beaked lithotrite (ramasseur), the blades of which can easily be carried to the inferior wall of the bladder, is introduced. With this instrument smaller pieces can be caught and broken up.

When it has been determined that no more fragments are present in the bladder, a 1:1000 solution of silver nitrate should again be injected, a retention-catheter inserted, if necessary, and the patient put to bed. If severe hæmorrhage has occurred, or if the patient cannot empty his bladder, the catheter should be used. Otherwise it is not necessary.

At the conclusion of the operation many surgeons like to assure themselves by a look through the cystoscope whether all fragments have been removed, but I consider such an examination useless. Even if only slight hæmorrhage has occurred the bladder is so obscured

that a clear view of it cannot be obtained. It is better to undertake this verification a few days later.

The **dangers of this operation** are slight provided that it is skillfully performed. It often happens that a piece of mucous membrane is caught with the stone and crushed, but this is without untoward effect. Perforation of the bladder is among the rarest accidents. It is also rare for the lithotrite to bend or break, yet I have seen such an accident happen.

The danger is materially lessened if strict asepticism is practised. Slight irritation of the bladder is often produced, but it soon subsides. I have hardly ever seen a permanent orchitis, epididymitis, or prostatitis as a sequel of the operation.

Litholapaxy is more difficult in woman than in man. The difficulty is due to the greater distensibility of the female bladder, to the distortion produced by its numerous pockets and folds, and to the absence of a firm point of support at the base of the bladder such as is supplied in the male by the prostate.

Cutting Operations.—The only cutting operations to be considered at the present time are suprapubic and perineal lithotomy. The median perineal operation, too, is ceding more and more to the suprapubic. In performing the former operation the regular perineal incision is made, but is prolonged into the prostatic urethra in order to secure more room for the removal of the stone. Even then great difficulty may be experienced in its extraction.

Perineal litholapaxy is a slovenly and uncertain procedure; it is impossible to tell whether all of the stone is removed. When a cutting operation is deemed advisable, it is best to resort to suprapubic lithotomy, which permits an adequate survey of existing conditions to be made.

The suprapubic incision is made in accordance with the usual rules. The bladder is filled with air and an incision begun a hand's breath below the umbilicus and carried down toward the symphysis. The patient lies in the Trendelenburg position. The transverse incision above the symphysis, although it gives more room, is not necessary for the performance of this operation. The bladder is opened without injuring the peritoneum, and the wound enlarged until the stone can be removed with one of the forceps shown in Fig. 170; the stone scoop is also useful for this purpose.

It is better to make the incision too large than too small, so that

in delivering the stone the edges of the vesical wound shall not be bruised. After the calculus is removed the bladder is washed with silver nitrate solution and either closed entirely or a small opening left. If hæmorrhage is not severe and the bladder was not too foul, it is better to close the bladder entirely and insert a retention-catheter through the urethra. When ammoniacal decomposition of urine exists a small slit is left open in the bladder and a drainage-tube inserted.

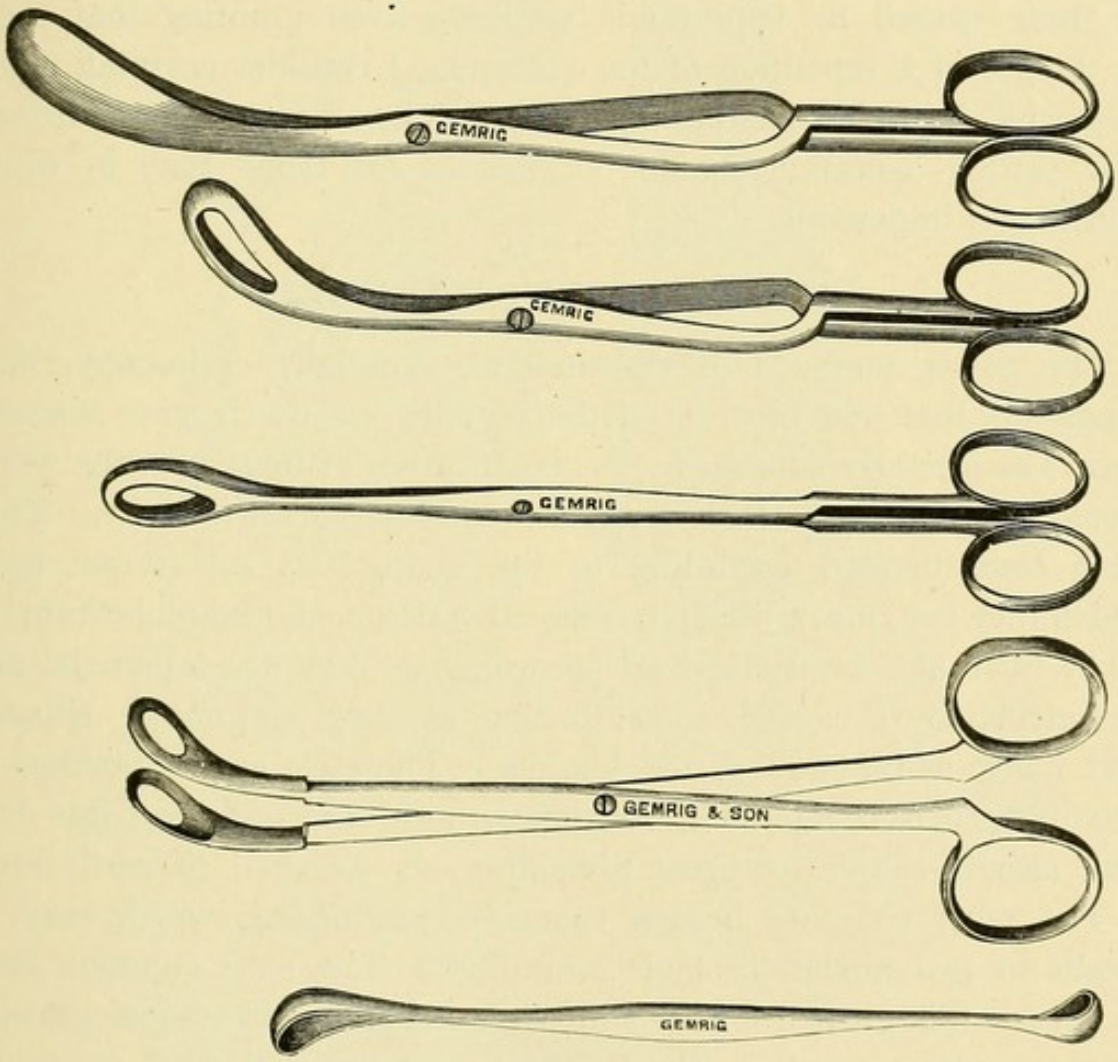


Fig. 170.—Stone-forceps and scoop.

After packing the prevesical space the superficial wound is closed with the exception of a small slit at its lower angle.

This operation is simple and offers a good prognosis except in the case of very decrepit persons or those suffering from advanced arterio-sclerosis or kidney disease.

It has been asserted that more relapses take place after litholapaxy than after suprapubic lithotomy, because in the first procedure it

cannot positively be known whether every fragment of stone is removed. If a piece remains it soon grows to form a new stone. Experience teaches that in the hands of those operators who thoroughly understand how to perform the operation, litholapaxy is not followed by more relapses than is suprapubic lithotomy. Cystoscopy in conjunction with litholapaxy enables one to free the bladder from all remnants of stone. Moreover, according to my experience, the effects of a skillfully performed crushing operation are not so severe as those caused by suprapubic section. Even granting that there be danger of a repetition of the operation, I consider crushing under otherwise favorable conditions to be the less dangerous procedure. The cutting operation should be reserved for those cases in which crushing is impossible.

TUMORS OF THE BLADDER.

The newer methods of examination, especially cystoscopy, have taught us that new growths of the bladder are much more common than was formerly supposed. A classification of these growths which would be satisfactory in all respects would be difficult to make. They have been divided according to the anatomical substratum upon which they rest, into epithelial, connective tissue, and muscular tumors. They have also been classified according as they are superficial and pedunculated or sessile, or according as they are deeply situated and infiltrate the wall of the bladder. The most natural method of classifying is to divide them into benign and malignant, but this division also is subject to great difficulties, as we shall presently see.

The most common benign tumor is **papilloma,** which may be sessile or pedunculated, single or multiple. The most common form in which this growth is met with is as a number of tumors growing from a common pedicle like the branches of a tree from its trunk. The branches are villi, each one of which is composed of a fine stroma of connective tissue having a loop of blood-vessels extending to its extremity, and being covered with several layers of epithelium (Fig. 171). When dry these villi collapse, but when brought in contact with fluid they unfold and float, as they are seen to do when viewed through the cystoscope.

When the connective tissue stroma is strongly developed the tumor is called a **fibrous papilloma;** when the villi are arranged in series of thread-like forms it is known, according to Thompson, as a

fimbriated papilloma (Fig. 172). These different names should be known, because if they are not, confusion will be caused when the different varieties are designated. It must, moreover, be remembered that Virchow calls these same neoplasms papillary fibromata, that Küster designates them as villous polypi, and that others merely term them papillomata.

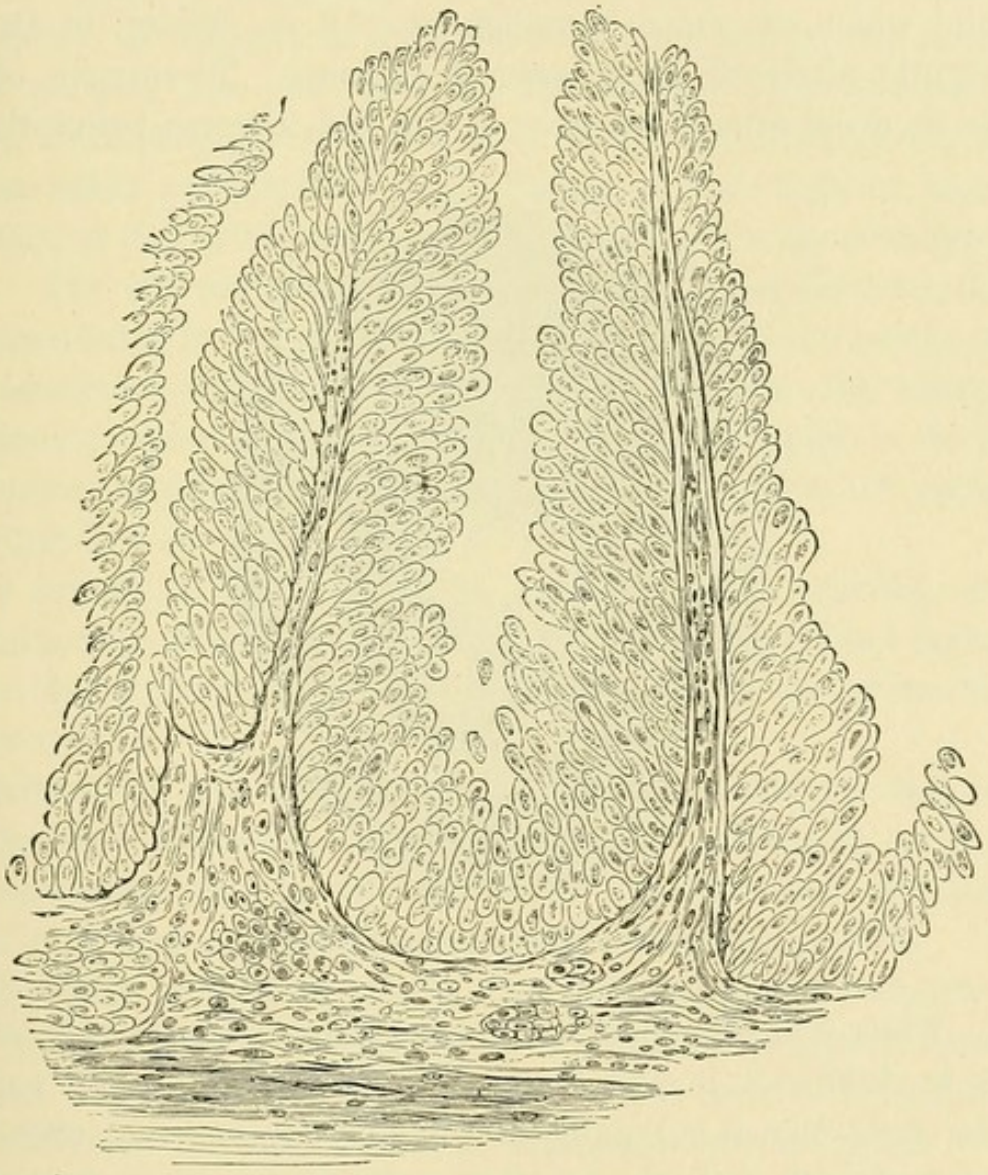


Fig. 171.—Villous papilloma.

Although these villous polypi are generally benign, it must not be forgotten that such is not always the case, inasmuch as they may extend over a wide area, or be benign as to their superficial portion only, the deep parts and base becoming malignant; furthermore cancerous growths may present villosites on their surface. Thus it is seen that it may be very difficult to decide whether a tumor is benign

or malignant. In practice, however, it will generally be correct to call a villous or papillomatous tumor benign.

Much rarer are true **fibromata,** which generally occur in the form of pedunculated polypi, and which lead to those rarer growths, fibro-myxoma, myoma, and adenoma. Sarcoma, enchondroma, angioma, chondro-sarcoma, and dermoids have also to be mentioned; of these, however, I have seen none but **sarcoma,** a growth which is not very rare, and which of course is malignant. [J. A. Wilder, of Denver, has recently analyzed fifty cases of sarcoma. Twenty-six of this number occurred after forty years of age and fourteen before the age

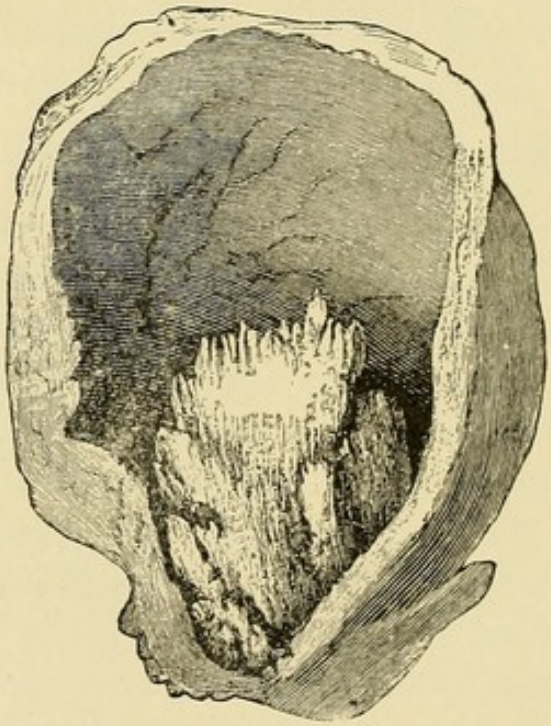


Fig. 172 —Fimbriated papilloma.

of ten. Thus it is seen that the disease is most common in middle life and in childhood; it may, however, occur at any age.

Wilder states that it is rapidly fatal in children, and that metastases as compared with sarcoma in other parts of the body seem rare.] [**Chorio-epithelioma.** Dewitski has recently reported a case of chorio-epithelioma occurring in a virgin aged seventy-five years, and terminating fatally.

Microscopic examination of the vesical tumor revealed Langhans cells and syncytium.

The genital organs were free from similar tissue, although fibro-myomatous nodules were found in the uterus. Metastases were present in the lungs, spleen and intestines.

This is the only case of the kind yet reported, although Lubarsch mentions one somewhat similar, which occurred in a girl aged thirteen. In his case, however, the growth probably originated in the uterus. This patient was also a virgin.

For further particulars the reader is referred to Dewitski's paper in the Medicinische Woche, August 7 and 14, 1905.]

Of the greatest importance, however, is **cancer,** which occurs very frequently. It appears in different forms, varying from a prodigious tumor growing into the cavity of the bladder to a layer of tissue merely infiltrating the vesical walls. In the first instance the growth may be either pedunculated or sessile; the surface may be smooth or irregular, or it may be villous, and thus be mistaken for a benign papilloma. The villi are exactly the same as those of papillomata, the only difference being in the base of the tumor. While in the benign growth the connective tissue stroma arises directly from the submucosa, in villous carcinoma there is a small-celled infiltration in the base of the tumor, together with an irregular proliferation of epithelium extending into the deeper parts.

The superficial carcinomata, to which class the scirrhus, alveolar and melanotic forms belong, cause diffuse or superficial induration of the bladder, which can usually be detected by palpation through the rectum.

Carcinomata, like benign growths, may be multiple, and, indeed, pedunculated malignant villous cancer and infiltrating cancer may be found together. It has also been observed that pedunculated cancer may recur after operation as an infiltrating growth.

It is highly interesting, too, to note that apparently authentic cases of the transformation of a benign into a malignant growth have been reported. In such cases it is, of course, necessary to be certain that no error as to the nature of the original growth occurred.

The extension of the cancerous masses, especially those forms which grow into the cavity of the bladder, may assume enormous dimensions, so that the viscus may be almost entirely filled by them.

The difficulty of determining from the macroscopic inspection or the cystoscopic appearance of a growth whether it is benign or malignant is shown by the fact that great differences as to their relative frequency are found in the literature of the subject. According to my experience, which embraces more than sixty cases, cancer is more common than benign tumors. The great majority of cancer cases

occur in elderly people, affecting mostly those who are over fifty years of age; the benign tumors more commonly affect younger persons.

We know very little concerning the causes of tumors of the bladder. Prolonged irritation of the vesical mucous membrane has been assigned as a cause, but there are countless cases of chronic catarrh of the bladder in which catheterism and its resulting irritation are not followed by neoplastic growths. There are innumerable cases of calculus unassociated with the development of tumors, and, conversely, new growths are found in cases in which no irritation of the wall of the bladder has taken place. It is true that catarrh of the bladder may lead to proliferation of the vesical mucous membrane, so that tumor-like outgrowths resembling villi may be formed, but these are different from true papillomata.

It would seem that chemical irritation by certain dye-stuffs is especially prone to result in the development of vesical tumors. Many cases have been observed in persons who work in fuchsin, so that it seems justifiable to assume that the anilin and toluidin which they handle exerts an irritating influence upon the walls of the bladder.

It has been asserted that gonorrhœa and syphilis of the bladder give rise to tumors, but as no proof has been adduced to show the truth of this assertion the existence of a causative relation between these diseases and tumors can be totally denied.

It also seems to me to be very doubtful whether tumors can be produced by the action of parasites. At all events it may be stated that there is no proof of such an occurrence. It is seen, then, that we are ignorant in respect to the causes producing tumors of the bladder, knowing no more about their origin than we know of the origin of new growths in other organs of the body.

As to the relative frequency in the two sexes I have found them to occur more frequently in men than in women. In this respect, however, it must be borne in mind that a distinction has to be made between primary and secondary growths, a distinction which, of course, applies only to malignant forms.

The secondary tumors are due either to metastasis from a growth situated in another portion of the body or to extension by contiguity from neighboring parts. Many a vesical carcinoma is merely the extension of a prostatic carcinoma. So likewise may a carcinoma of the uterus or its adnexa grow into the bladder. Contrary to the observations of Güterbock I find secondary carcinoma of the bladder

to be more frequent in men than in women. Metastases from other organs are generally conceded to be rare.

The site of tumors is by preference the trigonum, the base of the bladder, and the region of the ureters. This is especially true of malignant growths. I have often found papillomata on the superior and lateral walls of the bladder. Nothing definite can be said in regard to the size of vesical tumors; they vary from the size of a pea to that of a hen's egg. Finally it is worthy of mention that malignant tumors remain confined to the bladder for a long time, metastases occurring comparatively late.

SYMPTOMS, PROGNOSIS AND COURSE.

In the beginning of the disease there is little difference between the symptoms produced by benign and malignant tumors. The following symptoms are common to all tumors of the bladder: hæmaturia, pain, disturbances of micturition, and expulsion of fragments of the tumor. All these symptoms, however, need not be present in a single case, although they may be. In some cases nothing but hæmaturia is present, in other pain is the chief symptom, and in still others the only thing noticed is the expulsion of particles of the tumor.

The symptom of greatest significance, and the one which usually first directs our attention to the malady, is **hæmaturia.** It often remains for years the only perceptible sign of the disease. The hæmorrhage has distinct characteristics, being generally abundant, of long duration, and occurring irrespective of injury, violent efforts, or straining. It is very obstinate in yielding to our therapeutic measures, and finally disappears for as little reason as it apparently took place, perhaps to recur after a long lapse of time, extending frequently over several years. It may, however, recur in a few days after its cessation. Very often the hæmorrhage is entirely painless, and is also unaccompanied by tenesmus unless it be so abundant as to cause the formation of large clots in the bladder, which give rise to vesical contractions. In other cases the bleeding is slight and partakes of the nature of terminal hæmorrhage, only a few drops of blood being forced out at the end of micturition. I have observed this occurrence particularly when the tumor was close to the neck of the bladder, so that a few villi were compressed by the sphincter at the close of micturition.

The hæmorrhage is not well explained by assuming that it is due to ulceration of the tumor, for when ulceration occurs it usually produces

persistent hæmorrhage, which recurs after intervals of a few days, during which the urine is voided clear. In the benign papillary growths it is chiefly due to disintegration of the epithelium covering the vascular loop of the villi; the vessel then lies bare and powerful contraction of the bladder causes it to rupture. Very often circulatory disturbances exist in the region around the tumor, the vessels being congested so that they rupture when the bladder contracts.

The nature of the tumors cannot be determined by the severity of the hæmorrhage. It cannot be said that a tumor which causes violent bleeding is malignant, or that one which produces only slight hæmorrhage is benign. I have seen simple polypi bleed profusely, and have known carcinomata to cause very little hæmorrhage.

Experience has taught me, however, that a tumor which bleeds **constantly,** hæmorrhage being interrupted merely by the passage of non-sanguinolent urine for a few days at a time, is nearly always malignant. Mention has already been made of the fact that hæmorrhage may remain absent a long time. A lady under my care had no recurrence for seven years.

Pain is a most inconstant symptom. It may be entirely absent, and in benign growths usually is wanting unless the tumor is situated near the neck of the bladder. In event of the latter condition the interference with micturition is associated with pain, which usually supervenes as the last drops of urine are voided. Even malignant tumors may exist for a long time without causing any pain; some, however, give rise to pain which radiates to the thighs, or to the anus and perineum. Such pain is generally attributed to pressure of the growth or its metastases upon the nerves supplying these regions.

Although pain in the bladder is a symptom in a great many cases of vesical tumor, it is to be attributed to the accompanying cystitis; of this fact I have often had opportunity to convince myself. If the cystitis be treated correctly and subdued by proper internal and local remedies, the pain diminishes and not unfrequently disappears.

In most cases, too, the disturbances of micturition depend upon the associated cystitis, and as the latter condition improves they disappear or become less severe. Those cases in which the tumor is near the neck of the bladder, so that it constitutes a mechanical impediment to the outflow of urine, constitute an exception to this rule.

The presence of fragments of tumor in the urine affords a valuable

diagnostic sign, but, unfortunately, in the majority of cases none are voided. Occasionally, however, pieces are passed with the urine, and at times some are brought away by irrigation of the bladder. This happens especially in papillomata, their peripheral portion being easily broken off. The method formerly in vogue of endeavoring to tear off a small piece of a suspected growth with a catheter is no longer employed, because there are at present better and less dangerous methods of diagnosis.

These methods comprise palpation and cystoscopy. Palpation, of course, gives results only when it is positive. A tumor infiltrating the wall of the bladder can be felt through the rectum, and in the female through the vagina; but when palpation proves negative we cannot assert that a tumor is not present, for there may be one so small or so superficial that it cannot be felt.

Much more reliable and certain are the results of **cystoscopy.** Usually only a glance is required to show that a neoplasm is present in the bladder. (Compare the cystoscopic pictures pages 41 and 42.) A skillful examiner can without difficulty wash the bladder so clean that he can obtain a perfect view of the bladder-walls and cavity. It is only in very rare cases of severe hæmorrhage that this cannot be done. The hæmorrhage may be so severe that examination even with the irrigating cystoscope will not afford any information. In such cases nothing can be done except to wait for the hæmorrhage to stop, or at least diminish, and again undertake to illuminate the bladder. The danger of a patient bleeding to death because of this delay is very slight; I have seldom seen a patient bleed to death from a tumor of the bladder.

If the bladder can be inspected through the cystoscope, then cystoscopy will give information as to the size of the tumor, its location, its shape, whether it is pedunculated or sessile, whether it presents villi, whether more than one growth is present, etc. It is in the diagnosis of vesical tumors that cystoscopy has attained its greatest triumph.

Cystitis is a very common complication of vesical tumors. It may develop spontaneously or arise as the result of catheterization. In malignant growths the appearance of spontaneous cystitis is not long delayed, whereas benign growths may exist for years without it developing. This form of cystitis is dependent upon infection the same as all other forms are.

It may be that blood-clots which remain at the base of the bladder

a long time and become decomposed are the causative factors, although the congestion always present in association with a neoplasm of the bladder supplies favorable conditions for the reception of infective microörganisms. If the catheter is employed, be it for diagnostic or for therapeutic purposes, the urine frequently becomes turbid despite our most careful antiseptic and aseptic precautions.

This cystitis differs little from other forms, except that it is frequently associated with hæmorrhage and is very difficult to control. In cases of benign tumor the urine will often clear up, but in case of malignant growth our efforts are generally in vain. The symptoms can be ameliorated, the strangury and pain lessened, but the urine can seldom be rendered entirely clear. An ulcerative process is often present, and the products of ulceration keep up the infection, or cause it to become more diffuse.

If the tumor is so situated that it occludes the orifice of a ureter, or interferes with the outflow of urine from the same, engorgement of the corresponding kidney results. As long as infection does not take place the condition is merely a hydronephrosis, but whenever infection occurs it becomes converted into a pyonephrosis or pyelonephritis.

The course of the disease depends upon the occurrence or non-occurrence of these complications. Benign tumors may be present in the bladder for years or decades without producing any disturbance whatever, the only untoward effect being an occasional attack of urinary hæmorrhage. The patient neither presents the aspect of illness nor complains of feeling ill.

If the tumor grows so that the cavity of the bladder becomes much diminished in size, nature endeavors to afford relief by causing a spontaneous breaking-off and expulsion of villi. In other cases the tumor grows so large as to cause the patient discomfort. The bladder comes to have less and less room for the reception of urine, urgency of urination becomes frequent, and as the result of increased vesical contractions the hæmorrhages occur more often.

The course of malignant tumors is different. Hæmorrhage occurs more frequently than in benign tumor. The amount of blood lost is less than in the latter form of the disease, but the intervals at which bleeding occurs are shorter. The persistent loss of blood, the severe disturbances dependent upon the irrepressible urgency of micturition which deprives his nights of rest, together with the occurrence of

metastases, combine to produce a general enfeeblement and cachexia, which usually cause the patient to succumb, unless the kidney complications already mentioned develop and hasten the termination of life.

TREATMENT.

Our therapeutic efforts in dealing with tumors of the bladder may consist either in the use of palliative measures intended to mitigate the suffering of our patients, or in the employment of radical means for the removal of the neoplasm.

The symptomatic treatment of benign and malignant tumors is identical. Strangury, pain and hæmorrhage have to be combated. For this purpose narcotics (heroin, dionin, morphine, opium, belladonna) may be given internally; or rectal injections of antipyrin 1.0 [15 grains] and laudanum 10 to 20 drops, may be employed, together with irrigation of the bladder.

In general the treatment directed to subjugation of the cystitic symptoms is the same as that advocated in the article on the treatment of cystitis.

Great difficulty is sometimes experienced in arresting hæmorrhage. Although the bleeding seldom causes death, severe hæmorrhage of short duration, or constant slight hæmorrhage, may weaken the patient to a dangerous degree. We must therefore always endeavor to master such hæmorrhage. Unfortunately, styptics administered internally almost invariably fail to do good. I have hardly ever seen any noticeable effect exerted by the astringents, such as tannin, acetate of lead, and solution of sesquichloride of iron; ergotin and suprarenal extract have also failed. Subcutaneous injections of gelatine are both painful and uncertain in their action. Therefore when the hæmorrhage does not abate under rest and quiétude recourse should be had to local treatment. A fairly reliable remedy is a strong solution of silver nitrate. After emptying the bladder 100 cc. [about 3 ounces] of a 1:1000–1:500 solution are injected into the bladder. The use of larger quantities than this should be avoided, as it is not desirable to distend the bladder and separate its walls. The injections may be given at intervals of two days. Not uncommonly an eschar will be formed over the bleeding area and the desired effect thus obtained. I cannot speak so favorably of methylene blue injections, which have been highly praised. I have not been able to convince myself that

they influence bleeding or relieve pain. Further experience is needed to determine the value of suprarenal extract as a local styptic. My experience with it up to the present time has been unsatisfactory. I have seen a few favorable results follow the injection into the bladder of 100 cc. [about 3 ounces] of Merck's 2% sterilized solution of gelatine.

If despite the employment of these local measures the bleeding still persists, then the introduction of a permanent catheter is indicated, in order that the vesical contractions may be stilled and the bladder put entirely at rest. In this way it will usually be possible to check the hæmorrhage and subdue the irritation; indeed, it may be stated that hæmorrhage from a benign growth may always be controlled in this manner. Patients having malignant growths may thus be made to lead a tolerable existence. Those having simple papillomata are almost always free from suffering. It often happens that they are reminded of their disease only by the occurrence of a hæmorrhage.

As to the question of radical treatment directed to the removal of the tumor, a distinction must be made according as the growth is benign or malignant.

Benign tumors—and here it is well to recall the restriction we made in regard to the possibility of determining the nature of a growth by means of cystoscopy and its gross appearance—should be removed, provided that there is no contraindication to surgical intervention. There are two ways by which this can be accomplished, namely, the intravesical method by means of the operative cystoscope, and a suprapubic incision.

The intravesical method has often been assailed. It is considered dangerous and useless. My experience, which comprises about thirty cases, is as follows. In the first place removal of the tumor with the cold or galvano-caustic snare is not dangerous. I have not seen a single accident follow, especially any dangerous hæmorrhages. It is really astonishing how little blood is lost. The tumor must be firmly encircled with the snare and then torn away or burned off with the galvano-cautery.

In those cases in which the pedicle of the tumor can be reached the method is also useful. I have a series of perfect cures to record.

It must be limited, however, to those cases in which the tumor is favorably situated for its employment. If it be used for cases in which only the peripheral portion of the growth can be seized, the operation

becomes a farce which might better be left unplayed. Tumors near the neck of the bladder are not suitable for removal by this method; those at the base and on the posterior wall are favorably located.

Furthermore it must be emphatically stated that injury may be done by intravesical manipulation if a malignant tumor be mistaken for a benign one. In a few cases where this mistake was made I have seen severe irritation of the bladder result which doubtless hastened the patient's death.

Suprapubic cystotomy for the removal of a benign tumor is not always indicated. When the patient bleeds often and loses much blood, and the tumor increases in size, so that the cavity of the bladder is diminished, the operation is indicated. More frequently it comes to pass that nature affords relief by causing the expulsion of pieces of the tumor. The patients bleed very seldom and have no pain. In these latter cases suprapubic cystotomy seems to be too serious a procedure to warrant its performance for the trifling disturbance experienced. Especially is this so in the case of old, decrepit persons in whom the operation cannot be considered free from danger. In addition to these limitations the formation of fistulæ—and I see them often enough after the work of the best operators—has to be considered.

After all, the indication for operative treatment of benign tumors, as well for the intravesical method as for the suprapubic, depends entirely upon the nature of the individual case. These cases cannot be schematized, but on the contrary have to be strictly individualized.

Concerning the operative treatment of malignant tumor only one opinion can be expressed. Nothing but suprapubic cystotomy followed by the extirpation of the tumor, together with a portion of healthy bladder-wall, will suffice. There are a few cases in which part of the bladder and, indeed, even the whole viscus, has been removed.

According to my experience, which is founded on the cases I have operated on myself and those I have seen operated on by others, good results are seldom obtained. If the tumor lies at the base of the bladder—and this is its usual location—the operation is exceedingly difficult and very extensive. It is even more so when the ends of the ureters have to be removed and the stumps transplanted. Even when this is not necessary the removal of a malignant growth from the bladder is not a gratifying task. Here as elsewhere we must operate in healthy tissue, but it is not always

possible to do so for the reason that we cannot know how far the malignant process has infiltrated the wall of the bladder. It often happens that we think we are operating in healthy tissue and yet leave remnants of the carcinoma behind. Furthermore it is beyond our power to tell whether infection has not reached other organs by way of the lymph-stream.

These considerations are based on practical experience derived from an abundance of clinical material. A considerable number of the patients operated upon die from the operation or its results. A large number of those who survive operation have a recurrence of their local disease or die of carcinoma of other organs. In other cases in which operation seems to have produced a cure fistulæ remain and cause the patient much distress. For these reasons I advise patients not to be operated on unless definite indications, such as stanchless hæmorrhage or intolerable and uncontrollable tenesmus, exist. Patients generally do better and live longer without than with operation.

INJURIES OF THE BLADDER.

Injuries of the bladder are rare. If the external tissues are injured simultaneously with the bladder we speak of the condition as a wound (stab wound, gunshot wound) of the bladder, while tears of the bladder which are not associated with separation of the tissues which lie above it, especially the skin, are known as ruptures. An opening into the bladder resulting from an operation on another organ, and one persisting after the bladder has been opened, are not included in this category.

Wounds of the Bladder.—Penetrating wounds of the bladder are differentiated according as they do or do not injure the peritoneum. Cases have been reported in which the symptoms were so slight that a diagnosis could not be made. This is especially true in cases in which the peritoneum is not injured. In such injuries often nothing but slight pain and a constant desire to urinate are experienced. Attempts to void urine fail, the patient being able to force out only a few drops of blood-stained fluid at a time. Very little urine is obtained by catheterization, although the patient may not have voided for some time.

If the peritoneum is injured constitutional symptoms will predominate. The patient is the picture of collapse. The face is white or ashy and has an anxious sunken look; the pulse is small and frequent, often

thread-like; the sensorium is often disturbed; the body is covered with sweat and the temperature is subnormal.

Persons suffering from such an injury usually die unless prompt surgical intervention is practised. The prognosis becomes even worse if other vital organs, as the intestines, are injured. Less is to be feared from the foreign body which has produced the injury, even though it remains in the bladder, an occurrence which is not rare in gunshot wounds. Infective material, such as pieces of clothing or dirty skin, is frequently carried into the bladder; and in these cases, although the wound itself may not have been fatal, septic infection develops, beginning either in the bladder and extending to the peritoneum, or taking place as the result of invasion of the blood by microörganisms.

Another exceedingly dangerous complication of this injury is infiltration of urine. When the urine finds its way toward the exterior and forms a phlegmon the condition is not so serious, but when it infiltrates toward the peritoneum the prognosis is most grave.

From this description it will be seen that the diagnosis may be either difficult or easy. In cases in which there is only slight laceration caused by penetrating instruments, so that the external wound is very small, it may be impossible to make an exact diagnosis. It is equally difficult if there are injuries besides the tear of the bladder. As an early diagnosis is of the greatest importance—for oftentimes immediate surgical treatment will save the patient's life—the rule should be to treat all cases in which it is at all doubtful whether the bladder has been wounded exactly the same as those in which a wound is known to exist.

Rupture of the Bladder.—In subcutaneous lacerations of the bladder also, much depends upon whether the peritoneum is injured or remains intact. They are almost always caused by violence, such as a thrust, a blow, a fall, or the passage of a wagon over the hypogastrium. If the bladder is empty, subcutaneous rupture seldom or never occurs. The fuller the bladder, the greater is the likelihood of sudden violence producing rupture. Very rarely the bladder may be burst when it is over distended by an irrigation given under high pressure. Finally, puncture with a catheter or lithotrite must be mentioned as causes, which, however, are exceedingly rare.

The symptoms may at first be ill-defined. Usually other injuries have been sustained, and thus it may happen that the vesical injury

will escape detection. Micturition, however, is difficult or impossible. Violent strangury ensues, but the efforts to void are negative, or result merely in the expulsion of a little bloody urine. Upon catheterization blood-stained urine or pure blood is obtained. If the line of rupture becomes closed superficially, it may happen that a considerable quantity of urine will be withdrawn by the catheter, a circumstance which may readily be erroneously interpreted to mean that no rupture of the bladder has taken place.

This error may prove most fatal. The superficial closure generally gives way, and unless interference be soon practised, rapidly spreading infiltration of urine occurs. The prevesical tissue becomes filled with decomposing urine. The phlegmonous inflammation affects the entire pelvic cellular tissue, extending to the rectum, the peritoneum, the abdominal walls, the testicles, the perineum, the thighs or buttocks, rendering the affected parts emphysematous and discolored. Even when this condition obtains, timely intervention may ward off danger, but unless operation is done at once general infection, manifested by chills and progressive weakness, usually follows and soon causes death.

If the peritoneum is injured the symptoms of profound shock are usually present from the first. The pinched face with its anxious, restless expression, the fleeting pulse, the cold sweat, and the general prostration are signs which make this condition evident. The symptoms of septic peritonitis soon develop. The distended, sensitive abdomen, the small, thread-like pulse, together with hiccough and vomiting leave no doubt as to the seriousness of the condition.

The **treatment** of wounds and subcutaneous rupture of the bladder is surgical. We must not be deceived by the apparent good condition of the patient nor be content with the introduction of a permanent catheter. In the meantime infiltration of urine, irreparable as to its consequences, may take place and fatal septic peritonitis supervene.

If the wound be extraperitoneal suprapubic section will suffice, the bladder being opened and drained until it is evident that there is no longer danger of infection taking place through the wound, after which sutures may be introduced. In some cases the bladder can be drained through the laceration or rupture. In others it will be possible to suture the wound at once.

If the injury is intraperitoneal immediate laparotomy according

to the usual rules of surgery is indicated. The tear in the peritoneum and the vesical wound are both sutured, and a catheter is fastened into the urethra. The chance of saving persons who have sustained laceration or rupture is greater in extraperitoneal wounds than in intraperitoneal. In both instances, however, timely intervention will save a life which otherwise would certainly be lost.

PARASITES OF THE BLADDER.

In this country parasitic diseases of the bladder are rare, although with the increased relations between tropical lands and Europe [and America also] they are becoming more common than they formerly were. Three kinds of parasites have been found in the human bladder: 1. the echinococcus; 2. the filaria sanguinis hominis; 3. the distoma hæmatobium.

Primary **echinococcus** disease of the bladder is exceedingly rare, the parasite usually descending from the kidney by way of the ureter, or boring its way into the bladder from the pelvic cellular tissue.

Unless the characteristic cysts or the hooklets contained therein are voided with the urine, cystoscopy is the only means by which a positive diagnosis can be made. The symptoms are those of cystitis.

Treatment consists in opening and obliterating the primary cyst.

The **filaria sanguinis hominis,** which belongs to the group of nematodes, occurs only in the tropics (Egypt and Brazil), but it has been brought to Europe [and the United States] by persons coming from these regions. Under the microscope the parasites are seen to be cylindric snake-like bodies, which are either enveloped in a fine membrane or lie coiled up in an oval capsule. Elliptical ova are also found in the urine.

The parasites invade the kidneys and give a milky appearance to the urine; this condition is called chyluria, or if blood also be present, hæmatochyluria. When it invades the bladder symptoms of inflammation arise, such as pain, strangury, hæmorrhage, and also retention of urine. If the patient goes to a climate in which the parasite does not occur, the organisms are usually passed with the urine and spontaneous cure takes place.

The **distoma hæmatobium,** discovered by Bilharz, and for this reason also called Bilharzia hæmatobia, is a trematode parasite which very frequently infects the inhabitants of Egypt and the African coast

(Natal and the Cape). The embryos, which live in the water, gain access to the digestive tract and force their way into the portal vein, and thence through the vesical veins into the bladder, where, together with their ova, they are found in large numbers.

The distoma itself is a cylindrical body having rounded ends and measuring about 1 cm. The ova are elliptical in form and have a terminal spine.

They cause frequent hæmorrhage, strangury and pain. If their number is small hæmorrhage may be absent, or only microscopic traces of blood be present. Pus is present and makes the urine turbid. It is characteristic of this disease for outbursts of severe hæmorrhage accompanied by tenesmus and pain to alternate with periods of freedom from bleeding.

Treatment cannot be directed to removal of the cause; it must be confined to checking hæmorrhage, and for this purpose irrigation with nitrate of silver solution 1:1000–1:500 may be used, and a catheter fastened into the bladder

VALVES AT THE NECK OF THE BLADDER.

Under the term valves or strands at the neck of the bladder there has been described an altered condition at the entrance of the viscus which is of some clinical importance. This condition is quite different than the projections into the bladder caused by hypertrophy of the prostate, and the latter will receive special consideration in the chapter on prostatic hypertrophy. The condition now under consideration has no connection with enlargement of the prostate, although it produces symptoms similar to those observed in this affection.

There are two kinds of these projections, one due to muscular overgrowth and the other to hypertrophy of the mucous membrane. In the first form there is a thickening of the muscular fibers at the neck of the bladder forming an elevation at the internal meatus; in the other form there is a proliferation of the mucous membrane assuming a valvular or villous arrangement, which likewise interferes with micturition.

Although the latter form may be accounted for by the occurrence at some previous time of a proliferating inflammatory process, no explanation can be offered for the development of the muscular overgrowth. Both forms occasionally cause disturbances of micturition, as the result of which a more or less severe retention of urine occurs,

having all the characteristics of that form due to hypertrophy of the prostate. Diagnosis can be made only by a consideration of the combined results obtained from the clinical phenomena, rectal palpation, and cystoscopic examination.

As to treatment regular evacuation of the bladder should be secured by aseptic catheterization. Trendelenburg cured one of these cases by suprapubic cystotomy and incision of the projection.

ULCER OF THE BLADDER.

Before the perfection of the cystoscope little was known concerning ulcers of the bladder. Clinically they could not be recognized, and they were observed postmortem in association with other affections of the bladder. Now, thanks to the perfection of our methods of examination, a change has taken place, and we are able to observe clinically a whole series of vesical ulcers.

The most common ulcers are those met with in severe cystitis. In both acute and chronic cystitis, but especially in the latter, careful cystoscopic examination will sometimes reveal a circumscribed depression in the vesical mucosa. This depression, which usually presents a white coating, is undoubtedly an ulceration. Progressive improvement and final healing of the ulcer in response to appropriate treatment can be observed through the cystoscope. Generally these lesions are found in bladders which have been severely infected, and in which multiple and diffuse pathic changes have taken place, the ulceration being observed in isolated patches. This form of cystitis has commonly been called diphtheritic and the same term has also been applied to the associated ulcers, but there is no special reason why this nomenclature should be adhered to, inasmuch as any violent infection of the bladder may occasionally lead to ulceration.

It is well known that ulcers are produced by tuberculosis and tumors. Ulceration of a tumor, however, is not a true ulcer. Tuberculous ulcers have already been considered. The fact that there is nothing characteristic about them will, however, bear repetition in this place. Demonstration of the tubercle bacillus, contraction of the bladder, and other changes will confirm the diagnosis.

Another form of vesical ulcer is that due to traumatism. I have frequently had the opportunity of observing them, and have never seen one caused by a calculus, although I often come upon the declaration that the pressure of a stone can produce circumscribed necrosis

of the vesical mucosa. Unskillful catheterization or litholapaxy, as well as clumsy cystoscopy may, however, lead to ulceration, as may also injury inflicted by the point of an awkwardly introduced retention-catheter. The most common cause is unskilful cystoscopy, so that I believe myself to be justified in using the term **cystoscopic ulcer.**

I have never seen an abscess of the bladder-wall which broke externally lead to the formation of an intravesical ulcer, although paravesical disease, for example, a parametritic exudate, may rupture into the bladder and cause ulceration.

The much disputed simple ulcer of the bladder, which may be compared to gastric ulcer, is a reality. I am familiar with several instances in which a circumscribed ulcer of the bladder developed without demonstrable cause. The symptoms of cystitis present in these cases were not pronounced enough to account for ulceration. As in gastric ulcer, so here must we assume that embolism or thrombosis of a blood-vessel is responsible for the formation of the ulcer.

I am unable to say whether syphilitic ulcers of the bladder exist. I have never observed any, but I see no reason why a sloughing gumma might not form an ulcer in the bladder as well as in any other part of the body.

Special symptoms do not occur in ulcer of the bladder for the reason that the lesions almost never exist alone. Pus and blood in the urine, associated with pain and strangury, are the usual manifestations.

The treatment is the same as has been outlined for cystitis, tuberculosis, and tumors. A word of warning must be sounded against attempts to produce a cure by cauterizing the ulcer.

DIVERTICULA AND HERNIA OF THE BLADDER.

The term diverticulum of the bladder is applied to a condition in which bulging of the bladder-wall occurs, involving either the entire thickness of the wall or merely a part of it, as for example, the mucous membrane. English applies the term diverticulum to those expansions which affect the entire wall, and calls protrusions of the mucous membrane through the muscular layer pouches or cells.

A clinical distinction must be made between congenital and acquired diverticula. Cystoscopy enables us to make this distinction. Congenital diverticula have a sharply defined border and a round or oval opening which looks like a hole in a tense membrane. Acquired

diverticula have less regular boundaries, occurring as longitudinal, round, or triangular clefts, the edges of which are formed by projecting trabeculæ. The congenital diverticula are much deeper than the acquired, so that their posterior wall cannot be seen; the fundus looks black. Acquired diverticula are shallow and their posterior boundary can usually be seen; it varies in color from red to dark gray.

Diverticula vary greatly as to their number. The congenital variety are usually single, although now and then two or three are found. The acquired variety may be so numerous that the bladder may have the appearance of a net-work. The greater their number the less their extent. The thickness of their wall varies. In the congenital variety it generally includes mucous membrane, muscle and its covering. In the acquired form the wall is either composed of mucous membrane alone, or there may be a few muscle fibers covering the membrane.

The development of this condition is due to some obstacle to the free outflow of urine (stricture, hypertrophy of the prostate, partial paralysis, arteriosclerosis). Owing to the increased contractions of the bladder necessary to overcome the increased resistance, the muscle fibers are forced asunder and the mucous membrane protrudes between them like the sac of a hernia.

Clear urine or pus, as well as calculi, will be found in these diverticula and pouches. The stones sometimes fall out of the diverticula when the patient moves about. They may, however, remain in the diverticula and become encapsulated, becoming so large as the result of increased deposit of urinary salts upon them that they cannot pass through the opening between the diverticulum and the bladder.

Exact diagnosis is impossible without the cystoscope. They cannot be palpated and they produce no symptoms. When pressure over a bladder which has been thoroughly irrigated causes a sudden outflow of pus, and the possibility of its coming from the kidneys can be excluded, it is probable that a diverticulum of the bladder exists. Under these circumstances decisive information can be immediately obtained by cystoscopy.

Special treatment is not required for diverticula. If cystitis develops they can be cleansed by irrigation, especially if the bladder be well filled. Care must be taken, however, not to use enough pressure to cause rupture of the pouch. Only as much fluid should be injected as the patient can endure without its causing urgency to void.

Very rarely a process of peritoneum becomes invaginated in the

cleft formed by separation of the muscular fibers, in the same manner that the mucosa protrudes between them from within. Thus a true hernial sac is formed into which intestine may escape. The diagnosis of this rare condition is, of course, impossible.

Prolapse of the bladder through the urethra, a condition which is found only in females, is called **urethral cystocle.** This condition is divided, according to its degree of severity, into invagination, inversion, and prolapse; when the bladder-wall points outward into the urethra it is called invagination, when the bladder reaches the external orifice of the urethra is it known as inversion, and when the bladder protrudes from the urethra, forming a tumor covered with mucous membrane, it is spoken of as prolapse. Atony of the bladder, and dilatation of the urethra combined with increased expulsive force, are to be considered responsible for the development of this abnormality. Confusion with urethrocele may readily occur, so that the latter must be excluded before making a diagnosis. Treatment consists in reposition if possible, or if not, in operation.

True **hernia of the bladder** is a different condition from the one just described, the bladder or a portion of it protruding through a hernial orifice. It may occur in any part of the lower abdomen where other herniæ take place, but its most common location is in the inguinal canal. Even this form, however, is rare. The bladder is either adherent to other structures, with which it has escaped into the inguinal canal, or else fatty tumors pull it in; congenital abnormalities such as increased length of the superior suspensory ligament or of the ureters, diverticula, relaxation of the bladder, etc., may also be responsible for the occurrence of this condition.

Diagnosis may be exceedingly difficult or even impossible. Pronounced subjective symptoms are not usually present. A fluctuating tumor is found along the course of the inguinal canal similar to that which occurs in hydrocele of the cord. Percussion of the tumor elicits dullness. When reduction is not possible pressure over the swelling will give rise to a desire to urinate. It is not unusual for micturition to be interrupted several times. The tumor is increased in size by protracted standing, walking, and violent exertion, as well as by intraabdominal pressure. If other structures, for instance omentum, lie within the hernial sac diagnosis may be utterly impossible. It should be remembered that calculi are comparatively common in vesical hernia.

As to treatment, a truss should be worn and the bladder frequently catheterized; if no improvement follows, radical operation, perhaps with resection of the bladder, may be considered.

VARICES OF THE BLADDER.

The existence of varices of the bladder has been denied. It has been said that the cases diagnosticated as such were in reality cases of tumor, or some other disease capable of producing hæmorrhage. Although it is true that varices of the bladder are rarer than they have been supposed to be, I have, nevertheless, demonstrated their existence both by operation and by the use of the cystoscope. Tortuous veins of a distinct blue color are seen near the neck of the bladder. Not uncommonly, too, ecchymoses of the vesical mucous membrane are observed.

I have found these dilated veins in the subjects of hæmorrhoids, in persons suffering from hypertrophy of the prostate and the local engorgement incident thereto, as well as in those affected with arteriosclerosis of the genital tract, and those suffering with disturbances of the central nervous system (myelitis, tabes, paresis) in which there is probably paralysis of the vasomotor nerves.

Usually the only symptom is severe hæmorrhage, which arises spontaneously without any recognizable cause and continues without producing pain. Occasionally it is of such severity as to cause the formation of large clots, as the result of which the bladder cannot be properly emptied. Under these circumstances painful tenesmus occurs. If a catheter be introduced its eye becomes occluded, so that it is very difficult to cleanse the bladder. Removal of the blood-clots facilitates matters.

I have observed hæmorrhage so severe as to produce alarming anæmia and necessitate the performance of suprapubic cystotomy in order to control the bleeding. A milder method which should be tried first consists in the introduction of a retention-catheter and irrigation of the bladder with strong silver solution (1:1000-1:500), or the injection of 100 g. [about 3 fluid ounces] of Merck's 2% sterilized solution of gelatine. In this manner the hæmorrhage can almost always be arrested.

MALFORMATIONS OF THE BLADDER.

The bladder may be entirely absent, but the persons in whom it is not present are usually so afflicted with other abnormalities that they

do not survive. Cases of excessive atrophy of the bladder have been observed in which the ureters emptied into the urethra or rectum, or opened upon the abdominal wall.

An exceedingly rare condition is double bladder, which occurs exclusively in association with other double pelvic organs. When the bladder is divided into separate compartments by one or more longitudinal or transverse septa it is spoken of as **duplicated or lobulated bladder.** These malformations are to be differentiated from congenital diverticula, which, when very large, may have the appearance of double or multiple bladder.

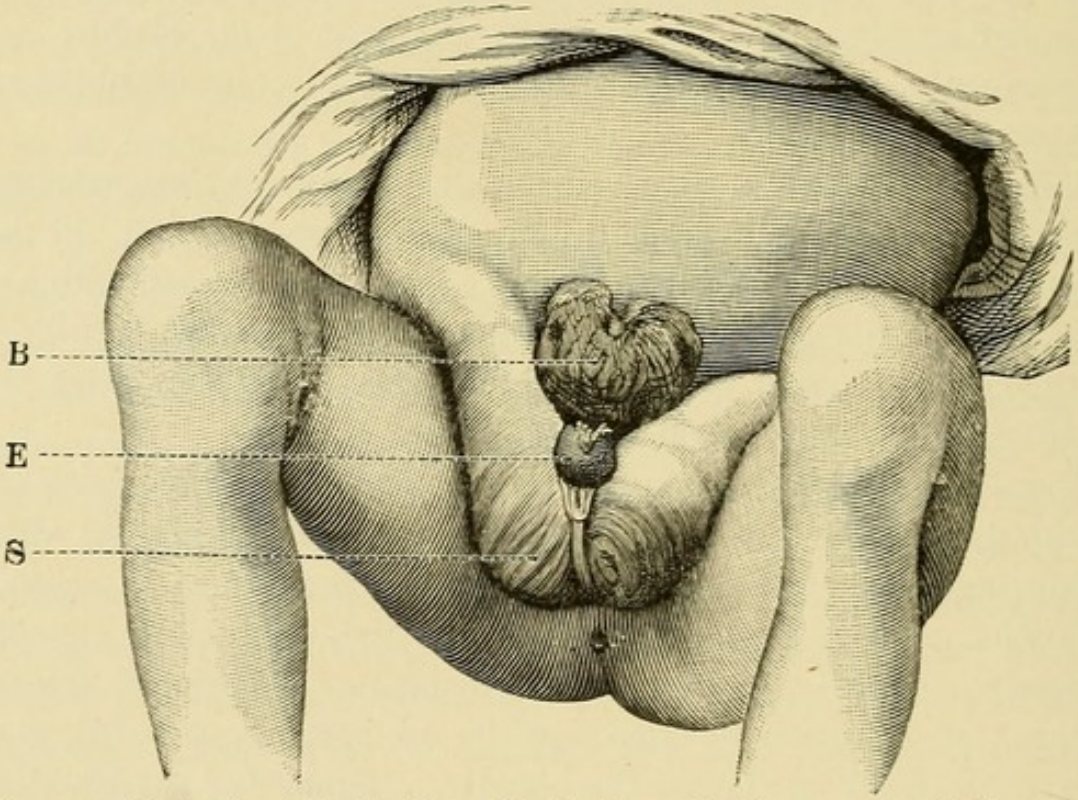


Fig. 173.—Exstrophy of the bladder. B. Bladder. E. Glans penis. S. Scrotum.

A very important and much more frequent malformation is **exstrophy of the bladder,** or congenital cleft, a condition in which the posterior wall of the bladder protrudes through an opening in the abdominal wall and forms a distinct red tumor. The mucous membrane covering the tumor becomes continuous with the skin of the abdomen. Careful search will reveal the orifices of the ureters in the region where skin and mucous membrane meet (Fig. 173).

Different theories obtain in regard to the development of this most distressing malformation. The supposition that injury during intrauterine life causes fissure of the bladder, or that the umbilical cord ying between the legs of the fœtus presses upon the anterior abdominal

wall and prevents its union with the bladder has little foundation. It is more probable that the condition results from some impediment which hinders the union of the lateral portions of the uro-genital cleft, and thus prevents the formation of the anterior wall of the bladder and the abdominal parietes.

There are different degrees of exstrophy varying from diastasis of the abdominal wall and symphysis pubis, in which the bladder is covered by skin, to complete exstrophy, which is almost always associated with epispadias (*quod vide*).

The condition of persons thus affected is most wretched. They are constantly wet and diffuse a foul, uriniferous odor; owing to the constant moisture eczema and other inflammatory diseases of the skin develop, and hæmorrhage from the exposed mucous membrane is not at all uncommon.

The treatment of this malformation is purely surgical, for even the greatest care and cleanliness cannot keep life from being a burden. Different procedures have been tried, many of which have now and then been crowned with success. Some have implanted the ureters into the rectum or into the epispadic opening of the penis, extirpated the bladder, and then closed the abdominal defect with sutures (Sonnenberg); others have forced the edges of the symphysis together and then endeavored to close the opening in the abdomen (Trendelenburg); finally, plastic operations have been undertaken for the purpose of providing a receptacle for the urine and closing the defect by means of flaps. Mikulicz constructs a bladder out of the large intestine. [Wood and Thiersch have also devised flap operations. More than thirty years ago the late Dr. Frank Maury, of Philadelphia, operated for exstrophy of the bladder by dissecting a flap from the perineum and scrotum, turning it over the cleft, and then covering it by a second flap taken from the abdomen.]

ANOMALIES OF THE URACHUS.

If the urachus, which together with the bladder is formed from the allantois, and in extrauterine life becomes the middle vesico-umbilical ligament, remains open, a **fistula of the urachus is formed.** The fistulous canal may be extremely small or it may be as large as a thread. The cause of this abnormality is some congenital obstruction to the passage of urine. If this obstruction, as for instance a congenital phimosis, be removed, it not uncommonly happens that the fistula

heals, although in some cases it becomes necessary to lay it open and curette it, or to extirpate it.

If an exudate is formed in the patulous vesico-umbilical ligament a cyst develops. It is, however, very rare for this to occur. The diagnosis of this abnormality is possible only when it can be positively determined that the oval, fluctuating tumor, which is fixed in the median line of the abdomen between the umbilicus and the bladder, is not connected with other pelvic organs (Ledderhose).

PREVESICAL PHLEGMON.

This disease is entitled to description only for the reason that it sometimes occurs independently of suppuration in neighboring organs and tissues, such as the bladder, the seminal vesicles, and the broad ligaments. Suppuration of the connective tissue in the space of Retzius also occurs in association with suppuration in other cavities of the body due to general infection through the blood-stream (typhoid fever, puerperal fever), as the result of injury, or without assignable cause.

The disease is characterized by disturbance of micturition, which is both painful and more difficult than normal, and also by a swelling over the symphysis, which, if it becomes extensive, may show signs of fluctuation. Resolution may take place and the symptoms subside, or the suppurative process may invade the neighboring tissues, in which case the phenomena of general infection—small, quick pulse, nausea, vomiting, and the local manifestations of peritonitis—supervene.

Diagnosis may be difficult, but the use of the sound will apprize us that the tumor is not in the bladder. Because of its acute course, this disease requires no differentiation from tumors.

An early diagnosis is of great importance because there is danger of the abscess rupturing into the peritoneal cavity. Free incision into the seat of infection before it has become extensive will quickly render the situation free from danger and produce a cure.

NEUROSES OF THE BLADDER.

Our knowledge of the numerous affections of the bladder is somewhat obscure. As in other departments of medicine so likewise here everything which cannot be called something else is termed a neurosis.

As a result of our improved methods of examination the diagnosis of vesical neurosis has become less common; but even now it often comes to pass that cases in which an objective basis for the symptoms present might be determined by the sense of touch or sight, or by changes in the urine, are denominated neuroses; in reality these conditions are only the beginning of organic maladies which later cause appreciable objective changes.

We will preface our treatise on the neuroses of the bladder with a description of the mechanism of micturition. We distinguish two muscles of the bladder, the detrusor[1] and the the sphincter, the latter of which has a circular arrangement of its fibers which enable it to keep the bladder closed when its tonicity is maintained. This closure of the bladder is aided by the so-called external sphincter, or compressor of the membranous portion of the urethra. If a contraction of the detrusor is engendered by the collection of urine in the bladder, abolition of the tonicity of the sphincter immediately follows, with the result that micturition can occur. Thus the detrusor and sphincter have an antagonistic action, inasmuch as the one contracts and the other relaxes in response to the same stimulus. While the former, in response to the pressure exerted by the urine, effectuates its expulsion, the latter causes the neck of the bladder to open so that it can flow out.

In explanation of these conditions it has been assumed that there are two motor centers in the spinal cord which lie at about the level of the third or fourth sacral nerve. The mucous membrane of the bladder is connected with the brain by sensory nerve-fibers. The brain transmits the impulses which it receives from these fibers to the motor centers in the cord. The following schematic representation of these relations is taken from Güterbock's "Diseases of the Urinary Bladder," he in turn having borrowed it from Bramwell (Fig. 174).

The sphincter muscle (SM) is in a state of contraction, the result of nerve-force continually sent to it from its tonic center (CSM) in the spinal cord, through *sm*, as indicated by the arrow.

V = the bladder, *which is represented as empty*. SM, the sphincter muscle. DM, detrusor muscle. AM, abdominal muscles. *mm*, mucous membrane of bladder. B, the brain. CDM, spinal center for the detrusor muscle. CSM, spinal center for the sphincter

[1] The term detrusor is applied to the musculature of the body of the bladder.

muscle. S, sensory fiber proceeding from the mucous membrane of bladder up to the spinal cord and brain. *dm*, motor nerve from the spinal center for the detrusor muscle. *sm*, motor nerve from the spinal center for the sphincter muscle. *b*, nerve filament proceeding from the brain to the spinal centers of the detrusor and sphincter

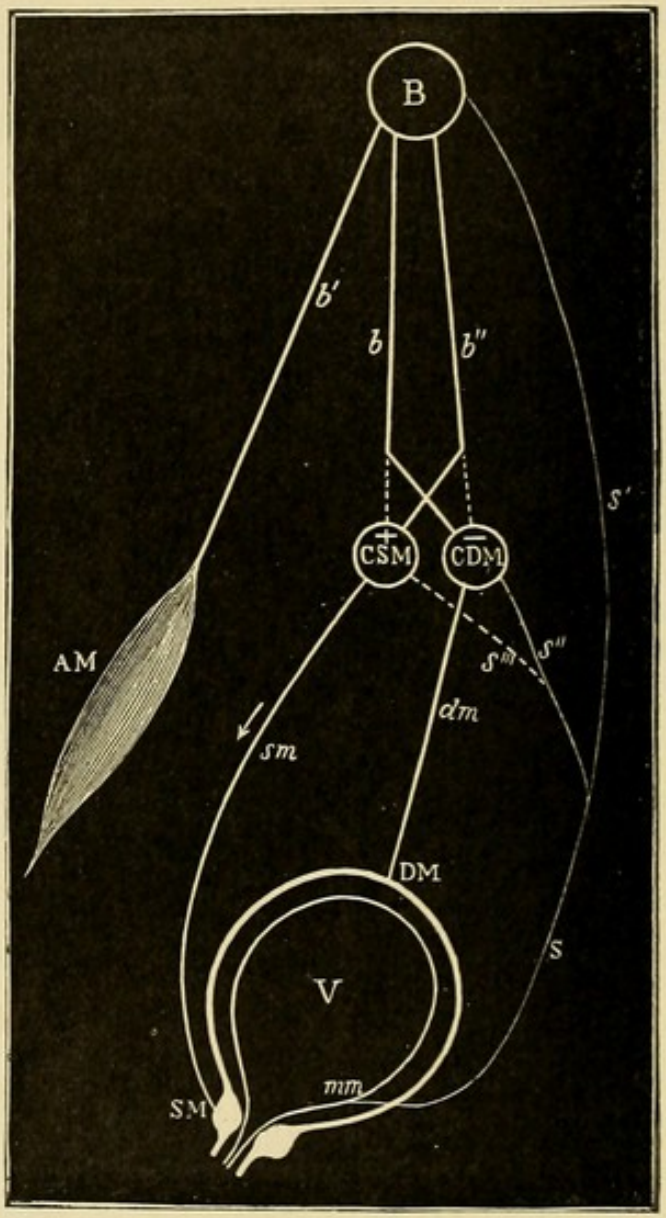


Fig. 174.—The mechanism of urination. (Bramwell).

muscles. An impulse from the brain through *b* inhibits the sphincter center (dotted line) and excites the detrusor center. *b''*, nerve filament proceeding from the brain to the spinal centers of the sphincter and detrusor muscles. An impulse along *b''* strengthens the sphincter and inhibits the detrusor center. *b'*, nerve filament from the brain to the abdominal muscles.

Fig. 175 is a diagrammatic representation of the parts concerned in the process of micturition while in action.

The bladder (V) is full of urine. The mucous membrane (*mm*) is stimulated, an impulse is generated, and is carried by the sensory (centripetal) nerve (S) to the brain (B), and to the spinal centers for

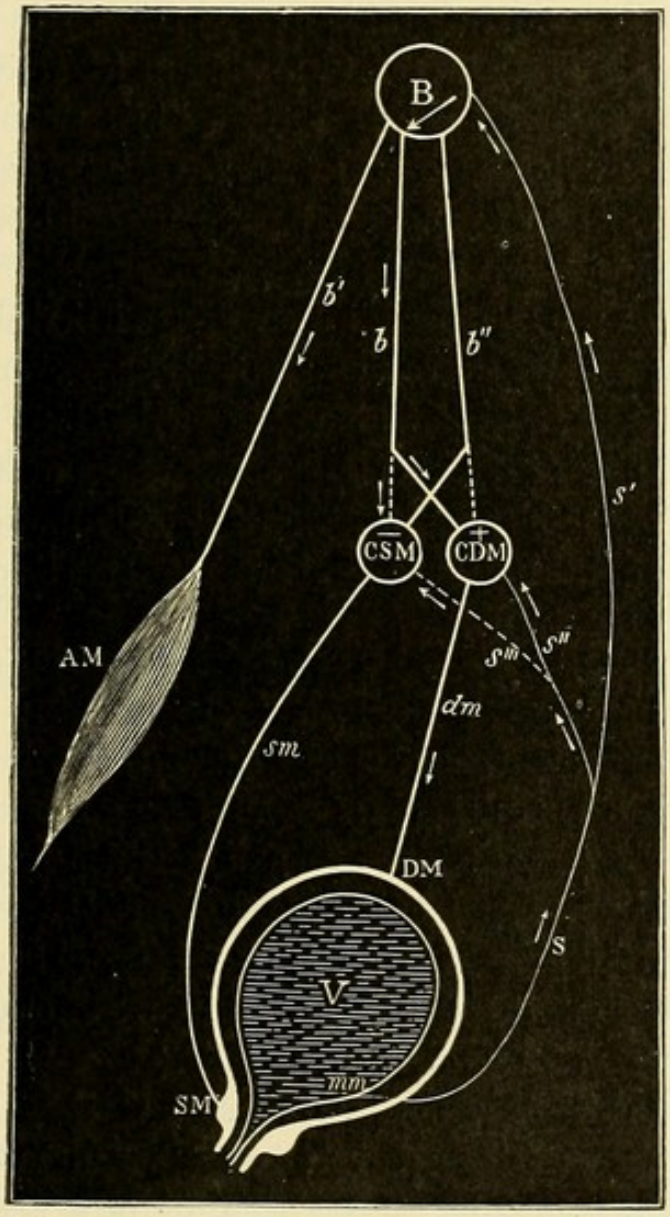


Fig. 175.—The mechanism of urination. (Bramwell).

the detrusor (CDM), and sphincter (CSM). From the brain an impulse is sent (1) along the nerve (*b*) which strengthens the action of the detrusor center (CDM), and inhibits the action of the sphincter center (CSM); (2) along the nerve (*b'*) which throws the abdominal muscles (AM) into action.

The reflex impulse which has passed from the mucous membrane

of the bladder to the spinal cord, excites the action of the detrusor center, and inhibits the action of the sphincter center.

The final result is contraction of the detrusor muscle (DM), relaxation of the sphincter muscle, (SM); and the expulsion of urine. The arrows indicate the direction of the nerve currents.

The conditions upon which retention of urine of nervous origin depend is well represented by these diagrams. An impulse from the brain is sent to the detrusor center inhibiting its action; or else the same stimulus increases the action of the sphincter center, or perhaps both effects are produced. The result is that the sphincter closes so firmly that the detrusor cannot overcome its resistance, and the individual is unable to void his urine.

Theoretically we would expect diseases due to irritability or paralysis of the sensory and motor nerves. Practically, however, we only have to do with the following conditions: 1. irritability of the sensory nerves; 2. irritability of the motor nerves; 3. paralysis of the motor nerves; 4. atony of the bladder, a malady which although it really has nothing to do with nervous diseases, is usually classified among them.

1. IRRITABILITY OF THE SENSORY NERVES OF THE BLADDER.

There is a malady dependent upon irritability of the sensory nerves of the bladder, which because of its obscurity and its want of objective symptoms has received various names, among which may be mentioned hyperæsthesia vesicæ, cystalgia, **irritable bladder,** and neurosis or neuralgia of the bladder.

This disease is characterized by total abscence of objective changes. Cystitic phenomena cannot be detected either by urine analysis or by cystoscopy. Urgency of urination, which at times becomes most imperative, is present. The patient is compelled to void his urine every half hour, or it may be every fifteen minutes, at times expelling a large quantity, at other times very little. The circumstance which separates this strangury from all other forms is, **that it is present only during the day.** At night the patients sleep without having to urinate more frequently than a well person.

Pain is commonly present, and it may occur simultaneously with micturition or exist independently thereof. The pain present between the acts of micturition is situated over the bladder and radiates toward the perineum, thighs and anus; that which occurs during micturition

is ordinarily located in the penis, and not uncommonly is felt at the end of the organ.

Another important symptom is polyuria. As much as four liters [one gallon] of urine may be voided in a day. It is as light as water, being a true "spastic urine" (urina spastica). The introduction of an instrument shows that the bladder is not so sensitive as it is in diseases having a material basis, such as calculi, inflammation, etc. The capacity of the bladder is well preserved, so that from 300 cc. to 500 cc. [10 to 16 fluid ounces] of water can be injected into it without causing a desire to void. The strangury and pain are very obstinate and do not readily yield to treatment. This is one of the characteristics of the disease.

In respect to diagnosis it may be repeated that all cases in which any material cause for strangury or pain can be demonstrated do not come under this heading. In the female prolapse of the vaginal wall or displacement of the uterus may give rise to these symptoms. Hæmorrhoids, disease of the pelvis of the kidney, and chronic prostatitis may also produce them, but in contradistinction to those produced by irritability of the bladder they disappear when the cause is removed.

Contraction of the meatus urinarius is the sole physical abnormality which I have ever been able to hold responsible for this condition. In such cases the neurosis is easily cured by slitting the meatus and keeping it open by means of proper sutures.

Even in those cases in which no cause can be determined the symptoms may often be alleviated or controlled, although they are likely to recur. Hot sitz-baths, the use of the thermophore either externally or in the rectum, morphine or belladonna internally, or better still small clysters composed of antipyrine, phenacetine, or pyramidon, with 10 to 20 drops of laudanum, exert a favorable effect. Occasionally good results are obtained by electricity, one electrode being placed over the bladder and the other on the perineum; or one may be introduced into the bladder, which has previously been filled with sterile water, and the other laid over the bladder.

2. IRRITABILITY OF THE MOTOR NERVES OF THE BLADDER.

The disease caused by motor irritability of the bladder has also been variously denominated. Spasm of the neck of the bladder, **vesical spasm,** (**cysto spasmus,**) stammering of the bladder, and contracture of the neck of the bladder are some of the names which

have been applied to it. An attempt has been made to distinguish spasm of the neck of the bladder from spasm of the body, and to differentiate between a transitory and permanent spasm. That which is generally meant by the term spasm of the bladder is a spastic contraction of the neck of the viscus. Contraction of the body of the organ will be considered under enuresis.

Spasm of the bladder is characterized by difficulty of micturition. The bladder seems as though closed, the stream of urine is as small as if a tight stricture were present, and at times it is interrupted; at other times the patient can expel only a few drops of urine. These symptoms exist without there being any narrowing of the urethra or any disease of the prostate. The introduction of a sound readily shows that neither of the latter conditions are present.

One result of these powerful contractions of the bladder is the retention of a large quantity of urine, which produces pain in the suprapubic region and the penis. The condition is analogous with retention due to stricture, or to displacement of the neck of the bladder by an enlarged prostate.

It is unusual for the peripheral portions of the motor nerves to be affected, it being generally the motor centers in the spinal cord, or their centrifugal tracks which are at fault. Thus it is that the condition is observed in myelitis, spondylitis, tabes, multiple lateral sclerosis, and hysteria, as well as in association with tumors which press upon the cord. The vesical spasm to which we alluded under stricture of the urethra is due to irritability of the peripheral tracks.

Those cases which have been referred to as **stammering of the bladder** are not caused by organic disease, but by transitory irritability of the motor nerves supplying the sphincter, or of the motor centers. The subjects of this complaint cannot void their urine freely, but pass it a little at a time, micturition being frequently interrupted. This comes to pass especially when they try to urinate in the presence of others; then their power to void may fail entirely. Even when alone they experience great difficulty and are forced to make strenuous efforts even to partly evacuate their bladder. At times, however, they can urinate with the utmost freedom.

The treatment of these vesical contractions and spasms is identical with that of the disease by which they are produced. It is more satisfactory than one would be led to believe from the nature of the causative maladies. Spasm due to stricture is readily overcome by

passing sounds, and that due to tabes and spastic spinal paralysis is notably benefited by the same procedure. I have seen a great many who could not pass a drop of urine become able to urinate after a short period of catheterization. Recurrences are bound to take place, for the reason that it is almost impossible to overcome the primitive cause of the evil.

3. PARALYSIS OF THE MOTOR NERVES OF THE BLADDER (PARALYSIS AND PARESIS OF THE BLADDER).

Paralysis of the motor tracks which lead to the bladder may affect the peripheral nerves or the central paths of conduction and the reflex centers. The results are the same. If only the tracks which go to the detrusor or the reflex centers governing it are affected, **complete retention of urine** follows. The detrusor is powerless to expel the urine, but the tonicity of the sphincter remains unimpaired. If the latter muscle loses its tonicity then incontinence is the result, and the urine constantly dribbles away. That portion of the urine, however, which lies below the level of the sphincter usually remains in the bladder. Under these circumstances **incomplete retention of urine results.** Thompson has correctly designated this condition as **overflow of the bladder.** As soon as enough urine collects to reach to the height of the sphincter a portion of it flows out through the relaxed muscle. It is self-evident that persons thus affected can urinate only when their bladder is full, and then only in the sitting posture, inasmuch as they expel the urine above the level of the sphincter by the help of abdominal pressure.

Very often merely partial paralysis is present. Not all the fibers or tracks are diseased, so that the power of the bladder to expel urine is not abolished, but only diminished. A portion of the urine is voided, but more or less is retained (paresis of the bladder). The power of the detrusor is measured by the quantity of urine remaining in the bladder after micturition; this quantity is called the residual urine.

If the tonicity of the sphincter is fairly preserved, but the detrusor paralyzed, a considerable quantity of urine will collect in the bladder. Although some of it is voided involuntarily, severe strangury may nevertheless occur, from which the patient can relieve himself only by making forcible efforts to urinate. This condition has been named **ischuria paradoxa.**

These paralyses of the vesical nerves may be caused by trauma (fracture of the vertebral column), in which case they are characterized by their acute onset. Compression of the cord by hæmorrhage or exudate, myelitis, hemiplegia, general progressive paralysis, tabes, and hysteria may all cause complete or partial paralysis of the bladder. The term *faux urinaires* has been applied by the French to persons affected with these latter forms of paralysis.

It is extremely important to remember that involuntary discharge of urine dependent upon partial paralysis of the bladder is often an initial symptom of tabes, and that the diagnosis of the latter disease may at times be made solely from the vesical symptoms.

Treatment is to be directed to the cause of the trouble. If the central disturbance can be overcome the vesical weakness will disappear. The prognosis is by no means bad in all cases. Patients frequently regain complete, or at least partial power, of voiding their urine. It is probable that this is brought about by increase of strength in the nerve tracks which have remained free from disease. Therefore the object of treatment must be to preserve as much as can be preserved.

The bladder must be relieved by regular catheterization, which must be practised under strict antiseptic precautions, as these cases of vesical paralysis are exceedingly susceptible to infection for the reason that the residual urine affords an excellent culture-medium for microörganisms. It is also a good idea to use slightly irritating vesical injections, for example, nitrate of silver 1:5000–1:1000 in conjunction with catheterization.

Large doses of strychnine are to be given, and electricity in the form of the faradic and constant current should also be tried. One electrode is placed on the perineum or over the bladder above the symphysis and the other, in the form of a metal sound covered, except as to its tip, with hard rubber, is passed into the bladder. If desired, one electrode may be inserted into the rectum instead of the bladder. The results, although transitory, at times confer considerable relief.

4. ATONY OF THE BLADDER.

Atony of the bladder is a condition which, although it seems very much like paralysis, is in reality altogether different, being due to partial or complete loss of contractility of the vesical musculature.

In paralysis of the bladder the inability to urinate depends upon disease of the motor nerve-tracks, in atony it is due to degeneration of the vesical musculature, the nervous mechanism not being affected.

It cannot be denied that the term atony of the bladder does not rightly express the condition above explained, and it would be better to speak of partial or complete degeneration of the muscles of the bladder; the name atony, however, has been adopted, the French school especially having used it to designate weakness of the bladder depending upon disease of the musculature in contradistinction to paralysis and paresis due to faulty innervation.

This impairment of the musculature most frequently is due to arteriosclerosis. Just as arteriosclerosis of the blood-vessels of the heart weakens the cardiac muscle, so likewise does arteriosclerosis of the blood-vessels of the bladder impair the vesical musculature, causing it to lose its power of contractility.

Another cause of this defect is persistent acute retention of urine producing overdistention of the musculature, as a result of which its power of contractility is more or less impaired. It thus comes to pass that after several of these attacks the patient can no longer empty his bladder. This condition is very common among prostatics. It is, of course, not caused by the prostate suddenly assuming such dimensions as to form a permanent mechanical obstruction to the outflow of urine, but rather to the fact that engorgement of the gland originally gave rise to retention of urine. After the acute exacerbations subside and the patient is still unable to void his urine, the circumstance is to be attributed to injury inflicted upon the vesical musculature by over-distention of the bladder.

I have also frequently observed atrophy of the musculature of the bladder for which there was no recognizable cause. It is interesting to note that in one of these cases there was also atrophy of the prostate. This atrophy manifested itself clinically by the occurrence of residual urine for which no other cause could be found.

Finally, severe parenchymatous cystitis, in which the inflammatory process extends through the entire thickness of the vesical wall, may result in this condition. Fortunately the inflammation generally confines itself to the mucous membrane and the subcutaneous fatty and connective tissue, but occasionally it involves the muscle and leads to sclerosis.

Treatment consists in the application of those measures which were

recommended for paralysis of the bladder. If possible the cause should be removed. Then strychnine internally, aseptic catheterization, irrigation of the bladder with silver nitrate solution, cold douches over the bladder, and electricity are to be considered. As the entire musculature is not often destroyed it frequently happens that the unimpaired portion can be strengthened by these means.

ENURESIS.

Enuresis, which may be either nocturnal or diurnal, deserves special consideration because of its frequency. As is well-known, this disease occurs almost exclusively among childern; it is rarely met with in adults. It occurs most frequently in children under eight years of age.

It is characteristic of this disease for the child, generally during sleep, to suddenly empty its bladder. Not a few drops are expelled, but the entire quantity of urine in the bladder is voided. Sometimes the child awakes, but at other times sleep is not interrupted and he does not know that he has wet the bed. The expulsion of urine does not occur only after the bladder has become full, but often takes place during the first hours of sleep, before much urine has collected. Some children urinate several times during the same night. During the day micturition may be entirely normal, although many children are obliged to satisfy a peremptory demand to make water or the urine will escape in their clothing.

The explanation of this malady is by no means easy. By some it is thought to be due to partial paralysis of the sphincter, by others to spasm of the detrusor; others again believe that it is caused by faulty development of the sphincter.

If the disease be considered from a practical standpoint, from the cases which we meet with in every-day practice, the theory of faulty development of the vesical sphincter must be relinquished. I have seen children affected with enuresis who were splendidly developed in every respect. I also believe that the theory of paralysis of the sphincter is untenable, for were the disease due to this condition the entire quantity of urine would not be voided at once, but the urine would trickle away slowly, and some would be found in the bladder after the bed had been wet.

I am of the opinion that enuresis is caused by spasmodic contraction of the detrusor muscle powerful enough to overcome the resistance of the sphincter. This disparity of innervation between the two sets

of vesical muscles, which is normal in infancy, persists during childhood, and constitutes an abnormal condition. While normally the contractions of the detrusor are held in check by the tonicity of the sphincter, in enuresis the conditions are reversed.

Upon what this disparity of innervation depends can frequently not be determined. Many cases occur in sensitive, irritable children, the so-called nervous children, if one cares to employ the expression. Rickets, chlorosis, and terror may act as predisposing causes. Exposure to wet and cold, fissure of the anus, worms, phimosis, balanitis, a very narrow meatus, and chronic constipation at times supply the cause for the abnormal irritability of the detrusor, which expresses itself in these involuntary contractions. Ill-breeding may now and then be responsible for the condition.

The prognosis is good, the disease either being overcome by treatment or undergoing spontaneous cure at puberty.

Treatment is very satisfactory. It is important above all else to ascertain the cause of the trouble. It is self-evident that the local abnormalities above mentioned which excite the reflexes of the detrusor must be overcome. A narrow meatus must be cut, a phimosed prepuce must be split open, balanitis must be cured. For rachitic and chlorotic children tonic treatment is indicated. The digestion must be regulated.

The diet must also be regulated. All stimulating foods, as well as those which produce flatulence, are to be avoided. The child should not be allowed to drink anything for an hour before retiring, and should be awakened once during the night and made to urinate. He should sleep upon a hard mattress and be only lightly covered. Sleeping upon feather beds is not permissible. Gymnastics, exercise in the open air, and the avoidance of mental overwork are indicated.

Of internal remedies belladonna, which is known empirically to diminish irritability of the bladder, accomplishes the most good. I have seen little good result from the use of other drugs which have been recommended.

[If the urine shows hyperacidity a mild alkali should be given. I have obtained good results with this treatment, and am led to believe that some cases depend upon vesical irritablity caused by abnormal acidity of the urine.]

It is well to elevate the foot of the bed so that the child may lie in a slanting position with the head downwards. By this means the urine will be forced away from the sphincter. It is not entirely clear

how this position exerts a favorable action, and the matter is not worth discussing. Of its value, however, I am convinced.

Faradization of the bladder from three to five times weekly is of considerable value. One electrode is placed over the bladder above the symphysis and the other is introduced into the rectum; as strong a current as can be well endured is turned on, and then its strength increased at short intervals for a few seconds, so that a strong electric shock is imparted. The slight transitory pain produced is more than counterbalanced by the good results which this method effectuates.

In cases in which all these measures fail dilatation of the urethra with as large instruments as the urethra will admit, and later with Oberländer's dilators, may be tried.

DISEASES OF THE PROSTATE GLAND.

ANATOMY AND PHYSIOLOGY.

The prostate gland lies between the symphysis pubis and the rectum, or, according to Kohlrausch, between two lines drawn from the tip of the coccyx to the upper and lower margins of the symphysis pubis, respectively. The upper and longer line touches the base of the gland, while the lower and shorter one strikes the apex. Thus it is seen that the base is above and the apex below.

The anterior surface, or *facies pubica* as it is sometimes called, is attached to the pubic arch by the pubo-prostatic ligament, the fibers of which are interwoven with numerous veins (plexus of Santorini); the posterior surface, or *facies rectalis*, is connected with the rectum by dense, non-fatty connective tissue in which there are no large vessels. The lateral surfaces are convex in shape and are covered by the anterior portion of the levator ani muscle.

The prostate, therefore, lies outside the pelvic fascia,—not within the pelvis, but in the layer of tissue which forms the pelvic floor; namely, the uro-genital diaphragm.

Strong bands of fibro-muscular tissue are found between the glandular portions, being continuous on the one side with the ligamentous fibers attached to the pubic arch and on the other side with the musculature of the bladder.

The urethra perforates the gland in such a manner as to make the larger segment lie below and the smaller one above.

In shape the prostate resembles a chestnut. It has an average weight of 15 to 20 grm. ($3\frac{3}{4}$ to 5 drachms.) Its greatest transverse diameter near its base is about 44 mm. (2 inches), its longest diameter from base to apex 34 mm. ($1\frac{1}{3}$ inches) and its greatest thickness about 15 mm. ($\frac{2}{3}$ of an inch).

The prostate is composed of a fibro-muscular and a glandular portion, the connective tissue and muscular fibers forming a net-work between the meshes of which the glandular substance is contained. The fibrous portion of the net-work extends toward the periphery of the gland and becomes lost in its capsule; the muscle fibers are more abundant near the bladder, where they have a circular arrangement,

being continuous with the musculature of the bladder. This aggregation of circular fibers, belonging partly to the prostate and partly to the bladder, has been named the internal sphincter of the bladder. The ends of the muscle fibers are continuous with the compressor of the membranous urethra, and with it form the so-called external sphincter of the bladder.

The glandular elements are not developed until puberty; they reach the height of their development during manhood, while in old age they atrophy and are replaced by connective tissue. The glandular substance is not evenly distributed throughout the organ; toward

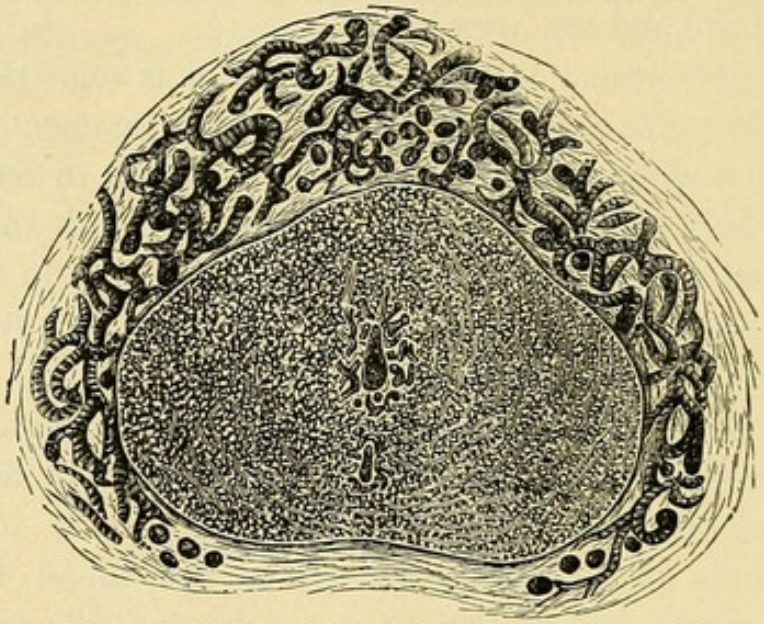


Fig. 176.—The periprostatic plexus. (Segond.)

the urethra there is a stronger development of muscle, while toward the rectum the glandular substance is more abundant.

The ducts of these glands unite to form larger ducts which have their outlet on either side of the verumontanum.

The fine blood-vessels which accompany the connective tissue septa are derived from the vesico-prostatic branch of the inferior vesical artery. The veins empty into the dorsal vein of the penis and the veins of the urethra. They form a plexus around the glands, the so-called periprostatic plexus, which may normally assume large dimensions (Fig. 176). The nerves come from the inferior prostatic plexus.

The prostatic secretion is a grayish-white fluid resembling milk and having an alkaline reaction. When seen under the microscope it looks like an emulsion. Numerous small drops of various size,

with epithelial cells lying between them, and a few lymphocytes or leucocytes scattered here and there are seen. Very seldom the stratified prostatic bodies, or corpora amylacea are met with; they are composed of concentric layers and contain granular substance in their interior.

It is supposed that the prostatic secretion maintains the vitality of the spermatozoa, and also vivifies those which have lost their vitality. If it is absent from the semen the fertilizing power of the spermatozoa is, according to Fürbringer, destroyed.

ABSENCE, ATROPHY, AND CYSTS OF THE PROSTATE.

Complete absence of the prostate is rare, occurring only when there are other defects of development in the urinary or generative organs.

In persons in whom both testicles were absent, and in cryptorchids, there has been complete absence of the prostate. Partial absence of the prostate is even rarer; a remarkable case in which the right half of the gland, together with the right colliculus seminalis, was absent in an otherwise well-developed infant has been reported by Beraud.

Luschka has reported an instance in which a portion of the gland was separated from the rest. In this interesting case a gland exactly like the prostate was found on the dorsum of the penis 2 cm. in front of the line of union of the corpora cavernosa This was supposed to be a misplaced middle lobe of the prostate.

Atrophy of the prostate is an affection which has been especially studied by Englisch. Occasionally an atrophied prostate is met with as a congenital malformation. Of greater interest are those forms which are associated with destruction of the testicles. If atrophy of the testicles occurs before puberty the prostate does not develop; if it occurs after puberty an atrophy of the gland begins, which, according to my observations, affects only the glandular substance, the connective tissue remaining intact.

In wasting diseases the prostate may undergo atrophy the same as other organs (Thompson).

Long-continued pressure upon the prostate gives rise to the so-called compression atrophy. With the exception of the rare cases in which tumors of adjacent organs compress the prostate, the usual cause is a tight stricture of the urethra, as a result of which the urine becomes dammed up behind the stricture and exerts continous pressure

upon the prostate. It is for this reason that prostatic hypertrophy so seldom occurs in men having pronounced stricture.

Finally, in old age the prostate as well as other organs may atrophy under the influence of sclerosis, all the tissues, fibrous, muscular, and glandular, being affected.

As a result of weakness of the musculature of the gland, a portion of which is really identical with the musculature of the bladder, incontinence of urine gradually develops, at first manifesting itself only at night, but later persisting through the day as well. In contradistinction to the condition which obtains in prostatic hypertrophy there is no over-distention of the bladder, and consequently the dribbling of urine which occurs is not the incontinence of retention. There is, moreover, no residual urine in atrophy of the gland.

In very exceptional cases of atrophy, however, retention of urine may occur as the result of irregularities or folds in the relaxed sphincter, so that the clinical picture resembles that of prostatic hypertrophy. Differential diagnosis can be made by rectal examination, which will reveal the condition of the prostate.

The urgency of urination ordinarily present in atrophy of the gland is to be attributed to the pressure exerted by the process of contraction which is going on.

The defective tonicity of the sphincter favors the entrance of bacteria into the bladder, so that cystitis seldom fails to develop.

Impairment of sexual power is partly due to the age of the patients, but may perhaps also be furthered by the associated atrophy of the testicles.

The symptoms just described, together with rectal examination and the use of the sound, enable one to make a correct diagnosis. The urethra is shortened instead of being lengthened, as it is in prostatic hypertrophy, and the resistance encountered in the prostatic urethra in the latter affection is absent.

Treatment is not at all promising. The use of large metal sounds, and also faradization with one electrode at the sphincter of the bladder and the other in the rectum, is worthy of trial. Cases in which retention occurs must be treated by regular aseptic catheterization.

Cysts of the prostate are exceedingly rare. The little that we know about them we owe to the researches of Englisch.

There are small retention cysts of the sinus pocularis due to occlusion of its orifice. They are of special importance because it is very

probable that retention of urine occurring in the new-born is due to their presence. When the child is catheterized it is probable that the cyst is ruptured, as he generally is able to empty his bladder afterwards. Englisch states that this occlusion of the orifice of the sinus pocularis finds its analogue in the coalescence of the layers of the prepuce or its adhesion to the glans, a condition which is very frequently seen.

Other cysts are supposed to be formed from embryonic remnants. At first they are small, but if they persist they become large, and it is likely that the few large cysts of the prostate which have been observed resulted from the growth of these small congenital anomalies.

These cysts must, of course, be distinguished from cyst-like formations such as hydrops of the seminal vesicles and echinococcus and dermoid cysts, which are different both in origin and nature. Solid tumors of the prostate, and diverticulum of the bladder, as well as an overdistended bladder may be confounded with these cysts.

Differential diagnosis can be made by emptying the bladder with the catheter and simultaneously pressing upon the viscus both above the symphysis and through the rectum, and finally by exploratory puncture through the rectum. A diverticulum and a distended bladder, which when felt through the rectum give the impression of being cysts, disappear after catheterization and compression of the bladder, while cysts of the prostate are uninfluenced by these measures. Prostatic tumors when palpated through the rectum over a sound passed into the bladder feel different than cysts. Exploratory puncture with a capillary trocar, although it is not dangerous even should the bladder be punctured, should be undertaken only in cases of exigency.

As to treatment, single or repeated puncture will often suffice, but in some cases the cyst has to be incised.

INJURIES OF THE PROSTATE.

Injuries resulting from catheterization will not be considered under this heading as they have been discussed under false passages (*see also under hypertrophy of the prostate*). Injuries of the prostate caused by gunshot or stab wounds, by falls in which the perineum strikes against an angular object, by splinters of bone from a fractured pelvis, and by pointed foreign bodies introduced into the rectum are the ones which will here occupy our attention.

The symptoms of injury of the prostate vary according as the urethra

is or is not wounded. When the urethra is involved, even though the wound be slight, severe hæmorrhage results, and owing to the close proximity of the injured part to the rectum infection readily occurs and leads to the formation of periprostatic abscess. Both blood and urine are seen to ooze from the wound. This symptom, however, is not constant, for the blood may flow back into the bladder, and, moreover, the wound may be so small as not to permit the visible outflow of urine. A careful examination with the finger and the sound, together with rectal palpation, will reveal the true state of affairs.

These injuries are dangerous when the periprostatic plexus is wounded. The resulting hæmorrhage may be most difficult to control. Urinary infiltration and phlegmon, as well as inflammation of the neighboring parts, are liable to occur.

When the urethra is not involved in the injury treatment may be confined to the arrest of hæmorrhage. In case the urethra is wounded a retention-catheter must be introduced to prevent the urine from contaminating the wound, and the wound then treated in accordance with the usual rules of surgery.

INFLAMMATION OF THE PROSTATE.

Inflammation of the prostate seldom occurs as an idiopathic affection, but usually follows inflammation in the urethra, especially gonorrhœa, although simple inflammation associated with vesical catarrh or stricture of the urethra, or resulting from frequent or permanent catheterization, may extend to the prostatic ducts and cause prostatitis. A single catheterization, a stone-crushing operation, forced injections, vesical calculi, in short any injury in which infection may take place is likely to be followed by the same results. It is to be remembered that the urethra is the habitat of bacteria which may become virulent when injury is inflicted.

Excesses in venery, and especially frequently repeated masturbation, as well as external injury such as severe jarring caused by bicycling or riding, may produce congestion of the urethra and prostate; as a result of the action of urethral microörganisms this condition is converted into one of inflammation.

In comparison with prostatitis due to extension of a catarrhal or suppurative process in the urethra this form is very rare. It is also rare for the prostate to become inflamed as the result of extension of

disease from neighboring organs, as for example, from the rectum or its surrounding tissues.

Finally, it must be borne in mind that suppuration in the prostate may occur in certain constitutional diseases, such as pyæmia, typhus fever, parotitis, angina, pneumonia, etc.

Inflammation of the prostate may be either acute or chronic.

ACUTE PROSTATITIS.

With the exception of metastases and the exceptional cases in which acute prostatitis follows injury of the urethra, the disease is caused exclusively by gonorrhœa, or to use a more general term, by urethral catarrh. In every case of gonorrhœa, and in any and every stage of the disease, this complication may develop.

There are different forms of acute prostatitis depending upon the extent and intensity of the inflammation.

The mildest form is **catarrhal prostatitis.**

Ghon, Schlagenhaufer, and Finger have shown how quickly the gonococci penetrate the epithelium of Littré's glands and Morgagni's crypts. They enter the orifice of the prostatic ducts with equal facility and produce suppuration and exfoliation of the epithelium the same as upon the surface of the urethra. The inflammatory process remains localized in the ducts, or in the glands immediately surrounding the caput gallinaginis.

The disturbance caused by this, the lightest form of the disease, is relatively mild. The symptoms of posterior urethritis predominate. Strangury and painful micturition are ordinarily of moderate degree. If the urine is voided in three portions all three will be found slightly turbid or flocculent. In the last glass comma-shaped bodies will frequently be seen; they are composed of masses of pus-cells which are expelled from the prostatic ducts. Gonococci are often found in them. The general health is little disturbed. Rectal examination reveals no changes in the prostate for the reason that the substance of the gland is not affected. Even though the posterior urethritis is cured the prostatic inflammation usually persists and becomes chronic.

From this affection the so-called **follicular prostatitis** differs little except in intensity, the causes of both forms and their manner of development being the same. The prostatic ducts and the superficial glandular structures become engorged with pus, or their orifice

even occluded, so that small abscesses are formed, which are known as follicular, or pseudo-abscesses, because they develop in a natural cavity.

The symptoms in this form of the disease are somewhat more severe than in the catarrhal form. The strangury is considerably more severe, and the pain increases during micturition, being felt especially at the end of the act. The urine is flocculent or cloudy and the previously mentioned comma-shaped bodies are seldom absent. Rectal examination rarely reveals any abnormalities, although some authors state that they have often felt indurated, sensitive nodules the size of a hemp-seed.

The general health is not materially deranged. The patients suffer from urgency of urination and pain, but are usually free from fever, and able to maintain their ordinary activity.

This follicular prostatitis terminates either by gradual absorption of the purulent exudate, in which case both strangury and pain subside and the urethritis simultaneously improves, or the inflammation progresses, the abscesses coalesce, and the deeper parts of the prostate become involved. The condition which then obtains is known as **parenchymatous prostatitis.** In this form either the entire gland, or at least portions of it remote from the urethra, is affected. The extension of the process first shows itself by a serous infiltration of the entire organ, a condition of congestion, as the result of which the gland becomes swollen and œdematous. The enlargement is readily detected by palpation through the rectum; the swelling may be either unilateral or bilateral. Pain upon pressure is not very severe. The patient experiences a sense of pressure in the perineum and at the anus, as though there were a foreign body in the rectum. Micturition is slightly painful and the stream somewhat impeded. The general health begins to suffer, but fever may be entirely absent.

If the serous infiltration and engorgement subside the symptoms improve and the patient may entirely recover. Usually, however, the morbid process advances, small-celled infiltration occurs in and around the glands, and small follicular abscesses, the same as those already mentioned, develop and become confluent owing to destruction of the connective tissue stroma.

Simultaneously with the advance of this morbid process the symptoms become intensified. High fever may be present, but again the patient may be entirely free from fever. The general health, however,

is always impaired; the appetite is poor, the tongue dry, dysuria and pain upon urination increase in severity, and there is an unbearable feeling of heaviness and fullness in the perineum and rectum, which may become so severe as to amount to sharp pain. Defecation causes great pain, and palpation of the prostate through the rectum gives rise to most exquisite suffering. Even the passage of the finger through the sphincter is excessively painful. The gland is hard and swollen, the enlargement occurring in whichever direction the inflammatory process extends.

If resolution occurs, which is not uncommon, the symptoms gradually become less and less intense; micturition becomes free and less painful, evacuation of the bowels less difficult, the appetite returns, and the general health improves.

In other cases the destructive process of suppuration advances and **prostatic abscess** is the result. The disease is then manifested by the most severe symptoms. The patient presents the appearance of being desperately ill, being completely prostrated and unable to take nourishment. The tongue is dry and coated and micturition is difficult or impossible. Complete retention of urine necessitates regular catheterization, which increases the discomfort felt in the perineum and rectum. The bowels will not move without the use of purgatives or enemata, and when a passage is secured it is attended with great pain. Palpation through the rectum reveals the presence of a fluctuating mass. This latter condition, however, does not invariably exist, for it may happen that the suppuration does not extend in the direction of the rectum. Thus it may be, especially in those cases which come under observation early, that the prostate is felt as an indurated, enlarged body. Pus may be present in the interior of the gland, but there is no fluctuation.

In such cases the surgeon must endeavor to determine from the clinical picture whether suppuration is or is not present. It is important to remember that fever is not an intrinsic part of the symptom-complex. I have seen more prostatic abscesses run their course without fever than I have seen accompanied by it. Puncture through the rectum is permissible as a diagnostic measure. It is performed by plunging a guarded capillary trocar into the portion of the prostate in which pus is suspected. A finger in the rectum guides the point of the instrument and prevents it from penetrating a pulsating spot. I have never seen any harm follow such puncture. Very often doubtful

cases have been cleared up by obtaining pus with a syringe attached to the end of the trocar.

If the process be left to itself it usually progresses until it results in complete destruction of the gland, which becomes converted into a large suppurating cavity. Fortunately, however, rupture generally occurs before this extreme condition is reached. The abscess most frequently breaks into the urethra, rupture either taking place spontaneously or resulting from catheterization necessitated by retention of urine. Rupture may take place through the perineum or into the rectum; or what is less frequent, the abscess may break into the ischiorectal fossa, into the groin, or through the obturator foramen Rupture into the abdominal cavity is an occurrence of the greatest rarity.

Rupture is usually immediately followed by relief. Micturition and defecation become easier, pain and tenesmus disappear, and the patient's general health improves. After spontaneous rupture, however, it is not uncommon for the opening to become closed again, and for retention to recur as the result of closure. The symptoms then return but they usually are less severe than during the primary period of suppuration, inasmuch as fresh rupture generally occurs from time to time. The final result of these spontaneous ruptures is chronic prostatitis.

If the first rupture causes a sufficiently large opening healing may take place. The abscess cavity becomes smaller, fills with granulation tissue, and a scar finally forms which can be felt as a depression when the gland is palpated through the rectum.

Sterility may follow suppuration of the prostate. It is caused in either one of two ways. The entire gland may suppurate so that its power of secretion is lost, in which case, provided Fürbringer's theory that the prostatic juice maintains the vitality of the spermatozoa is correct, the semen will be devoid of the power of fecundation. According to my experience, however, sterility is not often produced by suppuration, enough of the gland evidently being preserved to maintain the vitality of the spermatozoa. A large number of my patients who had prostatic abscess were later blessed with children.

The second way in which sterility may result is of more importance. It may come to pass that the vas deferens may be so constricted by the formation of scar-tissue in the prostate that its lumen becomes obliterated; the vas may also be obliterated by extension of the inflammatory process to its interior.

Acute prostatitis may run a very dangerous course when the connective tissue between the prostate and rectum becomes involved in the morbid process. **A periprostatic phlegmon,** or even **periprostatic phlebitis with thrombosis of the periprostatic venous plexus and consequent pyæmia,** may then result.

When a periprostatic phlegmon develops the symptoms become much worse. High fever and chills are always present, the temperature rising as high as 41° C. [105.8° F.]. The well-defined outline of the prostate can no longer be felt through the rectum as is the case when the inflammation remains confined to the gland itself. The contour of the gland is lost. The infiltration extends upwards and also laterally along the anterior wall of the true pelvis. The wall of the rectum is no longer movable over the prostate, but seems adherent to it. The termination of this condition cannot be foretold. There is danger of sepsis, although rupture of the phlegmon into the rectum is a more frequent termination. Urethro-rectal and vesico-rectal fistulæ occasionally result from this rupture.

The very uncommon phlebitis of the periprostatic plexus is an even more serious complication. The severest constitutional symptoms are present, the patient showing the typical signs of violent sepsis. In one such case Noguès palpated a hard, irregular tumor through the rectum which felt like a mass of thick cords. This case progressed to cure; as a rule, however, the prognosis is very bad.

The treatment of acute prostatitis varies according to the degree of severity of the disease.

In the mild forms, that is, the catarrhal, the follicular, the parenchymatous, and likewise in the beginning of serous infiltration, or even when small miliary abscesses have formed, antiphlogistic measures are to be employed. Rest in bed, light diet, regulation of the bowels, discontinuation of all local treatment of the gonorrhœa, leeches to the perineum, hot sitz-baths, and hot-water bags to the perineum are the appropiate measures. The application of heat to the perineum causes hyperæmia of the external parts and thereby relieves congestion of the prostate. I do not favor the application of heat to the rectum by means of the psychrophore.

For severe pain the narcotics are indicated. If retention of urine occurs, the patient must be regularly catheterized, and his bladder washed out with silver nitrate solution 1:2000. I always employ soft instruments (Nélaton's). The prostatic urethra is usually narrowed

by the swollen prostate, so that a metal catheter cannot be readily passed. For internal administration I advise small doses of salicylic acid (1.0 a day). This treatment usually arrests the disease.

If suppuration has occurred before the case comes under observation, an incision must be made at once, in order to prevent further destruction of the glandular substance.

In general it may be stated that the gland should be incised from the nearest point to the focus of suppuration. If the perineum is swollen the incision should be made there; if the suppurative process has extended toward the rectum, then the abscess may be opened by the rectal route, after the mucous membrane of the rectum has been carefully cleansed and the bowel above packed with iodoform gauze. The abscess may also be opened through a prerectal incision; the latter procedure has the advantages that it can be performed under strict asepsis and that the rectum is not involved in the wound.

By whatever method the abscess is opened healing will take place. I have treated innumerable cases of prostatic abscess due to urethral infection and have never lost a case, although I have had two fatal cases of prostatic suppuration occurring as a complication of prostatic hypertrophy. Both were in old men.

The prognosis of abscess of the prostate, then, is good in young persons, in whom it follows urethral infection; in old men affected with purulent vesical catarrh there is little chance of cure.

CHRONIC PROSTATITIS.

The etiology of chronic prostatitis is the same as that of the forms already discussed, for all the causes which produce acute or suppurative prostatitis may also give rise to the chronic form of the disease if the injurious influence is exerted in a slower and less violent manner. Thus it is that gonorrhœa, stricture, cystitis, vesical and prostatic calculi, hypertrophy of the prostate, injury with catheters and sounds, and excess in venery (onanism) cause chronic inflammation of the prostate. In other cases, acute prostatitis, though apparently cured, gradually passes into a state of chronicity.

The frequency of chronic prostatitis is very great. Although Fürbringer denies this, further investigation has shown that it is correct. These conflicting views, to which we shall again refer, are due to the difference of opinion as to what constitutes chronic prostatitis.

Considered from the standpoint of morbid anatomy several different

conditions may be included under the term. The simplest of these is a desquamative, or desquamatory-suppurative, inflammation of the prostatic ducts. This is merely an extension of the urethral inflammation to the surface of the ducts, the deeper portions being uninvolved. It is a superficial catarrh affecting the ducts and some of the glandular structure nearest the caput gallinaginis. The acini are filled with desquamated squamous epithelium and leucocytes; there are, however, no changes in the walls.

Conditions become altered if the inflammation penetrates deeper and attacks the walls of the acini and ducts. A glandular and periglandular infiltrate is then poured out, leucocytes and epithelioid cells permeating the parietes of the acini and invading the surrounding tissue. The epithelium lining the acini shows cloudy swelling, and the nuclei take stains poorly or not at all. In this stage of small-celled infiltration the prostate is soft and saturated with serum, and upon section is found to be of a dirty brown color. The walls of the ducts are thickened and their orifices distended.

In certain portions of the gland it will be found that the formation of connective tissue has already taken place. Part of the glandular substance is completely destroyed, the prostatic ducts are dilated, and small cavities filled with turbid, milky, or even purulent fluid are observed. The connective tissue between the acini seems more abundant than it is under normal conditions, and looks like broad bands of indurated scar-tissue. If destruction of the glandular substance progresses, cavities separated from one another by bands of scar-tissue are formed.

In accordance with these anatomic changes, catarrhal, sero-purulent, infiltrative, parenchymatous and sclerotic forms of chronic prostatitis might be distinguished, but it is not advisable to make such a distinction, for the reason that the different processes cannot be discriminated clinically, and also because they often exist simultaneously. Certain portions of a prostate may show nothing but beginning catharrhal inflammation; in other parts cysts with sclerotic walls are observed, and in still others small-celled and serous infiltration are perceptible.

Symptoms and Diagnosis. It is important to know that a large number of cases of chronic prostatitis are entirely without symptoms and can only be discovered by examination of the prostatic secretion.

The mild form in which only the ducts and neighboring acini are affected, and in which subjective symptoms as well as abnormalities

of the prostate as determined by rectal palpation are wanting, can rarely be diagnosticated. It is only in the case of patients who are examined because they are worried by the persistence of filaments in their urine after the subsidence of an attack of gonorrhœa that this condition is discovered; in such cases it will be found to exist with very great frequency. I do not place the percentage too high when I state that it is present in 85 per cent of all cases of chronic posterior urethritis.

It can be recognized only by massaging the prostate after the urethra has been cleansed, which may be done either by the patient allowing his bladder to become well filled and then forcibly expelling the urine and thereby washing away all the secretion from the urethra, or by irrigating both anterior and posterior urethra with sterile water until the fluid comes away clear. I do not advise the latter method because it causes slight trauma, so that many leucocytes will be found which otherwise would not be present. It is better, if the bladder does not contain enough urine, to inject sterile water and then let the patient expel it. By this means all the secretion will be washed away and the prostate can then be massaged.

In contradistinction to the normal prostatic fluid, which shows only epithelium, lecithin-bodies, with here and there a lymphocyte and occasionally a laminated prostatic body, the secretion thus pressed out contains red blood-corpuscles and a greater or less number of pus-cells, which are either free or lie between closely adjacent layers of epithelium. In order to be certain that these pus-corpuscles come from the prostate the urethra must have been previously cleansed.

The presence of pus-cells in the prostatic fluid is often the only abnormality which can be detected. As this method of examination is practised only in exceptional cases, it is readily seen why Fürbringer is of the opinion that prostatitis is a comparatively rare complication of gonorrhœa, whereas I believe it to be present in almost all cases of long-standing urethral catarrh.

There are similar cases in which the only sign of disease is occasional cloudiness of the urine. This cloudiness is caused either by pus or by bacteria, or in some cases by both. When a person thus affected is placed under treatment and his bladder irrigated with silver solution, his condition soon improves; the urine becomes clear, but in a short time the turbidity recurs. If the pathogenesis of these cases be sought, the prostate massaged and its secretion examined, it will be found

that the secretion contains pus. The condition will then be plain. As soon as the bladder is disinfected clear urine is voided; when treatment is stopped, however, reinfection takes place from the purulent and germ-laden secretion of the prostate.

Although this class of cases constitute the majority, yet there are others in which subjective symptoms are present, and in which other objective symptoms than turbidity of the urine exist.

The subjective symptoms consist in slight strangury, painful micturition, especially at the termination of the act, a feeling of heaviness and fullness, together with a sensation of itching in the perineum and rectum, and pain upon defecation. Sexual intercourse and pollutions are also painful. In addition to these symptoms many nervous phenomena occur, but they undoubtedly owe their existence to a concomitant neurosis rather than to the prostatitis. The patients believe that their sexual power is impaired; cohabitation is difficult or impossible, ejaculation occurring too soon, or at times taking place even before intromission can be effected. Frequent emissions, pain in the back, and irritability of temper are constant manifestations. In general it may be stated that this condition, which can give rise to severe hypochondria, is to be attributed to the fact that the patients believe themselves to be sicker than they really are. No material basis for their symptoms can be found, and, moreover, the readiness with which their condition improves under proper treatment shows that their trouble is largely imaginary.

The idea that **prostatorrhœa,** a condition in which the prostatic fluid is discharged during defecation or micturition, or independently thereof, is a sign of prostatitis, must be relinquished. The two have nothing in common. There are many cases of prostatorrhœa in which the secretion contains no pus, and, on the other hand, there are many cases of prostatitis in which no signs of prostatorrhœa are present. They may, however, be coexistent. As a rule, prostatorrhœa is due to relaxation of the prostatic ducts. This diminution in muscular tonicity is often referable to a previous gonorrhœa, which has extended to the ducts and caused a thickening of their walls which keeps them from coming into close apposition. This relaxation may also be caused by masturbation.

I desire to call attention to a symptom of this malady which is little known, namely, the occurrence of residual urine in young men in whom no cause for its existence is to be found. It is probably due

to contraction of the sphincter caused by the prostatic trouble, as a result of which the bladder cannot completely empty itself.

I have frequently observed another important symptom in chronic prostatitis which was first described by Ultzmann, that is, the expulsion of sandy masses with the last drops of urine. They are sometimes of large size, so that they cause considerable pain. They are composed of phosphate and carbonate of lime which incrustate pus-cells, and also are voided by themselves, appearing as free amorphous masses when viewed through the microscope. These calcareous particles are forced out of the excretory ducts of the prostate into the urethra by contractions of the sphincter. It is generally conceded that phosphaturia is frequently associated with prostatorrhœa.

Finally, there remains to be mentioned as important objective symptoms, the results obtained by palpating the prostate through the rectum. In those cases in which nothing but a superficial catarrh of the excretory ducts of the prostate is present—cases to which Fürbringer does not even apply the term prostatitis—it is evident that no deviations from the normal will be elicited by palpation.

In other cases, however, it is plainly recognized that the gland is enlarged either in its totality or in single portions. Projecting areas alternate with even surfaces and with depressions which manifestly correspond to places in which contraction has superseded loss of substance. The consistency is not uniform, being hard in some portions and soft in others; the soft areas represent parenchymatous degeneration, the firm portions cicatricial contraction. The surface of the gland, as already stated, is seldom even as in health, but irregular and rough. Nothing definite can be stated as to painfulness. Palpation of a normal prostate is painful, but I have examined many patients with prostatitis in whom the normal sensibility was not increased.

The same may be said of urethral examination with metal sounds. As healthy persons are frequently very sensitive to this manipulation it is difficult to determine whether the sensibility manifested by the subjects of prostatitis is or is not in excess of the normal.

The endoscope imparts no information, because its introduction into the posterior urethra produces so many artificial conditions that it is impossible to discriminate between that which is extrinsic and that which is due to the prostatic inflammation. Moreover, nothing can be learned of conditions beyond the orifice of the prostatic ducts.

I advise against this method of examination; it is injurious instead of advantageous.

Cystoscopy, on the other hand, reveals characteristic changes at the vesical sphincter. The border is not even as in health, but uneven and fringed, showing prominences and large arches. These abnormalities are due to the fact that the irregularly enlarged prostate has here and there distorted the mucous membrane covering the sphincter.

Treatment. The treatment of chronic prostatitis is not an easy task. As concerns the milder forms which give rise to no symptoms, and which are brought to light only when examination of the filaments voided with the urine is made, treatment is required only when the nature of the filaments is such as to demand its institution. If the filaments consist of epithelial cells and a few leucocytes, and if repeated examination shows them to be free from microörganisms, no treatment is necessary. Too much attention to the condition of these patients leads them to believe that they are afflicted with a serious malady, and thus makes them nervous. These, the mildest forms of chronic prostatitis, may persist for years without occasioning the slightest harm.

If, on the contrary, the secretion of pus from the prostate be so great as to cause the previously described intermittent pyuria and bacteriuria, then, of course, treatment is indicated. It consists in regular irrigation of the bladder with nitrate of silver solution 1:5000–1:1000, or sublimate solution 1:10000, and massage of the prostate.

Massage of the prostate is the most efficient means we possess for treating chronic prostatitis. Because of the inaccessibility of the prostate it is evident that a suppurative process affecting the organ will be very difficult to influence. By regular massage and expression of the secretion, which, however, must be continued for months, the process can be much ameliorated, and occasionally entirely cured.

At first massage is painful and therefore must be sparingly practised. As soon as the patient becomes accustomed to it, however, sufficient pressure may be exerted to force large quantities of prostatic fluid out into the urethra. In comparison with massage all other measures play a subordinate rôle.

The causative conditions must also be treated. Strictures, urethral discharges, purulent vesical catarrh, calculi, and any other abnormal condition must be attended to. Treatment of the urethra, however, must not be continued too long. It is justifiable only as far as it is

directed to the removal of the condition which is responsible for the prostatic trouble, and when this condition is overcome then the urethral treatment should be stopped, for it will not cure the prostatitis. An exception to this rule is to be made concerning cauterization of the colliculus seminalis and its environs, as a few caustic applications to this region exert a very favorable action, especially in the forms associated with prostatorrhœa, precocious ejaculation, and uncomfortable sensations in the posterior urethra and perineum.

I have not seen any great results from medication, either from the internal use of drugs or from local applications in the form of suppositories. The use of ichthyol and iodine, particularly the latter, appears to me to be the most rational. Suppositories of iodine and potassium iodide may be prescribed, and their employment continued for months. In order to preserve the bladder from infection by the frequently discharged purulent masses it is well to let the patient take 0.5 [7½ grains] of urotropin three times a day.

If the pain becomes intolerable narcotics may be occasionally used, but caution should be exercised in giving them, the same as in all other chronic diseases, lest a drug-habit be superimposed upon the already existing trouble. As a rule, the pain is not so severe as to call for the administration of narcotics. In most cases it can be controlled by antipyrine, phenacetine, and pyramidon, the last of which exerts a particularly sedative action.

As local measures I recommend the injection of hot saline solution, or the introduction of a heat-diffusing apparatus into the rectum, the use of the thermophore catheter in the urethra, and faradization of the prostate.

The hot injections are made of 200 cc. [7 fluid ounces] of water as hot as the rectum can endure, to which are added salt, Kreuznacher salt, and Darkauer iodine-bromine salt in increasing quantities. They produce very little irritation of the rectum.

If a more protracted action of heat be desired Finger's or Atzberger's irrigator may be used, by means of which a stream of hot water can be made to flow through the rectum. A more agreeable method of applying heat is by the use of a pear-shaped thermophore which I have had made, and which retains its heat from fifteen minutes to half an hour. This instrument has proved itself of service, especially as the patient can learn to use it himself.

Winternitz's urethral psychrophore may also be employed, but hot

water should be used instead of cold, the temperature being gradually increased until as high a degree as the patient can bear is reached.

Faradization of the prostate is performed by introducing one electrode into the rectum and placing the other over the pubes. Instead of the usual rectal electrode the rectal thermophore, which is also equipped for electrization, may be used.

By means of these various measures the subjective symptoms especially are greatly benefited; objective symptoms, however, are only slightly influenced. The most potent factor is massage, which gradually reduces the suppurative process, although the prostatic fluid will scarcely ever be found entirely free from pus-cells. A small amount of pus usually persists, but it can be left to itself, as it does no harm whatever.

Injections of carbolic acid into the prostate through the rectum, and cauterization with the Bottini instrument are dangerous and should not be used; for although prostatitis certainly is difficult to cure it is not a grave malady.

General hygienic measures are of value, particularly if nervous phenomena are marked. The relinquishment of work and residence in a sanitarium where mild hydrotherapeutic treatment can be obtained often have a very favorable effect. If the patient cannot afford this a general hygienic-dietetic cure may be undertaken at home. The diet should be regulated and simple food ordered. Highly seasoned food, as well as any which produces flatulence, should be interdicted. Daily evacuation of the bowels must be secured. The upper portion of the body should be massaged one day and the extremities the next. Sitz-baths of alternating temperature are useful for stimulating the circulation. The patient sits in a tub of water at a temperature of 35° C. [95° F.] and then hot water is added every minute or two until the temperature is raised to 42° or 43° C. [107.6° or 109.4° F.]. The next day water at a temperature of 40 C. [104° F.] is begun with and gradually cooled to 25° C. [77° F.].

All the above mentioned measures must not be employed indiscriminately, but used in moderation and for definite objects; otherwise we shall overtreat our patients and do them harm. It is as bad to overtreat them as it is to let them go untreated. It must be borne in mind that the disease is often of a nervous character, even though the changes in the prostate supplied the foundation of the neurosis; that we can only slightly influence the prostatic disease; that in many cases

it is self-limited; that in the anatomical sense it seldom is serious in its results, and that for these reasons our chief effort must be to convince the patent that he does not have a dangerous disease, but only a slight variation from the normal, such as often exists in other organs of the body.

HYPERTROPHY OF THE PROSTATE.

Hypertrophy of the prostate is such a common disease that there are practical reasons for according it special consideration.

Generally speaking prostatic hypertrophy consists in an increase in volume and alterations in form of the prostate gland, which normally is the size of a chestnut. What causes this increase in volume is a matter concerning which the most varied opinions are still held. The etiology and pathologic anatomy of the disease stand in such close relation to one another that they must be discussed together.

If we confine ourselves to that which experience teaches, we see that there are two kinds of prostatic enlargement, a hard and a soft, the first being due to hypertrophy of the connective and muscular stroma, the second to hyperplasia of the glandular elements. The condition, then, is one of idioplastic benign growth, that is, one in which only those elements normally present in the gland increase and multiply, thus differing from malignant tumors, which are characterized by their heteroplasia.

We distinguish three forms of prostatic hypertrophy:—1. the circumscribed or nodose myomatous; 2. the diffuse myomatous; 3. the adenoid or glandular.

These three forms present characteristic differences when examined macroscopically, and these differences are also observed when the gland is studied microscopically.

In the first form, the **hyperplastic myoma of Virchow,** the cut surface of the gland shows well-marked protruding, spherical nodules, white or grayish-yellow in color, between which there are softer areas of a yellow or yellowish-red color, containing here and there a few brown or black granules, varying from the minutest dots to specks the size of a hemp-seed. The firm, prominent nodules are typical myomata or fibromyomata, which can often be enucleated; the softer areas represent undiseased glandular substance, and the brown or black granules are pigmented amylaceous corpuscles containing degenerated and thickened prostatic secretion in their center.

These changes can be much more plainly recognized under the microscope. The fibro-muscular tissue of the nodules, in which some traces of glandular substance still remain, can be clearly seen (see Figures 177 and 178, representing a normal and a fibromyomatous prostate respectively). Socin has called attention to the fact that this myomatous hyperplasia and hypertrophy proceeds from the smooth muscle fibers, large numbers of which accompany the glandular ducts. This form of hypertrophy is by far the most common.

The diffuse fibro-myomatous form differs from the one just described in that the fibro-muscular overgrowth does not occur as nodules, but

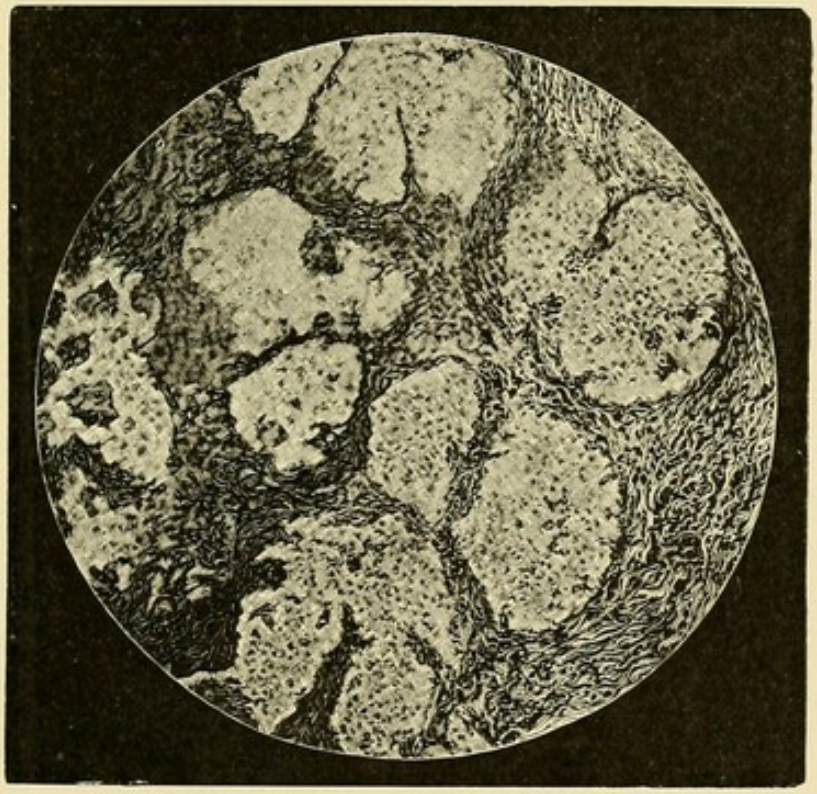


Fig. 177.—Cross section of normal adult prostate showing numerous ducts separated by thin musculo-fibrous septa.

as a diffuse filamentous striation of a gray or white color, which stands out sharply from the darker-hued surrounding tissue, and gives the organ a dendritic appearance. If slight pressure be made upon the gland very little or no fluid will exude, it differing in this respect from the circumscribed form, in which a yellow, mucoid mass can almost always be expressed. When examined microscopically the fasciculi are found to consist of connective tissue fibers, which are only slightly nucleated, and of muscle fibers, with obliterated and distorted glandular ducts between the two. In comparison with the connective tissue, the glandular substance is considerably reduced in quantity.

The third form, **glandular hypertrophy,** represents a typical adenomatous growth, the glandular substance undergoing hypertrophy and hyperplasia, while the fibro-muscular stroma remains unaffected. This morbid process may also be diffuse or circumscribed, the latter form being by far the more common.

The cut surface of such a prostate is spongy, soft, and of a grayish-red color. Slight pressure causes a copious outflow of yellow fluid. The glandular ducts are widely dilated; their epithelium is well preserved. Some of the acini are converted into cysts, which contain

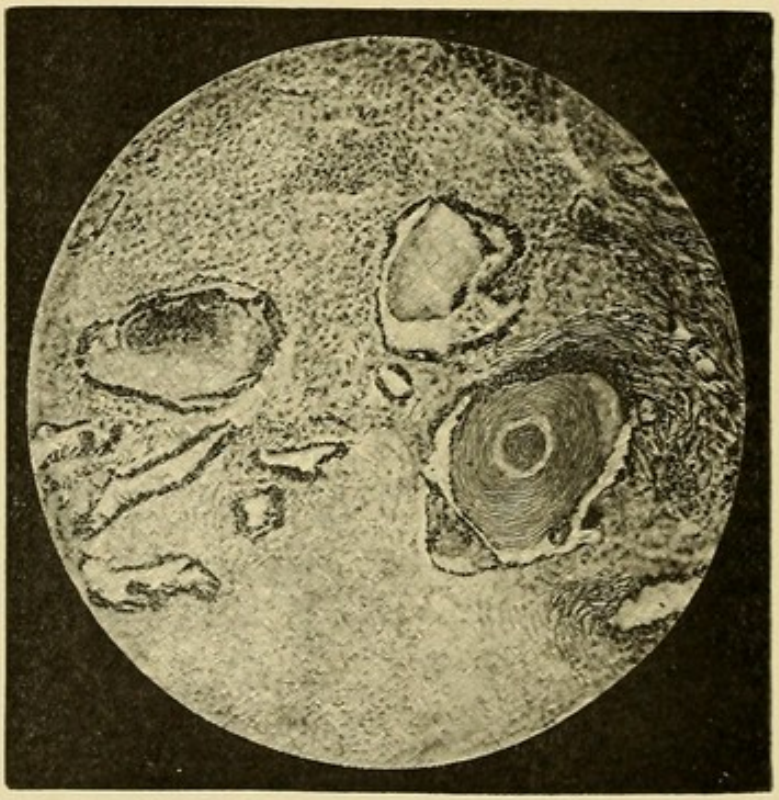


Fig. 178.—Hypertrophy of the prostate. Some of the ducts are atrophied and some are filled with stratified bodies. The glandular substance has been destroyed by the increasing fibro-muscular tissue, which takes up the greater part of the field.

disintegrated epithelium and the stratified amyloid bodies. All in all this form is very rare.

[Some investigators have found the adenomatous form to be comparatively common, and others assert that it occurs more frequently than the myomatous or fibrous. Greene and Brooks, however, in an examination of fifty-eight specimens, found the fibrous variety to predominate. It is evident that further study, based on an examination of a large number of diseased prostates representing various stages of hypertrophy, will be necessary in order to settle the question.]

Thus it is seen that an active process of overgrowth is common to all three forms, whether it affects the stroma or the parenchyma.

What, now, is the cause of this proliferative process leading to enlargement of the organ? As has already been stated the opinions on this matter are greatly at variance. In the first place it may be said that the most comprehensive reasons have been given, such as diathesis (gout, scrofula, rheumatism), local irritation resulting from catheterization or sexual excess, occupations which entail constant sitting, constipation, and the abuse of alcohol. These hypotheses are so vague and so entirely unfounded on the results of experience that they may be dismissed as untenable.

Launois, a pupil of Guyon's, advanced the hypothesis, which he derived from anatomical investigation, that the disease is merely a part of universal arteriosclerosis, or local arteriosclerosis affecting the urinary organs, and that the accompanying retention of urine is not a result of the prostatic disease, but an associated phenomenon evoked by arteriosclerosis of the wall of the bladder.

I proved this theory to be incorrect fifteen years ago, showing that hypertrophy of the prostate exists independently of vesical or prostatic arteriosclerosis, and, conversely, that arteriosclerosis occurs without hypertrophy of the prostate. Both are affections of old age, and therefore are often associated, but they bear no causal relation to one another.

The correctness of this assertion is confirmed by clinical experience, which teaches that in many cases in which complete retention of urine has existed for years the contractile power of the bladder remains unweakened. This would be impossible were the wall of the bladder much affected with sclerotic degeneration.

Ciechanowski, in a very diligent investigation of the subject, has recently endeavored to prove that prostatic hypertrophy is merely the **terminal result of chronic gonorrhœal inflammation.** This theory likewise is not valid; neither the history of cases nor pathological investigation lend it support. In fact the exact reverse is true. It is certain that there are men who have had gonorrhœa and prostatitis for years without getting prostatic hypertrophy, and, conversely, I know many persons with enlarged prostates who never had gonorrhœa.

If considered from the standpoint of pathological anatomy, it would naturally be supposed that if gonorrhœa and prostatitis were causative factors in the production of prostatic hypertrophy, evidence

of them would be found in the posterior urethra. Such, however, is not the case.

Ciechanowski's views may perhaps be explained by the fact that prostatitis is occasionally accompanied by considerable enlargement of the prostate, under which circumstances the disease may simulate hypertrophy both clinically and anatomically. But this is exceptional, for prostatitis, the same as every chronic inflammatory process, generally leads to destruction of the parenchyma, contraction of the connective tissue, and atrophy.

Rovsing still contends that the morbid process is one of myomatous overgrowth; he sides with those who favor the theory of glandular hyperplasia.

I am of the opinion that the cause of the three forms of prostatic hypertrophy is as yet entirely unknown; we know just as little about its cause as we do about the cause of other tumors, benign and malignant. We only know that it is a senile change which seldom manifests itself before the fiftieth year.

In order to account for the apparent inconsistency of the prostate undergoing active hypertrophy at a period of life when retrogressive and atrophic changes are taking place, Rovsing assumes that the glandular hypertrophy is an effort on the part of nature to compensate a beginning senile insufficiency, an attempt being made to overcome the poor quality of the prostatic secretion by increasing its quantity.

Overgrowth of the glandular substance, however, is rare; it is usually destroyed, the stroma being the portion which hypertrophies. Therefore it seems to me that Rovsing's hypothesis is untenable. I do not believe that the idea of the gland undergoing hypertrophy at an advanced period of life is at variance with our knowledge of pathology, for other tumors, particularly the malignant, which certainly show a high degree of activity, are especially prone to occur during old age.

Finally, it must be declared that hypertrophy of the prostate does not always begin between the ages of sixty and seventy, as has frequently been stated. It is true that the disease generally manifests itself after the age of fifty. This is probably largely due to the fact that in the earlier stages of its development it produces no symptoms. I have, however, often seen considerable enlargement of the prostate as early in life as the middle and even the beginning of the fourth decade.

In this respect the statistics of my honored teachers, Thompson and Guyon, are very instructive. They show that 34 per cent of all cases occur after the sixtieth year, but that only from 50 per cent to 60 per cent of this number cause any symptoms of illness.

Furthermore, it is seen from these investigations that no definite relation exists between the size of the prostate and the difficulty which is produced. Persons having a very large prostate may have little or no trouble from it, while comparatively slight hypertrophy may cause unbearable suffering (see Figure 179).

It follows, then, that hypertrophy of the prostate is in itself an

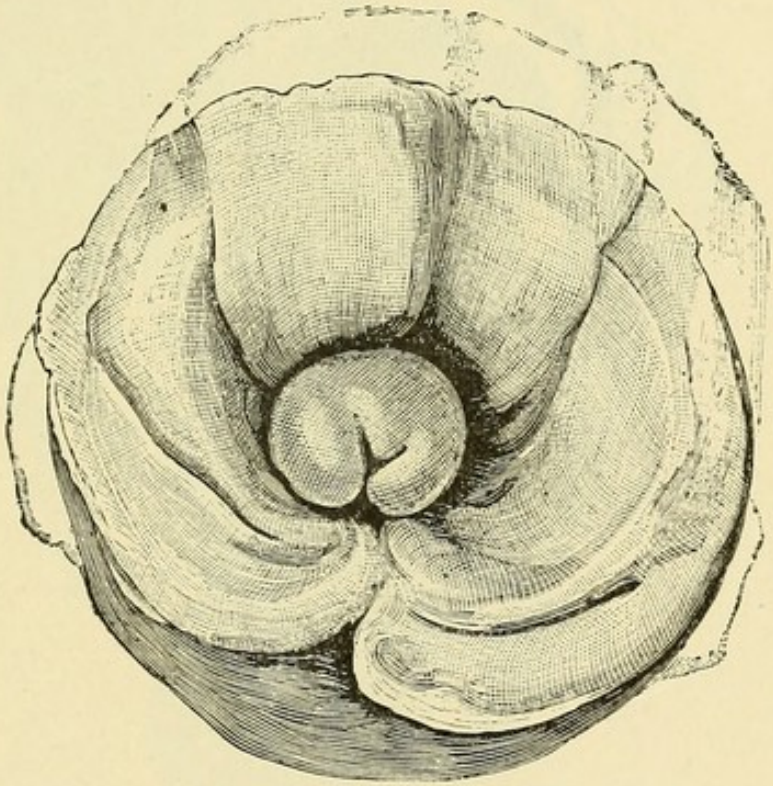


Fig. 179.—Hypertrophied prostate from a man aged sixty-eight years, which produced no symptoms during life. (Güterbock.)

abnormality, but not necessarily a disease any more than is a small lipoma on the arm. It is only when the reaction of the enlarged gland upon the urinary organs gives rise to disturbances that the condition becomes a disease, and then, indeed, one which is often of great severity.

Therefore it is especially desirable thoroughly to understand what alterations in the urinary organs and the function of micturition are produced by the enlarged gland.

The **macroscopic changes** concern form, size and weight.

The normal prostate is shaped like a chestnut; increase in thickness

causes it to assume a spherical shape. Its normal weight is between 15 and 20 grammes [225 and 300 grains]. In hypertrophy it is not unusual for it to attain a weight of 80 grammes [1200 grains]. Exceptionally it may be much larger, and Gross has recorded a case in which it weighed 288 grammes [4320 grains].

The prostate may hypertrophy in its entirety or in single portions, and the overgrowth may be either symmetrical or asymmetrical.

If the whole gland enlarges symmetrically (Fig. 180), a large, regular, spherical mass extending equally on either side and protrud-

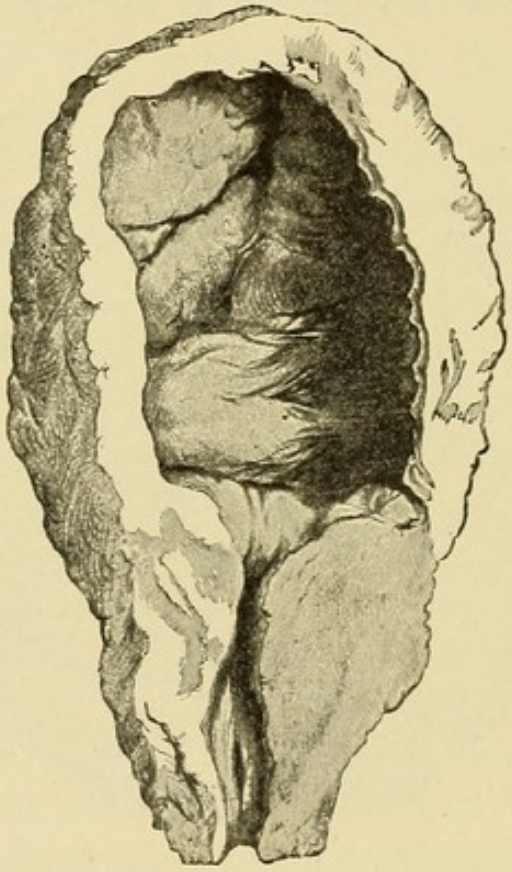


Fig. 180.—Total hypertrophy of the prostate.

ing backward into the rectum can be felt by rectal palpation. The groove between the two lateral lobes is obliterated, the base of the bladder is pushed upwards by the upward bulging of the gland, and the orifice of the urethra is likewise carried upwards so that it no longer occupies the lowest point in the bladder.

When the enlargement is asymmetrical one lobe is larger, broader, or extends further backwards than the other. If the median portion develops excessively, a so-called **third lobe** is formed; this condition was first described by Sir Everard Home, and for this reason the name of **Home's lobe** has been applied to it.

According to some authors this form of hypertrophy results from proliferation of pre-existing accessory glandular elements situated immediately at the urethral orifice. This third lobe plays an important rôle in the pathology of prostatic hypertrophy. It may attain enormous dimensions; I have seen it vary in size from a protuberance as large as a pea to a mass as large as a small apple. It may be either pedunculated or sessile.

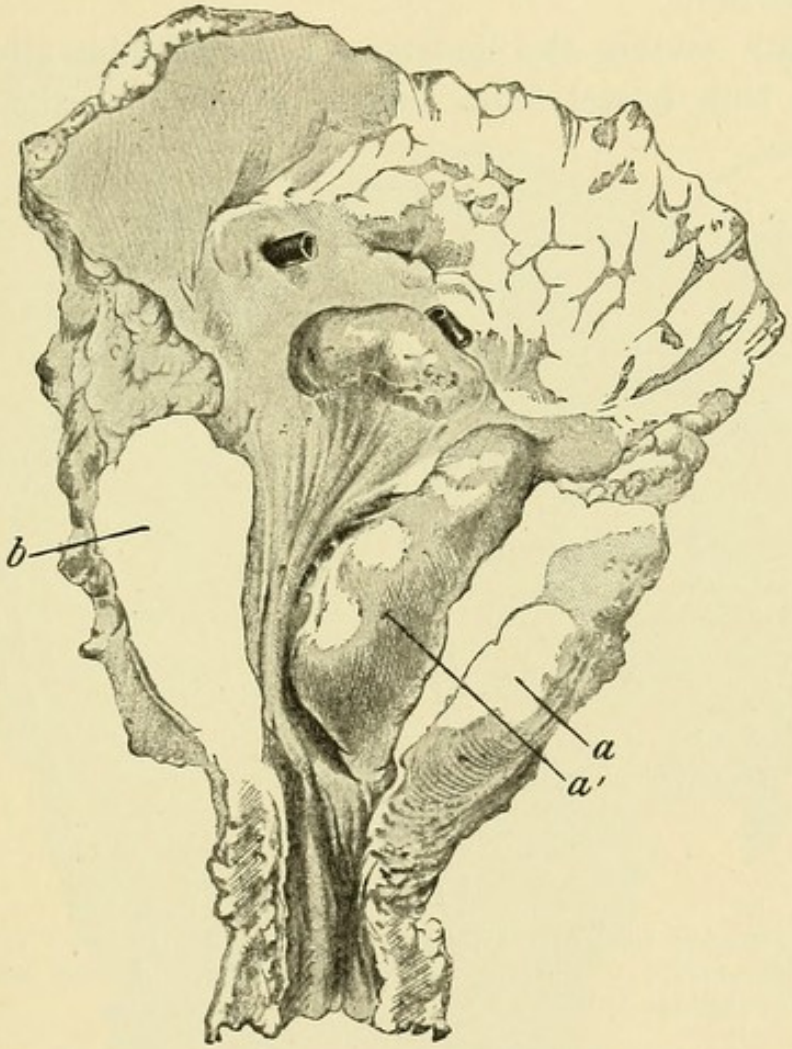


Fig. 181.—Hypertrophy of the prostate, *a* and *a'* show the left lobe, which is the more enlarged of the two. *a'* represents the portion covered by the urethral and vesical mucosa, *b* right lobe. The urethra is displaced toward the right. A middle lobe and catheters projecting from the ureters are also shown. (Viertel.)

The portion of the gland lying anterior to the urethra, between it and the symphysis, is rarely the seat of hypertrophy.

The changes which the bladder and urethra suffer through the enlargement of the prostate are of great practical interest, and should be thoroughly understood. The prostatic urethra is altered in caliber, shape and length.

The normal **length of the urethra** is about 20 cm. [8 inches], the prostatic portion being from 2 to 3 cm. [$\frac{4}{5}$ to $1\frac{1}{5}$ inches]. When the prostate forces the bladder upwards the urethral portion is carried up with it and the neck of the bladder is much higher than normal. The displacement is often so great that an ordinary catheter is too short to reach into the bladder. I have known such a displacement to measure 9 cm. [$3\frac{3}{5}$ inches], the entire length of the urethra being 30 cm. [12 inches].

The prostatic urethra also undergoes a considerable **alteration in caliber.** If both lateral lobes become closely approximated as the

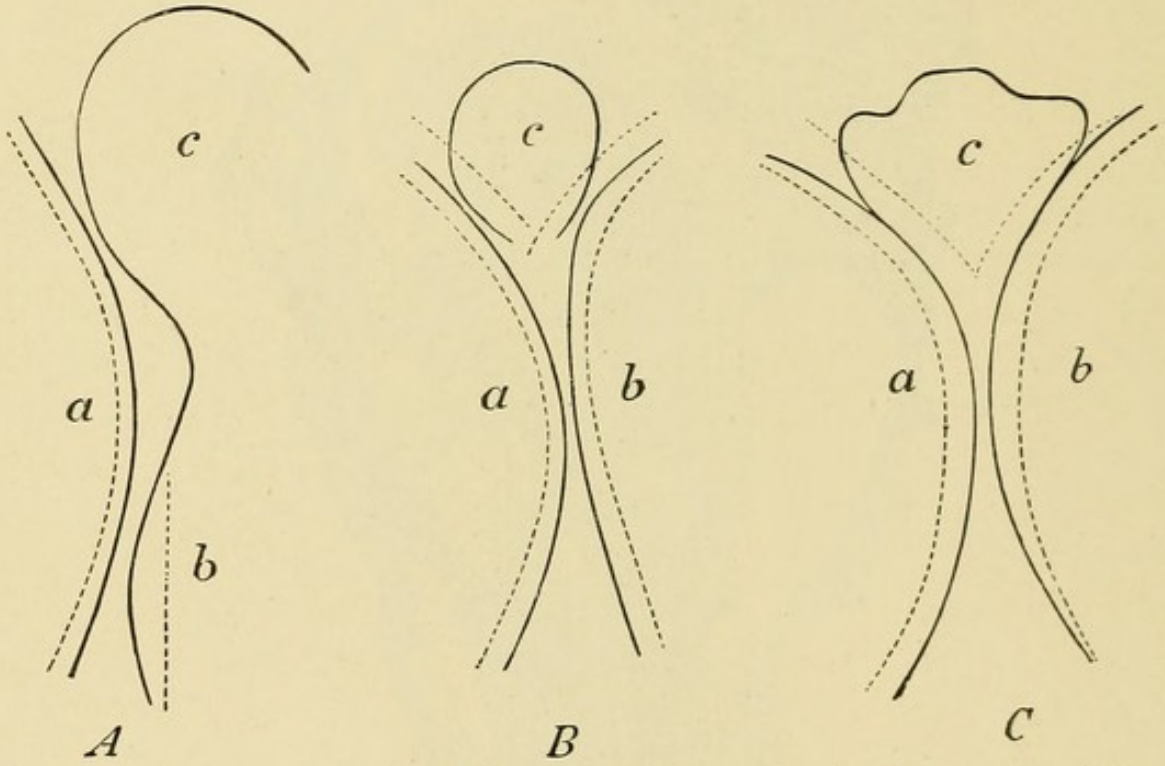


Fig. 182.—Different forms of deviation of the urethra in hypertrophy of the prostate. (Thompson.) *a* the right, *b* left, *c* middle lobe. Dotted lines show the direction for the catheter to take.

result of overgrowth, the urethra may be so narrowed that the use of a certain amount of force is required to pass a catheter through the constriction. It feels as though the instrument were being forced through a stricture. Often, however, an opposite condition exists. The urethra is extended over the mass. If, for example, it is chiefly the posterior portion of the prostate which is enlarged, the posterior wall of the urethra will be distorted in such a manner as to produce ampulla-like dilatations, which may be so large that the beak of the catheter can be turned as much as 360° on its axis. Inasmuch as this manipulation is generally considered proof that the catheter is in the

bladder, it is evident that this dilatation of the urethra may lead to very serious errors in diagnosis unless its existence be recognized.

If one lateral lobe hypertrophies greatly while the other does not enlarge the first will push the urethra toward the opposite side (Fig. 181). This produces lateral deviation of the course along which the catheter has to pass. If several of these deviations are present, the urethra is made to assume an S-shaped form, a circumstance which may make

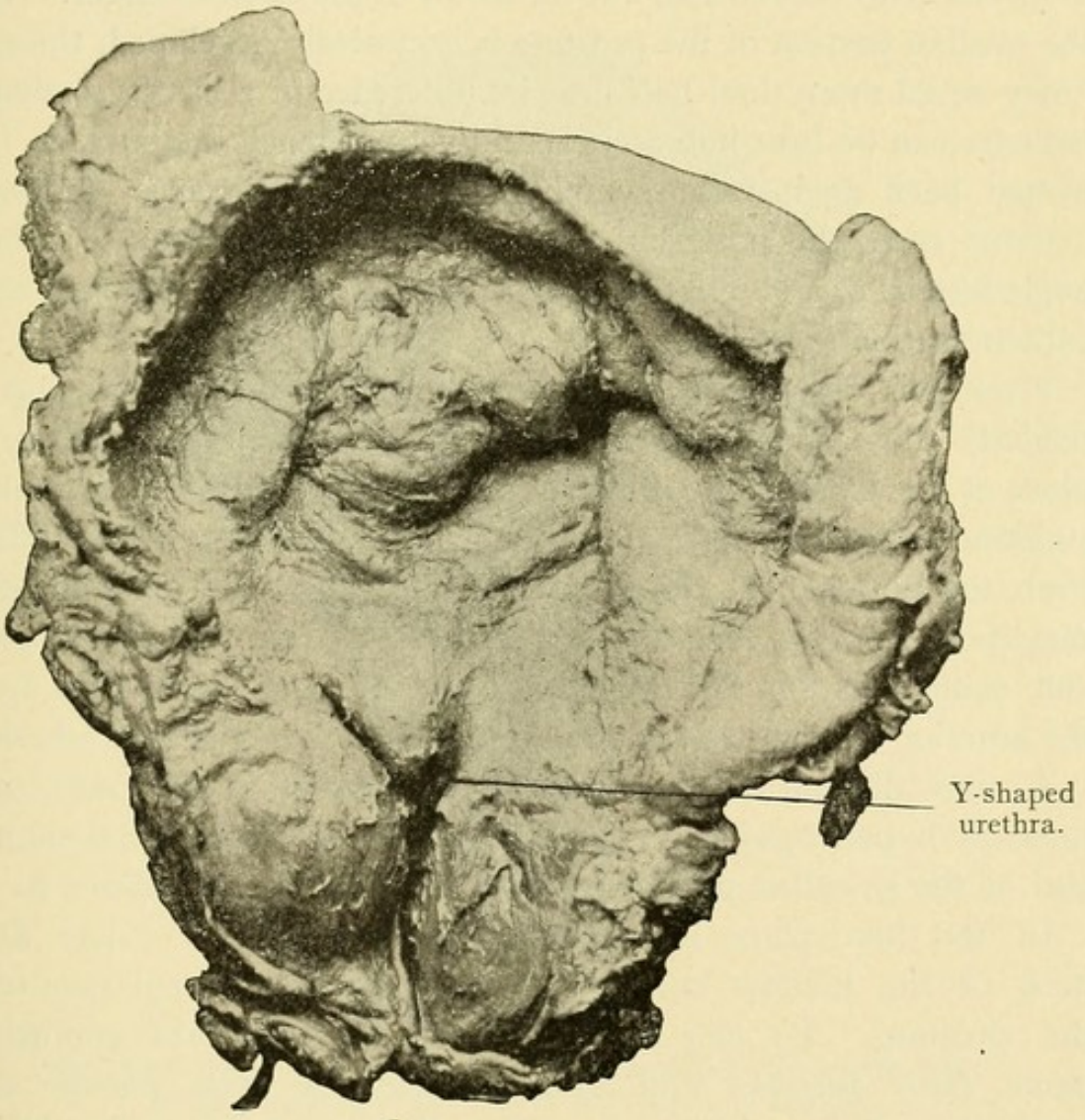


Fig. 183.

catheterization very difficult. Finally, if a wedge-shaped projection of the prostate into the median line occurs, a bifurcation of the urethra takes place in such a manner that a Y-shaped passage is formed (Figs. 182 and 183).

In addition to these changes, which alter the perviousness of the urethra to instruments—and that to a degree often incalculable—**changes in its shape** also occur. The posterior urethra is usually

more curved than in health. As the hypertrophy of the gland does not exert an equal effect on different portions of the urethra, because the hypertrophied portions are not evenly disposed around it, and furthermore because it is firmly fixed to the perineal fascia below and the symphysis in front, it is evident that the lateral and posterior portions will yield more than the superior part.

The radius of the circle which the prostatic urethra then forms is shorter than the normal, but the sector of the circle is larger. When the median portion of the prostate is excessively developed, the sector "may equal more than half the circumference of a circle, so that the catheter can be bent into a circle and yet not reach the bladder, being turned back against the symphysis instead." (Socin). Indeed, in extreme cases the posterior urethra may be so bent as to form an angle instead of an arch, thus producing a condition which may render catheterization impossible.

From this description it will be seen that all the changes, but particularly those concerning the caliber and shape of the urethra, take place at the expense of the inferior wall of the canal, while the anterior superior wall remains practically unchanged, its curve hardly differing from the normal. It cannot be bent, it cannot be made to deviate materially from its course; therefore, the old rule that in every difficult catheterization the tip of the instrument should be held against the anterior (upper) wall of the urethra, is well worth remembering.

A more difficult but more important matter in the pathology of prostatic hypertrophy is the condition of the internal vesical sphincter and of the so-called **middle lobe** situated within and above it.

In the first place it must be remembered that valves at the neck of the bladder may occur independently of enlargement of the prostate. To this form of valve Lienhard has applied the name *luette vesicale*, and Amussat uses the term *vulvula vesico urethralis*. Concerning these valves Henle says that the longitudinal elevation of the trigonum of Lieutaud becomes more pronounced as it approaches the urethral orifice, and that its highest point lies within the urethra, so that when the growth is especially large a semilunar cleft having its convexity forward is formed. Dittel denies the existence of such valves, but Thompson, Virchow, and Socin recognize them. It is important to remember, as König has shown, that these valves at the neck of the bladder may constitute a material impediment to the emptying of the bladder. This is especially true

when besides the valve there is an invagination of the bladder behind the internal meatus.

Similar barrier-like valves are formed by the middle lobe of an enlarging prostate. It has long been known that this intravesical prostatic tumor may become an insurmountable impediment to the emptying of the bladder. Contractions of the detrusor vesicæ, which otherwise are followed by relaxation of the sphincter and opening of the bladder, press the prostatic tumor directly into the urethral

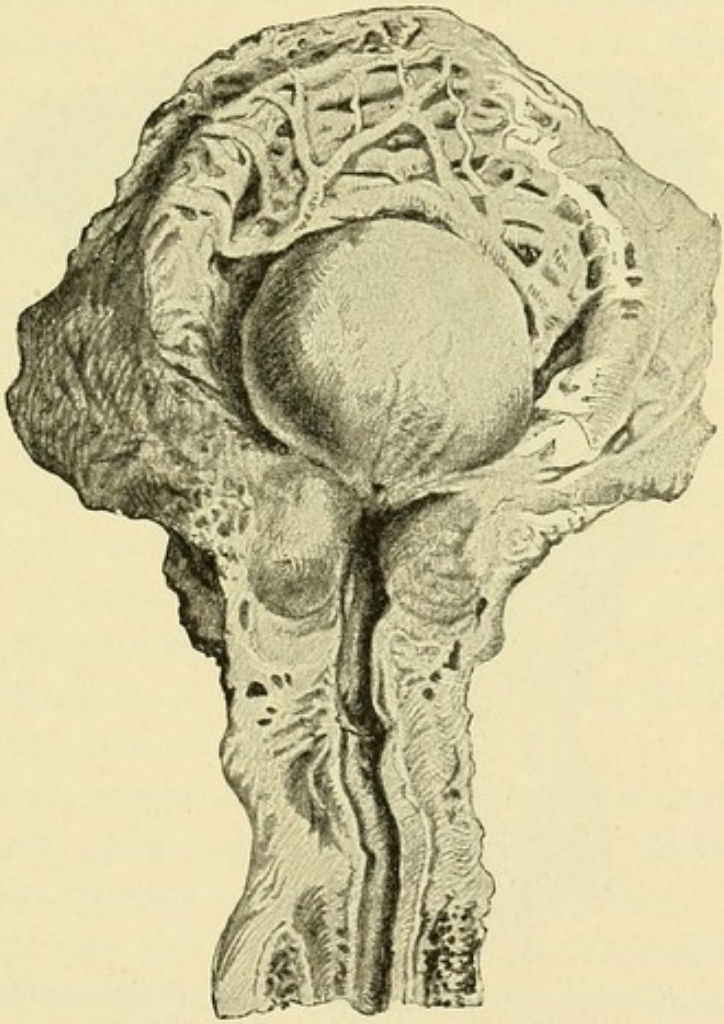


Fig. 184.—Hypertrophy of the prostate, especially of the middle lobe, which projects into the bladder like a ball. (Viertel.)

orifice and completely close it (Figures 184 and 185). It is very characteristic that, in contradistinction to stricture of the urethra, in this condition the harder the patient strains the more difficult micturition becomes. This is due to the fact that the stronger contractions increase the solidity of the closure.

These middle lobes vary as to their size and form. Small warty growths, slight elevations from the size of a pea to a bean, alternate with linguiform tumors and large, solid, sessile growths as big as an

apple. I have often seen several of these middle lobes encircling the mouth of the bladder like a wreath and making it appear as though two isolated tumors were present. I have never known this third lobe to separate the sphincter and cause incontinence of urine. When incontinence occurs in these cases it is produced by overdistention of the bladder of sufficient degree to cause the sphincter to open.

Finally, there remains to be mentioned, the so-called muscular barrier, consisting of muscle fibers of the hypertrophied internal sphincter which spread out between the hypertrophied lateral lobes. It may

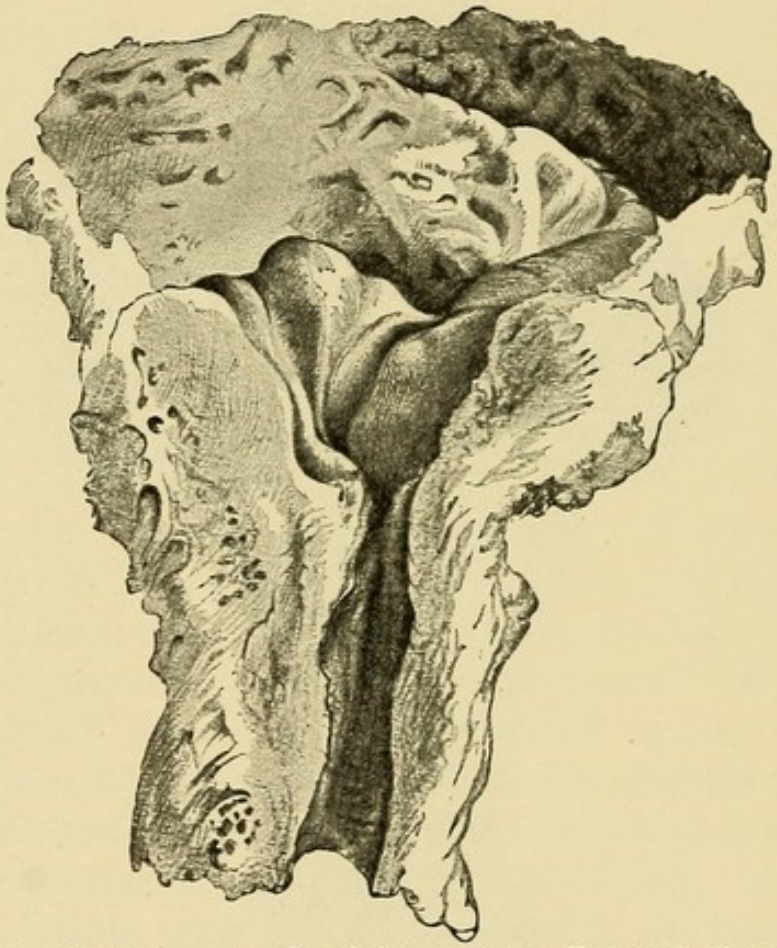


Fig. 185.—Total hypertrophy of the prostate. Epiglottis-like middle lobe which impedes the outflow of urine.

interfere with micturition in exactly the same manner as the barrier which is occasionally formed in the trabecular bladder by hypertrophy of the interureteral ligament.

The effect which this interference with urination exerts upon the upper urinary tract does not differ materially from that caused by other forms of obstruction, notably stricture. It should, however, be noted that the effect is more severe and lasting, because the retention of urine occurs in the weakened bladder of old and often decrepit persons.

Thus it will be understood that in the majority of cases we shall have to do with distention of the bladder. The cavity of the bladder becomes greatly enlarged and its distensibility increased.

As a result of the increased work which the bladder has to do to overcome the prostatic obstruction its walls hypertrophy. If the hypertrophy occurs simultaneously with distention it is called eccentric hypertrophy. The hypertrophied muscle fibers may be seen on the interior surface of the bladder as trabeculæ. Between these trabeculæ invaginations, pockets and diverticula form. These pockets may be composed of the entire thickness of the bladder wall, but they frequently merely consist of mucous membrane with a thin muscular covering. Thus there is danger of perforating the bladder if a pointed catheter enter one of these pockets and be forced against the wall. The musculature of the bladder shows both fatty degeneration and connective tissue formation.

The engorgement may extend further upward to the ureters and pelvis of the kidney. The pelvis of the kidney presses upon the substance of the organ and may lead to complete atrophy, so that a typical hydronephrosis may exist and only a narrow zone of cortical substance remain. It is noteworthy, however, that this engorgement of the upper urinary tract is comparatively rare. I have made postmortem examination in many cases in which retention had existed for years, without finding any dilatation of the ureters and pelvis of the kidney, nor any alteration in the kidney itself.

Changes in the upper urinary tract are much more frequent when, as unfortunately often happens, infection of the bladder takes place. Then ureteritis, pyelitis and pyelonephritis develop.

The prostate may also be affected by other changes, as for example, inflammation, but the latter condition is of slight importance in comparison with the principal malady. Only when it leads to abscess formation in the hypertrophied prostate is it of serious significance. As previously stated, prostatic abscess greatly endangers the life of old men who suffer from hypertrophy of the gland (See under *Prostatic abscess*).

It is only natural that the ejaculatory ducts, which pass through the prostate, should be frequently affected by the morbid process. They may be either distorted, or obliterated completely so that the semen cannot pass through them. In such cases the seminal vesicles are enlarged and filled with stagnant semen. In view of the usually

advanced age of the patients this aspermatism is not of much moment.

The **circulatory disturbances** produced by the enlarged prostate are of greater importance. The prostate is surrounded by numerous veins which communicate with the dorsal vein of the penis and veins at the base of the bladder. The vessels of this prostatic plexus have a tendency in advancing age to become dilated and varicose. As a result of engorgement occasioned by cold or by excesses in drinking and in venery, the prostate likewise becomes engorged and infiltrated with serum throughout its entire substance. It is this condition of the prostate which causes the frequent acute though transitory attacks of retention.

The mucous membrane of the prostatic urethra also shares in the infiltration; it is swollen, soft, and bleeds readily as soon as it is touched by a catheter. The gland itself, which under normal conditions is not very vascular, may be traversed by dilated blood-vessels, so that an injury may result in profuse and often uncontrollable hæmorrhage. I have frequently seen such occurrences, and, indeed, have had two patients bleed to death from this very form of hæmorrhage. The prostate, or at least the periprostatic tissue through which the periprostatic plexus runs, is almost like a cavernoma.

SYMPTOMS, COURSE AND DIAGNOSIS.

The disease is of such long duration and its individual phases usually occur with such regularity, that it is advisable to divide it into several stages, as has been done by Guyon. The first stage is the premonitory, the second that of retention without distention of the bladder, and the third retention with distention of the bladder. In any of these stages congestive and infective processes may supervene and at times alter the clinical picture.

In the first stage of the disease the symptoms are ordinarily so slight that comparatively few patients take any notice of them. They consist of scarcely more than a slightly increased desire to urinate, which is experienced during the day as well as at night, an occasional slight burning in the urethra, and a little delay in starting the stream of urine. This sign of interference with micturition is more pronounced when the bladder has not been emptied for some hours, so that the patient's attention is unpleasantly attracted to it when he arises in the

morning. During the day, when the patient is active, the flow of urine becomes free again.

The urine is clear. The general health is in no wise impaired. The urinary stream has lost some of its **power of projection,** falling more perpendicularly to the feet of the patient. As the French say, *il pisse sur ses chaussures.* If the patient lies down or sits for any length of time during the day, micturition is more difficult than if he moves about. The condition of patients in this stage of the disease is not uniform, as they may urinate better for a day or a week, or indeed even a month, than they could for corresponding previous periods of time. Anything which causes congestion of the pelvic organs augments the symptoms.

Thus it is observed that the patients are made worse by severe constipation, irregularities in eating and drinking, sexual excesses, and particularly by exposure to wet and cold, being compelled to urinate more frequently and to make greater efforts to expel the urine from the bladder, it often requiring two or three attempts to complete its expulsion. At night they sometimes suffer from persistent erections. The amount of urine voided during the night is greater than that passed during the day, constituting a **nocturnal polyuria.** If a catheter be passed after micturition the bladder will be found empty. Thus there is no residual urine, a fact which is characteristic of this stage of the disease.

The process may continue this way for many years, until it finally leads to the development of partial retention, the symptoms remaining the same as above described, with the exception that they become a little more troublesome. The frequency of micturition is increased, the patients being obliged to arise from three to eight times a night to make water. It is impossible for them to urinate in the recumbent position. The nocturnal polyuria is augmented and the pain caused by the resistance of the obstruction to vesical contractions becomes more severe. The periods of freedom from difficulty which occur during the first stage become shorter, until at last the bad days constitute the greater part of the year.

The general health begins to suffer, the patients are deprived of sleep by frequent urination, and gradually become emaciated, although their condition is decidedly different from the true cachexia which accompanies malignant prostatic tumors. These two conditions are also to be differentiated by the fact that in the case of prostatic hyper-

trophy improvement takes place if a period of rest and amelioration of the local trouble can be obtained, while true cachexia always becomes progressively worse.

If a person in this stage of the disease be catheterized immediately after he has urinated, more or less **residual urine** will be found in the bladder. The amount varies from 50 to 200 cc. [1⅔ to 6⅔ ounces]. Occasionally even more remains, although the patient can still void a goodly portion. It is, however, very noticeable that the individual quantities of urine which the patient passes are considerably less than the normal.

This stage of incomplete and partial retention may likewise continue for years, extending even beyond a decade, without any especial episodes occurring. The greater the quantity of urine remaining in the bladder, the greater the pressure upon the vesical wall, and consequently the greater the distention of the bladder; as this distention increases the power of the bladder to contract and empty itself becomes more and more impaired. It finally comes to pass that the bladder is converted into a large sac, in which an enormous quantity of urine is retained after each and every act of micturition.

With the establishment of this condition the **third stage** soon becomes fully developed. Incomplete retention is generally superseded by complete retention, the patient being unable to void any urine except when the accumulation reaches above the level of the sphincter. Even under these circumstances micturition must be effectuated by the help of abdominal pressure. The patient squats, bends forward, or, in short, assumes any position in which he finds he can eject a few cubic centimeters of urine.

The distention of such bladders is often enormous. I have known them to hold 2 to 3 liters [approximately 2 to 3 quarts]. Strange as it may seem the patients are frequently not much inconvenienced by this condition. Although the abdomen is filled by the distended bladder, which reaches above the umbilicus, not much pain is experienced. As the bladder is filled to overflowing, there is a continual endeavor to expel the surplus quantity, and hence the frequency of micturition is much increased. The general health has already materially deteriorated. The patient has become feeble and emaciated, but his condition, when compared with the serious morbid changes which exist, is quite tolerable. This is especially the case when the urine has remained clear, that is, when no infection of the bladder has taken place. The appetite may remain good.

A most troublesome complaint is the involuntary discharge of urine, which has been erroneously termed incontinence. As soon as the bladder is so over-filled that the urine rises above the level of the sphincter the latter is separated and the urethra is opened like a funnel, with the result that the urine escapes. Thompson has rightly called this condition **overflow of the bladder.** Guyon designates it as the **incontinence of overflow** (*incontinence par regorgement*). The patients wet themselves. At first this happens only at night, the sphincter still being able to hold back the urine when the upright posture is maintained; later, however, this power is lost and the patients wet themselves during the day. When this state is reached the period of freedom from infection generally terminates; to this matter we shall soon refer again.

The course of the disease is not always as it has been above depicted. According to this description retention of urine develops gradually.

As often at least, if not oftener, **acute complete retention** takes place at intervals. Patients who have been voiding urine without difficulty are suddenly seized with inability to pass as much as a single drop. Despite the greatest efforts, despite the auxiliary force of abdominal pressure, despite every conceivable form of medication and baths the bladder remains tightly closed. The earlier this acute retention occurs the more serious is the disturbance it produces, for early in the disease the bladder is not distended and the vesical musculature cannot yield to the pressure exerted by the urine. Most frightful vesical spasms occur as the bladder becomes more and more distended; this state, in fact, is as painful as any which can affect mankind. The sufferer cannot keep still, but walks the floor constantly, trying by every possible means to force out a few drops of urine. These efforts are made as often as every five minutes, but they usually are productive of no result. If assistance is not obtained and the distention of the bladder persists for any considerable time, the bladder is violently stretched and severe and usually permanent injury is inflicted.

The development of this acute retention of urine is due to congestion, engorgement, and serous infiltration of the prostate resulting from obstruction in the prostatic vessels, especially in the periprostatic plexus. All the circumstances which have previously been mentioned as being liable to cause exacerbation of the symptoms of simple prostatic hypertrophy are also capable of inducing complete retention

of urine. Therefore it occurs in both the first and second stages of the disease; in the third stage it cannot occur for the reason that chronic retention already exists. In fact it is the rule for the disease to begin with such a retention, or for retention to supervene in connection with other symptoms. The slight symptoms often present in the first stage are hardly noticed by the patient until a sudden retention of urine drives him to the surgeon. The malady, of course, is already of long duration, perhaps having existed for years. I have arrived at this conclusion from clinical observation, as the result of which I think it may be stated that the disease often begins before the fiftieth year. I have observed such a condition in the beginning of the fortieth year, and have seen it develop later into a typical prostatic hypertrophy.

That the development of retention of urine is due to congestion, and not to sudden growth of the prostate, is shown by the fact that it subsides and the patients are again able to urinate.

Unfortunately, however, an exact prognosis cannot be made. I have seen cases in which, after a single attack of acute retention, the patients never regain the power of voluntary micturition. These cases, however, constitute the exception. Usually the congestion subsides, and with it the retention gradually disappears. The process of resolution may occupy days, weeks, or even months.

In the gradually progressive chronic retention conditions are entirely different. Here a permanent mechanical obstruction exists, either in the form of a tumor encroaching upon the prostatic urethra, or as a third lobe which obstructs the neck of the bladder like a valve. It is characteristic of the latter form of obstruction that the more the patient strains the more firmly he shuts the valve. Efforts to urinate then are futile.

Acute retention may recur frequently. There are prostatics in whom the slightest departure from regular habits of living, or the most trivial exposure to cold, will induce an attack of retention, and again there are others who go for years before a second attack supervenes. I have also known persons who have had a single attack of retention and then have remained free from it many years. It frequently happens that acute retention ushers in a period of chronic incomplete retention; in other words, after the acute complete retention subsides and the patients regain the power to urinate a certain quantity of residual urine remains in the bladder.

The effect of both forms, but especially that due to chronic retention

of long duration, is felt by the entire organism. The first manifestation—provided that the bladder is not infected—occurs in the form of digestive disturbances. Guyon has very appropriately termed these digestive disturbances *dyspepsia urinaria.* The patients lose their appetite, and show a particular disinclination to take meat and heavy foods, rather preferring liquids to solids. This may be due to diminution of the power of the kidneys to eliminate waste material from the blood, their function being impaired by the engorgement with which they are affected. As a result of this renal insufficiency urinary intoxication is produced, and it in turn gives rise to the dyspeptic symptoms, which are sometimes called the aseptic cachexia of prostatics. It differs only in degree from the anorexia which is characteristic after infection has taken place (septic cachexia), and which will be considered in connection with the complication of hypertrophy of the prostate.

The most frequent complication of prostatic hypertrophy is cystitis. It occasionally develops in the first stage of the disease, before retention has occurred, and it almost always takes place during the stage of partial retention. The causes have been fully explained in the article on cystitis.

In cases which have not been examined or treated instrumentally it must be assumed that the infective microörganisms which circulate in the blood, or which gain access to the bladder from the urethra or rectum, find a favorable soil prepared for them by the prevailing engorgement and hyperæmia.

In those cases, however, in which catheterization has been followed by cystitis it is probably due either to the introduction of germs from without, or to infection with microörganisms which have lain dormant in the urethra, but which become virulent as a result of the engorgement affecting the bladder. It is possible to catheterize patients having prostatic hypertrophy without infecting them, provided that sterile instruments and a sterile lubricant be used and the bladder afterwards washed out with a 1:1000 solution of silver nitrate; but if the catheterization be frequently repeated, as it inevitably must be in cases of chronic retention, cystitis is wont to develop despite all precautions. It differs little from the previously described forms of vesical inflammation. It is difficult to cure because of the residual urine, but yet a cure is often effected. The classical proof for the existence of cystitis is the presence of pus in the urine; other symptoms,

such as urgency of urination and pain, are of little importance because they are also symptoms of prostatic hypertrophy and generally pre-exist.

Of less importance is the frequent urethritis, which usually is caused by irritation incident to the necessary catheterization. Prostatitis, on the other hand, requires increased attention because it may proceed to suppuration, and, as already stated, **prostatic abscess** in an hypertrophied prostate offers a bad prognosis.

The diagnosis of abscess can be made by palpating the prostate through the rectum; softened areas in the enlarged gland will be detected. Intermittent or remittent fever is also present. In two cases in which the abscess ruptured into the urethra I have noticed that the urine, which was very turbid, became even more cloudy from the increased admixture of pus. In other cases suppuration seemed to have a curative effect, as urination became less difficult. This improvement is comparable to that which it is sought to obtain by removing the prostate.

Now and then unilateral or bilateral epididymitis occurs. It is probably due to the extension of infection from the urethra to the ejaculatory ducts. It presents no peculiarities. It usually pursues a chronic course, although it often shows a tendency to exacerbation; it generally terminates in induration, rarely in suppuration.

Vesical calculi are not uncommon in the subjects of prostatic hypertrophy. They are mostly secondary phosphatic stones. Their development is due to the vesical catarrh which is present, the mucus and pus forming a nucleus around which the salts of the residual urine, especially the phosphates and carbonates, crystallize. They are observed more frequently, therefore, in prostatics with neglected cystitis. Occasionally they cause trouble, giving the patient pain when he walks or exerts himself, and also producing hæmorrhage; they may, however, give rise to no symptoms whatever.

It is characteristic that recurrences soon take place after litholapaxy is performed; this is due to the persistence of conditions favorable to stone-formation. The diagnosis of these stones is not always easy. They usually lie in the recess behind the prostate, which is not accessible with a short-beaked stone sound; therefore they often cannot be felt. Cystoscopy may also fail to detect them if they are concealed by a projecting lobe.

Hæmorrhages occur in prostatics irrespective of vesical calculi.

They may be exceedingly profuse and uncontrollable. They occasionally follow congestion due to retention of urine. The bladder becomes filled with blood-clots which are too large to be voided through the urethra. It is only with great difficulty that the thick clots can be washed out through a catheter. The hæmorrhages may last for days. They generally originate in the bladder, but may also take place from the kidneys.

Of special importance are the hæmorrhages which follow catheterization. It is obvious that severe hæmorrhage may result from injury —however slight—of the spongy vascular tissue of the prostate and prostatic urethra. But even when no injury has been inflicted a violent hæmorrhage often follows catheterization for the relief of retention. This is hæmorrhage *ex vacuo*. It is due to sudden removal of the high pressure to which the bladder has been subjected by the excess of urine. The result is that the relaxed veins suddenly become filled, and if they be atheromatous they may rupture.

A complication which is important, because it is severe and endangers life, is **ascending pyelonephritis**. It is well known that vesical infection frequently does not extend upwards. In performing autopsies upon old prostatics who had had vesical infection for ten years or more I have frequently found the kidneys to be perfectly healthy, or to present only slight changes, such as are produced by pressure-atrophy or mild chronic interstitial nephritis. In other cases, however, the infection ascends, being particularly favored by the engorgement which exists. We then have to do with chronic pyelitis, pyelonephritis and pyonephrosis.

These are also the cases in which signs of general infection are usually present. It manifests itself by loss of strength. The patients become miserable and cachectic. Anorexia is marked, intense thirst is complained of, and the tongue becomes coated and so parched that it can hardly be protruded from the mouth. If this cachexia increases the patients die.

It must be stated, however, that this chronic urinary intoxication can take place without the kidneys being involved, resulting entirely from the diseased prostate and bladder. In the latter case it is probably due to absorption of urinary or bacterial toxins. This form of chronic urinary intoxication, or **urosepsis,** is occasionally associated with mild febrile disturbances. According to my experience it is more dangerous than acute sepsis occurring through the urinary passages.

The organism responds to acute infection with a chill and fever, which seems to relieve the blood of poison, inasmuch as the patients recover after the occurrence of one or more of these phenomena. On the other

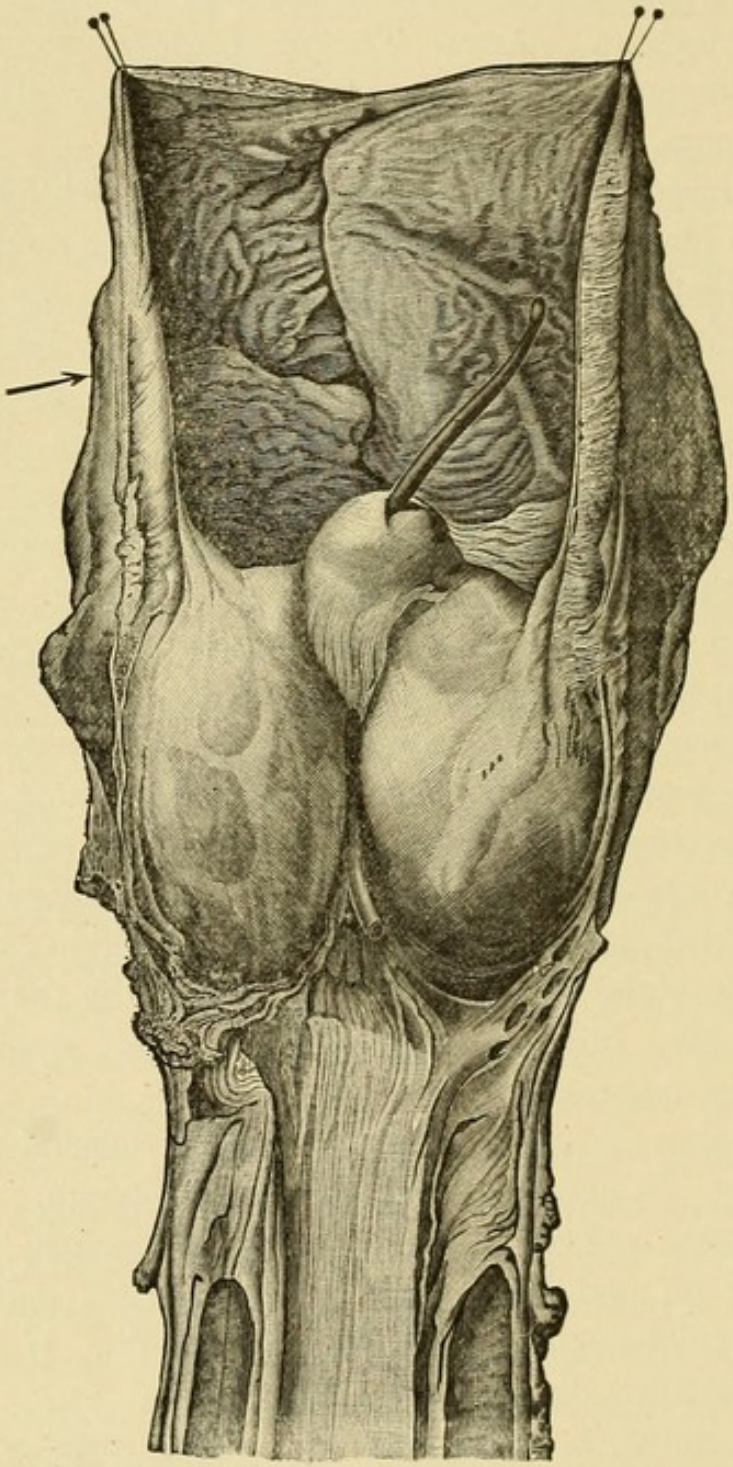


Fig. 186.—Enormous hypertrophy of the prostate. The catheter has perforated the middle lobe. (Albarran.)

hand, I have seen only a few patients recover from chronic urinary sepsis.

The development of acute as well as chronic sepsis is especially favored by injury to the urethra or prostate. When catheterization

is difficult false passages are not uncommonly made. Figure 186 shows a very good picture of one. The catheter has been forced directly through the middle lobe. Figure 187 shows a constriction of the prostatic urethra caused by the enlarged prostate, together with a false passage, the course of which is marked by the bougie. Severe bleeding

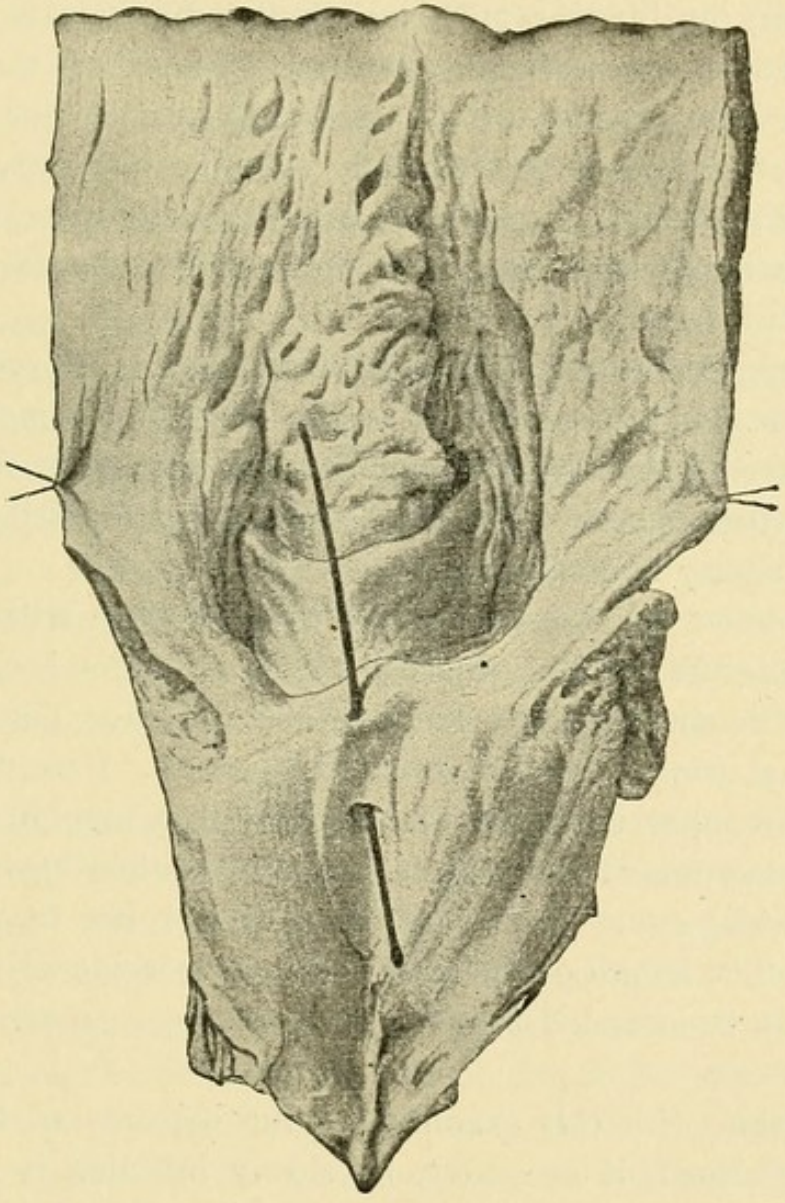


Fig. 187.—Hypertrophy of the prostate with narrowing of the prostatic urethra. (Albarran.)

results, which makes catheterization, and especially emptying of the bladder, more difficult than it formerly was because of the large clots which are formed. In robust persons acute urinary fever, together with chills, generally follows, but, as a rule, the patients recover. In the weak, who can no longer offer resistance to the invading micro-organisms, chronic urosepsis develops and usually causes death.

After this detailed description of the symptoms, complications and course of hypertrophy of the prostate it may be said that the diagnosis is generally not difficult. It is completed and perfected by physical examination, consisting in palpation of the prostate through the rectum, catheterization, and cystoscopy.

As concerns **palpation,** it is practised with the patient in the knee-chest position; the bladder must be empty. As soon as the finger passes beyond the membranous urethra a projecting mass will be detected. It varies greatly in size. Its lateral and superior boundaries should be determined if possible; the superior boundary, however, can often not be defined, because the prostate may attain such dimensions that its upper edge cannot be reached by a finger of ordinary length.

Furthermore, information should be sought as to whether the surface of the gland is smooth or rough, whether the gland is hard or comparatively soft, whether portions of it are softer than others, and finally whether both lobes are equally hypertrophied or whether distinct asymmetry is detectable.

After palpation has been employed **examination with catheters** should be undertaken. The object of this examination is to determine the degree of retention and the length of the urethra. The determination of residual urine is requisite for exact diagnosis. It must be remembered, however, that conditions vary. The true amount of residual urine can be ascertained only after several examinations have been made at long intervals, and at times when the patient is free from attacks of congestion. The length of the urethra may be considerably increased; it has already been stated that it may measure as much as 30 cm. [12 inches].

In connection with this examination the capacity of the bladder may be determined, if necessary, by slowly injecting it with sterile water. The urinary conditions, however, will often show its degree of distensibility.

Cystoscopy will reveal the prostatic enlargement. (*See the illustrations accompanying the article on cystoscopy.*) The projection of the enlarged prostate into the bladder can be plainly seen, as can also the narrow channel formed by the convergence of the right and left lobes toward the median line; in lesser degrees of hypertrophy the irregular margin of the sphincter is shown; finally, the third lobe is distinctly seen, sometimes jutting into the bladder like the cervix

uteri into the vagina. In addition the state of the bladder may be ascertained. In most cases typical trabeculæ and diverticula will be recognized, together with the evidences of cystitis, and possibly calculi may be seen as well. Calculi concealed in diverticula should be carefully looked for as they readily escape notice unless special attention be given to their discovery.

Although, as a rule, the diagnosis will not be difficult, there are three conditions with which certain cases may be confounded: these are vesical tumors, malignant tumors of the prostate, and retention of urine occurring irrespective of prosatic enlargement.

In regard to **vesical tumors** it may be said that the clinical symptoms they produce are very different from those of prostatic hypertrophy. Rectal palpation also shows unequivocal differences, as tumors infiltrating the vesical wall—and these are the only ones which enter the question—never form a nodular mass projecting into the rectum. Finally, the cystoscopic picture shows differences. Solid neoplasms of the bladder, which, of course, are the only ones to be considered, are seldom so regularly formed and so evenly and smoothly covered with mucous membrane as are prostatic tumors. The latter are also situated directly at the sphincter, with which they are continuous, so that they can be followed by the cystoscope if it be turned on its axis.

As concerns **malignant tumors of the prostate** the following considerations will afford a diagnosis: prostatic tumors may occur in young persons, whereas hypertrophy seldom takes place before the fiftieth year; tumors cause more rapid enlargement of the gland than does hypertrophy, and produce cachexia sooner; rectal palpation reveals the irregularity of tumors, which are almost always asymmetrical and give off processes to one side or the other. These projections are usually external, in the direction of the seminal vesicles, or lateral, along the wall of the pelvis. The consistency of tumors, too, is much harder. Finally, the occurrence of metastases offers a means of differentiation. They are invariably present in cases of malignant prostatic growths, occurring mostly in the inguinal region, where they are readily palpable. They give rise to neuralgic pains in the lower extremities, which are not experienced in prostatic hypertrophy. Cystoscopically the two conditions can often not be distinguished one from the other.

Urinary retention without prostatic hypertrophy, for example,

that due to paralysis of the bladder, or fibrous degeneration of the vesical wall resulting from arteriosclerosis, is readily differentiated from hypertrophy by rectal palpation, and especially by the shortness of the urethra. The history of the case and the clinical findings are also of help.

The **prognosis** of prostatic hypertrophy as to cure is absolutely bad. Of more importance, however, is the prognosis as to life. In this latter respect it may be said that with proper care and treatment the subjects of prostatic hypertrophy may live comfortably for years or tens of years and attain an advanced age. On the other hand, frequent attacks of retention of urine, difficulty of catheterization, and complications, especially infection of the upper urinary passages, make the prognosis worse.

Those patients do best whose bladder undergoes adequate compensatory dilatation. When this takes place the bladder is converted into a large reservoir which can receive and hold the urine for twelve to eighteen hours without causing the patient inconvenience and without exerting any deleterious influence on other organs of the body. The prognosis is much less favorable for those patients whose bladder is small or contracted (concentric hypertrophy). The uncontrollable strangury reduces their strength and lessens their power of resistance.

The most dangerous complication, urosepsis and uræmia, occurs much more readily in these patients than in those of the first-named group. Frequently recurring hæmorrhages also make the prognosis more unfavorable. The worst cases of all are those in which there are great obstacles to catheterization, so that in case of retention of urine the danger of creating false passages and thereby causing infection becomes especially great.

TREATMENT.

The treatment of prostatic hypertrophy is a difficult task. It requires great knowledge and much patience on the part of the surgeon. In view of the fact that there are many men with an enlarged prostate who remain free from trouble as long as they live, our efforts must be directed to guarding the patient against those injurious influences which are known to produce such unfavorable conditions as congestion and engorgement of the prostate. Consequently exposure to cold,

especially of the feet, alcoholic excesses, protracted sitting, fatiguing walks, horseback riding, and holding the urine too long must be forbidden. A light diet, attention to digestion, avoidance of spices, and regular exercise are to be enjoined. It is important that the bowels be kept regular.

Apart from these prophylactic measures treatment may be instituted either for the relief of symptoms or for the purpose of decreasing the size of the prostate. Many prostatics can get along for years without any treatment, a careful regimen of living according to the principles above outlined preserving them from trouble and enabling them to attain a vigorous old age.

If, in course of years, occasional attacks of severe strangury, pain, and difficult micturition occur, hot baths, especially sitz-baths at a temperature of 35° C. [95° F.] increased to 42° C. [107 F.], and hot applications to the hypogastric region and perineum, together with the use of morphine or heroin suppositories, or an injection containing these drugs with antipyrin 0.5 [7½ grains] or pyramidon 0.3 [5 grains], may be employed with advantage. These measures in association with confinement of the patient to bed or to his room usually promptly ovecome the congestive attacks.

The principal symptomatic treatment is **catheterization.** It is self-evident that it must be employed in cases of chronic or acute complete retention of urine. In incomplete retention, too, it is also our chief recourse. As catheterization is especially difficult in the subjects of prostatic hypertrophy, and as it is also not without danger, the greatest precaution is necessary in its performance; it should not be employed, moreover, unless it is strongly indicated. It scarcely need be mentioned that the strictest asepsis must be practised.

First, in regard to the technic of catheterization, great stress must be placed upon the selection of proper instruments. In general nothing but soft instruments (Nélaton's catheters) should be used. If these cannot be made to pass then Mercier's or Guyon's may be tried.

If the introduction of these soft instruments cannot be effected the following expedient should be tried. Both anterior and posterior urethra are cocainized with about 6 cc. [1½ drachms] of 2 per cent cocain solution; it is injected with an ordinary male syringe and pressed backward into the deep urethra; or a 1 or ½ per cent solution may be instilled with Guyon's or Ultzmann's capillary catheter.

Adrenalin is also worthy of trial, as it produces even greater anæmia

than cocain, and thus may cause shrinking of the tumescent prostatic urethra. The injection of 5 to 15 cc. [1 to 4 drachms] of warm sterile oil is also often useful, as it lubricates the parts and frequently permits the passage of a Nélaton catheter which previously could not be introduced.

If all attempts with soft-rubber instruments fail silk-web catheters, provided either with Mercier's or Guyon's curve, should be tried. In introducing these instruments care should be taken to have the angle at the junction of the shaft and beak point upwards. The object of this curve is to have the point glide along the superior [or anterior] wall of the urethra, which, as is well known, makes the least divergence. These silk-web catheters with Mercier's curve are the real prostatic catheters, by which name they are also known.

As to semi-hard catheters only those of English make need be considered. They are made of some material which becomes malleable when heated and remains firm when cold. They are dipped in hot water, bent to the desired curve, and allowed to cool. There is no uniformity of opinion in regard to which curve is the best. The various curves shown in the accompanying illustration, reproduced from Socin's work, represent those which have been found useful by different surgeons (Fig. 188). The English catheters are best bent to the curve shown in *e*. During its introduction the catheter becomes warmed somewhat and its excessive curvature yields and so adapts itself to the shape of the urethra that the bladder can be entered even in very difficult cases. This procedure, devised by Sir Henry Thompson, requires much practice and great skill.

Guyon practises a similar procedure with a catheter coudé, which he partly but not entirely draws over a stylet in such a manner as to convert it into a bicoudé, or double-elbowed instrument (see Fig. 188 *f*).

If careful and not unduly protracted efforts with soft and semi-hard instruments result in failure, then metal catheters may be used, the rule being to employ one of large caliber having a free curve and a long beak. In moderate degrees of hypertrophy catheters bent almost to a right angle and having a moderately long beak will suffice. Where excessive enlargement with considerable lengthening of the urethra exists, Sir Benjamin Brodie's catheter (*e*), the curve of which corresponds to the arc of a circle, is very serviceable. In the illustration the catheter is overcurved. In reality the tip should end 2 cm. [$\frac{4}{5}$ of an inch] above the eye.

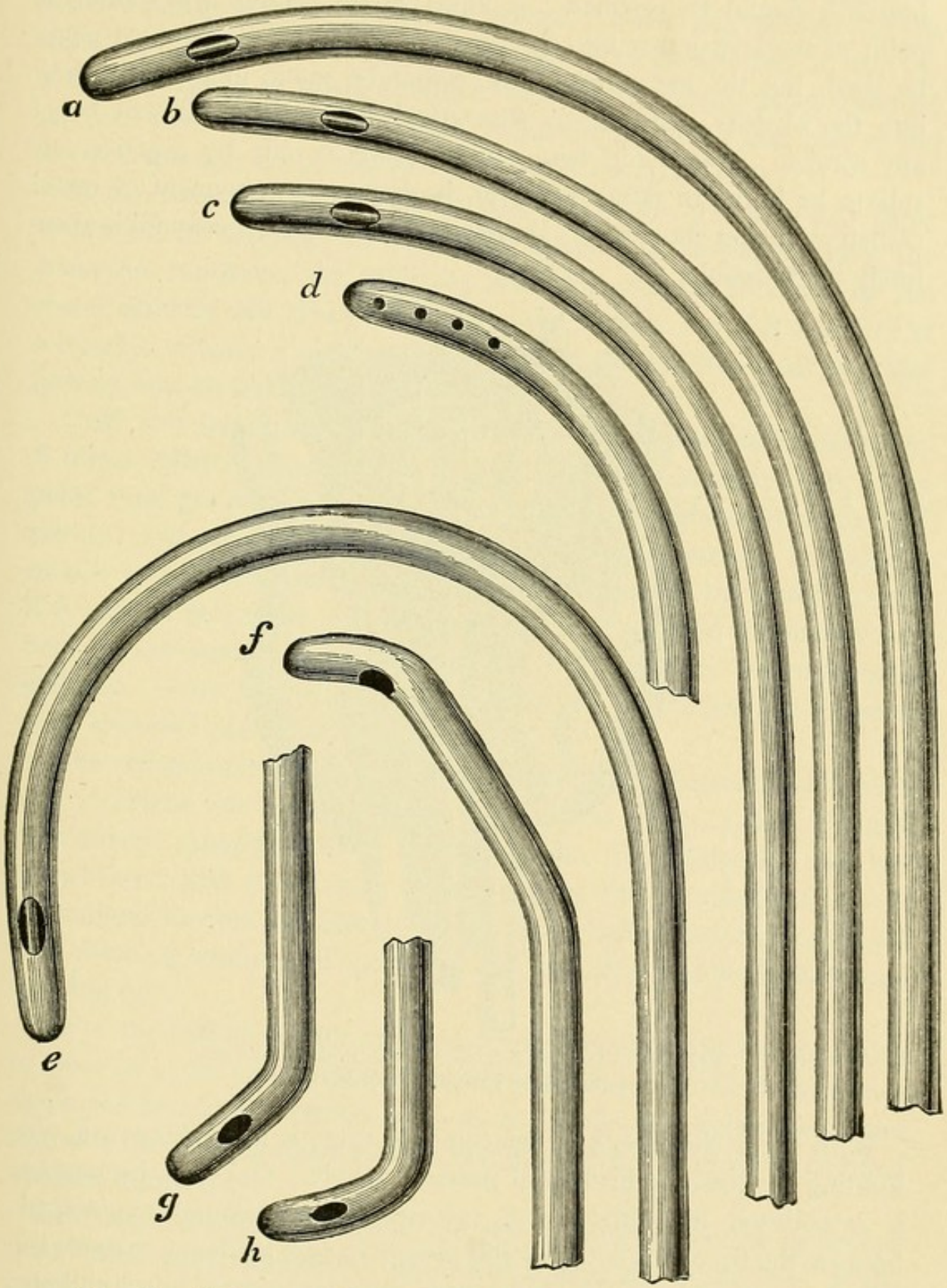


Fig. 188.—Catheters of different curves used in hypertrophy of the prostate.

Metal catheters should be slowly and cautiously passed. The buttocks should be elevated. A finger in the rectum will guide the point of the instrument into the prostatic urethra. Force must never be used, but the instrument must rather be made to grope its way into the bladder. Manifestly theoretical descriptions will not be of any service. Mastership here can be attained only by practice. A rule to be borne in mind, however, is that the employment of metal catheters having short beaks similar to that of the stone-sound is absolutely inadmissible.

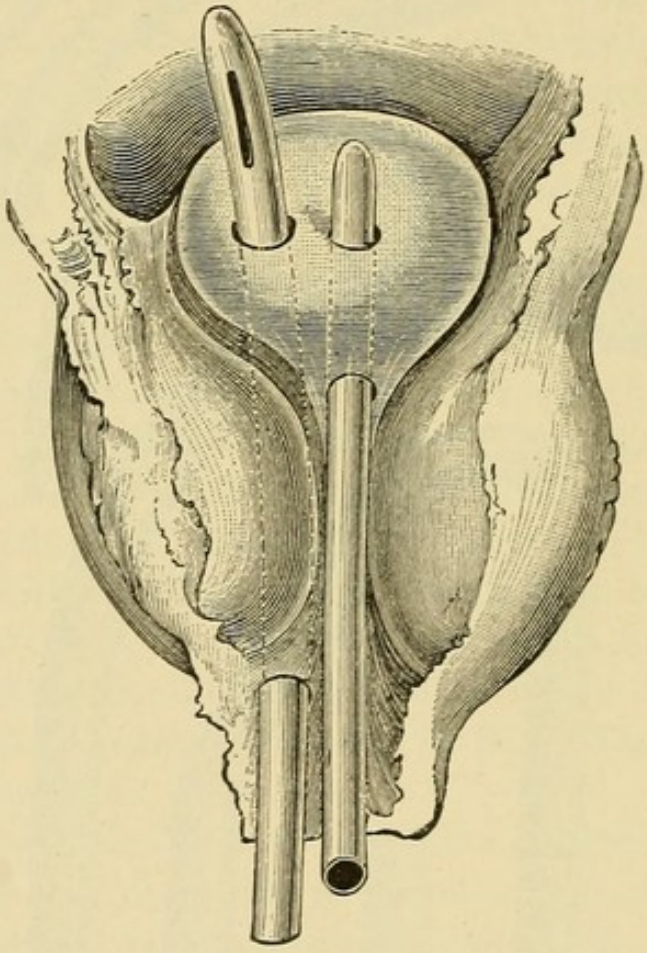


Fig. 189.—Two perforations of the middle lobe of a hypertrophied prostate. (Güterbock.)

With such short-beaked instruments there is great danger of perforating the prostate instead of passing over it. Once a false passage is established the difficulty of catheterization becomes augmented, because the tip of the catheter will always have a tendency to enter the false passage. Figure 189 gives a good representation of how a catheter may perforate the middle lobe; it shows two perforations.

The great danger of hæmorrhage and infection occasioned by a false passage has already been described.

Patients having false passages should not be catheterized unless some urgent indication exists. Such indications will be stated presently. If it becomes necessary to catheterize, if, for example, retention of urine develops, then a large metal catheter should be tried first, its beak, if possible, being carried along that wall of the urethra through which the perforation did not take place.

If the retention is relieved by this procedure and does not recur it will not be necessary to catheterize again. If, on the contrary, the retention continues, the difficulty attending the introduction of the metal catheter will always be experienced anew. For this reason it is advisable to leave a permanent catheter in the bladder until the false passage has healed.

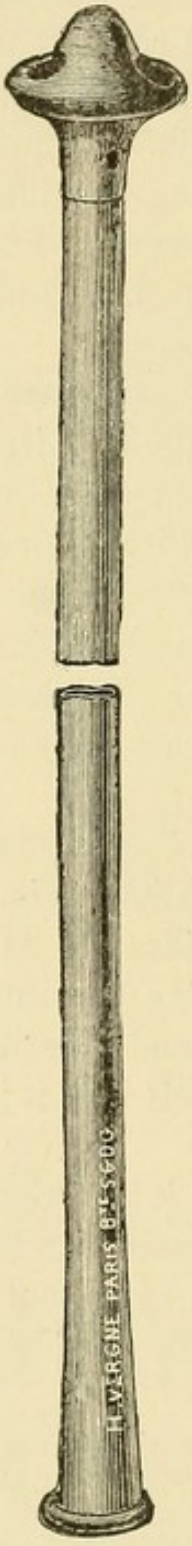
Only soft instruments are adapted for permanent catheterization. A metal catheter should never be left in the bladder over night, as its point may perforate the wall if the patient moves unduly while half asleep. I know of a case in which this accident happened. A Nélaton or silk-web catheter with or without a curve should be tried first, and if it cannot be passed a stylet should be inserted and the instrument bent to the same curve possessed by the previously inserted metal catheter. After the wire has been removed the catheter is fastened with adhesive plaster or a bandage.

The self-retaining catheters devised by Pezzer, Malecot, and myself are excellent for permanent catheterization (Fig. 190). Pezzer's instrument expands into a mushroom-like tip, Malecot's has two projections, and mine four, which, during the introduction of the instrument, lie even with the stylet, but expand after the latter is removed and come up against the sphincter. In this way it is prevented from slipping out.

As to the indications for catheterization it is obviously indispensable in cases of acute and chronic complete retention. If the usual means employed in acute retention, such as hot baths, hot applications, and injections of morphine produce no result, the bladder must be emptied by catheterization.

In chronic complete retention, too, the catheter cannot be dispensed with. The small quantity of urine which rises above the level of the sphincter and escapes spontaneously is not sufficient to afford relief. The patients have continuous strangury which can be relieved only by emptying the bladder. Similar to these are the cases of incomplete retention in which a large quantity of urine remains in the bladder.

In all these cases catheterization is necessary to empty the bladder. If it be very difficult it is better to introduce a permanent catheter and thus save the patient the suffering incident to repeated passages of an instrument.



Pezzer's catheter.

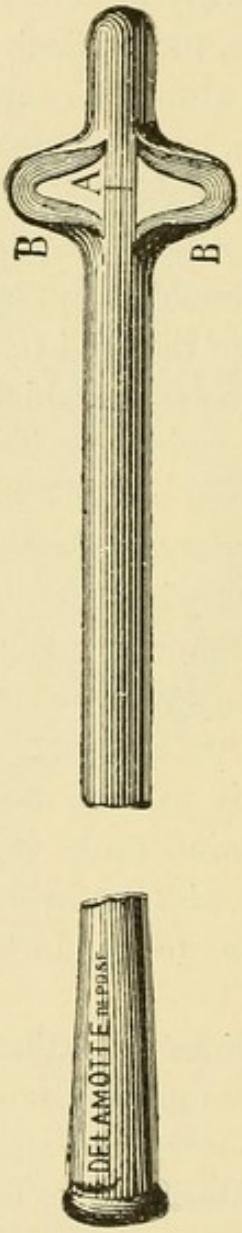


Fig. 190.—Malecot's catheter.

If the bladder is as yet uninfected and the urine obtained is clear, I would advise the use of the permanent catheter only in exceptional cases, because it is almost always sure to lead to the development of

cystitis. It gives rise to urethritis which extends to the bladder; therefore when the urine is clear the permanent catheter should be employed only when catheterization is very difficult and associated with hæmorrhage.

If the bladder is infected then no hesitancy need be felt as to its use. Care should be taken, however, to cleanse the bladder once daily with silver nitrate 1–1000 and thrice daily with mercury oxycyanate 1–5000. These irrigations also serve to keep the catheter from becoming encrusted.

Although it was formerly the custom to follow Bazy's recommendation and keep the subjects of permanent catheterization in bed, and, moreover, to continue the procedure for only a few weeks at most, I have introduced a method of **treatment by permanent catheterization** which has proved to be very valuable in a number of cases. It consists in allowing the catheter to remain in for months, or indefinitely for that matter, and also allowing the patients to walk about and follow their usual vocation. I use my own self-retaining catheter, which has four arches, and which does not easily become encrusted. The bladder must be irrigated once or twice a day, and the catheter changed every month or at least every two months. At first a suppurative urethritis is produced, but it soon heals and the urethra becomes dry; thus the natural passage is converted into an artificial fistulous canal. If the patient experiences much difficulty at first he should be kept in bed and given morphine.

This treatment possesses the great advantage of doing away with the necessity of confining the patients to bed, and thus abolishes the danger of hypostatic pulmonary congestion, so prone to develop in old, decrepit persons who are bed-ridden. They are free from the strangury and pain caused by each passage of an instrument, and urinate easily every hour or two, according to their needs, by simply removing the cork which closes the catheter.

The question as to how much residual urine must remain in the bladder to necessitate this form of permanent catheterization, or ordinary catheterization, can be easily and accurately answered. It depends upon the size of the bladder and the properties of the urine. It may be said that the dilatation of the bladder, which increases as the quantity of residual urine becomes greater, represents a curative effort on the part of nature. Patients with well-marked chronic retention (2 or 3 liters of urine) are occasionally met with who suffer

no impairment of health, only they have to urinate more frequently than other men.

The condition of patients having contracted bladder is much worse. While the urgency of micturition experienced by the first class subsides as soon as they are catheterized once or twice daily, the tenesmus suffered by patients with small bladders is uncontrollable. **The indication for catheterization, therefore, depends upon the disproportion between the capacity of the bladder and the amount of residual urine.**

If cystitis complicates chronic retention catheterization almost always works favorably. It rarely does harm, although occasionally a single catheterization may prove fatal. I have had two deaths occur immediately after simple catheterization. It had hardly been begun before the patients became worse, while previously their general condition had been good. The tongue became dry and coated, anorexia and nausea developed, stupor supervened, and death took place within two days. As cystitis was already present in both cases, infection as the cause can be excluded; the temperature was not elevated; no hæmorrhage had been produced. It cannot be explained otherwise than by assuming that the difference in pressure between the emptied and previously filled bladder resulted in such a profound alteration of the organism as to cause the exitus of the feeble and atheromatous patients. Therefore it should be an established rule to draw off the urine cautiously and slowly from patients who have not been catheterized before and whose bladder is much distended, and afterwards to inject 100 cc. [3½ ounces] of sterile water into the bladder. In time we may come to empty the bladder completely and also to draw off the water used for irrigation.

The severe complications, **acute and chronic urosepsis,** which may follow a simple catheterization even when it has been practised with the utmost precaution, have already been mentioned. They have nothing in common with the condition just described. While in robust persons infection is followed by chills and fever, the urine becoming turbid and purulent, in the old and decrepit either an acute sepsis develops, which soon ends in death, or chronic sepsis, the so-called **urinary fever,** occurs; this latter condition runs its course with only slight elevation of temperature. The patients are plainly on the decline; their nutrition becomes poorer and their aversion to food more and more noticeable. Intense thirst is the predominant

symptom. The urine is purulent and does not become clear in response to irrigations. The patients become gradually weaker until death occurs.

This chronic urinary intoxication or urinary fever is difficult to combat. Naturally recourse will be had to the internal disinfectants, of which urotropin holds first rank, it being a drug, too, which should always be administered as a prophylactic to those who have entered upon catheter-life. Permanent relief for the bladder should be secured by regular catheterization or by the use of a self-retaining catheter, and the bladder should be cleansed by antiseptic irrigations, preferably of silver nitrate. In extreme cases the establishment of a perineal fistula will be resorted to in order to afford exit for the urine at the deepest part of the bladder, and thus prevent further absorption of septic material by permitting the urine to drain away as soon as it is discharged from the ureters. Cardiac stimulants, nourishment supplied in every possible way, even in the form of nutritive enemata if necessary, a liberal quantity of alcohol, and periodic saline injections or hypodermoclysis are indicated. By these measures the patients can frequently be saved. Anorexia, thirst, fever and general weakness slowly disappear, and the patients recover to the extent of regaining the same degree of health which they possessed before the infection occurred.

The treatment of acute complete retention requires special consideration. There are many obstacles to catheterization. It generally happens that the surgeon is called to a case in which several fruitless attempts to pass an instrument have already been made, and in which false passages are often present. In such cases it is best not to dilly-dally with soft catheters, but, after cocainizing the urethra, to try a large, long-beaked metal instrument having a pronounced curve, and if this will not pass to use one with Brodie's curve.

No hesitancy need be felt about anesthetizing the patient, for he generally is in such a state of excitement and restlessness that the catheter cannot be passed with ease and caution. If catheterization does not succeed after a reasonable trial, it should be abandoned and **puncture of the bladder with a capillary trocar** at once made. The skin is incised a little above the symphysis and the trocar plunged quickly and forcibly downwards and backwards. Capillary puncture is entirely without danger, even when repeated. I have practised it six times on the same patient without doing him any harm. The fine puncture agglutinates at once. Injury of the peritoneum or

bowel is out of the question because of the high position of the peritoneum. Moreover, I deem it more conservative to puncture the bladder than to persist in efforts at catheterization, especially if false passages be present. If puncture be performed a few days in succession and the urethra left undisturbed, it will usually be found that the catheter can then be easily passed.

It is only in cases of severe hæmorrhage into the bladder that capillary puncture fails; the admixture of urine and blood is too thick to flow through the fine trocar, which may also be occluded by clots. In these cases of violent prostatic hæmorrhage into the bladder, suprapubic section must be contemplated as an operation of necessity.

Severe hæmorrhage with simultaneous retention of urine and dilatation of the bladder can frequently be relieved by catheterization. A large catheter is introduced and a small quantity of sterile water injected through it at high pressure as soon as the eye becomes clogged with clots; powerful contractions of the bladder result and the clots are generally expelled with the urine. This manœuvre is repeated until as many clots as possible are removed. If need be suction may be made with a good syringe; the clots are thus drawn into the syringe and the urine can then escape. If these measures do not succeed after reasonable trial they should not be unduly prolonged; the patients become weak and anæmic, particularly if further bleeding takes place. It is better to open the bladder suprapubically, clear out the clots, and tampon the bladder firmly with sterile gauze in the event of continued hæmorrhage.

In such cases the bladder has been punctured with Fleurant's large trocar and a catheter introduced through the wound for the purpose of emptying the bladder. This method of puncture is not suitable for these cases and should not be practised. In cases where the hæmorrhage is severe it is uncertain, as the thick clots may not go through the trocar. The establishment of a permanent suprapubic fistula is not advisable. No appliance can be worn which will close it tightly; the patient is greatly annoyed by always being more or less wet. Moreover, the fistula is situated much too high, so that a residuum of urine remains in the bladder.

The peritoneum has been injured in making the puncture, and Frisch mentions a case reported by Monod in which the prostate itself was injured to such an extent that abundant hæmorrhage resulted.

This procedure is justifiable only in that condition which I have named **prostatismus,** a condition in which there is violent and uncontrollable strangury, although little or no residual urine is present in the bladder. In most cases of this kind the bladder is somewhat diminished in size; if its cavity be very much lessened the case is to be considered as one of contracted bladder.

In both these classes of cases little is to be expected from ordinary measures. Contracted bladders cannot be influenced by any kind of treatment, and prostatismus shows obstinate resistance. Before an artificial canal is established an attempt should be made to institute permanent catheterization, a measure which possesses the additional advantage of draining the bladder at a lower level. Unfortunately the attempt often proves futile because the bladder is too irritable to tolerate a catheter. Nevertheless, it should always be tried.

If it fails, another procedure may be selected for the prostatismus cases, namely, division of the vas deferens, or vasectomy, which will also be discussed later as an operation for the radical cure of hypertrophy. This operation has no effect upon contraction of the bladder, although it acts very well in prostatismus. It is probable that the latter condition is due to irritation of certain nerves which is produced by the enlargement of the prostate, and that this irritation is abolished by section of the vas deferens together with the nerve filaments which accompany it to the prostate.

Only in exceptionally urgent cases, and after the last mentioned method has failed, would I advise the establishment of a suprapubic fistula, and even then I think cystotomy and the use of Witzel's canula preferable.

In 1901 Goldmann proposed the operation of cystopexy for retention of urine in cases in which vesical distention and infection has not occurred. In this operation a portion of the anterior vesical wall not covered by peritoneum is attached as high up as possible to the anterior abdominal wall. The traction thus made upon the anterior wall of the bladder is said to bring the viscus upwards and forwards and prevent the formation of recesses in the posterior wall. It is also supposed to draw the lips of the internal meatus apart. Goldmann has obtained good results in several cases in which he did this operation. He had the opportunity of making an autopsy on one patient who died of myocarditis a number of years after the operation was performed. The following conditions were revealed:

1. A broad adhesion between the bladder and the anterior abdominal wall.
2. Anteversion of the bladder.
3. Widening of the internal urethral orifice.
4. No signs of recesses in the posterior wall of the bladder.
5. No signs of dilatation of the ureters and pelvis of the kidneys.

Unfortunately this operation is too new for its exact value to be stated.

All the procedures which we have mentioned thus far come under the scope of symptomatic treatment. We now have to consider **radical treatment,** the object of which is to reduce the size of the prostate, or even remove it completely, and thus by radical means take away the hindrance to micturition.

A series of procedures formerly recommended and practised need only be mentioned, because they have proved to be worthless, and therefore have merely historical interest.

There are no internal remedies which can diminish the size of the prostate. Prostaden, which was recently recommended, proved to be merely a fashionable nostrum. Organotherapy also was in vogue at one time, and dried prostatic substance was fed to patients. The results were absolutely negative.

Massage of the prostate for the purpose of reducing hypertrophy has been abandoned as ineffective. The same may be said of electric massage and electrolysis. The latter undoubtedly causes the gland to become slightly smaller, for it certainly destroys small portions of tissue; the effect, however, is only slight, and the number of treatments necessary to bring about any considerable diminution in size so great that the method has never become established.

Compression of the prostate by large sounds and catheters is without effect; it does not cause atrophy and it is doubtful whether it enlarges the caliber of the urethra.

I tried the X-ray treatment recommended by Moskowitz in 1905, in three cases, but as the results were entirely negative I made no further experiments with it.

The injection into the prostate of fluids which cause destruction of tissue and subsequent contraction, such as solutions of iodine and arsenic (Iversen), has been abandoned as too dangerous. The danger of suppuration within the capsule of the prostate, with consequent thrombosis, is too great.

It thus came to pass that all operative procedures for the cure of hypertrophy of the prostate were discontinued until within the last few years, during which time a complete reversal of opinion has taken place, and three kinds of operations have been devised one after another, and each has been declared to possess superior merits.

We will first mention Bier's operation, which consists in the **ligation of both internal iliac arteries.** Bier believes that the prostate can be made to atrophy by ligaturing these vessels, which supply it with blood, just as myoma of the uterus atrophies after the uterine arteries have been tied. Aside from the fact that the cases reported by Bier do not prove the good results of the operation, for the reason that they were mostly cases of comparatively recent retention of urine, which not uncommonly undergo spontaneous relief and therefore cannot be taken as criteria, the procedure is much too formidable and dangerous to be practised on old and enfeebled persons. With few exceptions (Willy Meyer) it has found no supporters.

Treatment took an entirely new course with the introduction of the so-called **sexual operations,** which were devised almost at the same time, in the years 1893 and 1894, by Ramm, of Christiana, and White, of Philadelphia. These surgeons recommended **double castration,** their theory being based on observations which had convinced them that the prostate ceased to grow in young animals which had been castrated, that in older ones it atrophied, and that the analogous condition of uterine myoma diminished in size after removal of the ovaries.

The smallness of the gland in eunuchs and in the subjects of anorchism and cryptorchidism was adduced as proof of the correctness of their theory.

Except as to the comparison of prostatic hypertrophy with uterine myoma, which is not apposite to the subject, for the reason that the prostate is an organ which cannot be compared to the uterus, the result of the experiments is correct. I have myself conducted a large number of similar experiments upon dogs and rabbits, and have found that the glandular portion of the prostate of these animals atrophies after the performance of double castration. The accompanying illustrations fully elucidate the change which ensues (Figs. 191 and 192).

Although shrinking actually takes place, the theoretical conclusion drawn from this fact is erroneous. It is the glandular elements of the enlarged prostate which shrivel; but it has been definitely deter-

mined that only the minority of cases of prostatic hypertrophy depend upon hyperplasia and hypertrophy of these elements. In the majority of cases there is a typical nodular myoma, and it cannot be affected by castration. Thus it is seen that castration will result in shrinkage

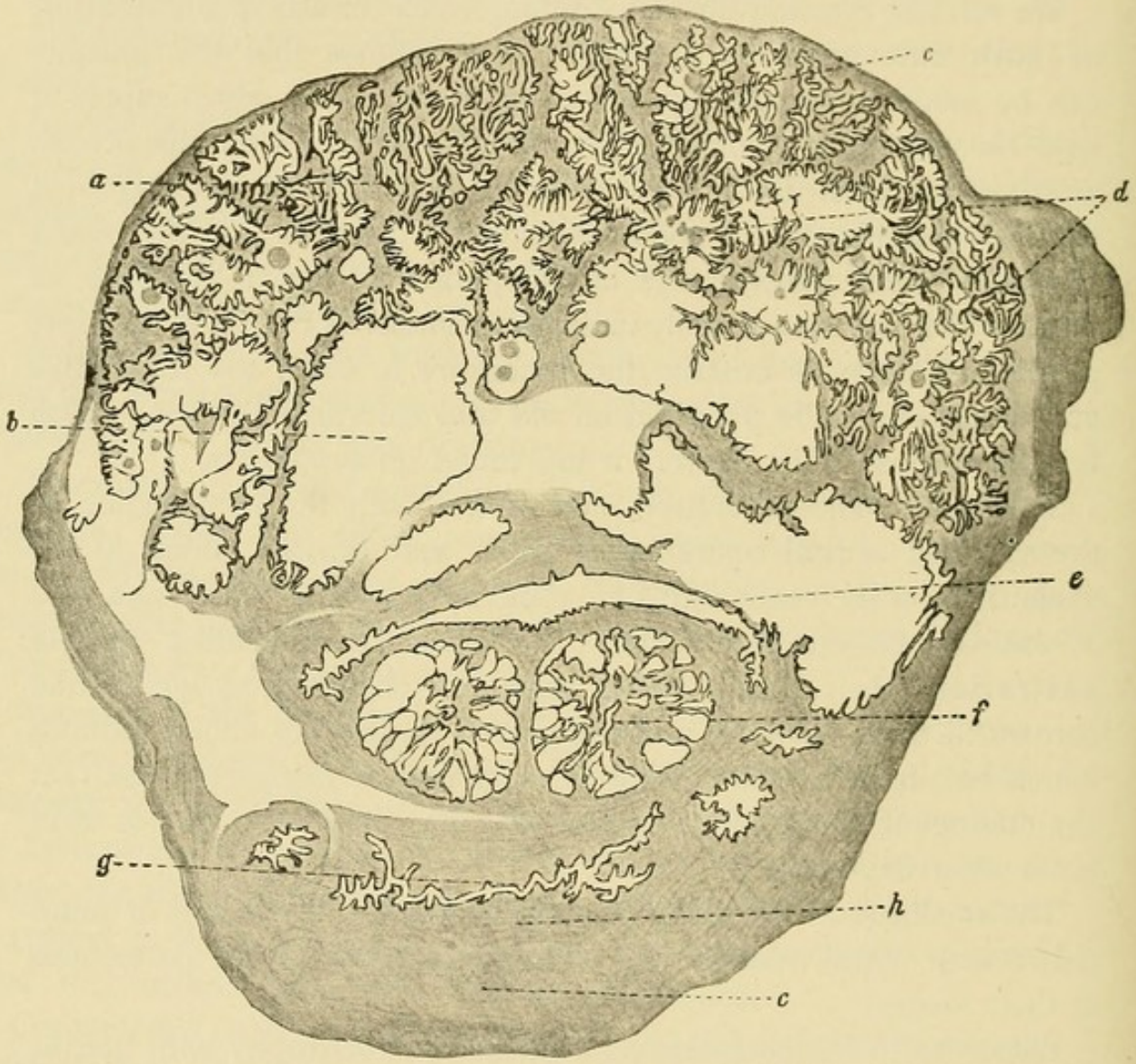


Fig. 191.—Section from the prostate of an old rabbit. *a* gland-lobules, *b* cysts, *c* stroma. *d* stratified bodies, *e* prostatic vesicles, *f* seminal vesicle, *g* urethra, *h* musculature.

of the gland in only the few cases which are of true adenomatous overgrowth.

The results of practical experience, both my own and that of others, is in accord with these deductions. I have performed castration for prostatic hypertrophy about twenty times. At first, influenced by the reports of others, there was a tendency to attribute some value to the procedure, but upon more candid judgment it has been found

to be without practical value; indeed, it may be declared to be injurious, as it exerts an unfavorable influence upon the patient's mind. It is an operation which has been abandoned.

A little more favorable statements may be made in regard to **division of the vasa deferentia.** Theoretically its effect upon the prostate is even less valuable than that of castration, for it has been shown that neither the testicles nor the prostate regularly atrophy after its performance. (See Figs. 193 and 194.) In some instances shrinkage

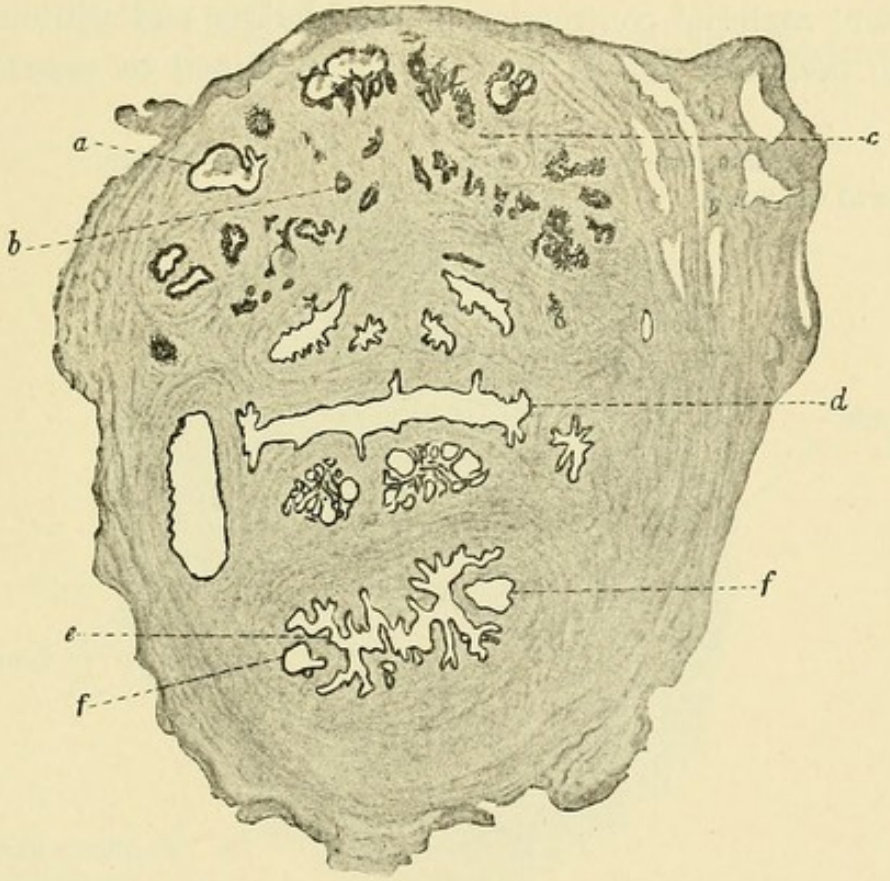


Fig. 192.—Section from the prostate of an old rabbit 3½ months after castration. *a* stratified body in an atrophied gland-tubule, *b* collapsed and contracted tubule, *c* fibrous stroma, *d* prostatic vesicle, *e* urethra, *f* seminal vesicle.

took place; in others it did not occur. In order to prevent the vasa deferentia from growing together again Isnardi excised a portion; the result, however, remained the same.

The results obtained in practice correspond to those given by experimentation. Vasectomy has no effect upon the size of the prostate. Notwithstanding this, however, it has acted beneficially in a few cases, and for this reason I would not exclude it from the treatment of prostatic hypertrophy. Primarily it is important to bear in mind that the procedure is entirely harmless, and that it can be done under

Schleich's local anæsthesia in a very short time. I have done the operation in this manner twenty times and allowed the patients to go home at once. They suffered no inconvenience and the wounds healed by first intention.

The operation is of value in two kinds of cases, namely, those in which epididymitis develops as the result of repeated catheterization, and, secondly, in prostatismus, which has already been described. The frequently recurring and painful epididymitis is permanently cured. In prostatismus, in which increased desire to urinate is present without material contraction of the bladder and without residual urine, the favorable results have to be attributed to something else

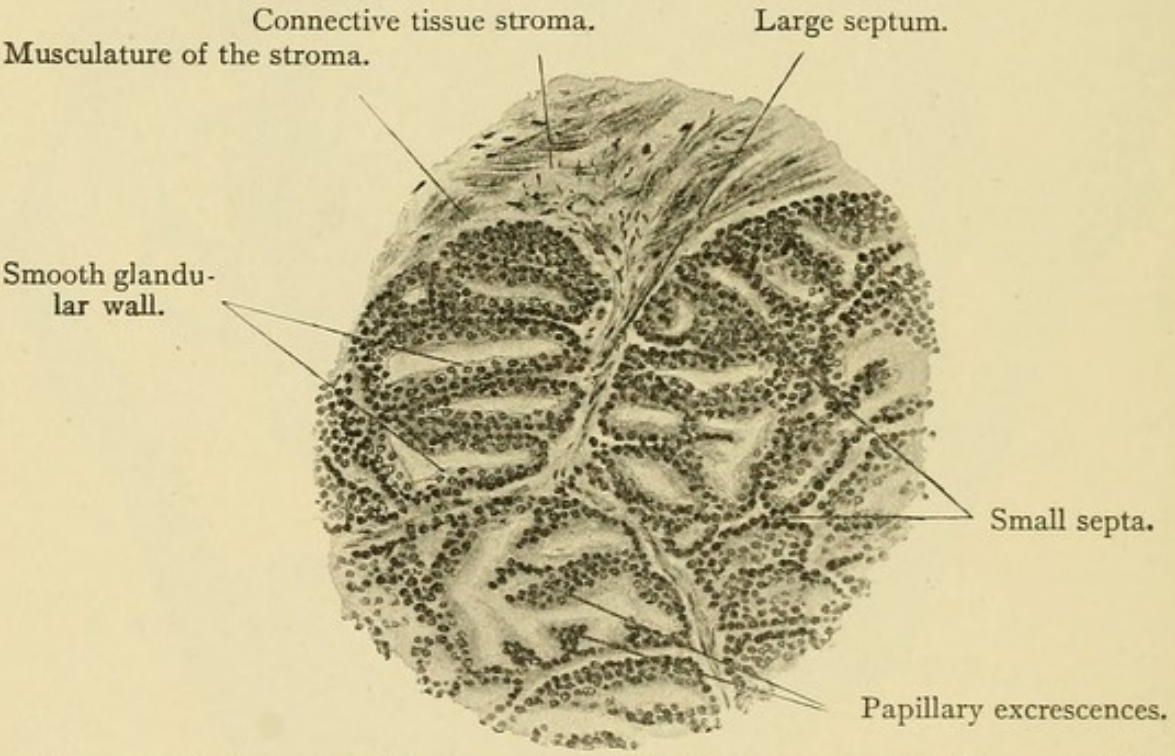


Fig. 193.—Prostate of a full-grown dog. (Glandular tubules. Highly magnified.)

than diminution in the size of the prostate. We are led to this conclusion by the fact that the benefit often ensues within a few days after the operation, a period of time, of course, in which the prostate could not have undergone contraction. It must, therefore, be taken for granted that the division of the nerves which accompany the vasa deferentia to their entrance into the prostate relieves the irritation. It is only for these two classes of cases that vasectomy can be recommended.

Division of the entire spermatic cord, as well as the injection of zinc chloride into the parenchyma of the testes, both of which have

been advised, are to be condemned because they are liable to produce gangrene of the testicles.

In recent times there has been a return to, and an attempt to improve, the more formidable operations which had formerly been tried in a few cases. These operations are **complete and partial prostatectomy.** Partial or total removal of the prostate has been attempted through a suprapubic cystotomy incision, through a perineal opening, and also by the prerectal route.

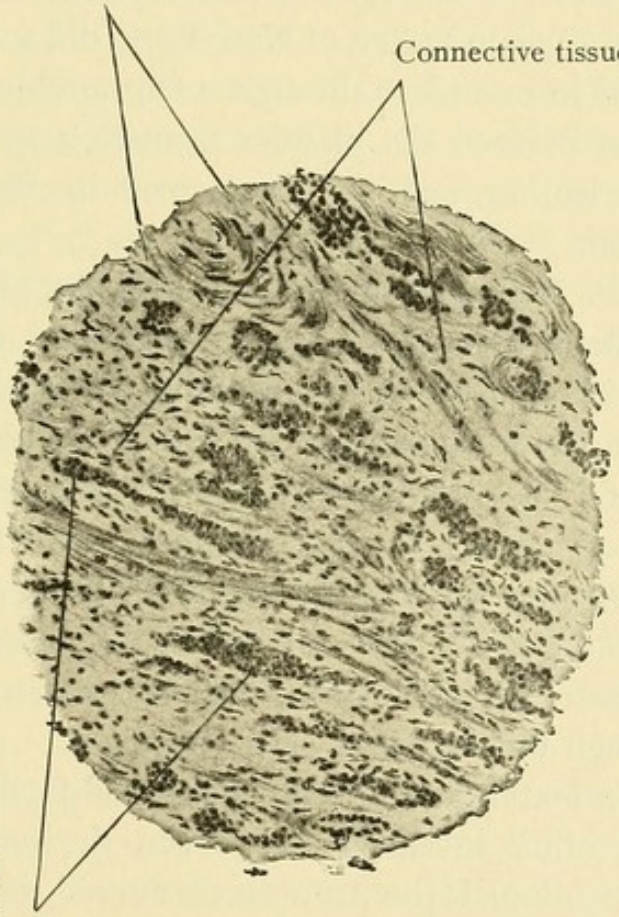


Fig. 194.—Prostate of a full-grown dog 4½ months after double vasectomy. (Highly magnified.)

To trace the evolution of prostatic surgery would, indeed, be interesting, but in a work of this character space will not permit it to be followed from its origin to its present stage of development. Therefore only the most important epochs will be mentioned.

In regard to **suprapubic prostatectomy** the first noteworthy procedure was that practised by Belfield, of Chicago, and McGill, of Leeds. These surgeons did a **partial prostatectomy** through suprapubic and transvesical incisions, opening the bladder, incising

the mucous membrane over the prostate and then removing the obstructing portions of the gland by cutting them away or enucleating them with the fingers. This operation, though generally known as McGill's, had been performed three times by Belfield before McGill operated on his first patient.

I practised this procedure in several cases; in some the results were gratifying, in others the patients died, and so I came to consider it too severe for the majority of prostatics.

As surgeons gained experience with this operation the idea of enucleating the prostate in its entirety was conceived and executed. Accordingly, in 1895, Dr. Eugene Fuller, of New York, did a complete enucleation of the gland in one piece through a suprapubic and transvesical incision, and then drained the bladder through a perineal opening.

A similar enucleation was also performed in 1897 by Dr. F. S. Watson, of Boston.

In 1900, Mr. P. J. Freyer, of London, adopting and modifying the principle of Fuller's method, began the series of operations which have connected his name with suprapubic prostatectomy. He has found it possible to enucleate the prostate in its entirety in almost every instance, and has shown that perineal drainage is not necessary.

The perineal operations as first practised were partial prostatectomies, the obstructing portions of the gland being removed through a median perineal incision. This method has been largely practised by Goodfellow, of San Francisco, who finally came to do a complete enucleation through this incision.

In order to gain better access to the gland and facilitate its complete removal various other incisions have been devised. Chief among these may be mentioned the transverse curved incision advocated by Proust and Albarran and the inverted V incision of Young.

These operations are to be welcomed as a decided advance in the therapy of prostatic hypertrophy, inasmuch as they afford relief in a class of cases not otherwise amenable to treatment. They are not without danger, however, and therefore should not be employed indiscriminately nor undertaken lightly, being reserved for those cases in which milder measures prove futile.

When catheterization fails or has to be frequently repeated owing to smallness of the bladder produced by thickening of its walls, when it is very painful or is followed by hæmorrhage, when severe cystitis is present or frequent attacks of retention occur, and when a case is not

suitable for the Bottini operation, then a radical operation is to be considered.

The one selected will depend upon the nature of the individual case. No doubt further experience will result in better knowledge of the exact indications for the two recognized procedures, namely, the suprapubic and perineal operations. At present the weight of evidence seems to be in favor of the former for the majority of cases. The functional results are better, the complications less frequent, and a decided decrease in mortality has occurred as improvements in operative technic have taken place. In my clinic it has been the operation of choice. It is easier to perform than perineal prostatectomy, and as it affords a better view of the field of operation than the latter method, it enables the operator more surely to enucleate the gland in its entirety. Moreover, when operating through the suprapubic route the surgeon is not at all liable to leave calculi in the retroprostatic pouch. The great disadvantage of the operation is the poor drainage which it affords. In order to overcome this disadvantage external perineal urethrotomy has been performed and the bladder drained through the perineal wound. I have never done this myself, being satisfied to drain through the suprapubic wound by means of a large rubber tube.

Among the unpleasant sequelæ of the operation, the first to be mentioned is hæmorrhage. As the field of operation is easily accessible, bleeding can almost always be controlled (see under *Technic of the Operation*). Infection must also be taken into account, as it is liable to occur owing to the action of the septic urine upon the wound. Fistulæ sometimes persist, but they are not so frequent as after the perineal operation, in which injury to the rectum is very liable to lead to the formation of urethro-rectal and vesico-rectal fistulæ. Incontinence of urine sometimes though rarely occurs. In my clinic it is exceedingly uncommon. Of twelve patents operated on in the Jewish Infirmary, however, two suffered from a slight degree of incontinence.

The mortality of the suprapubic operation still remains higher than that of the perineal. Thus Tenney and Chase collected 396 cases of suprapubic prostatectomy, with a mortality of 9.8 per cent and 617 cases of perineal prostatectomy with a mortality of 7.6 per cent. These statistics are based upon the work of many operators and not upon series of cases reported by surgeons especially skillful in the performance of

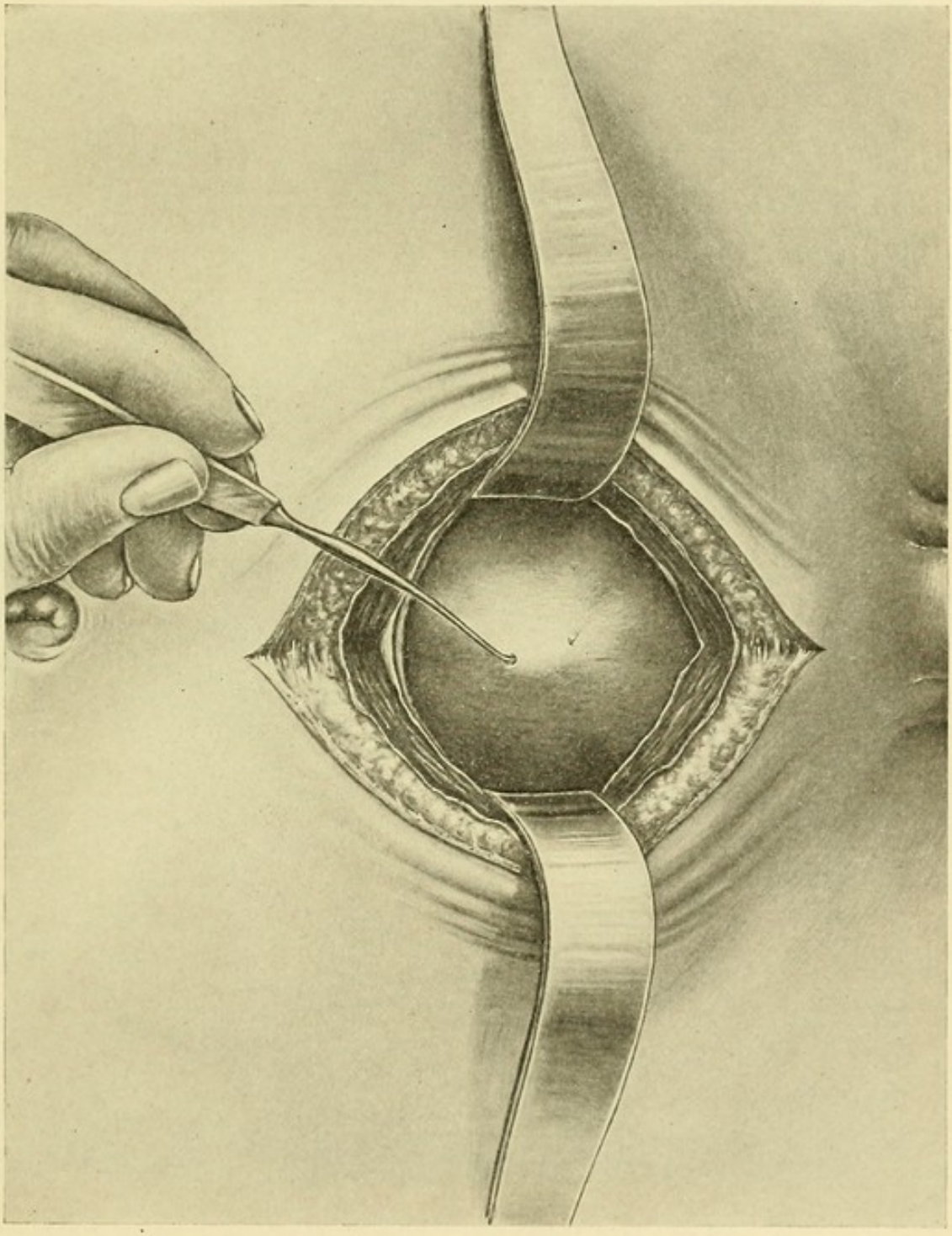
the respective operations. Therefore they may be considered as representing a fair average mortality-rate of the two procedures up to the year 1906. Freyer's last published statistics (1908), based upon 481 cases, give a mortality of 6.65 per cent for the suprapubic operation. Young's latest published statistics (1908), based upon 238 cases, give a mortality of 2.9 per cent for the perineal operation. These latter statistics are very significant, representing as they do the mortality-rate of two surgeons who have had unusual experience in the performance of the respective operations. Owing to improvements in technic there has been a constant decrease in mortality, and in all probability this decrease will continue. In 1900 Fuller stated that the mortality after suprapubic prostatectomy was from 15 per cent to 18 per cent; in 1904 Watson gave it as 11 per cent; in 1905 Freyer's statistics showed it to be 9 per cent, and, as already stated, in 1908 he had reduced it to 6.65 per cent.

Notwithstanding its higher mortality, I consider it the preferable operation for the majority of cases. If the prostate is entirely removed and the patient recovers from the operation, he will be completely and permanently cured of his trouble.

It would be difficult to define the exact contraindications to this operation because improvements in its technic will render it applicable to a greater and greater number of cases. It is very important that the patient's nutrition be not reduced too low. Advanced atheroma, severe bilateral renal disease and other serious organic diseases must be looked upon as contraindications. Unilateral pyelitis and cystitis, however, are not contraindications. A large number of my patients had a very bad cystitis, which disappeared after the operation. Even when these contraindications do not exist, the operation is by no means a trivial one. A patient of mine, aged fifty-nine years, who showed no signs of cardiac or arterial disease, succumbed to shock on the fourth day after the operation.

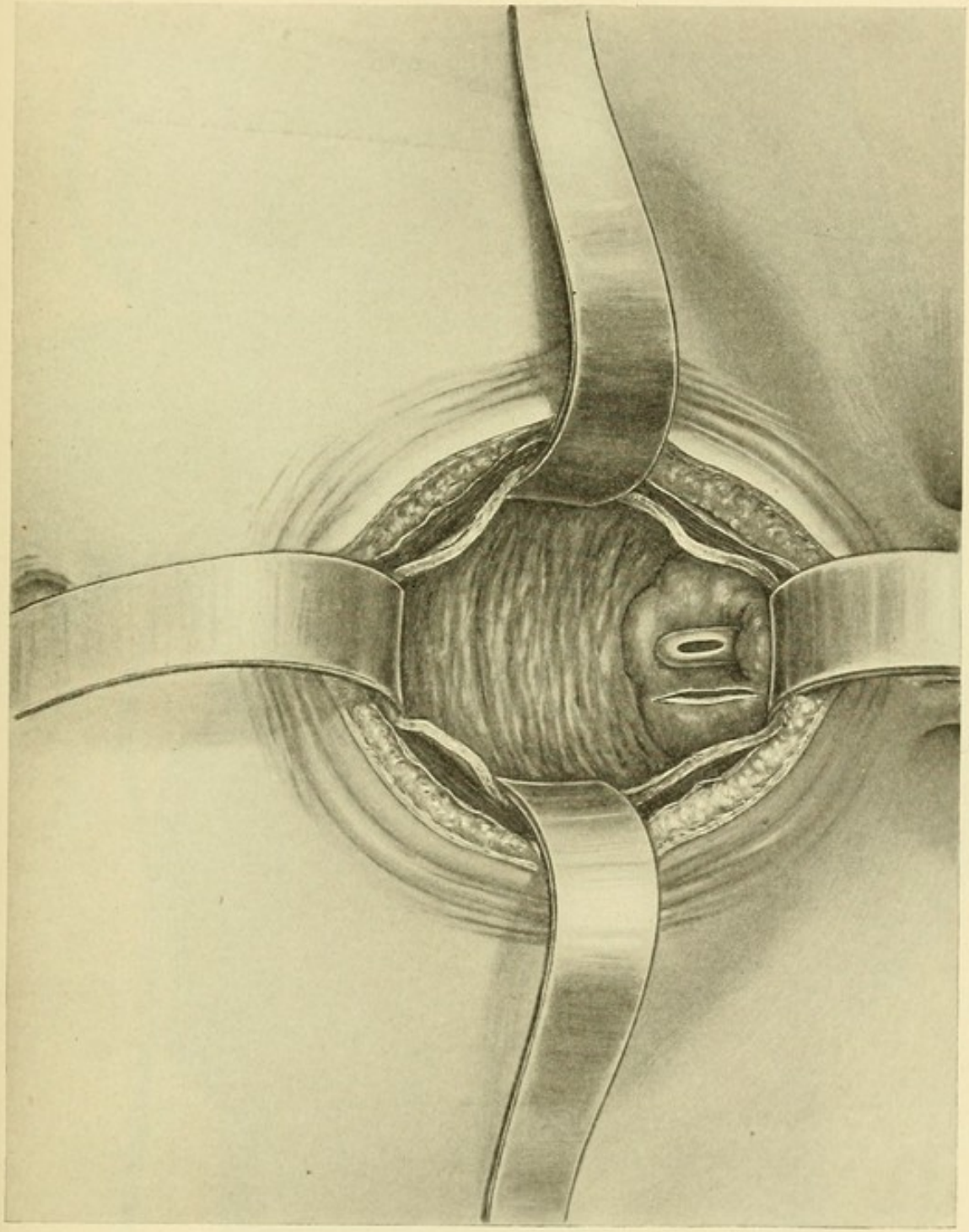
The technic of the modern operation of suprapubic prostatectomy is as follows: After the bladder has been thoroughly washed out with hot saline or boric acid solution and about four ounces of the fluid left in the viscus, the soft rubber catheter through which the irrigation has been done is clamped and left in situ, the patient put into the Trendelenburg position, and the bladder exposed by a suprapubic incision from two to five inches in length, according as the patient is thin or very obese. The lower end of this incision should come directly

PLATE II.



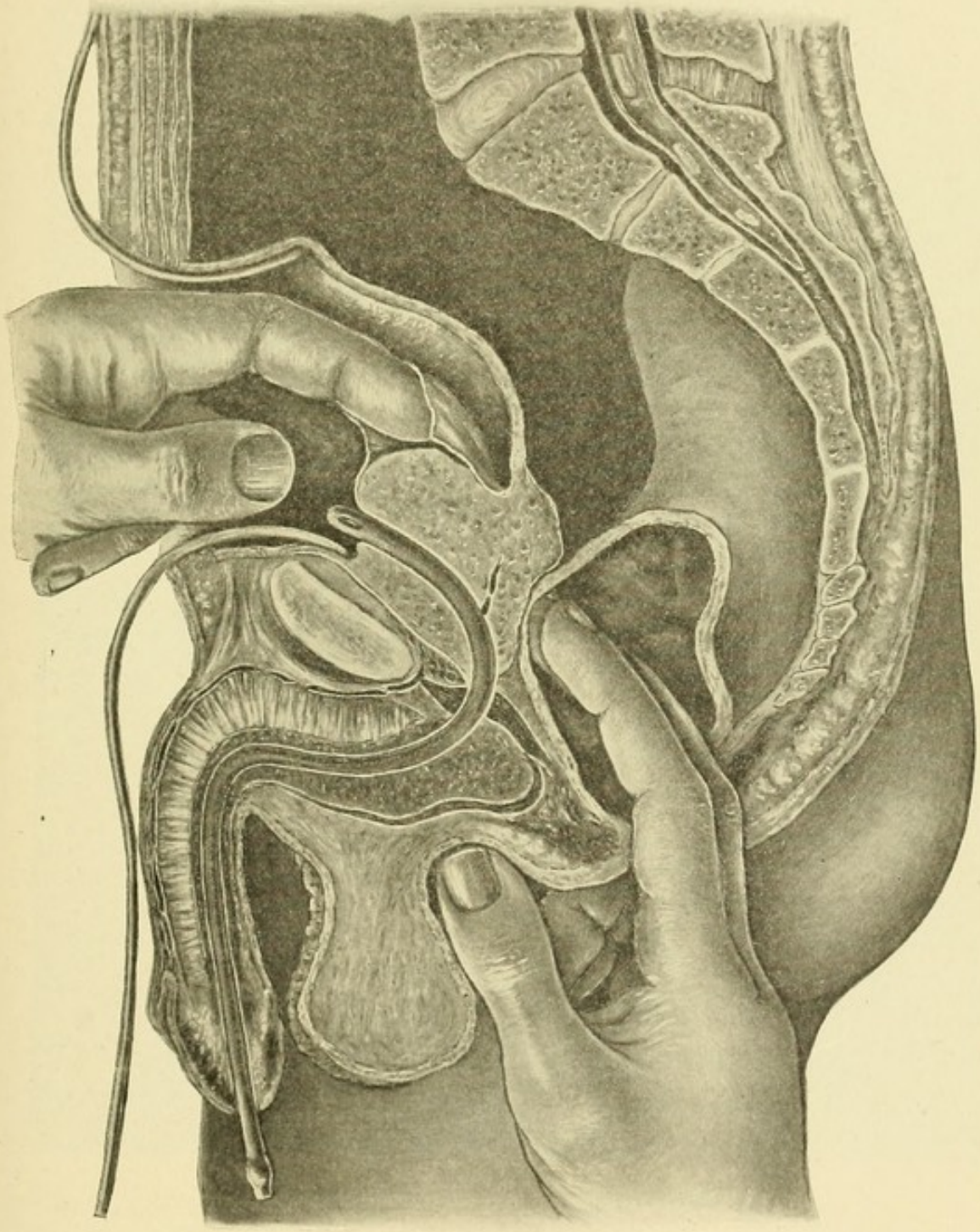
Bladder exposed and steadied with a tenaculum preparatory to being opened. (Deaver.)

PLATE III.



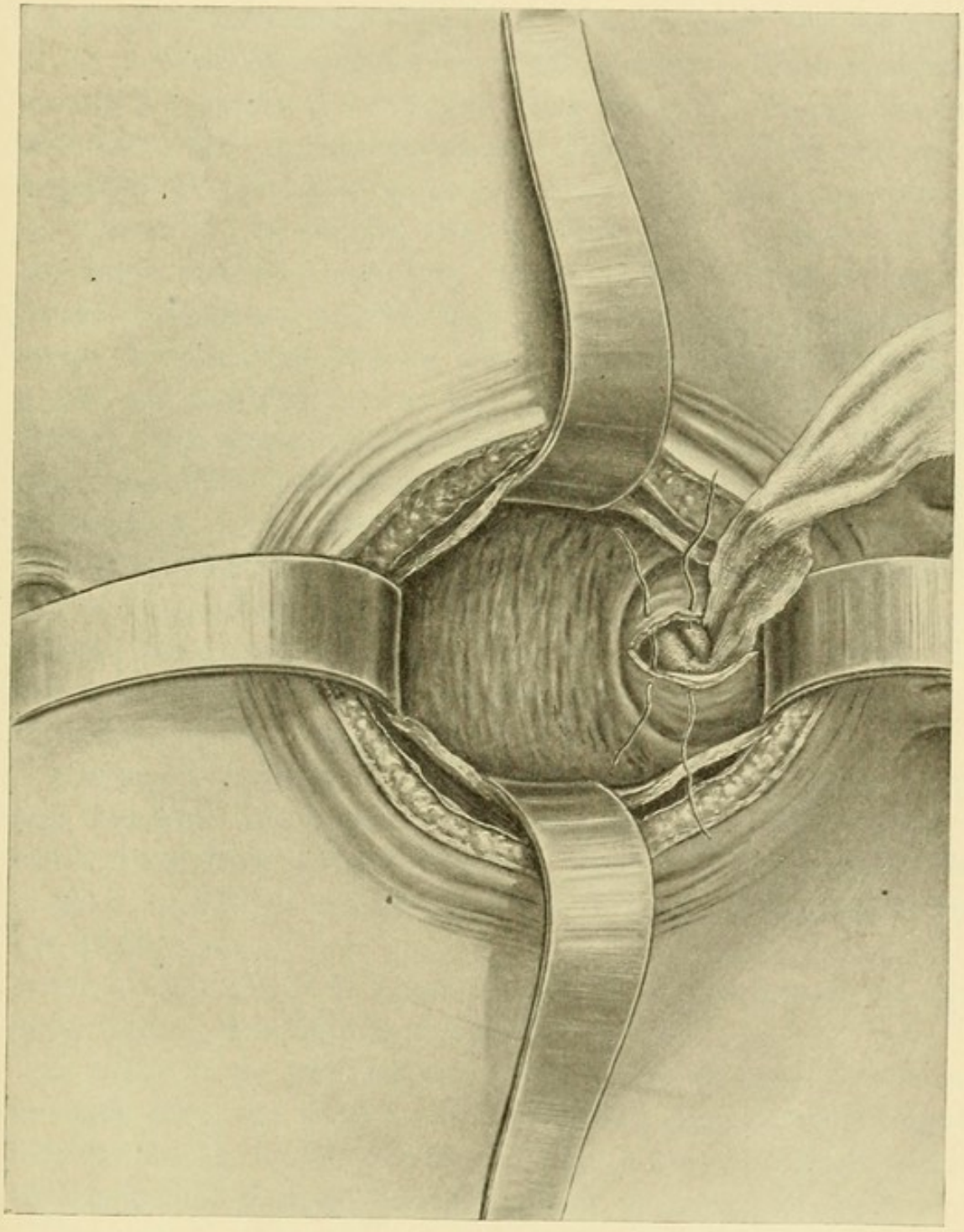
The bladder has been opened and an incision made in the vesical mucous membrane over the right lobe of the prostate. The end of the catheter is seen projecting from the internal meatus. (Deaver.)

PLATE IV.



Enucleation of the prostate. Counter-pressure is made with the other hand in the perineum and rectum. (Deaver.)

PLATE V.



The cavity from which the prostate has been enucleated is packed with gauze, and the margins of the vesical mucous membrane sutured over the packing with catgut. (Deaver.)

against the symphysis pubis. When the bladder is brought into view two retention sutures are passed through its outer coats, one on either side of the line through which it is to be opened; or the viscus may be steadied with a tenaculum while the incision is being made and also until the prostate is reached. (Plate II.) The catheter acts as a guide to the urethral orifice and lobes of the prostate. When the gland is located the mucous membrane covering one lobe is incised, the finger introduced and enucleation begun. (Plate III.) With one or two fingers of the other hand in the patient's rectum the prostate is pushed up toward the enucleating finger. (Plate IV.) In some instances the finger may be passed across to the second lobe and the latter removed through the original incision in the mucous membrane. In others the membrane over the second lobe will have to be incised. As a rule, the prostatic urethra and ejaculatory ducts will be divided. Deaver, from whom this description of the operation has chiefly been taken, states that he considers it impossible to preserve the attachments of the ducts. After the enucleation has been completed the cavity formed by removal of the prostate is irrigated with hot saline solution, and if hæmorrhage persists, is packed with gauze and the vesical mucous membrane forming its roof sutured over the gauze. One end is left long and brought out through the suprapubic wound so as to facilitate its removal (Deaver) (Plate V).

Drainage is provided by a long rubber tube passed into the bladder and connected with a bottle or jar containing an antiseptic fluid. A sterile gauze dressing is cut so as to fit around this tube, which is held in place by a stitch through the skin. It is left in the bladder from two to six days.

The bladder should be irrigated regularly, at first through the suprapubic wound, later through the urethra.

In regard to the **perineal operation** it may be stated that in cases in which the gland is hard and fibrous, and does not project upward into the bladder for any distance, it may probably be better removed by this method than by the suprapubic.

The technic of the operation is practised by Hugh Young, who is one of its strongest advocates, is as follows: The patient is placed in the exaggerated lithotomy position and an inverted V-shaped incision (Plate VI), each branch of which is about two inches long, is made through the superficial structures of the perineum. The deep tissues, except the central tendon and the recto-urethral muscle,

are divided by blunt dissection. The membranous urethra is then opened on a grooved staff, its edges drawn apart with forceps or sutures, and the prostatic tractor (Fig. 195) introduced and opened. (Plate VI.) By making traction with this instrument the gland is drawn into the wound. When it has been brought well into view an incision is made through each lateral lobe parallel with and as deep as the urethra. (Plate VII.) The capsule of the gland is then separated by blunt dissection and the urethra is also isolated in the same manner. Deep enucleation is accomplished with the finger.

"If a medium lobe or bar is present, it can generally be removed by engaging it with one blade of the tractor, making traction and rotating at the same time. This will generally cause the lobe to present in the left lateral cavity (Plate VIII), where it can be engaged

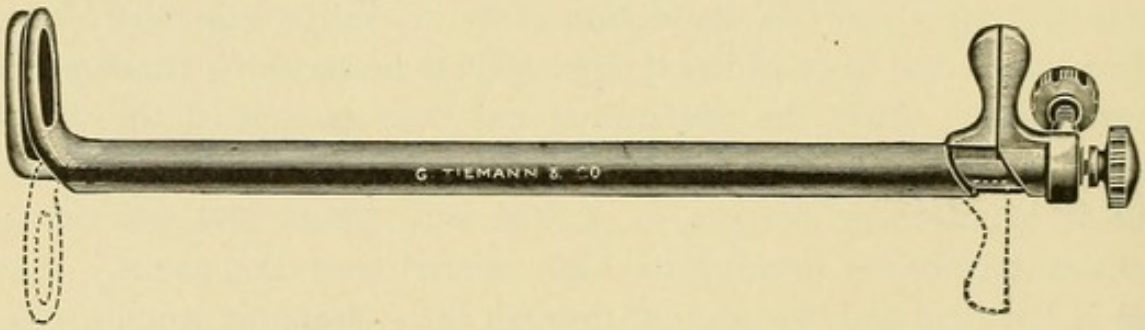


Fig. 195.—Young's prostatic tractor.

with the small lobe-forceps, or, if it is too small for these, by some small toothed forceps, and enucleated or cut away with scissors.

"If it is too small to be engaged with the blade of the tractor, this instrument may be removed and the index-finger of the left hand inserted through the dilated urethra and used as a tractor, as shown in Plate IX."

In this operation a bridge of tissue containing the urethra and ejaculatory ducts is preserved. Occasionally, however, a fibrous median lobe is present which cannot be removed by forcing it into one of the lateral cavities with a blade of the tractor, and then it is necessary to cut through the capsule covering the ducts and destroy them in the removal of the obstruction. The lateral cavities are packed with gauze, a double catheter inserted into the bladder and fastened to the skin-wound by a suture and continuous irrigation begun. The divided ends of the levator ani muscles are united with a catgut suture. The drain is removed on the second day.

PLATE VI.

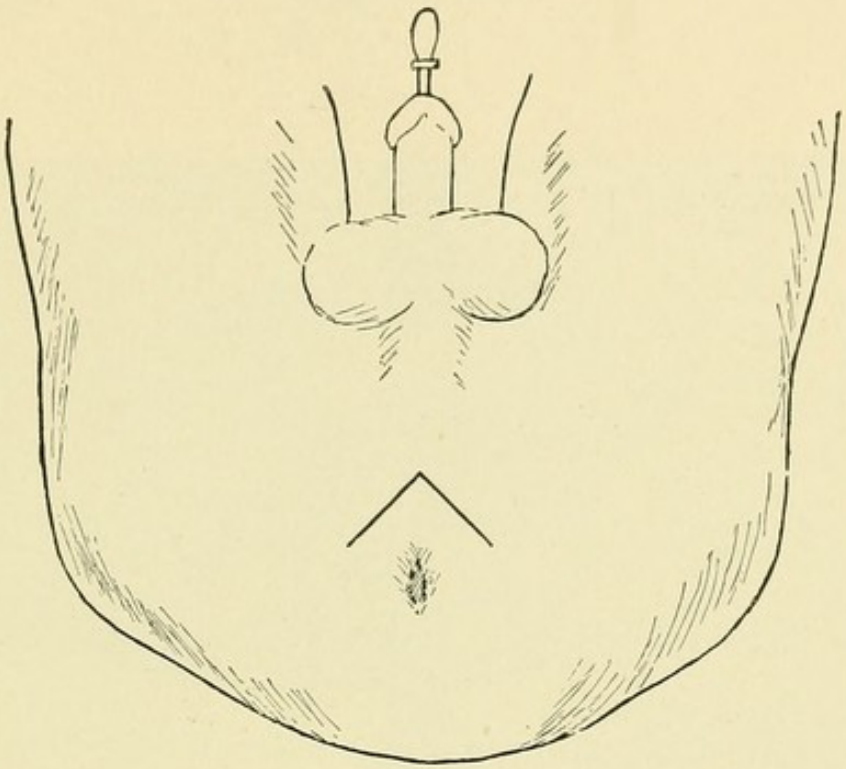


Fig. 1.—The inverted V cutaneous incision. (Young.)

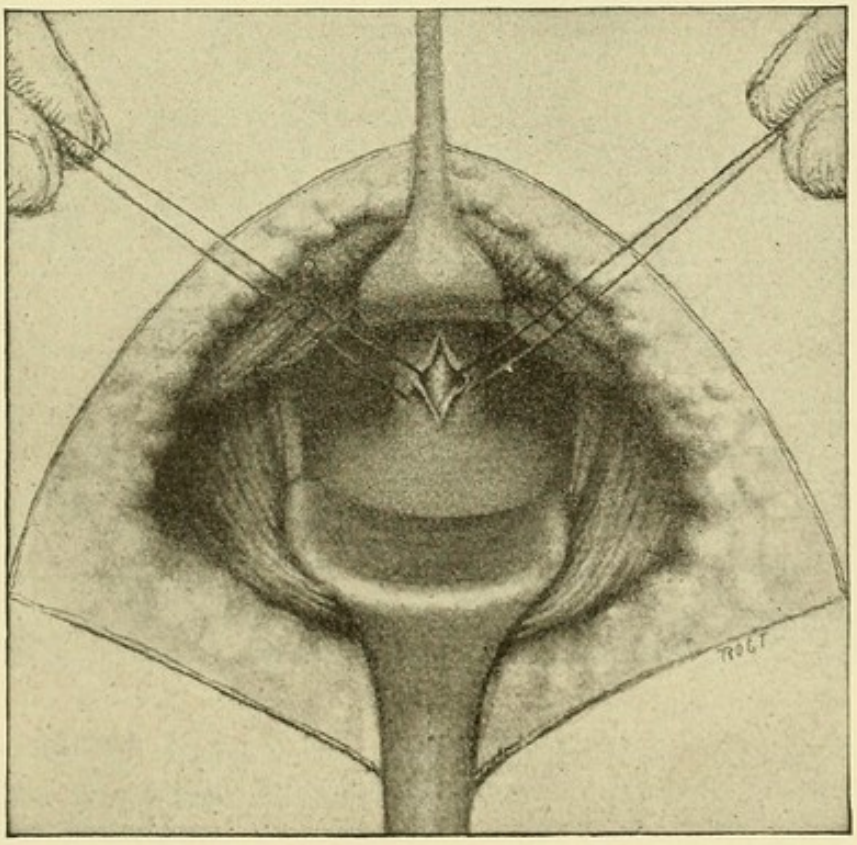
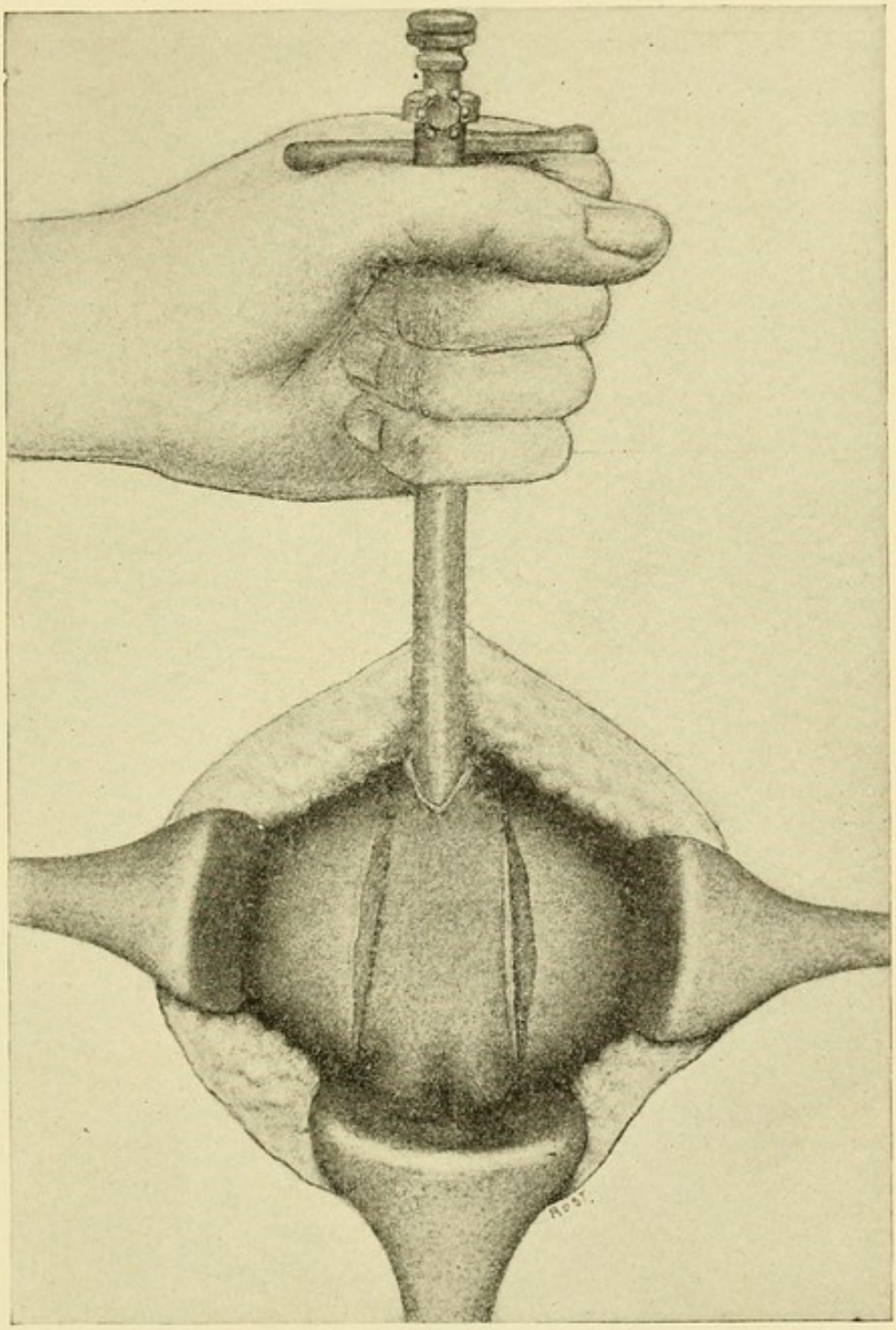


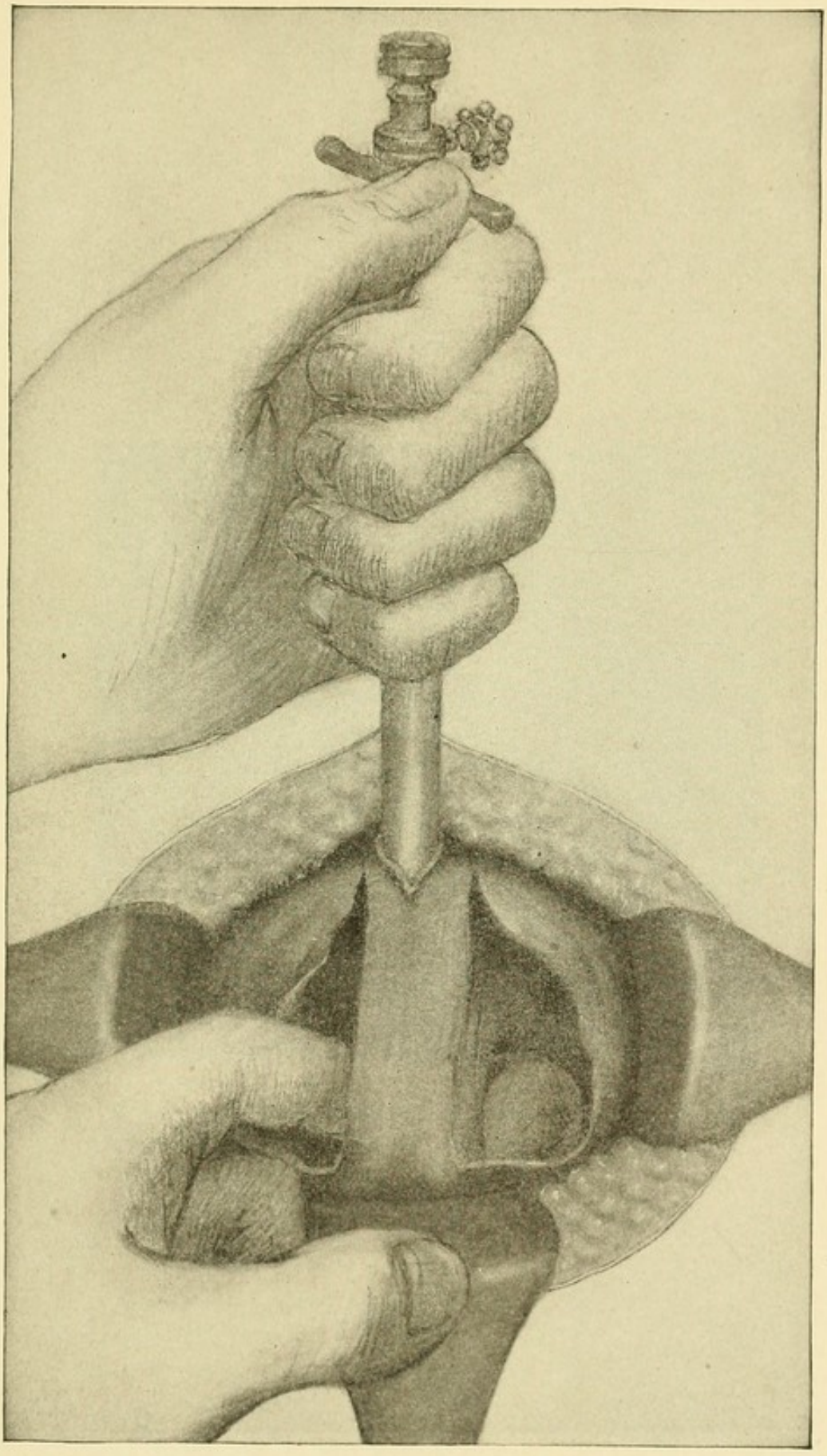
Fig. 2.—Opening of urethra on sound, preparatory to introduction of tractor. (Young.)

PLATE VII.



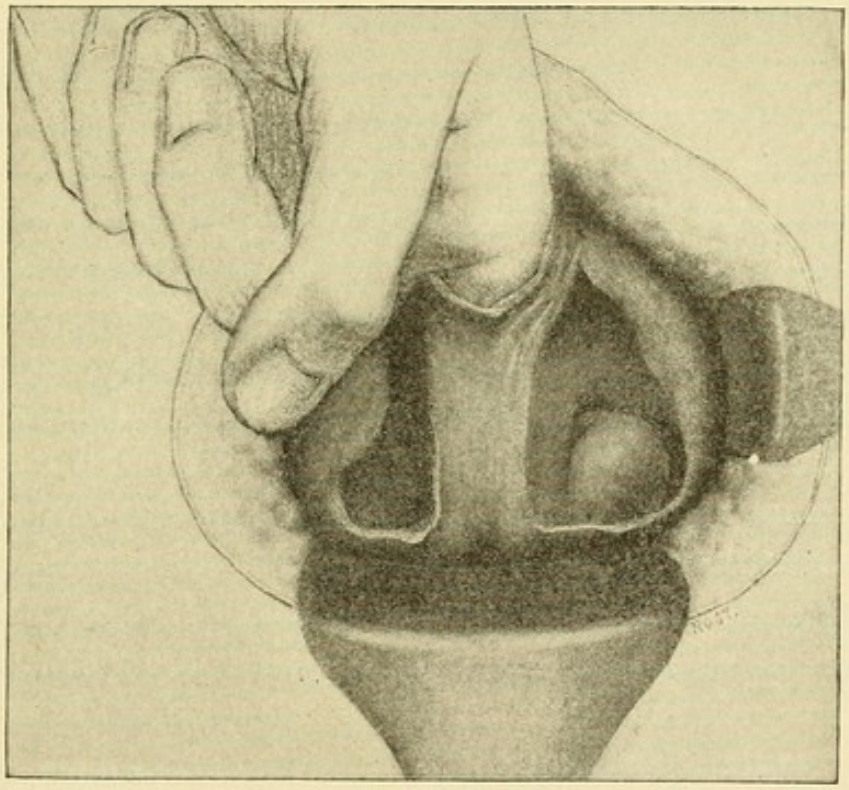
Tractor introduced, blades separated, traction made exposing posterior surface of prostate. Incisions in capsule on each side of ejaculatory ducts. (Young.)

PLATE VIII.



Showing technique of delivery of middle lobe into cavity of left lateral lobe. (Young.)

PLATE IX



Showing use of finger instead of tractor to draw down small median lobe into lateral cavity. (Young.)

Dr. Young has had good results from this operation in a large number of cases, his last published report being based upon 238.

In regard to the mortality of the perineal operation, the statistics of Proust, based upon a collection of 813 cases, show a mortality of 7.63 per cent, which is somewhat higher than that based upon smaller series of recent cases.

For example, in 322 cases collected by Deaver the mortality was 6.83 per cent, and in 1192 cases collected by Tuffier, 6.6 per cent. Young's total mortality in 238 cases is only 2.9 per cent.

Among the sequelæ of the perineal operation may be mentioned perineal and rectal fistulæ, incontinence of urine, epididymitis, impotence and contraction of the neck of the bladder. In 410 cases studied by Escat perineal or rectal fistulæ were present in over 8 per cent and permanent incontinence in over 3 per cent.

Young believes that urethro-rectal fistulæ are due to a breaking down of the rectum resulting from the absence of support normally afforded by the levator ani muscles. It is for this reason that he unites the divided ends of the muscles with a heavy catgut suture when the operation is completed. When this suture is tied it brings the muscles together in front of the rectum, thus affording support against pressure of gauze as well as the straining which takes place at stool.

The prostate has also been attacked by the combined suprapubic and perineal routes. Thus Nicoll opens the bladder, incises the perineum down to the prostate, and then pushes the gland into the perineal wound by pressure exerted upon it through the bladder. He does not open the urethra.

Samuel Alexander performs suprapubic cystotomy, opens the urethra on a grooved staff from the bulb to the apex of the prostate, pushes the gland down into the wound through the bladder, enucleates it, and then introduces both a suprapubic and perineal tube. The former is removed on the fourth day, the latter on the seventh. The bladder is irrigated daily.

Finally we come to a consideration of the Bottini operation, with reports of which medical literature has been flooded during the last ten years. In 1874 Bottini published his method of galvano-caustic incision of the prostate, and later, at various medical congresses, reported and lauded the results he obtained, without, however, succeeding in awakening any interest in the operation.



Fig. 196. Bottini's prostatic incisor.

Freudenburg, who improved the instruments used in this procedure, was the first to attract serious attention to it, and since his time it has been tried and studied everywhere.

The operation is really a modification of the old Mercier and Civiale operations, which consisted in cutting out a piece of the prostate. Bottini sought to accomplish the same result with the galvano-caustic incisor and at the same time lessen the danger of hæmorrhage.

The construction of the instrument is shown in Fig. 196. The platino-iridium blade, which is concealed in the shaft during the introduction of the instrument, is brought out of the beak by turning a screw at the handle, in a manner similar to that in which the male blade of a lithotrite is withdrawn from the female blade. The platinum blade is heated by a strong battery; a current of cold water flows between the blade and the shaft to keep the latter from becoming hot.

The technic of the operation is very simple. It can be done under local anæsthesia, but I advise the use of a general anæsthetic because I consider thorough burning advantageous, and this is poorly borne when only local anæsthesia is employed. The bladder is emptied and then partly distended with air [or fluid]; the instrument is then passed into the bladder the same as a metal catheter, the beak turned downwards and laterally and brought firmly against the projecting prostate. The best place to make the incision has been previously determined by cystoscopic examination.

The knife should be white-hot. The tissues should be burned slowly, ten minutes being consumed for each cut; one incision is made downward and to the right, one downward and to the left, and one directly downward; an upward incision should never be made. The cut must not be too long. As a rule, 3 cm. [1 $\frac{1}{5}$ inches] will suffice.

A finger should be placed in the rectum and the tip of the instrument sought for behind the prostate. The instrument must be held close against the prostate, which is best done by keeping the

handle somewhat elevated; it must also be kept fixed so that the beak will not slip into the urethra. A catheter is introduced and fastened in place after the operation if complete or serious incomplete retention has previously existed.

The important questions which arise concerning this operation are, first, what results are obtained by it; second, what are its dangers; third, should it be employed, and if so in what cases. These questions have been answered differently by different surgeons. At first surgeons were generally enthusiastic over it. The results were apparently brilliant. Gradually, however, more and more bad results followed its employment, so that its value finally came to be judged more calmly. I withheld my opinion six years so that I might be able to speak from experience. As I have now performed the operation thirty times, and as it is a comparatively new procedure, in regard to which personal experience counts for considerable, I will express solely my own personal views concerning it.

If we adhere to the above mentioned classification of cases into those associated with retention and those of prostatismus without residual urine, it is plain that the operation is suitable only for those of the first class. Three cases of prostatismus which I operated on were made worse, the painful urgency of urination being increased instead of diminished. From the day of operation until six, nine, and eighteen months afterward, respectively, more severe pain was experienced than had ever been present before. It was felt in the penis and also in the rectum.

These observations are entirely in accord with the theoretical considerations. Although the prostate is enlarged in prostatismus, no obstruction great enough to prevent the patient emptying his bladder is present. It is self-evident, moreover, that the burning of one or more grooves in the enlarged prostate will increase the nervous irritability upon which the condition largely depends. Therefore, in these cases the Bottini operation is contraindicated.

As to its employment for cases of **retention,** either partial or complete, those which are chronic are the only ones which need be considered. Acute retention of urine [due to hypertrophy of the prostate] never requires operative interference, because it can be made to yield to regular catheterization. If it has persisted longer than three months, then, according to my experience at least, the question of operation arises.

Some of these chronic cases were entirely cured by the Bottini operation. The residual urine and pain disappeared and micturition was reduced to normal frequency. These were all cases in which the urethra was lengthened, a circumstance which shows that the principal trouble lay in the urethra.

Many patients also were improved. It is true that they did not empty the bladder completely after the operation, but they voided better than they could before. The stream of urine was more free and the pain disappeared or became considerably lessened.

In a few instances the first operation was fruitless, although after the second, the patients, who had not voided a drop of water for years, began to urinate again, and were able to empty or nearly empty their bladder. In other cases absolutely no result was observed. This latter class included both complete and incomplete retention. Patients with complete retention could not void after the operation, and those with incomplete retention continued to have the same quantity of residual urine. In some cases, too, a second operation was likewise ineffective.

I have four deaths to report. Only three of these were directly due to the operation, one patient having succumbed to heart failure. He was a decrepit man of seventy-five, with advanced arteriosclerosis, in whom catheterism produced intense suffering. On account of this pain I decided upon operation, which was performed in the usual manner. The patient became weaker day by day. His temperature remained normal; the pulse was small; nothing abnormal could be found in the abdomen and rectum. Four days after operation he died of heart failure.

The second death resulted from **hæmorrhage.** At first the operation seemed to have been successful. No bleeding occurred. On the third day a sudden and inexplicable hæmorrhage occurred, which was so violent that it occluded the catheter with clots. With difficulty the catheter was kept free. At the expiration of four days the bleeding ceased, but in the meantime the patient had become so weak and anæmic that he died on the eighth day after operation.

The third patient was killed by **sepsis** resulting from phlegmonous inflammation of the cut surface in the prostate. He was old and feeble and suffered with complete retention of urine; catheterization was difficult. The prostate, especially the middle lobe, was of immense size (Fig. 197); the bladder was much inflamed and filled with

purulent ammoniacal urine, and the pelvis of both kidneys was filled with pus.

The fourth death was also due to sepsis. In this case the bladder was punctured for the purpose of introducing the cystoscope so that the incision made by the Bottini knife could be seen and guided. This method was recommended by Hurry Fenwick, of London, and Kraske, of Freiburg. Autopsy revealed an abscess in the pelvic connective

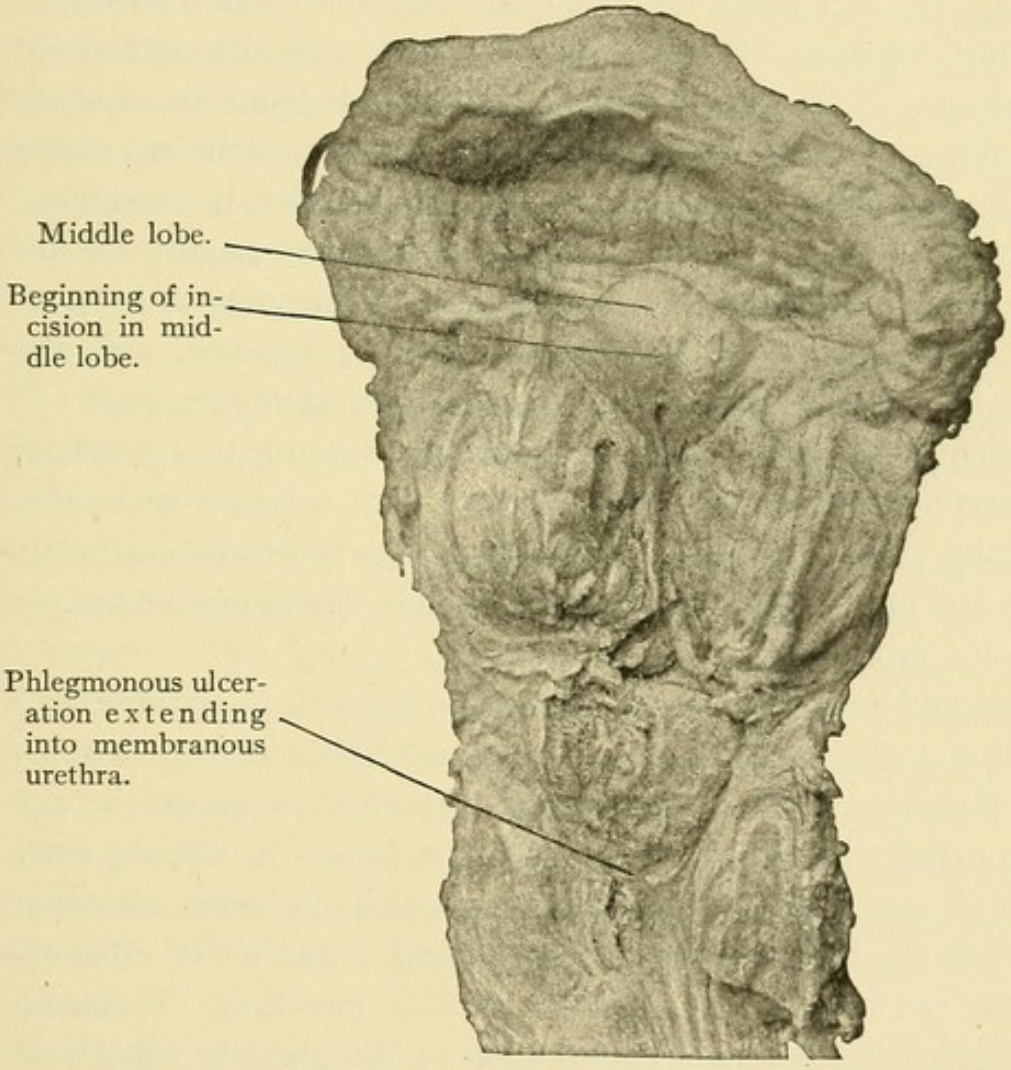


Fig. 197.—Very large hypertrophied prostate operated on by Bottini's method.

tissue. The Bottini incision was covered with a healthy eschar and there was no evidence of inflammation or suppuration around it. This fatality, therefore, is to be attributed to the vesical puncture rather than to the Bottini operation.

If, after these statements, we come to define the **indications for the Bottini operation,** the following considerations are in place.

When an operation is recommended for the relief of a condition in which vital indications for its performance are not present, it is

for the reason that non-operative measures are ineffectual, or because it is feared that the condition will become worse and more difficult of control if allowed to progress without interference.

Such operative interference is, of course, justifiable only when it offers at least a reasonable chance of improvement, or when it does not entail too great danger to life. What relation, now, does this question bear to hypertrophy of the prostate, and particularly as concerns its treatment by the Bottini operation?

First of all the fact must be borne in mind that many prostatics having chronic retention of urine enjoy the best of health and attain an advanced age. The state of their health depends upon the capacity of their bladder. Transitory exacerbations can always be overcome and thus do not enter the question. If the bladder is capacious, holding from ½ to 1 liter [1 to 2 pints], the patients usually do not need to be catheterized more than twice a day, or they may catheterize themselves. By this means the bladder is fully relieved, and the patients are disturbed neither during the day nor at night.

Such patients naturally have no desire to submit to operation, and the surgeon surely cannot do otherwise than approve their attitude, especially when they have enough spare time to practise catheterization with the utmost care and caution, thereby obviating the danger incident to this procedure.

To recommend operation to them because there is a possibility of their condition becoming worse would be inadvisable for two reasons. In the first place many of my patients have reached or passed the age of eighty on catheterism with entire comfort so far as the urinary tract is concerned; it cannot be asserted that these cases of chronic retention will progress to the bad, and on the other hand, it cannot be affirmed that they may not become worse after a Bottini operation. It can no more be expected that partial cauterization of the prostate will arrest the formation of new tissue than it can be assumed that fibro-myomatous or adenomatous overgrowth will not progress and cause enlargement of the gland when left undisturbed. Accordingly no change for the worse may take place when operation is not done, while it may occur after operation has been done. Therefore, in this class of cases, operation should not be advised.

It is different when the bladder is small, or when catheterization is very difficult. In the first instance, because of the patient's inability to empty his bladder, the catheter has to be used from six to ten times

in twenty-four hours, or even oftener. This is a great discomfort, causing irritation of the urethra and increasing the danger of infection. If it is difficult to insert the catheter, or if exacerbations take place which make its insertion impossible without repeated trials, then life becomes wretched, and we are warranted in concurring with the patient's wish to be freed from catheter-life.

Operation is also indicated in those patients who are subject to frequent attacks of acute retention of urine. The more frequently retention develops the more certain is the patient to acquire cystitis. As is well known, too, nothing predisposes to infection more than the reduction in pressure which takes place after the bladder is freed from complete retention. These attacks can often be lessened by careful living, attention to diet, keeping the bowels free, and avoiding excesses, but there are cases in which the congestion of the prostate is so great that the attacks of retention frequently recur. The more difficult catheterization is, the stronger is the indication for operation in these cases.

The **dangers of the operation** constitute its chief contraindications. I learned from my own cases that hæmorrhage and sepsis have to be taken into account.*

If the patients are very feeble, affected with arteriosclerosis, and suffer from chronic urinary fever, they will not tolerate the slightest interference. The Bottini operation is too severe for them, they die after it, as I have had occasion to observe in my own and other cases. It is true that they do not live long even when no interference is practised, but they last longer than when they are operated on. Pyelitis or pyonephrosis, if unilateral, constitutes no contraindication to the operation, for, as is well known, persons with these affections may live a long time. When both kidneys are involved, however, we should not operate.

The danger of hæmorrhage, which may occur either during or after operation, is not to be underestimated. It is of great consequence because it sometimes cannot be arrested, styptics and the permanent catheter often proving of no avail; even operative measures do not invariably control it. Neither by the suprapubic nor perineal operation is it always possible to tampon the prostate sufficiently to control the bleeding. I have seen cases of prostatic hæmorrhage which could not be stanched. These hæmorrhages may occur during the operation, or afterwards, when the slough separates. The first

*In 1907 Freudenberg reported 152 cases with a mortality of 7 per cent.

are preventable if proper cases are selected for operation and the cauterization be thorough and protracted. Proper cases are those which have shown no tendency to severe hæmorrhage. Patients who show such a tendency I consider to be very poor subjects for the Bottini operation.

As already stated, the manner of cauterization is important. With the knife at a white heat four minutes should be consumed in burning one centimeter, at which rate twelve minutes will be required for an incision three centimeters in length. The incisor should be heated to a white heat, because the moisture of the tissues will reduce it to a red heat; if it be heated only to a glow before it is introduced it will not remain red-hot, but will become considerably cooled, with the result that there is danger of tearing instead of cleanly dividing the tissues.

Although hæmorrhage during operation can be prevented by the means above mentioned, there is no way in which bleeding can be guarded against when the eschar separates; I have repeatedly seen it occur under this circumstance.

Finally, **sepsis** constitutes a great danger. The instrument can, of course, be sterilized, but if the patient has a purulent cystitis, the surface of the wound is bound to be bathed with septic fluid. We should not be deceived in regard to this condition. In such cases it is imperative to previously cleanse the bladder, and if possible to institute continuous catheterization and employ irrigations of silver nitrate. If the cystitis cannot be bettered by these means—which seldom happens—then it is better not to operate.

The direct dangers of the operation, namely, burning the wall of the bladder or rectum, and injury to the membranous urethra, I consider of slight importance, as I also do the danger of dribbling of urine after the operation. Proper technic overcomes these dangers. In my cases none of them occurred.

I managed my cases in accordance with these principles. I cannot say that the results are brilliant, but yet some patients were cured and many relieved. Therefore I am an advocate of the operation in selected cases. On the other hand, I do not fail to recognize its dangers, and, above all, to realize that its results are altogether uncertain.

For these reasons I consider it unjustifiable to advise the operation in the early stages of the disease, at a time when the urine is clear and only a slight residuum is present, as in this stage the patient

experiences little trouble; in the first place we do not know whether the operation will help him, and in the second, we cannot tell but what he may continue to the end of his days in an equally good condition without operation. Finally, even when the operation proves of benefit it does not guard against recurrence, as the gland may continue to grow. I have seen several such cases. By a second operation, however, it will often be possible to afford the patient relief again.

From the above account it will be seen that the treatment of hypertrophy of the prostate is a very satisfactory undertaking for the surgeon who is thoroughly conversant with the nature of the disease and understands how to individualize. Those prostatics who cannot be helped constitute the minority; the majority can be relieved, either by or without operation, according to their condition.

My views on the various methods of treatment may be summarized as follows:

1. For all patients whose social condition permits them to carry on a careful and prolonged palliative treatment, regular catheterization is at first to be considered the method of choice.

2. If catheterization is very difficult or very painful, if it has to be very frequently repeated, or if it produces hæmorrhage, then suprapubic vesical puncture or cystotomy is to be employed when a major operation is contraindicated or refused.

3. When a major operation is not contraindicated by advanced arteriosclerosis, cachexia, or any other serious organic disease, the choice of procedure lies between the Bottini operation and suprapubic prostatectomy. According to my experience the Bottini operation, as a rule, is only palliative. In a few specially selected cases, however, it affords permanent relief.

4. Suprapubic prostatectomy offers the best chance for complete cure. The relatively high mortality after this operation, however, militates against its universal employment. It is to be hoped that improvements in technic will constantly reduce the mortality rate.

5. Division of the vasa deferentia is to be considered only in the case of those patients who suffer from prostatism or recurring epididymitis due to catheterization.

TUBERCULOSIS OF THE PROSTATE.

Tuberculosis of the prostate usually affects young adults, rarely children and old men. As in most other tuberculous diseases, hered-

itary predisposition has to be assumed in explanation of the development of this malady. Although we are as yet unable to explain the exact nature of this hereditary influence, the fact remains that many young persons in whom there is no apparent cause for the development of disease are taken ill with an affection the diagnosis of which is at first obscure, but which, as it progresses, proves to be tuberculosis of the prostate. If the history of such persons be investigated it will be found that they belong to tuberculous families. Weigert states explicitly that the prostate seems to afford a particularly favorable soil for the growth of infective microörganisms.

It is easily conceivable that tuberculosis will break out more readily in those having the above mentioned hereditary predisposition when they have sustained some injury to the genital tract. A prominent cause, and one the importance of which was for a long time not sufficiently recognized, is gonorrhœa. I have seen numberless cases of urogenital tuberculosis involving the prostate, the soil for the development of which had been prepared by a long-standing gonorrhœa. Gonorrhœa, especially the chronic form—which might well be named eternal—is similar in effect to an injury, which in the predisposed favors the development of tuberculosis of the genital tract just as it does in other organs of the body. It has not been proved that excesses in venery or masturbation are causes of tuberculosis of the prostate in persons who have no hereditary tendency to tuberculous disease, and such a theory, moreover, is not confirmed by clinical experience.

It is conceivable that tubercle bacilli may gain access to the urinary passages from without, either from cohabitation with a tuberculous person (Cornet) or through infected catheters, although such occurrences are rare in comparison with infection through the blood or lymph-streams.

This view is corroborated by the circumstance that prostatic tuberculosis seldom occurs or remains as a distinct and isolated disease. There are almost always tuberculous lesions in other parts of the body. It is either preceded by phthisis, or else renal tuberculosis is the primary disease; the morbid process is either carried to the prostate by the blood, or reaches it by direct descent from the kidneys to the bladder. In other cases tuberculous epididymitis appears as the first manifestation of disease, the prostate and seminal vesicles becoming involved afterwards. The latter organs are very often affected with the prostate. In short, few cases have been observed in which autopsy

showed the prostate alone to be affected. The work of Jani, who found tubercle bacilli in the testes and undiseased prostate of the subjects of phthisis, is important in showing the readiness with which infective microörganisms take up their abode in the latter organ.

Pathological Anatomy. The prostate is sometimes enlarged and sometimes decreased in size, according to the manner in which the pathic process manifests itself. In this respect it is well to discriminate between **tuberculosis of the prostate and tuberculous prostatitis.** In the first condition, which is rarely observed at autopsy, isolated nodules are found in the acini, there being no changes, or at most only slight alterations, in the surrounding tissue; whereas in prostatitis the alterations ordinarily observed in this condition are plainly discernible. These changes consist in an eruption of tubercles, at first isolated, later confluent, which pursue the same course as they always take in other parts of the body. In the early stages there are gray nodules in the tissue surrounding the acini, together with an infiltration of round cells and some giant and epithelioid cells; later the center undergoes caseous degeneration and the whole tubercle softens, the dead cellular elements becoming converted into a thick, greasy, caseous mass. These small caseous collections are surrounded by a zone of infiltration. The tubercle bacilli are particularly abundant between the epithelium and its underlying connective tissue. The tubercles are more common toward the periphery of the gland than they are near the urethra (the excentric form of Thompson and Guyon). The countless number of these small foci, which increase in size and communicate with one another, cause, in conjunction with the reactive inflammation to which they give rise, considerable enlargement of the gland. Its surface becomes uneven and tuberculated; as to consistency, hard and soft portions alternate with one another.

In addition to caseation, the most common pathic process which occurs in tubercles, purulent disintegration may take place, as the result of which abscesses are formed. The number of abscesses depends upon the extent of the destruction which takes place. In the more advanced stages of the disease these purulent collections coalesce and form one large tuberculous abscess which destroys more or less of the substance of gland.

Even when considerable alteration has been produced by caseation and suppuration of many tubercles a relative cure may yet take place.

The contents of the suppurating and caseating cavities becomes resorbed, or slowly undergoes induration and calcification (Broca). Unfortunately, however, such an occurrence is very rare; generally the morbid process advances uninterruptedly toward the periphery, through which it forces its way; or the abscess may rupture externally or break into the urethra or bladder. Thus the abscess may empty itself completely at once, so that a cavity with tuberculous walls remains, or if rupture takes place by means of small and irregular passages, only a portion of the tuberculous mass may be evacuated. The fistulæ thus formed, which open into the urethra, bladder, perineum, or anus show no tendency to heal.

English calls attention to an especially virulent form, **tuberculous periprostatitis,** which may give rise to a general dissemination of tuberculosis. The tubercle bacilli are carried to the periprostatic plexus by the blood or lymph-current, and they may get out of the veins into the surrounding connective tissue. Their presence in the veins, too, may readily cause thrombosis and pyæmia.

Symptoms, Course and Diagnosis. A clinical distinction also has to be made between tuberculosis of the prostate and tuberculous prostatitis. The first, that is, the development of one or more isolated tuberculous foci in the prostate, may take place unnoticed, and the lesion may remain latent for years without producing the slightest symptoms. It is only when the process extends to the adjacent parts, or the latter become infected through the blood, or when vesical or renal tuberculosis breaks forth that symptoms are produced, and the prostate, upon examination through the rectum, is found to be diseased with tubercles which must have existed for a long time.

Thus it is seen that a beginning tuberculosis of the prostate confined to the parenchyma of the gland, and not affecting the urethra and bladder, is difficult or impossible to diagnosticate. As no symptoms are present there will be no occasion to palpate the prostate.

As concerns the subjective symptoms which sooner or later manifest themselves, it may be said that they have little which is characteristic. They consist in disturbances of micturition, pain, hæmaturia, and hæmospermia.

The disturbances of micturition have no peculiarities. The patients urinate more frequently by day than by night, urination causing a burning sensation, which is more pronounced at the end of the act. It seems as though the urine is expelled with difficulty. This form of

tenesmus is exactly the same as that which is observed in simple cystitis colli, except that it resists all treatment, whereas in the latter disease good results are obtained.

Independent of micturition there is a feeling of pressure and heaviness in the perineum and around the anus, a painful sensation which becomes much intensified by activity, by sitting, and also at stool. Here, again, the difficulty with which this symptom can be overcome is characteristic.

In regard to hæmorrhage, it may be said that severe bleeding seldom occurs; on the contrary, usually only a few drops of blood are lost, this slight hæmorrhage sometimes taking place at the beginning of micturition, although usually following the act. While the same phenomenon is observed in gonorrhœal inflammation of the neck of the bladder (*cystitis colli gonorrhoica*), it must not be forgotten that one or two instillations of silver nitrate suffice to control the bleeding. In tuberculous prostatitis, however, this treatment has an exactly opposite effect: it increases hæmorrhage and intensifies the pain.

About the same thing may be said of hæmospermia. The last drops of semen expelled during coitus, and occasionally also when pollutions occur, are blood-stained; this is a symptom, too, which is met with in simple inflammation of the seminal vesicles. While in the latter condition it is characterized by benignity, in tuberculosis it often cannot be overcome. On the other hand it must be remembered that occurrence of hæmospermia in tuberculosis is not constant.

Although these symptoms of prostatic tuberculosis present nothing specific, the diagnosis can, however, be confirmed by physical examination, especially if the constitutional condition of the patient be thoroughly investigated and his history carefully elicited.

In regard to urethral discharge little importance is to be attributed to it, as it is by no means always present. The disease must reach the urethra and produce ulcers or fistulous passages before it can give rise to a discharge manifesting itself at the external orifice, or produce filaments in the urine. In order to prove that the discharge is tuberculous tubercle bacilli must be found in it, and this is a thing which seldom comes to pass; moreover, it must be determined at least beyond probable doubt that the discharge comes from the prostate. In order to determine this the prostate may be massaged, the urethra being previously cleansed, and the secretion thus obtained stained and examined in the usual manner.

A much more certain method is careful palpation of the prostate through the rectum. The isolated nodules can be plainly felt. They occur in no other prostatic disease. The prostate is also excessively sensitive to pressure. If the finger be long enough, the thickened, nodular and tortuous seminal vesicles can be felt above the prostate.

Examination with the cystoscope and sound is unnecessary. With the cystoscope nothing can be seen, for the changes in the prostate can at most manifest themselves at the sphincter, and similar changes are also produced there by ordinary prostatitis. The introduction of a sound gives rise to so much pain, and is of such varied significance, that it should not be made use of.

The above depicted subjective and objective symptoms are sufficient to enable one to make a diagnosis, especially when considered conjointly with the general condition of the patient, knowledge of which can be obtained by an adequate examination of the entire body. If the suspicious symptoms are accompanied by a tuberculous infection, if the patient has a hereditary taint, if the disease is characterized by inveterateness and resistance to treatment, error of diagnosis will seldom be made.

Prognosis. The prognosis is not altogether unfavorable unless there are associated tuberculous lesions which threaten life. If, for example, there is in addition to the prostatic disease a unilateral renal tuberculosis, cure is possible, and in the case of persons otherwise strong, and having good powers of resistance, it is even probable. Cases in which the disease ascends, and in which the bladder, epididymes and seminal vesicles are involved offer a much poorer prospect of cure. These cases usually tend to bilateral involvement of the ureters and kidneys, or there are so many associated tuberculous foci in the body that cure is impossible.

But apart from remote localization of the tuberculous process the disease progresses more commonly than it retrogrades. Abscesses and fistulæ are formed in the manner already described. The thing most to be feared is the development of the painful and uncontrollable vesical tuberculosis. Frequently a miliary tuberculosis brings an end to the patient's suffering.

Treatment. There is very little to be done for prostatic tuberculosis. In view of the above described predisposing causes, we should endeavor by every possible means to cure chronic gonorrhœa, so that tuberculosis may not be superimposed upon it. On the other hand,

it must not be forgotten that heroic treatment so weakens the organism, and particularly the sexual organs, that there is danger of any tubercle bacilli which may be in the blood taking up their abode in the prostate. For this reason too active treatment is to be avoided. Such diseases as urethritis, epididymitis, and prostatitis occurring in those predisposed to tuberculosis are to be treated with the utmost caution, and, if possible, without resort to active local measures.

The medical treatment of tuberculosis of the prostate with creasote and similar drugs offers little hope of success. I have never seen any results from their use.

Local applications of silver nitrate, iodoform, and corrosive sublimate to the posterior urethra are to be considered only when the urethra is involved; under other circumstances their employment is irrational. But even in cases in which the urethra is affected I advise against their use. They do little good and cause the patient much suffering. They do not reach the source of the tuberculous process, but merely a portion of it which has developed secondarily.

General hygienic measures, such as are useful in other forms of tuberculosis, as for example, sanatorium-treatment, mild hydrotherapeutic measures, the rest-cure, residence in a southern climate, overfeeding, and the avoidance of all injurious influences are of value. If micturition or defecation is very painful, the employment of morphine, heroin, or belladonna in the form of rectal injections or suppositories is to be recommended. If symptoms referable to the bladder predominate, then the sublimate instillations used for vesical tuberculosis may be tried. Their effect is usually beneficial.

Continuous catheterization for the relief of tenesmus is not to be advised, because in tuberculous cystitis, which is usually associated, the permanent catheter cannot be endured. If the pain and urgency of urination become intolerable, then the only measure which will bring relief is puncture of the bladder and establishment of a fistula.

Surgical treatment consisting in removal of the entire prostate, together with the seminal vesicles, as practised by Young and others, has as yet been insufficiently tested to enable us to recommend it. Furthermore, it would be appropriate only for those cases in which no other tuberculous foci exist, or for those in which the associated lesions are of such a character as to permit such a formidable procedure and offer a prospect of cure.

It is quite a different matter when we have to do with cold tuberculous

abscesses of the prostate, or with fistulæ, which are exceedingly annoying to the patient. Prostatic abscesses may be opened through the classical perineal incision or by means of the prerectal incision; they should then be curetted and injected with iodoform emulsion. Fistulæ should be laid open and similarly treated.

CONCRETIONS AND CALCULI OF THE PROSTATE.

In the prostate gland of every adult there are small bodies called stratified corpuscles, or corpula amylacea, mention of which has already been made. Their development, according to Virchow, is due to thickening of the prostatic secretion and its cohesion with one or more degenerated cells to form a nucleus, around which successive layers are deposited. Recklinghausen considers them to be closely allied to starch-corpuscles, and Stilling believes them to be purely amyloid. Posner's investigations show that they are produced by coagulation of albuminous secretion or necrotic cells, the coagulum becoming infiltrated with lecithin. These become superimposed one upon another, with the result that concretions are formed, which may attain the size of a flax-seed; they occur in large numbers in the acini and ducts of the gland. Their color varies from light pearl-gray to amber, brown, or black. The dark color is due to pigmentation. The gray or brown granules are seen on the cut surfaces.

These stratified bodies, aggregations of which form concretions, are not a product of disease, but are rather to be considered as the expression of disturbed glandular secretion. They may remain in the prostate for years or for a lifetime without causing any trouble. When they increase sufficiently in size, or become incrusted with lime salts to such an extent that they project above the level of the urethra, it is then that they are often first recognized. As a rule, they remain small; when deposits of carbonate or oxalate of lime, or triple phosphates, are added to them they become true calculi.

Entirely different in origin from these are those stones which lie in the prostatic urethra; they are either true urethral calculi or fragments of vesical calculi. To the latter category belong the so-called pipe-stones, which lie partly in the bladder and partly in the urethra, being bent at an angle after the manner of a pipe-head.

Those which have received the name of hour-glass calculi because the expanded ends are united by a slender median portion may be urethral, vesical, or prostatic. These stones result from the deposition

of urinary salts upon the primary calculus. True prostatic calculi are seldom singular, generally being present in large numbers. Golding-Bird describes a case in which there were one hundred and thirty calculi in the prostate. Calculi in the prostatic urethra, on the contrary, are usually single. The larger their number the smaller they are, and *vice versa*. Stones weighing as much as 120 grammes [1800 grains] have been found.

If the prostate undergoes calcareous degeneration in the manner thus described, the calculi generally lie in cavities which are irregularly distributed throughout the entire gland, although they may be confined to certain portions, or perhaps to one side, of the gland. If there is a single stone of considerable size, the substance of the gland around it atrophies, and the cavity in which it is then contained will be surrounded by a zone of atrophied tissue.

Incrustations must also be included with prostatic calculi, although in origin they differ from the latter, originating as they do from small circumscribed collections of pus which undergo inspissation and calcification. They are extremely rare.

The same is true of venous calculi, or phleboliths, which occur in the dilated veins of the periprostatic plexus. They seldom attain a size larger than a pea. Their development is favored by dilatation of the veins and also by venous stasis. Phleboliths also are very rare.

In general it may be said that prostatic concretions and calculi produce **no symptoms,** and therefore that their existence cannot be determined. They are only discovered during operation or found post-mortem. Sometimes, however, especially if they protrude into the urethra, they give rise to trouble, producing difficult and painful micturition. The patient has to urinate oftener than usual and there is perceptible resistance to the outflow of urine; it is noteworthy that this resistance is not constant, being present at times and absent at others. The condition is analogous to that which obtains when small vesical calculi are carried to the neck of the bladder and occlude it. Complete retention of urine may result. Urination is painful, the pain radiating to the tip of the penis. Defecation likewise causes pain. The patient also experiences a sense of heaviness and pressure in the perineum existing independently of micturition.

Hæmorrhages due to prostatic calculi are not frequent, although they sometimes occur. When the stone projects into the urethra

blood-cells are almost always found in the urine. In one case I saw a severe and almost fatal hæmorrhage produced by a calculus a little larger than a pea, the sharp edge of which jutted out into the urethra. The patient died a few weeks later and the above described condition was revealed at autopsy.

Other inflammatory processes also not uncommonly make their appearance in the posterior urethra and bladder without causing the urine to show the characteristics of cystitis. The calculi have eroded the urethral mucosa and produced small areas of necrosis. If the stone is expelled, the urethral inflammation usually subsides, although it sometimes resists all treatment.

The expulsion of the calculi occurs in one of two ways: either they escape from the prostatic ducts into the urethra, or they ulcerate their way through the substance of the prostate and thus reach the canal, from which they are then washed away by the urine. They may also be carried backward into the bladder, and become vesical calculi.

If they lie further away from the periphery, more toward the center of the gland, they lead to inflammatory phenomena, as the result of which atrophy takes place.

Such an occurrence renders diagnosis more easy for the reason that the stone can then be detected by palpation through the rectum. It is this circumstance which first leads to certainty of diagnosis, for the above described subjective symptoms of difficult, painful and interrupted micturition are too ambiguous to permit the nature of the trouble to be determined. With the finger in the rectum the uneven, hard and enlarged prostate can be palpated, and at times the grating of one calculus upon another can be felt.

If a metal sound be introduced into the urethra, those stones, and only those, of course, which project into its lumen can be felt. The sensation imparted cannot be mistaken; it consists in a distinct grating or crepitation. Naturally this is not characteristic of prostatic calculi alone, for urethral calculi give the same results. If simultaneous palpation with a sound in the urethra and a finger in the rectum be practised, it may happen that a hard body will be detected between the two.

Radioscopy is to be considered as a further means of diagnosis; the bladder and rectum must be empty when the examination is made. Golding-Bird has succeeded in obtaining very good X-ray pictures of prostatic calculi. Proof is obtained only when the picture is positive.

Prostatic calculi may be present even though no shadow appears on the plate, for the X-rays are not absorbed by all varieties. Owing to the rarity of prostatic calculi it is evident that this method is yet in its formative stage.

Treatment. In those cases in which the calculi, which perhaps have been discovered accidentally, produce no trouble, treatment is unnecessary. Even when pain and difficulty of micturition are occasionally experienced the surgeon may wait to see whether the stone will not be spontaneously expelled before resorting to treatment, which, because of the nature of the condition, can only be surgical.

If the trouble increases, if inflammation and suppuration ensue, and if there are grounds for believing that the calculus or calculi are becoming larger, then, of course, operation is necessary. Crushing and evacuation through the natural passages, the lateral prostatic incision, similar to that made in lateral lithotomy (Dupuytren), and opening the prostate through the rectum (Mazzoni), have been abandoned. The only choice to be made is between the perineal and the prerectal incision (Demarquay, Dittel, Zuckerkandl, Socin). The latter is constantly winning more supporters, because the prostate can be reached more surely and safely by it. If the calculi are firmly imbedded in the substance of the gland, it may be necessary to use a stone-spoon, or some instrument which affords leverage, to get them out. The prognosis of the operation, as of the disease itself, is favorable, and cure usually takes place without any difficulty.

NEW GROWTHS OF THE PROSTATE.

The only new growths of the prostate which we shall consider here are the malignant ones, carcinoma and sarcoma; the benign growths, fibromyoma and adenoma, were designated as hypertrophy of the prostate and described as such. The malignant tumors are almost always primary; it is very rare for them to be secondary. The latter form may be due to direct extension from a neighboring growth, as for example, intestinal carcinoma; or it may be caused by metastasis from a growth more remotely situated, such as cancer of the stomach, dura mater, or penis. It is worthy of notice that malignant vesical tumors have no tendency to invade the prostate, although prostatic growths often extend to the bladder.

That an ordinary prostatic hypertrophy may be transformed into a

carcinoma, as Albarran and Hallé have stated, does not seem to me to have been proved. The theory that the seeming hypertrophy was a slowly progressive malignant neoplasm is irrefutable.

The causes are entirely unknown, as is the case with malignant disease of other organs. That heredity or gonorrhœa plays a rôle has not been proved, and it is particularly improbable that the latter has any causative influence in their evolution. Carcinoma shows a predilection for old people. In children and young men it is very rare. Sarcoma, on the contrary, has often been observed in early childhood. Klebs attributes the latter circumstance to intrauterine influences.

PATHOLOGICAL ANATOMY.

Carcinoma of the prostate occurs in two principle forms, the soft, medullary, or adeno-carcinoma, also called epithelioma, and the hard or schirrus form. Macroscopically the diffuse and circumscribed forms require differentiation.

Medullary or adeno-carcinoma is characterized by its softness and succulency. The small mononuclear cells are imbedded in a delicate fibrillary stroma. Orth describes them as follows: "Microscopically the cancer is a cylindric cell new growth, the cells often being arranged in gland-like ducts or tubes, so that adeno-carcinoma must be diagnosticated. The stroma may either be normal or show small-celled infiltration, being in the latter case involved in the neoplasm."

It is upon this condition that Albarran and Hallé base their theory of the transformation of simple prostatic hypertrophy into carcinoma.

As already stated, the growth may be diffuse or circumscribed. In the latter case only one, or at most a few portions, of the gland are affected and show the characteristic signs of the disease, the remaining part showing typical prostatic tissue. These more rare forms are of slow growth. The prostate usually does not attain a large size.

In sharp contradistinction to these tumors are those which affect more or less of the entire gland, and advance rapidly to the surrounding tissue. They soon break through the capsule of the prostate and extend to the small pelvis, filling it with tumor-masses, and go on to the seminal vesicles, the ureters, the perineum, and the innominate bones.

Guyon has named these forms, which are characterized by enormous size, diffuse prostato-pelvic carcinoma. This large tumor may

either be of homogeneous consistency, or present alternating hard and soft portions. The surface is lobulated, uneven, and hard, and the mucous membrane of the rectum is adherent to it. These tumors grow through the bladder, proliferating freely, so that when viewed through the cystoscope they simulate typical vesical neoplasms; or they may push the vesical mucosa in front of them, so that the convexity shown in the cystoscopic picture appears to be covered with hyperæmic, though otherwise normal, membrane.

The rectal mucosa is simultaneously affected; the carcinomatous masses ulcerate and give rise to a malodorous discharge. Later, or perhaps at the same time, the lymph-glands situated near the

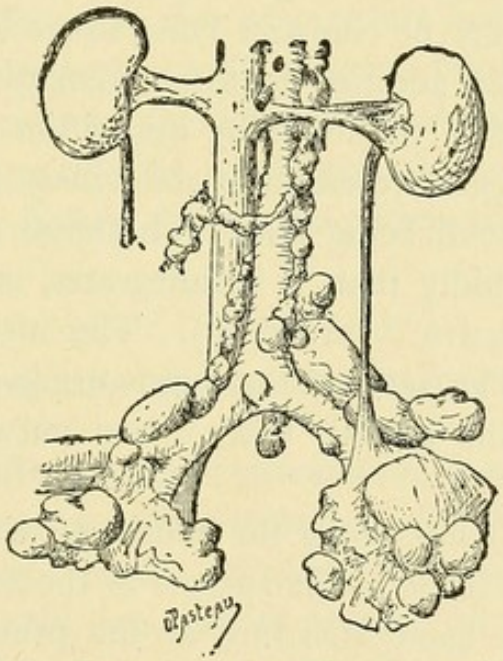


Fig. 198.—Extension of carcinoma through the lymph-glands. (Musée Guyon.)

prostate become infiltrated; the mesenteric, inguinal and retroperitoneal glands are affected (Fig. 198). Secondary nodules are found in the liver, the pleura, the lungs, the corpora cavernosa, the kidneys and spleen.

Different from these in form, structure, and evolution, as well as in the manner in which they produce metastases, are the **osteoplastic carcinomata of the prostate,** which have been studied by Recklinghausen.

The remarkable thing about them is that the primary lesion in the prostate is small and insignificant in comparison with the abundant and widely disseminated **bone-metastases.**

While the primary focus is often so small that it is not demonstrable clinically, and is even hard to find at autopsy, numerous diffuse carcinomatous infiltrations of bone are always present. They affect the pelvis, the lower portion of the vertebral column, the joints of the lower extremity, the ribs, the sternum, the scapula, the humerus, and the bones or the skull, showing a special predilection for the lower end of the femur and humerus. The internal organs are usually not involved.

Von Recklinghausen describes the changes in the bones as follows: "there is wide spread sclerosis and eburnation of parts which are normally spongy, or in which cavities are present, such as the epiphyses and diaphyses of the long bones, the vertebræ, etc.; extensive resorption and atrophy of compact bone tissue alternate irregularly with one another. In addition to these changes marked thickening of the diseased parts is produced by deposition of new bone tissue in the form of spicules resembling stalactites, the spaces between them and the canaliculi being filled with cancer cells." The cancer proliferates more rapidly than it disintegrates, so that its nature is not markedly destructive (Von Frisch). The metastases are of myelogenous origin. "The seed of these growths is disseminated in the bone-marrow, and the growth takes place outward and perforates the bone."

Osseous cancer extends along the course of the blood-vessels, and breaks through the vessels at the surface of the bone. These osseous metastases show the same structure as the primary prostatic focus of disease, consisting of connective tissue alveoli filled with cuboid and cylindric cells. Just as cancer of the mammary gland is the most common cause of carcinomatosis in woman, so likewise is prostatic carcinoma often responsible for general diffusion of cancer in man,

It has already been stated that **sarcoma** is considerably rarer than carcinoma, and that it occurs particularly in the earliest years of childhood and in old age. This disease is almost exclusively primary. A few exceptional cases of secondary sarcoma which has extended from other structures, such as the seminal vesicles or bones, for instance, have been reported.

The tumor is almost always composed of round or spindle-shaped cells, and in the beginning of its development its limits are sharply defined; it looks like a fibroma embedded in the substance of the gland.

As proliferation advances first a portion and finally the entire gland becomes transformed into a malignant growth. Proliferation does not stop here. Sarcomata are characterized by their large size and rapid growth. It is less common for sarcoma of the prostate to be diagnosticated when it has merely grown sufficiently to cause the middle lobe to protrude into the bladder as a pedunculated fungous mass, than it is for it to be found extending in various directions and involving many different structures. It fills the true pelvis, compresses the ureters, grows around the bladder, pushes outwards and forwards; occasionally, too, it grows through the bladder and narrows the broad expansion of the rectum.

The metastases, in contradistinction to those of carcinoma, are characterized by the fact that they appear late in the disease and that they affect in comparatively small measure the inguinal and other neighboring glands, which are extensively involved in carcinoma. Generally there are metastases of remote organs, such as the liver, pancreas and lungs, before the lymph-glands of the pelvis become affected.

SYMPTOMS, COURSE AND DIAGNOSIS.

We will first consider prostatic sarcoma as it occurs in childhood, and which is first discovered when retention of urine develops suddenly and without apparent cause. If these little patients be examined a tumor of considerable size will be found. In some cases difficult and painful micturition, pain upon defecation, and sometimes, though rarely, the occurrence of urinary hæmorrhage, will first attract notice and bring the case to the surgeon's attention. When palpation is practised, especially bimanual, a tumor will be felt through the rectum where the prostate would lie later in life. This growth is hard, and often presents projections which reach to the symphysis and bladder. The tumor develops rapidly and death invariably ensues in from one to two years after the beginning of the disease.

The symptoms of carcinoma and sarcoma in adults are so near alike that they may be considered conjointly. A few minor differences will be pointed out. The symptoms consist in disturbances of micturition—of pain occurring both in association and independently thereof—and in disturbances of defecation; objectively the general cachexia, the presence of blood and pus in the urine, and perhaps

of fragments of tissue, the results obtained by sounding, cystoscopy, and rectal palpation, together with the demonstration of metastases, confirm the diagnosis.

The disturbances of micturition are essentially the same as those of prostatic hypertrophy. According to the size of the growth, and the interference with the normal relation of the part which it produces, the patient is compelled to strain more or less in order to void his urine; the stream loses its former projectile power. The frequency of micturition is increased in varying degree, the bladder gradually comes to empty itself with more and more difficulty, and chronic incomplete retention, which may become converted into complete retention, soon ensues. The latter, however, is less frequent than in hypertrophy of the prostate. In such cases involuntary voiding of urine may, of course, take place; in other words overflow of the bladder occurs. Incontinence of urine, which also occasionally occurs, is different from this, coming on, as a rule, toward the end of the disease, and being due to interference with the sphincter by the new growth.

Pain upon urination is a typical symptom; it is characterized by the fact that it can be relieved only slightly and for short periods at a time. If the use of narcotics be discontinued it returns at once.

A more characteristic point of difference between the pain of malignant disease and that of prostatic hypertrophy, is that the former is not only present during micturition, but that it remains constantly with the patient. It is located in the glans and root of the penis, in the rectum, in the perineum, in the hypogastrium, and also in the sacral region. Severe exacerbations may occur. As the pain is unremitting, it may seriously impair the patient's strength.

It extends along the ischiatic and crural nerves; the whole region supplied by the sacral and lumbar plexus may be affected. There is no doubt that these pains are evoked through compression of nerve-trunks by the tumor and its metastatic glandular swellings. This view is corroborated by the persistence and obstinacy of the pain, which cannot be overcome; the circumstance that the prostate is as yet relatively small at the time these pains occur does not militate against it, for we know that small tumors of the lymphatic glands may be accompanied by metastatic processes of considerable size.

As regards the last class of subjective symptoms, namely, the disturbances referable to the rectum, it may be stated that they are the same as those occurring in simple hypertrophy. Evacuation of the

bowels is difficult, and chronic constipation, which may become so severe as to constitute complete obstruction, results.

A circumstance worthy of attention, too, is that defecation is often attended by pain, a symptom which is absent in prostatic hypertrophy. If the tumor attacks the rectal mucosa itself and causes ulceration, a severe catarrh is produced, the secretion being thick and bloody and containing particles of decayed tissue.

Of the objective symptoms, cachexia will at once attract notice. The face is sallow and the body emaciated; the patient cannot be made to gain weight even under the most careful nourishment. It is true that prostatics occasionally show the same picture of bodily decline, especially when they are suffering from urinary infection, but it is possible to distinguish between the two.

The cachexia of prostatics, evoked by exacerbations and complications, proves to be transitory. If the complications are subdued, the patient usually improves and his general condition becomes better; the symptoms of urinary infection subside. The absorption of intensely purulent and decomposing urine is recognized as the cause of the decline in these cases. In the cachexia of malignant disease, on the contrary, the urine may be perfectly clear, or show only the most trivial departures from the normal. Loss of weight and progressive weakness are incessant.

As just stated marked changes in the urine are, as a rule, not present. There is usually some pus and occasionally some blood, and when the tumor pushes its way into the bladder fragments of tumor may be voided. The last phenomenon is so rare, however, that it cannot be reckoned upon as a help in making a diagnosis. Admixture of pus with the urine is much more common. The circulatory disturbances which are produced in the bladder by the tumor naturally prepare a favorable field for the reception of infective microörganisms. It is rare, though, for the cystitis to assume any great degree of severity.

Urinary hæmorrhage due to prostatic tumors has nothing characteristic about it. The bleeding may be either initial or terminal, or the blood may come out of the bladder thoroughly mixed with the urine. Hæmorrhage occurs not only when the tumor has broken into the bladder, but may also take place as the result of venous stasis produced by the prostatic tumor growing around the bladder. In common with all hæmorrhages due to tumors of the bladder the bleeding occurs without apparent cause, resists all treatment, and disappears spon-

taneously; it is neither excited by activity nor can it be subdued by rest.

It differs from ordinary vesical hæmorrhage in being less profuse; very copious bleeding from prostatic tumors is exceptional.

In regard to examination with sounds and the cystoscope we should be forewarned that it usually proves deleterious. The sound generally shows that the urethra is displaced, the same as in hypertrophy of the prostate. There are deviations which render the passage of an inflexible instrument into the bladder very difficult. I have seen cases in which it was absolutely impossible to get a metal sound into the bladder, whereas a flexible bougie went in with ease. For this reason soft instruments are to be preferred for examination as well as for treatment. Slight hæmorrhage generally follows the use of instruments.

Examination with the short-beaked cystoscope may also be very difficult and impracticable. If the cystoscope can be introduced into the bladder without producing hæmorrhage, or if the bladder can be freed from blood which has escaped as the result of instrumentation, it will be seen that the tumor of the prostate has either pushed its way into the bladder, carrying the vesical mucous membrane before it, or that it has broken through the vesical wall. When the tumor is covered by mucous membrane the latter appears entirely normal except that it is somewhat injected; when the tumor has ruptured the bladder-wall the cystoscopic picture is not different from the one generally presented by vesical tumors. In such cases rectal palpation will clear up all doubt, as in vesical tumors the prostate is normal.

Oftentimes the results of rectal palpation are so precise that from them alone the diagnosis of prostatic tumor can be made. One must take the precaution to examine when the bladder is empty, for if the examination be made when it is full, errors are likely to result. Whenever possible bimanual palpation should be employed. The prostate is almost always considerably enlarged. The initial elements of disease which have not yet led to enlargement can of course not be felt, but such a condition of affairs is very unusual.

The surface of the prostate usually presents marked irregularities, and is exceptionally firm and dense; occasionally it is as hard as wood, a condition which does not obtain in simple hypertrophy. The rectal mucous membrane covering the tumor is not movable. If, in addition, there is irregularity in the extension of the tumor, for instance if hard

conical projections grow out into the surrounding tissue upwards or laterally, so that the gland cannot be outlined, there will be no doubt that we are dealing with a tumor, and not with hypertrophy of the prostate. These horn-like offshoots extending in different directions—now toward the seminal vesicles, now laterally to the wall of the pelvis—are typical of tumors both as to form and hardness. In order to feel anything by bimanual palpation the patient must be thin and the abdominal walls compressible.

Finally, if metastases can be felt, for example, in the inguinal region; or if there is probability of their existence in the viscera; or if incessant pain in the legs, in the region of the sacrum, or in the shoulders make it seem likely that metastases are pressing upon nerve-trunks and invading the bones; and if the lower extremities show signs of œdema, which point to the presence of venous thrombi, the diagnosis becomes less and less doubtful.

The course of the disease usually proves to be most painful. In some cases vesical symptoms predominate, in others rectal, and in still others neuralgic. The duration of the disease does not exceed five years. The malady begins with symptoms similar to those of prostatic hypertrophy, but hæmorrhage soon manifests itself, and it is not long before painful micturition, together with pain in the bones and sharp, shooting pains along the course of the nerves are superadded to the other symptoms. Cachexia comes more and more to the front, but, as a rule, before the patient succumbs to it, complications ensue which cause a more speedy termination of the disease than would result from this gradually progressive decline. Retention of urine, intestinal obstruction, compression of the ureters with consequent hydro- and pyonephrosis, anuria, infection of the bladder, erosion of the vertebræ resulting in total hæmiplegia (which I have twice seen), thrombosis of the pelvic veins, and finally hypostatic pneumonia, constitute the direct and indirect causes of death.

TREATMENT.

The treatment of malignant tumors of the prostate is entirely symptomatic. We must be satisfied with lessening the patient's pain and trying to sustain his strength. For the control of pain narcotics in the most varied forms cannot be dispensed with. Morphine, belladonna, heroin, and dionin by mouth, and by rectum in the form

of injections, are useful; when given per rectum pyramidon or antipyrin may be combined with them. Hot sitz-baths, hot applications, the thermophore—in fact heat in all its forms—are useful. Catheterization should be employed both for complete and incomplete retention of urine.

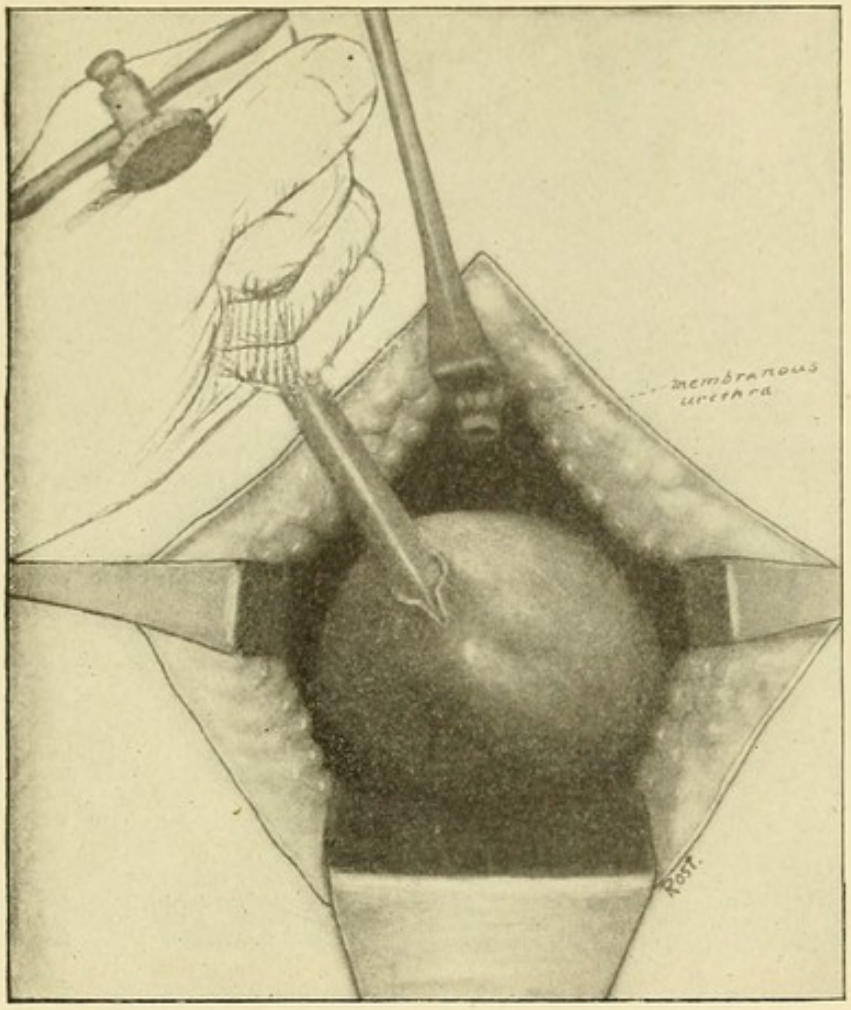
I will again call attention to the fact that only soft instruments are to be used. The condition of the bowels must be looked after; evacuations are best secured by means of high enemata. A generous diet should be provided. Local treatment is not to be made use of except when it is specially indicated, for instance, when retention of urine takes place, or when suppuration cannot be controlled by other measures. Formidable methods of examination, such as cystoscopy, should not be resorted to unless absolutely necessary for making a diagnosis.

Radical treatment of prostatic tumors, having in view the removal of the entire neoplasm, is to be advised against, because, judging from the results thus far obtained, it shortens life. Partial removal of the gland is irrational, because it is impossible to say whether diseased areas are not contained in the portion which remains behind. Nothing short of complete extirpation is to be considered, and even this can offer hope of results only when it is undertaken before metastases have occurred. The prospects of success are exceedingly small, because the tumor has usually existed a long time before its real nature is learned.

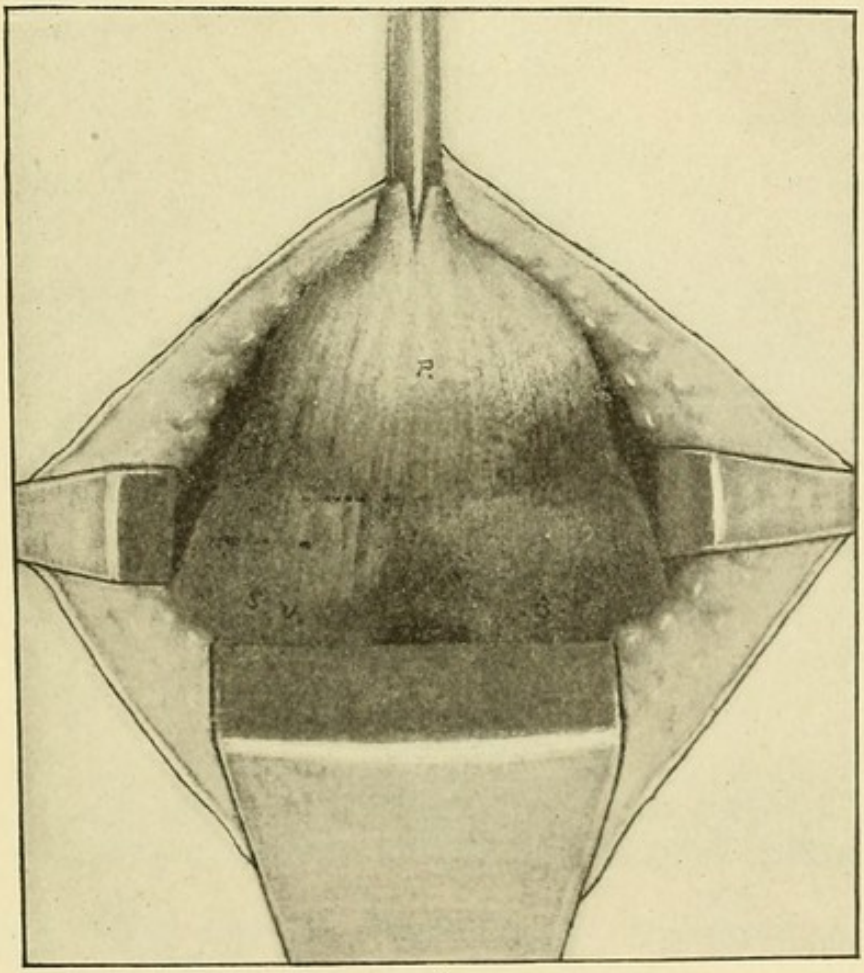
These considerations are in accord with the following results obtained by operation. Billroth's patient, the first ever operated on, recovered from the operation, but died fourteen months later of a recurrence; Stein's first patient died at the end of nine months; his second patient, and also Leisrink's and Depages's did not survive the operation. In Verhoogen's case death due to recurrence of the disease took place in nine months, and in Fuller's in eleven months. Socin's patient, however, was still living four years after operation without any return of the disease.

While it must be admitted that these statistics are the worst conceivable, and that the prospects of success are very slight, it must not be forgotten that even without operation the patient is sure to die. In view of our improved technic in operation for hypertrophy of the prostate, such as the introduction of the prerectal incision, and such procedures as Fritz Koenig's operation for removal of carcinoma of

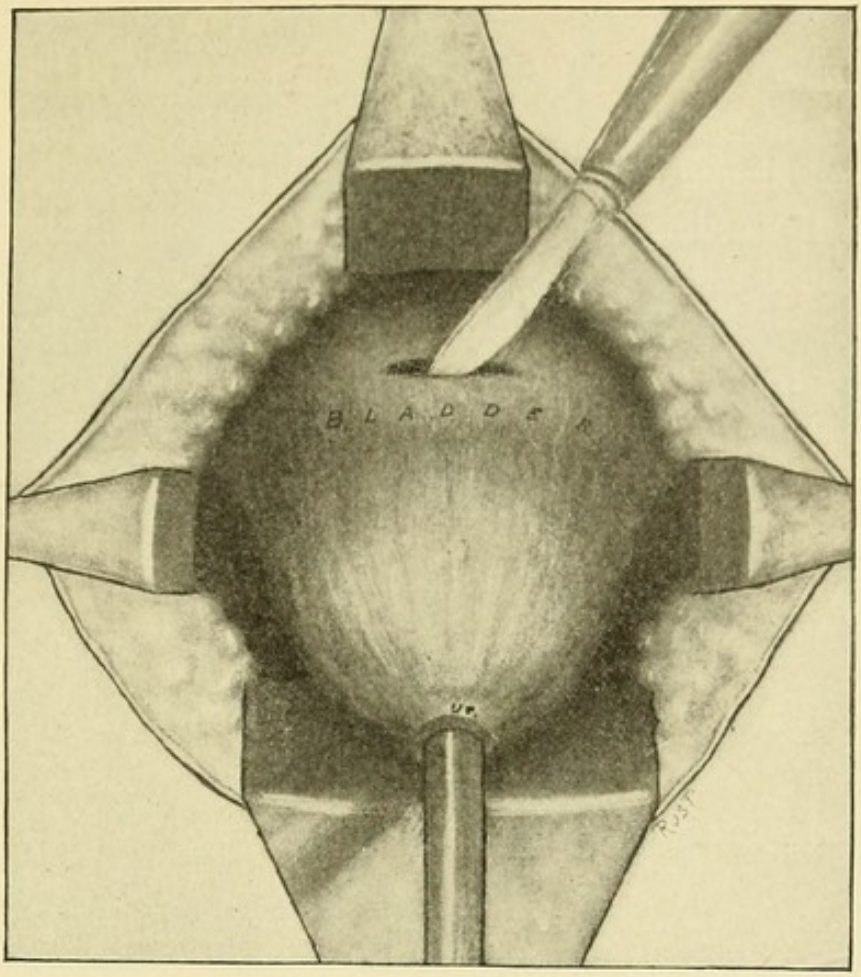
PLATE X.



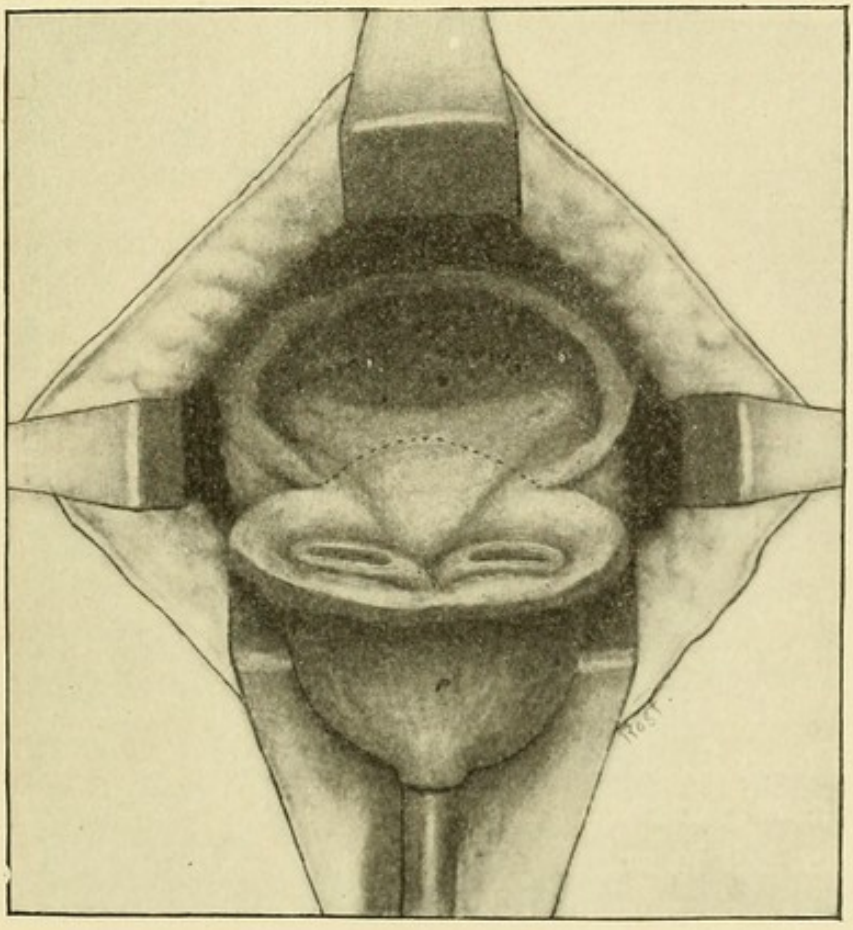
A. Prostate separated from surrounding structures except posteriorly



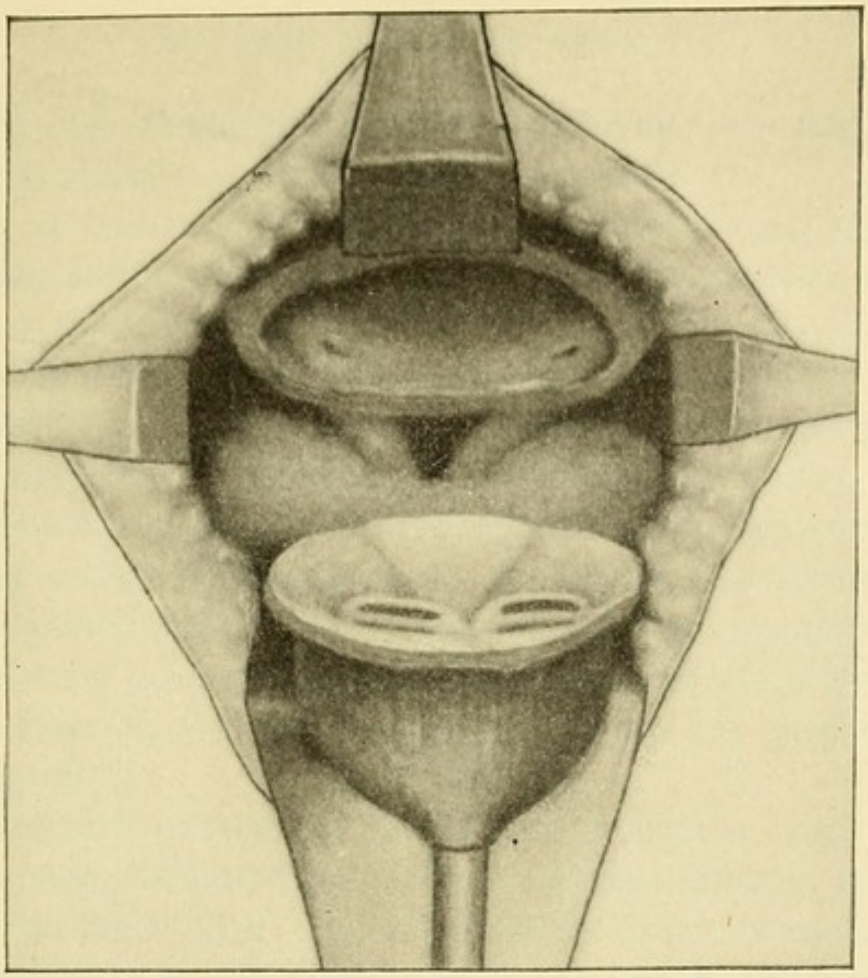
B. Prostate completely freed and drawn well out into the wound (Young.)



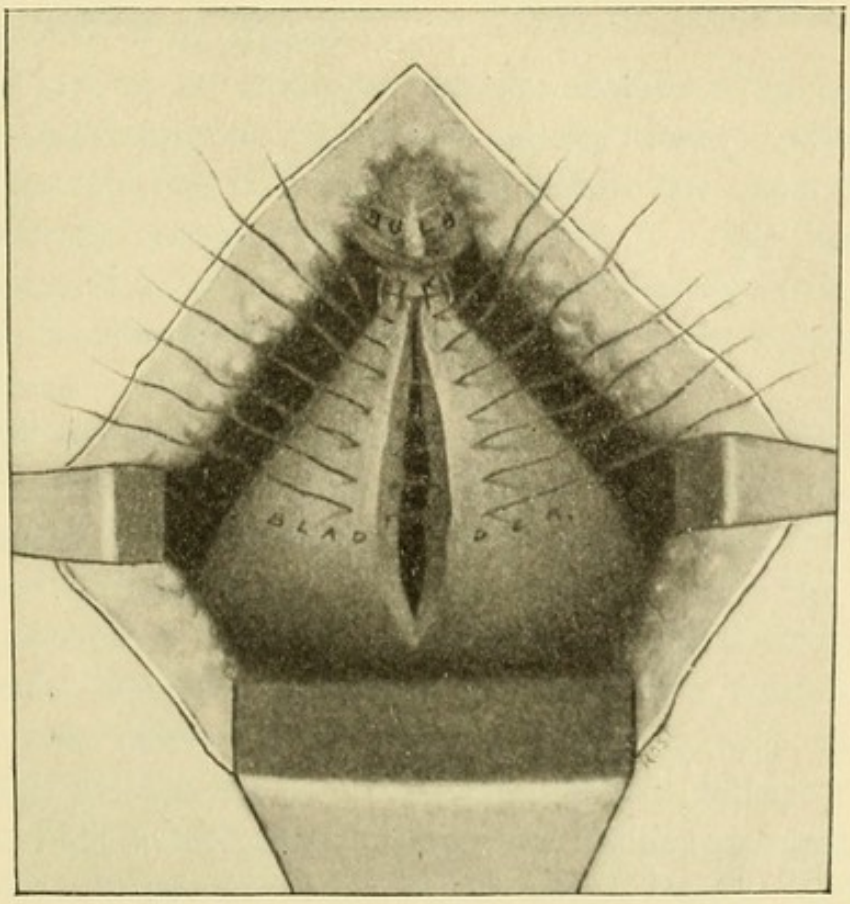
C. Bladder incised at prostato-vesical junction.



D. Vesical incision continued. Trigone exposed. The dotted line marks the incision across it. (Young.)



E. Base of bladder pushed upwards exposing anterior surface of seminal vesicles and vasa deferentia.



F. Showing anastomosis between the membranous urethra and bladder, and the sutures passed through the margins of the vesical wound. (Young.)

the rectum, hope should not be entirely abandoned, but further efforts should be made to completely remove the neoplasm.

[Young, of Baltimore, has recently reported four cases in which he removed the entire prostate, the seminal vesicles, the vasa deferentia and most of the trigonum.

Dr. Young describes his operation practically as follows:

The prostate is exposed as in the operation of perineal prostatectomy. The handle of the retractor is then depressed so as to expose the membranous urethra, which is then divided transversely. By further depressing the handle of the tractor the pubo-prostatic ligament is exposed, and is divided with scissors, thus completely severing the prostate from all important attachments except posteriorly, as shown in Plate X, A. The lateral attachments are then separated by the fingers.

The posterior surface of the seminal vesicles is then freed by blunt dissection, the now mobile prostate being well out of the wound, as shown in Plate X, B. In exposing the posterior surface of the vesicles care must be taken not to break through the fascia of Denonvilliers, which covers the posterior surface of the prostate and seminal vesicles, and which undoubtedly forms an important barrier to the backward growth of the disease.

The next step is to expose the anterior surface of the bladder by still further depressing the tractor and making strong traction. The bladder is then incised at a point in the middle line about 1 cm. behind the prostato-vesical junction (Plate XI, C). The dissection is then continued on each side with scissors until the trigone is exposed. The trigone is then incised transversely about 1 cm. in front of the ureteral orifices. (Plate XI, D.)

While still making traction upon the prostate, the base of the bladder is pushed upward so as to expose the anterior surface of the seminal vesicles and the adjacent vasa deferentia (Plate XII, E), all of which are carefully freed by blunt dissection with the finger as high up as possible, so as to remove with the vesicles the circumjacent fat and areolar tissues on account of the lymphatics which they contain. The vasa deferentia are divided as high up as possible, care being taken to see that the ureters are not cut with them.

An anastomosis is then made between the bladder and membranous urethra and the remainder of the vesical wound closed. (Plate XII, F.) The first suture is placed by inserting the needle into the tri-

angular ligament above the urethra and out through the anterior wall of the bladder in the median line, from within out, care being taken to include only the submucosa and muscle. When this suture is tied, the median line of the anterior wall of the bladder is drawn to meet the urethra, the knot outside, and the thread left long.

Lateral sutures, similarly placed (including the periurethral muscular structures below), and two posterior sutures complete the anastomosis of the membranous urethra with a small ring into which the anterior portion of the margin of the vesical wound has been fashioned by the tying of the sutures.

It is most interesting to note that the functional results after this extensive operation were good.

One patient died at the end of six weeks, death being attributed to the removal of the valvular ends of the ureters, owing to the belief that they were involved in the malignant process; one patient died at the end of a year as the result of a stone-crushing operation; the other cases were too recent for consideration, six and two months respectively having elapsed between the date of operation and the time the report was made.*]

SYPHILIS OF THE PROSTATE.

From the circumstance that I have not met with a single positive case of syphilis among a large number of diseases affecting the prostate I am led to conclude that its occurrence is exceedingly rare. Moreover, only a few cases are mentioned in literature which may possibly have been true cases of lues of the prostate. These have been reported by Reliquet, Rochon, Wroszynski, and Grosligk. Grosligk's case is the one in which there is the greatest probability that the lesion in question was a gumma.

This case was that of a man aged forty-five who complained of painful and urgent urination and tenderness in the perineum. He had had gonorrhœa a long time before, but had been cured of it and had remained perfectly well. There was a scanty brownish urethral discharge containing pus-cells and erythrocytes, but no gonococci. A 19 French sound was passed without difficulty. Upon rectal exami-

*Since the publication of the first edition of this book two other patients have been operated on. Of six, the total number upon whom the operation was performed, two were well and apparently free from recurrence January 1, 1908, nearly three years after they were operated upon.

nation the prostate was found to be as large as a man's fist, uneven, of the consistency of cartilage, and sensitive to pressure. These findings naturally aroused the suspicion of carcinoma, and this suspicion was strengthened by the patient's denial of syphilis. Later, however, he admitted having had the disease, and energetic antisyphilitic treatment was begun, with the result that in four weeks all signs of the tumor and all subjective symptoms had disappeared. In course of time the prostate enlarged again simultaneously with the occurrence of a syphilitic affection of the neck; both lesions subsided under antiluetic treatment.

This carefully observed case must be taken into account, and in cases of prostatic inflammation in which there is no determinable cause it should direct our attention to the possibility of syphilitic disease.

Above all this case teaches us to be careful in making a diagnosis of cancer. In dealing with cases of prostatic tumor in which the origin, nature, rapid growth, and findings upon palpation are in anywise suspicious, and especially if other known signs of syphilis are demonstrable, antisyphilitic treatment may be tried after all the other means of diagnosis have been exhausted.

PARASITES OF THE PROSTATE.

The echinococcus is the only parasite requiring consideration, and it is doubtful if the cases reported as such were cases of true echinococcus disease, or whether they were cases in which the echinococcus had taken up its abode in the tissues and grown into the prostate. In the space between the bladder and rectum echinococcus cysts have been repeatedly found. Of cases which have been carefully observed, and some of which have been studied postmortem, we will mention three which best illustrate the development and symptoms of the affection.

In one case, that of Maunder, and which I take from Englisch's description, a man twenty-four years old was attacked with retention of urine, which lasted four days. The region above the symphysis, up as high as the umbilicus, was much distended by a spherical tumor, which upon pressure was sensitive and plainly showed signs of fluctuation. This fluctuating mass could be plainly felt through the rectum, through which it was punctured, and a liter of clear serous fluid obtain-

ed. This fluid contained no formed elements. While it was being discharged a large quantity of high-colored urine was passed through the urethra. Two days later the patient died of peritonitis. Autopsy revealed a healthy bladder, but in the space between the bladder and the rectum an empty sac was found which plainly showed a punctured opening. Hydatid cysts were found here and there on the abdominal viscera, and a large one was present in the inguinal canal, resembling a reducible inguinal hernia.

A second case, reported by Lowdell, was that of a man aged sixty-four who had for several years complained of difficulty in voiding his urine, and finally came to be affected with complete retention. Postmortem examination revealed a much thickened bladder. In place of the prostate there was a tumor the size of a child's head, which upon being opened proved to be a collapsed hydatid cyst. The reticulum contained hydatids. It is not clear whether this hydatid cyst developed in the prostate or whether it originated without the gland and caused atrophy of the latter by pressure.

Spence's case is very instructive. It is that of a man aged fifty-five, who had suffered from retention of urine six months and on whom catheterization had often been unsuccessfully tried. Examination revealed a tumor in the recto-vesical space. In the right hypochondrium a large tumor had developed without any signs of inflammation. Catheterization was tried again; it was successful and a large quantity of urine was voided, but the tumor remained unaltered. It was then punctured with an ordinary trocar and a large quantity of clear fluid rich in hydatids was obtained. Discharge of fluid through the puncture continued for two weeks. During severe straining at stool the cyst ruptured and discharged a large number of hydatids into the rectum. Suppuration of the cyst followed and healing took place, so that a thickened area on the anterior wall of the rectum, around the site where puncture had been made, remained. The tumor in the hypochondrium, however, grew very rapidly.

From the history of these cases, for which I am indebted to the careful researches of Englisch—echinococcus disease of the prostate being very rare, so that I have not had the opportunity of observing any cases myself—it will be seen that urinary disturbances characterize the disease. Micturition is interfered with for a long time, and therapeutic measures have no effect upon the trouble. Finally complete retention occurs.

Upon examination a tumor will be detected, generally one of large size, which is palpable through the rectum, and also can often be felt upon bimanual examination over the symphysis. The tumor fluctuates and is characterized by its size. If the patient be catheterized the tumor remains unaffected, a sign which shows that it was not an over-distended bladder which was felt. Exploratory puncture with subsequent aspiration will confirm the diagnosis by revealing scolices, single hooklets, or stratified pieces of membrane. Moreover, it is worthy of mention that other cysts as large as those produced by echinococci are not found in the space between the bladder and rectum, so that the presence of a large cyst in this locality should of itself give rise to strong suspicion of echinococcus disease.

Treatment is entirely surgical and will be determined somewhat according as other cysts are or are not present. Puncture, incision, and enucleation of the sac through a prerectal incision are the procedures to be employed. [It seems to me that large cysts could be removed easier by the suprapubic route than through the perineum.]

NEUROSES OF THE PROSTATE.

The term prostatic neurosis has been applied to a series of nervous sexual disturbances in which the prostate shares in the trouble, although it is not exclusively affected. This class of cases will be discussed under sexual neurasthenia, whereas here we shall confine ourselves to the genuine neuroses of the prostate.

In the prostate, which is so richly supplied with nervous elements, we meet with, according to Peyer, three kinds of nervous disturbances: hyperæsthesia of the gland itself; hyperæsthesia of the prostatic urethra; nervous irritability of the muscular portion of the gland, which in part constitutes the sphincter of the bladder.

These three conditions seldom occur distinct and alone, but are found in association with one another, or one merges into the other, so that the symptoms of one form are more prominent at one time and the symptoms of another form advance to the fore at another time.

Prostatic neuroses affect young persons, as a rule, an occurrence which is doubtlessly explained by the fact that they usually follow inflammatory processes in the urethra, that is to say, chronic gonorrhœa, which either involved the prostate at an early stage of its evolution or extended to it through the prostatic ducts at a later period.

Although the majority of prostatic neuroses have their origin in this manner, yet I have seen many cases in persons who had never had any venereal disease. For the most part they occurred in neuropathic persons who had masturbated excessively for years, and who had not been in the habit of having sexual intercourse, either for the reason that they were impotent or thought themselves to be. Then there was a series of cases in persons who had led a very active sexual life, and finally another in the subjects of general neurasthenia, whose trouble, though due to exacting mental application or overwork, assumed the form of sexual neurasthenia with symptoms referable to the prostate.

The symptom-complex of the prostatic neuroses is especially characterized by absence of objective signs of inflammation in the sexual organs, or by manifestations so slight that they do not suffice to explain the severe symptoms complained of.

The general hyperæsthesia of the organ is well shown by a constant feeling of pain and heaviness, which at times becomes exacerbated and gives the physician the impression that he has to do with an acute prostatitis. Palpation and examination of the prostatic secretion show the error of such a view. To be sure, the gland is very sensitive to pressure, but the swelling present in acute inflammation is wanting. Occasionally a few white cells are found in the secretion as the expression of a previous inflammation, but this is quite a different thing from finding a secretion composed almost entirely of pus-cells and erythrocytes, such as is found in acute catarrh of the prostate. Furthermore difficulty of micturition is absent in this form of prostatic neurosis, but is always present in extensive acute inflammatory disease; the urine also is clear and perfectly normal in other respects.

In those cases, too, in which the neurosis affects the prostatic urethra more than it does the prostate gland itself there are likewise no demonstrable objective changes either in the urethra or in the urine. The urine is clear and free from abnormal elements, except perhaps for the presence of a few filaments, which represent the remnants of a previous catarrh that may have supplied the cause for the development of the neurosis. There is no explanation for the pain which is experienced during micturition. Upon palpation the gland is found of normal size and not excessively tender.

If a sound is introduced into the urethra, however, the patient grows faint with pain as soon as the instrument enters the prostatic

portion. I place no reliance upon apparent anatomical changes in this portion of the urethra as shown by the urethroscope, because I am of the opinion that they cannot be distinguished from such as might artificially be produced by the introduction of the instrument. For this reason it is better to spare the annoyance of such an examination, which, moreover, can result only in harm.

The third form of prostatic neurosis, which is characterized by spasm of the sphincter, and the detrusor vesicæ as well, is the one most frequently met with. The spasm of the sphincter is shown by the difficulty with which the patient urinates; the tonicity of the muscle, which under ordinary circumstances readily yields to the contractions of the detrusor, is increased.

In the mildest grade of this neurosis the patients cannot urinate in the presence of others, but when they are alone they regain control over the sphincter. When the neurosis is more pronounced the disturbance of micturition is more severe. The patients are obliged to strain and call the action of abdominal pressure into play before they can get any urine out of the bladder. The stream is small at first, without force, and often interrupted, as though a small calculus had cut it off. When it once becomes established and the urine flows out more freely a burning sensation is felt in the urethra near the end of the penis. If a catheter be passed into the bladder after the patient has urinated, more or less residual urine will be found, a fact which shows that the bladder has not completely emptied itself.

All these phenomena resemble those which are found in association with some real impediment at the neck of the bladder. They differ from the latter, however, in the following respects: they are not constant, being present at one time and absent at another; the quantity of residual urine may vary considerably; the urethra is not lengthened as it is in prostatic hypertrophy; catheterization is easy unless a fine-pointed instrument is used. Fine-pointed instruments are ill-adapted to the purpose because the point becomes caught and firmly held by the sphincter. Large cylindrical sounds and catheters, especially metal ones, which cannot be bent, generally overcome the resistance at once. It is not necessary to lower the instrument as much as in hypertrophy of the prostate. This condition is distinguished from stricture by the distance of the obstruction from the external meatus; as is well-known, strictures are almost never present near the neck of the bladder.

The spasm of the detrusor, also called vesical spasm for short, is characterized by the fact that the patient has occasional attacks of strangury for which no objective basis can be found. This urgency of micturition is not constant, as it is in inflammatory conditions, but it comes on suddenly, then disappears and remains absent for a long time. **It is never present at night.**

Micturition is painless, and, as a rule, the urine is voided without difficulty. The urine is clear and contains no abnormal elements. Any mental or sexual excitement increases this strangury, but no cause for its origin can be found.

The first as well as the last form, both spasm of the sphincter and of the detrusor, is often the sequel of a previous gonorrhœa and prostatitis, but they are also met with in persons who never had these diseases. It has already been stated that all of these neuroses may merge one into another, or be combined.

The course is of long duration, and characterized by periods of months or years in which the patient is free from all difficulty, until, for some reason or other, the old trouble makes its appearance again.

The effect of treatment is as a rule satisfactory, although there are cases which resist all therapeutic measures. If signs of previous inflammatory and suppurative processes are found, their successful treatment will exert a very favorable effect upon the neurosis. In general it may be stated that the obstinacy of the symptoms is due, as it also is in other neuroses, to the fact that the patients believe their condition to be worse than it really is.

In the class of cases just referred to they believe that the filaments in the urine, the sense of pressure at the anus, and the pain upon micturition are signs of serious disease. If these objective manifestations of their trouble can be removed, the neurasthenic symptoms will be considerably ameliorated, or often entirely overcome. Therefore, in such cases, judiciously conducted local treatment will often be of great advantage. It consists, as has already been stated in reference to the treatment of these inflammatory conditions, in massage of the prostate, cauterization of the urethra, irrigations, and the use of sounds.

There are cases, however, in which these measures cannot be employed without causing pain, and when this happens the reverse is the result: the patients are made worse than they were before, the

pain to which they are subjected increasing their nervousness. It is evident that in this latter class of cases local treatment must not be resorted to. In other cases also it should not be carried too far, especially if it becomes apparent that the remains of the urethritis and prostatitis cannot be removed, as very often happens.

I can warmly recommend other local measures directed solely against the neurosis. To this class belongs electrization of the prostate and bladder, which is performed by inserting one pole into the rectum and placing the other over the symphysis. The interrupted and constant current are of equal value. The use of the psychrophore, or my rectal thermophore, has an excellent effect. In addition, baths, massage, exercise, and regulation of the diet should be ordered. Sitz-baths at a temperature of 35° C. increased to 42° C. [98° F. to 103.5° F.], or reduced to 25° C. [90° F.], cold douches to the perineum, the cold rub, exercise in the open air, walking, and medical gymnastics are all indicated.

To overcome spasm of the sphincter a large sound may be passed and left in place for a short time. Belladonna, either internally or in the form of suppositories or rectal injections, may also prove of service. Such nervines as sodium bromide, tincture of gelsemium, valerian, antipyrine and phenacetine should constitute our list of drugs for internal use. Narcotics are to be avoided if possible. [The coal-tar products should also be used with caution.]

If, despite these measures, the disease persists, the patient may be sent to a sanatorium, where the same procedures we have mentioned will be found to exert a more powerful effect.

DISEASES OF THE TESTICLE, EPIDIDYMIS, SPERMATIC CORD AND THEIR COVERINGS.

ANATOMY.

The scrotum consists of five layers: the cutis, the dartos, the cremasteric fascia, the tunica vaginalis communis, and the tunica vaginalis propria.

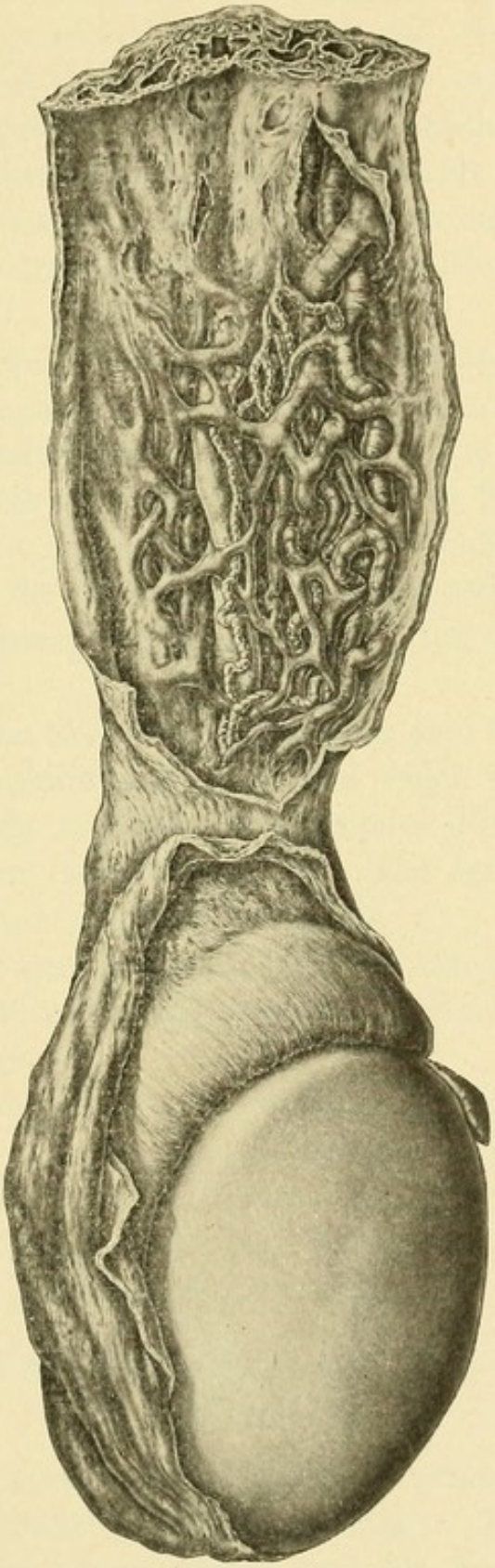
There is a raphé in the cutis in the median line of the scrotum. The dartos is continuous posteriorly with the connective tissue of the perineum and passes anteriorly into the root of the penis forming a septum between the two testicles. The cremaster is a continuation of the lower fibers of the internal oblique and transversalis muscles; its delicate fibers are intimately blended with the tunica vaginalis communis. The latter is a continuation of the transversalis fascia, which covers the testicles and seminal vesicles, and is adherent to the outer layer of tunica vaginalis propria.

The tunica vaginalis propria is a serous sac consisting of parietal and visceral layers, the former of which is attached to the tunica vaginalis communis, while the latter is closely adherent to the testicle, covering it entirely except at its posterior border. The serous cavity within the tunica vaginalis propria extends upwards as far as the parietal peritoneum in the form of a funiculus, which represents the remains of the connection that existed during fœtal life between the tunic and the peritoneum.

The testicle at its superior border is overlapped by the head of the epididymis; it is covered by the tunica albuginea, the outer surface of which is in relation with the tunica vaginalis propria. The tunica albuginea sends septa into the substance of the gland which divide it into a number of lobules, the ducts of which meet in the rete vasculosum Halleri and perforate the thickened portion of the albuginea known as the body of Highmore [or mediastinum testis].

The epididymis has a thick anterior part known as the head [globus major] and a slender posterior portion, called the tail [globus minor]. It consists of a narrow tube made up of many complex coils which originate from the efferent ducts in the rete vasculosum Halleri and end in the vas deferens.

PLATE XIII.



Testicle and spermatic cord. Anterior view. (Deaver.)

The spermatic cord is composed of the vas deferens and its accompanying vessels and nerves; it runs through the inguinal canal, curves over the horizontal ramus of the os pubis and winds around the epigastric artery, crosses the external iliac vessels and unites at the base of the prostate with the duct of the seminal vesicle to form the ejaculatory duct. In relation to the other structures of the cord it lies posteriorly and externally. It can be felt through the integument as a smooth, firm cord, and is easily distinguished from the vessels and nerves.

The arteries of the spermatic cord are the spermatic, the artery of the vas deferens, and the cremasteric. The spermatic, which is a branch of the abdominal aorta, supplies the testicle and the epididymis; the artery of the vas deferens is derived from the superior vesical, supplies in part the tunica vaginalis communis and the cremaster, and anastomoses with the spermatic; the cremasteric is the principal artery of the cremaster; it anastomoses with the other arteries of the cord.

As the veins of the testicle ascend into the cord they form a network known as the pampiniform plexus, from which the spermatic veins originate. The right spermatic vein empties directly into the vena cava, the left one into the left renal vein. The lymphatics of the cord empty into the lymph-glands of the pelvis.

The nerves also form a plexus, which is known as the spermatic plexus; they are derived partly from the lumbar plexus and partly from the sympathetic.

The scrotum is supplied by the artery of the septum, which comes from the internal pudic, and by the external pudic, a branch of the femoral. The lymph-vessels empty into the superficial inguinal glands. The nerves are derived from the internal pudic, the external spermatic, and the posterior femoral cutaneous.

THE CONGENITAL DISEASES OF THE SCROTUM AND TESTICLES.

Occasionally the scrotum is divided, each testicle lying in a separate compartment surrounded by its own coverings. This anomaly causes the scrotum to resemble somewhat the labia majora of the female. The testicles in these separate compartments may be perfectly normal. The condition is caused solely by a separation of the two organs which took place in fœtal life.

A more frequent congenital anomaly is rudimentary development or complete absence of the testicles and their adnexa (hypoplasia or atrophy, and aplasia or anorchism). Usually the abnormality is unilateral. Microscopically such atrophic testicles show either the structure of the infantile organ, that is, a rich connective tissue stroma, and absence of spermatozoa in the seminal tubules, or else they consist almost entirely of connective tissue through which masses of fat are distributed, but in which no seminiferous tubules are contained.

Much more frequent than any of these abnormalities is excessive development of the testicle, known as hypertrophy or hyperplasia. Although it is usually unilateral, occurring in association with absence or atrophy of the opposite organ, it may be bilateral.

When the position of the testicle is abnormal, the condition is known as inversio testis; it may be either vertical or horizontal, according to the axis upon which it is rotated; the rotation may be either complete or partial. The causes of this abnormality are not known. Le Dentu attributes it to faulty attachment of the gubernaculum testis.

Cases in which the testicle does not descend into the scrotum are known by the name of ectopia testis. When it lies under the skin of the abdomen the condition is spoken of as ectopia abdominalis; when in the region of the thigh as ectopia cruralis. It may also be found in the perineum, in which case the condition is called ectopia perinealis.

RETENTION OF THE TESTICLE.

Of greater practical importance than the abnormalities thus far mentioned is retention of the testicle, a condition in which the testicle does not descend, but remains in the abdomen or is arrested in some portion of its passage downward. [This condition must not be confounded with *ectopia testis*, which is a *displacement* of the organ.]

Before the testicle descends from its embryonal bed within the abdomen, through the inguinal canal into the scrotum, the peritoneum surrounding it anteriorly and laterally projects itself downwards, so that when the testicle reaches the scrotum there is a sac-like process of peritoneum extending from the internal abdominal ring above to the gland below. This diverticulum is known as the vaginal process of peritoneum. Normally its walls grow together so that it becomes obliterated and forms a fibrous cord. The process of peritoneum covering the testis itself forms the tunica vaginalis propria.

Under normal conditions the descent of the testis ends when it reaches

PLATE XIV



CHRONICALLY INFLAMED TESTICLE REMOVED FROM THE ABDOMEN. TORSION OF THE CORD AND HÆMORRHAGE HAD OCCURRED. (DRAWING FROM A SPECIMEN PRESENTED TO THE EDITOR BY DR. L. W. STEINBACH.)

the scrotum. If its descent is arrested and it remains fast in some portion of its course, a condition known as *retentio testis* is produced. The testicle may remain in the abdomen, or be arrested in the inguinal canal. If the retention is unilateral the condition is known as monorchism, if bilateral as cryptorchism. The cause of these conditions is an arrest of development, which may be due either to hereditary influences or to fortuitous conditions such as peritoneal adhesions.

The diagnosis is not difficult; one side of the scrotum is empty, and in case of inguinal retention the testicle can be felt in the inguinal canal. If it is in the abdomen, on the contrary, it is not palpable.

For various reasons a certain importance is attached to this abnormal situation of the testis. The retained testicle, particularly when arrested in the inguinal canal, often atrophies; it often becomes the seat of inflammation owing to the pressure to which it is subjected, or to the effects of gonorrhœa. Kocher has observed that retained testicles often become carcinomatous, and Kœnig confirms this observation. For this reason alone it is apparent how important the diagnosis and correction of this abnormality is. [Sarcomatous degeneration may also take place. I have known a testicle retained within the abdomen to undergo cystic degeneration, and in another case to become very much inflamed. (Plate XIV.)]

Retention of the testicle requires treatment only when the organ is in the inguinal canal; when retained in the abdomen no treatment is needed [unless it gives rise to trouble]. [The possibility of its becoming inflamed or undergoing cystic degeneration or malignant change must be remembered.] When the gland is movable an effort may be made to bring it down before puberty by manipulation and massage. Haidenhain recommends drawing it down and keeping it in place by means of a truss. [Little is to be expected from such procedures.]

Several surgeons, among whom may be mentioned Julius Wolf, Max Schüller, Nicoladoni, [and Arthur D. Bevan], have endeavored to fix the testicle in the scrotum by operative procedures. These procedures are conservative and are commendable so long as the operation does not endanger life. In case of the latter event the certain and safe procedure of extirpation is to be recommended. The surgeon should not be too loath to resort to the latter operation, because the testicle is commonly atrophied and therefore is of no use, and furthermore, because, as has been shown by Kocher and others, it is liable to undergo malignant change.

For removal of the testicle from the inguinal canal an incision is made parallel with and about half an inch above Poupart's ligament, and the gland freely exposed. The vas deferens is first isolated, the vessels ligated by a double ligature either en masse, or better separately, and the cord then divided. The operation is difficult only when the testicle is adherent to a tumor or when a hernia is present. In the latter case the peritoneal cavity may easily be opened. [In all cases in which the testicle appears to be normal, that is, in which it is neither atrophied nor inflamed, nor subject to malignant changes, I deem it conservative surgery to transplant the gland to the scrotum.

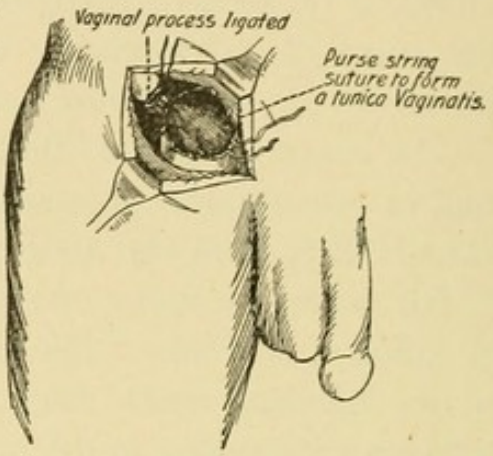


Fig. 199. (Bevan.)

For this purpose Max Schüller divided the vaginal process of peritoneum and stitched the testicle into the scrotum.

A more complete and satisfactory operation has been devised by Arthur D. Bevan, of Chicago. It is performed as follows. The testicle is exposed by a three inch incision over the inguinal canal, similar to the one made in Bassini's hernia operation; the vaginal process of peritoneum is divided above the testis and ligated just as the neck of a hernial sac is ligated; and a tunica vaginalis for the testis then formed by closing that portion of the peritoneum which surrounds it with a purse-string suture. (Fig. 199.) The testicle is now lifted from its bed, the cord is lengthened by making traction upon it, and is entirely freed from connective tissue, so that only the vas deferens and blood-vessels remain. These structures are separated from the peritoneum by introducing the finger into the abdominal cavity and dissecting them away. When this has been accomplished, a cavity is made in the scrotum by blunt dissection and the testicle pulled down into it and retained in place by means of a purse-string suture run through the neck of the scrotum. "This suture

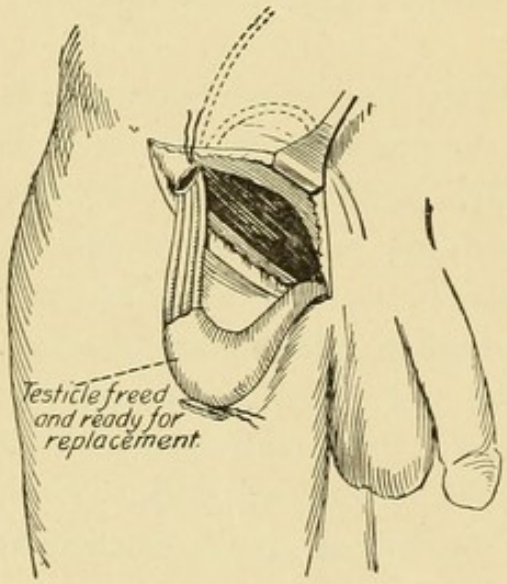


Fig. 200. (Bevan.)

should pass through the superficial fascia and the external oblique on both sides; that is, both the internal and external pillars of the external ring and above the cord." If the cord has been properly freed in the manner described, it will be so lengthened that the testicle can be drawn into the scrotum without tension. (Fig. 200.) When the testicle is well up in the abdomen, or perhaps in other exceptional cases, this method will not suffice to free the testicle so that it can be drawn down without being subjected to tension; in such cases the spermatic vessels are ligated and divided, it being these structures which constitute the impediment to lengthening. (Fig. 201.) The artery of the vas deferens is said to afford sufficient nourishment to the testicle. The incision is closed as an ordinary hernia incision, with the exception, of course, that the cord is not transplanted.]

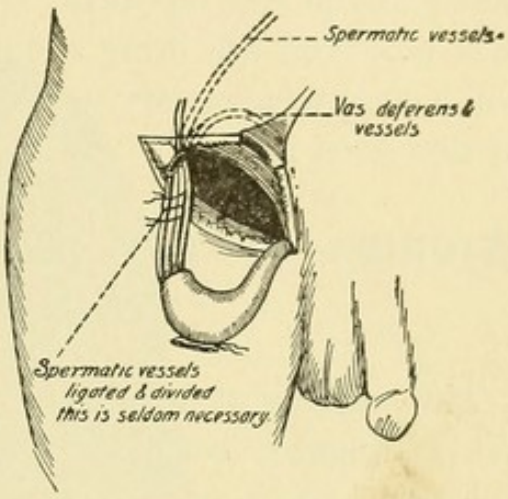


Fig. 201. (Bevan.)

CONGENITAL HYDROCELE.

When the vaginal process of peritoneum fails to close after the testicle has descended, but remains partly or entirely open, so that the communication between the peritoneal cavity and the cavity of the tunica vaginalis persists, a congenital hydrocele results. As the result of the connection between the two the serous fluid of the peritoneal cavity can flow down into the tunica vaginalis, and, conversely, the fluid secreted by the tunic can gain access to the abdomen. The passage between the two cavities is usually very small.

The diagnosis of this condition rests upon the circumstances that the tumor emits a dull percussion note, that it is translucent, that it does not glide back into the abdomen with a gurgling sound as does a hernia, but undergoes reduction very slowly because of the smallness of the communicating passage. If a hernia is present with the hydrocele the intestine will usually be found in the upper part of the tumor, the fluid in the lower.

Congenital hydrocele sometimes disappears spontaneously, the fluid being resorbed and the funiculus subsequently becoming obliterated. If parietal adhesions form small serous cavities remain in the

cord (see also under *hydrocele*). If the swelling persists and is in any way annoying, the fluid may be pressed back into the peritoneal cavity and a truss applied, or straps of adhesive plaster fastened around the testicle for the purpose of lessening the size of the opening and causing its occlusion. If such measures fail the sac may be punctured once or repeatedly with a fine needle. Usually the irritation thus produced will bring about occlusion. Only in exceptional cases will it become necessary to do one of the radical operations which will be described later.

INJURIES OF THE SCROTUM AND OF THE TESTICLE AND ITS COVERINGS.

The majority of injuries to the scrotum are bruises and lacerations. We distinguish between subcutaneous wounds and open wounds. Subcutaneous wounds frequently involve only the coverings of the testicle, the gland itself being uninjured; even in gunshot wounds the testicle usually escapes the bullet. Of course, in any of these injuries the testicle may be involved. Incised wounds of the testicle occur almost always as the result of operative procedures.

Contusions of the scrotum are characterized by a copious extravasation of blood from the numerous vessels with which the tissues are supplied. The blood diffuses itself extensively under the skin and the subcutaneous connective tissue. If the coverings of the testicle and spermatic cord are affected the blood gravitates to the net-like tissue of the tunica vaginalis communis and forms a hæmatoma.

This tumor differs from hæmatocele, which is a collection of blood in the cavity of the tunica vaginalis. While hæmatocele is similar to hydrocele, in that it forms a circumscribed elastic tumor, hæmatoma forms a more diffuse soft tumor in the scrotum or along the course of the spermatic cord. If the testicle itself is injured an effusion of blood may occur within the tunica albuginea and form a hæmatoma testis.

Although it is of no great practical importance to determine whether the superficial layers of the scrotum alone or the tunics investing the testicle are affected, it is desirable to distinguish these injuries from injury of the testicle itself. In contusion of the testicle the pain is extreme, often being so severe that the patient faints, or even becomes profoundly shocked. Contusion of the scrotum, on the contrary,

PLATE XV



TORSION OF THE SPERMATIC CORD. THE TWISTED CORD, EPIDIDYMIS AND TESTICLE ARE SEEN BELOW THE REFLECTED TUNICA VAGINALIS, THROUGH AN OPENING IN WHICH THE STUMP OF THE VIABLE PORTION OF THE CORD IS VISIBLE. (E. ELIOT, JR.)

is not so painful, but the extravasation of blood often assumes enormous dimensions, not uncommonly extending to the penis and abdomen. These extravasations of blood are generally benign. Under appropriate treatment they become resorbed. More rarely the parts become gangrenous. Subcutaneous injuries of the testicle may pursue the same course as these wounds, even though at first syncope or the phenomena of shock were produced. In some cases, however, inflammation of the testicle follows; it may end in abscess formation or atrophy. The treatment of these injuries to the scrotum, the tunics of the testicle, and of the testicle itself consists in placing the injured part at rest, elevating the penis, and applying lead water or a solution of aluminum acetate. As a rule, the swelling and discoloration disappear. Pressure bandages for the purpose of hastening resorption are contraindicated; in view of the delicacy of the skin and the possibility of gangrene the utmost caution should be observed.

In case signs of inflammation appear and abscess is feared, the parts must be incised, under strict antiseptic precautions, so that the effusion may be liberated. As a rule, the development of abscess and the occurrence of gangrene of the testicle is marked by severe constitutional disturbance, such as chills, high fever, violent pain, and perhaps some mental hebetude. In such cases the parts should be laid freely open before the destructive process reaches the surface. Redness of the skin and fluctuation will mark its advance.

Gangrene of the testicle often follows subcutaneous laceration of the spermatic cord and contusion or torsion of the spermatic artery. Swelling of the testicle, together with associated violent constitutional disturbance, usually makes the situation clear. In these cases we should not wait for atrophy of the testicle to take place, but should remove the gland at once.

[Torsion of the cord has been known to occur as the result of violent sexual intercourse, and has also taken place without any assignable cause.

In the latter class of cases it has been mistaken for strangulated hernia.] (Plate XV.)

Finally, the testicle may be so dislocated by injuries which do not involve the skin, that it may be pushed into the inguinal canal, above the symphysis, or into the thigh. Such a luxation of the testicle must be reduced by pressure or traction, or by operative means, for the reason that the gland may become gangrenous.

OPEN WOUNDS OF THE SCROTUM AND TESTICLES.

Open wounds of the scrotum generally result from contusions, more rarely from punctured or incised wounds. As already stated, the testicle frequently escapes injury in gunshot wounds of the scrotum. If the latter is lacerated or so bruised that it bursts, the margins of the wound usually retract so that the testicle protrudes. As dangerous as this injury may appear the testicle generally retracts and the skin comes together over it. Occasionally the testicle may become incarcerated owing to retraction of the edges of the wound. Severe hæmorrhage often takes place from the scrotal wound, the edges of which also frequently show a tendency to become gangrenous.

Treatment is in accordance with the established rules of surgery. Arrest of hæmorrhage, strict asepsis, removal of tissue which is so crushed that it may become gangrenous, provision for drainage, and, finally, careful suture of the wound, are the measures to be practised.

As concerns wounds of the testicle, the punctured wounds usually heal spontaneously. Incised wounds, however, may cause prolapse of the seminiferous tubules, with the result that they slough. If the prolapsed tissue can be replaced, the tunica albuginea should be carefully sutured over it. If there is danger of gangrene a timely castration must be considered, as it is important to prevent the development of phlegmon or septicæmia. The danger of these complications is especially great if the albuginea has been sewed firmly over a prolapsed testicle which was already gangrenous.

ECZEMA, ŒDEMA, ERYSIPELAS AND PHLEGMON OF THE SCROTUM.

The thin, delicate skin of the scrotum, supplied as it is with numberless sweat glands and sebaceous follicles, is predisposed to erythema and eczema, diseases which are especially common in summer among fat persons of uncleanly habits who sweat freely. Cleanliness, supporting the scrotum by means of a suspensory bandage, applications of a 2 per cent solution of aluminum acetate, or oxide of zinc ointment, usually effect a rapid cure.

Œdema of the scrotum is observed in dropsy and also occurs as the result of local circulatory disturbances. Compression with bandages is to be avoided, because it will increase the danger of gangrene, which already threatens, owing to the tension to which the tissues are sub-

jected. If the distension is considerable multiple punctures should be made with a sterilized needle; this will liberate the fluid and relieve tension. If the cause cannot be overcome the effusion will return.

Erysipelas of the scrotum differs from the disease as it affects other parts of the body in that the characteristic redness is absent, or present only in slight degree. It is for this reason that marked swelling terminating in gangrene may develop suddenly and without being preceded by a preliminary stage of redness. In the same manner the so-called spontaneous gangrene of the scrotum is explained, it being assumed that the preceding erysipelatous infection manifested itself but little. Diffuse gangrene of the scrotum may thus occur during the course or after the termination of acute infectious diseases, such as typhoid fever, small pox, pneumonia, etc.

Phlegmonous inflammation of the scrotum occasionally follows wounds or abscesses, but it occurs much more frequently as the result of infiltration of urine. It produces violent disturbances. The scrotum and neighboring tissues, particularly the penis, are red, swollen, and very sensitive to pressure. The penis may be œdematous throughout its entire length, and by compressing the urethra often gives rise to difficulty of micturition. Chills and fever are also present. Dark spots of varying size, the premonitors of gangrene, appear on the superficial tissues. If the phlegmon soon opens the ragged gangrenous parts will slough away; healing may then take place, although death sometimes results from sepsis.

In regard to treatment, erysipelas requires rest, elevation of the parts, and the application of antiseptic dressings; as soon as the parts become tense multiple scarification in the long axis of the skin should be practised. For phlegmon free deep incisions should be made as early as possible. The gangrenous parts may be left to take care of themselves; they will come away spontaneously. Fever and the other constitutional disturbances usually subside after surgical intervention, and healing ensues.

TUMORS OF THE SCROTUM AND TUNICA VAGINALIS.

Benign growths such as lipoma, fibroma, angioma, atheroma and cysts of the scrotum are comparatively rare, and when they do occur differ in no wise from those in other organs of the body.

A tumor peculiar to the scrotum is **elephantiasis,** which develops

under the manifestations of erysipelatous inflammation as the result of irritation produced by parasites (filaria sanguinis hominis), or other causes, and which may assume enormous proportions. It seldom affects the inhabitants of the temperate zone, but occurs more frequently among those who dwell in the tropics, attacking both natives and immigrants. All the elements of the skin hypertrophy, but particularly the epidermis, so that laceration easily takes place. Indentations alternate with protuberances.

As to treatment, dressings wet in alcoholic solution of salicylic acid may be used for a protracted period of time; if the swelling does not subside under their use, the tumor may be reduced by the excision of wedge-shaped pieces of tissue.

Certain forms of **cancer** also affect the scrotum. Frequent irritation such as may be produced by eczema in hot countries, or by chemical substances, such as are contained in sut, paraffin and anilin products, are responsible for the development of these growths.

Chimney-sweepers' cancer, as well as that due to the anilin products or fumes of tar, begins as wart-like growths at the root of the penis, and may remain as such for a long time. It generally extends superficially before it invades the deep structures and involves the lymphatics, thereby giving rise to metastatic processes, so that extirpation offers a comparatively favorable prospect of cure. [These growths are really epitheliomata.] True carcinoma also occurs in the scrotum as in other parts of the body, and its cause here is as little understood as it is in other regions.

Treatment consists in a careful and thorough removal of the diseased tissue. Here as elsewhere the first principle is thorough extirpation. It is essential to operate in healthy tissue, beyond the diseased parts, and this should be done though it necessitates sacrifice of a part of the sexual organs. Hæmorrhage is usually abundant, and special care must be taken to control it.

Of tumors affecting the tunica vaginalis, cysts, lipomata and fibromata have been observed; very rarely enchondromata, myomata and sarcomata have been found. These tumors are confined strictly to the tunica vaginalis, being distinct from the testicle, epididymis and cord, so that they can be removed without injuring these structures. Lipoma usually affects the tunica communis, the others the tunica propria. If lipomata remain small they may not require treatment. Fibromata are large and therefore should be extirpated, and the genital

organs thereby preserved; in myxomata and sarcomata it is necessary to remove the testicle, dividing the cord as high up as possible.

TUMORS OF THE TESTICLE AND EPIDIDYMIS.

Of the numerous tumors affecting the testicle and epididymis fibroma, enchondroma, myxoma, and the rare myoma present neither clinical nor histological peculiarities. For this reason a detailed description of them may be dispensed with. It may be stated, however, that all these tumors, and likewise those about to be mentioned, are apt to occur in mixed form.

More frequent than the aboved named is **sarcoma** of the testis and epididymis, which, according to Virchow, occurs during early childhood and old age, although König states that it is also met with in middle age. Macroscopically there are two chief varieties of sarcoma, the hard and the soft. As a rule, the softer the tumor, the more malignant it is. Some are round-celled and some spindle-celled sarcomata. They attack the testicle first, causing considerable enlargement of the gland, then after a short time they advance to the epididymis, and finally break through the tunica albuginea. After this happens they grow very rapidly, become adherent to the skin and perforate externally, or extend upwards along the cord to the inguinal glands, and then become widely disseminated, giving rise to metastases in remote organs of the body, such as the brain, the lungs and the liver.

Kraske thinks that trauma is the cause of these sarcomata.

Treatment consists in castration at the earliest possible moment. It is only when the tumor is still confined within the tunica albuginea that there is any hope of cure; otherwise the metastases in other organs render operation fruitless.

The **cystic testicle,** cystoma or adenoma testis, which has been carefully studied by Billroth, Virchow and Kocher, is the direct analogue of the cystic ovary. It is a cysto-adenoma, and results from overgrowth and constriction of the seminiferous tubules, as the result of which cystic dilatation of the constricted part takes place. If proliferation has the ascendency the tumor more closely resembles adenoma, but if cyst-formation predominates it is of the type of cystoma.

As long as the tumor remains distinctly adenomatous or cystic it may be classified among benign growths, but when sarcomatous portions are found in it, which is exceptional, it is then, of course, malignant. These tumors are characterized by the fact that the

epididymis and vas deferens usually remain free. The tissue of the testicle partly covers the tumor as a smooth flat coating and partly insinuates itself between the cysts and the solid portions of the growth. These growths may attain the size of a man's head; they usually have a smooth surface, are soft and elastic and occasionally fluctuate.

Cystoma of the testicle usually occurs between the ages of twenty and forty, that is, at a period of life during which strength and the power of procreation are at their height. It grows rapidly and sometimes causes great pain. For the purpose of confirming diagnosis puncture may be made, although the results obtained thereby will seldom be conclusive. For this reason incision is indicated. During the operation it can be decided whether conservative treatment is possible or whether castration is necessary. [If the tumor proves to be a cyst-adenoma it should be removed. An old hæmatocele might be mistaken for a cystic testicle, and in such a case the testicle would naturally be left undisturbed after the clots had been turned out.]

Carcinoma of the testicle is more common than sarcoma. It occurs in two forms, the hard and the soft, or schirrus and alveolar. Clinically, the two forms may be differentiated by the fact that the medullary type grows more rapidly than the schirrus and is of a more symmetrical shape and softer consistency; the schirrus grows slowly, is of irregular form, and shows well-marked dense nodules. The retroperitoneal lymph glands into which the lymphatics of the testicle drain become infiltrated early in the disease; they lie on each side of the vertebral column on a level with the kidneys.

As long as the neoplasm remains confined within the tunica albuginea the enlarged testicle maintains its ovoid shape; when it breaks through this structure, however, the testicle assumes an irregular shape, grows more rapidly, becomes adherent to, and finally perforates, the skin of the scrotum.

The prognosis of carcinoma of the testicle is very unfavorable, because the inguinal, iliac and retroperitoneal lymph-glands become involved early in the disease, usually before a positive diagnosis can be made.

The only treatment of any value is early extirpation of the diseased testicle.

[**Teratomata.** The mixed tumors above mentioned are probably all teratomata, that is, congenital tumors containing embryonal

PLATE XVI.



Chorio-epithelioma of the Testicle. Drawing from a specimen removed by Dr. W. Joseph Hearn. (A microscopic section of this tumor is shown in Plate XVII.)

elements from the three blastodermic layers. Dermoid cysts also belong to this class.

Various theories have been advanced to account for the development of these growths, but as they are of more interest to the pathologist and embryologist than to the surgeon and practitioner they will not be discussed in detail here.

The important thing for us to remember is that these growths are much more dangerous than they usually have been considered to be, and that their presence demands a radical operation.

Wilms, in his classic paper on teratoma of the testicle, has reported ten cases of mixed tumors, two of which proved to be malignant. F. R. Sturgis, of New York, has also collected from literature forty cases of what he terms cystoid disease of the testicle, many of which, however, were evidently teratomata. His own case likewise may be rightly classed under this heading. One-fourth of this number showed signs of malignancy, and in sixteen cases fatal metastases occurred.

In 1902 Wlasson and Schlagenhaufer called attention to the presence in teratomata of tissue resembling **chorio-epithelium,** and since that time other cases have been reported by Carey, Steinhaus, Pick, Smauch, Scott and Longcope, and Robert Frank. The accompanying illustrations (Plates XVI and XVII) show the macroscopic and microscopic appearance of an enormous tumor of this kind which was recently removed by Dr. Joseph Hearn, of Philadelphia. The clinical diagnosis was carcinoma, and the true nature of the growth was revealed only upon microscopic examination. Fatal metastases occurred within a few months after the tumor was removed.

These tumors, like chorio-epithelioma of the uterus and vagina, are of the most malignant type.

That many growths diagnosticated as carcinoma and sarcoma were in reality teratomata containing chorio-epithelium, is attested by the recent investigations of Robert Frank, of New York, who, by the way, has collected nineteen authentic cases, not including the one here mentioned.

There is a diversity of opinion in regard to the origin of the chorio-epitheliomatous tissue in these tumors. Thus, Schlagenhaufer believes that they develop from isolated blastomeres or fertilized polar bodies. Risel and Pick, who think they have observed transitional epithelium in the masses, are of the opinion that the latter are formed from the epiblast. Scott and Longcope have called attention to "the possibility

of the chorio-epitheliomatous elements present in a teratoma composed of all three germinal layers growing more rapidly than the other elements and thus causing disappearance of the latter or so outgrowing them that they are difficult to detect unless serial sections be made."

As has already been stated, the important thing for the practitioner to remember is the possible malignancy of all growths of the testicle the nature of which is obscure. I would advise the removal of any suspicious tumor of the testicle which does not yield rapidly to energetic antisyphilitic treatment. In doubtful cases mercury and the iodides in large doses are always to be tried. If they fail to act within a short time recourse should be had to operation.]

TUBERCULOSIS OF THE TESTICLE, EPIDIDYMIS AND VAS DEFERENS.

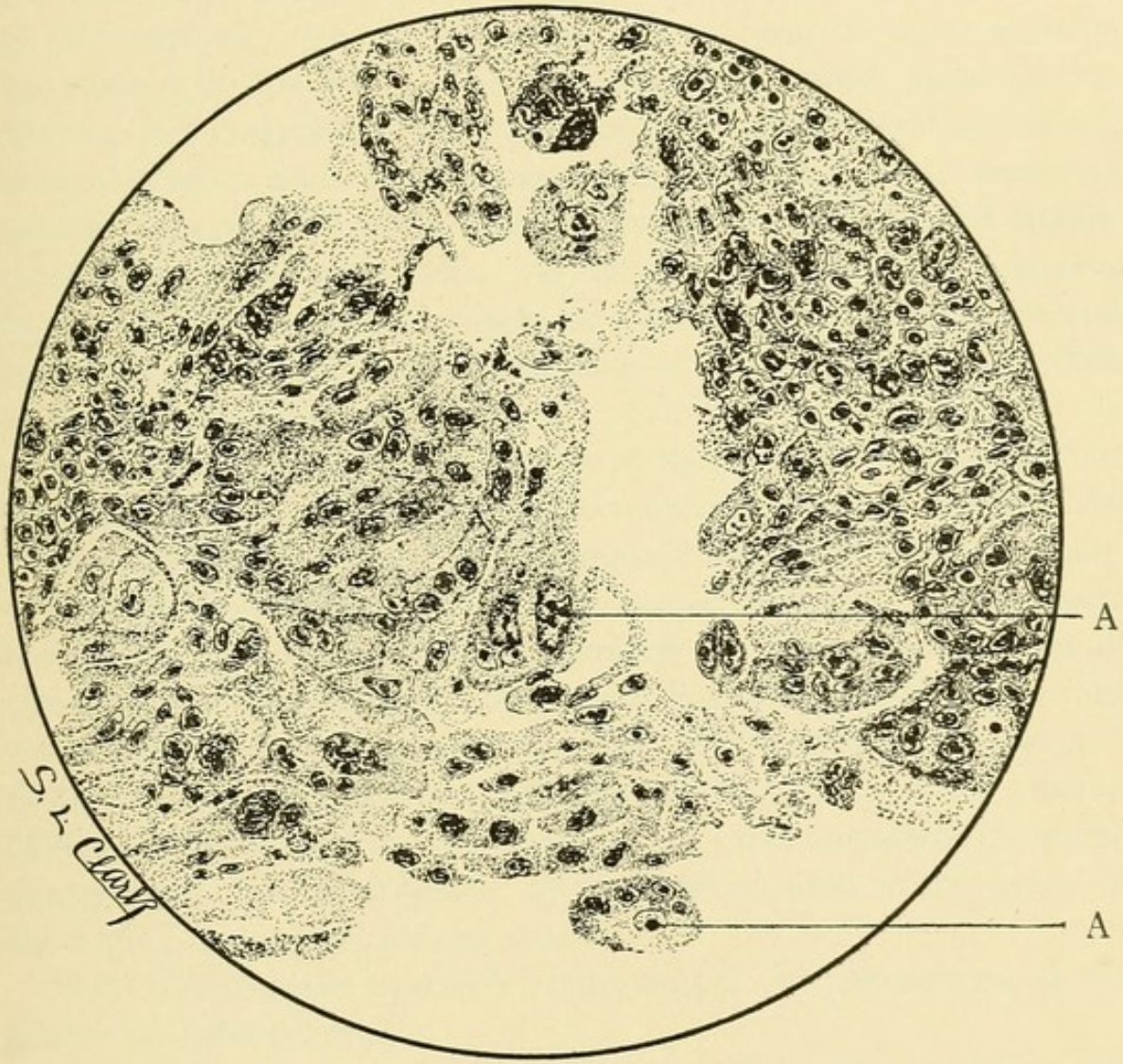
Tuberculosis of the genital glands is a relatively frequent disease. It may develop either primarily or as a metastasis from a remote tuberculous focus (as in the lungs for example), or extend from neighboring structures. In case of the last mentioned occurrence, the urinary tract or the seminal vesicles are usually the seat of the primary lesions. It also often happens that a descending renal tuberculosis with associated tuberculous cystitis is the source of the trouble.

As exciting causes trauma and gonorrhœa are especially to be blamed, since they may lead to the development of tuberculosis in persons who are predisposed to this disease.

Although in certain persons injury results in an acute inflammation of the testicle and epididymis which soon subsides, and gonorrhœal epididymitis undergoes resolution with the exception of leaving a small infiltrate behind, in other persons tuberculosis will follow either of these conditions, and that, too, when not a trace of it could be found before in any part of the body. In these cases it must be assumed that tubercle bacilli circulating in the blood select for their abode the point of least resistance—and the epididymis is to be considered as such—and there cause the development of tuberculosis.

The disease almost always begins in the epididymis or vas deferens, very rarely in the testicle itself, which becomes involved later as the disease progresses in the epididymis. This mode of advancement may be considered the rule, and made use of in diagnosis. It is either in the head or the tail of the epididymis that the formation of tubercles

PLATE XVII.



Microscopic section of the tumor shown in Plate XVI. A A. Large syncytial cells.

first takes place; it is exceedingly uncommon for the portion between the two extremities to be the site of the first tubercles, although in rare instances the entire organ may be affected at once.

Fortunately the disease in the beginning is usually unilateral, although it often comes to pass that the other testicle becomes tuberculous. [I have seen marked involvement of the second testicle within three months after removal of its fellow, and this in a case in which operation was performed within ten days after the patient's attention was attracted to his condition. No signs of pulmonary or renal tuberculosis could be detected in this case.] The morbid process extends along the vas deferens if this structure was not its primary seat. Later the prostate, seminal vesicles and bladder may become involved, or, as more frequently happens, the disease begins in the seminal vesicles and extends downwards to the epididymis. As concerns the urinary tract, it may be stated that it is more common for tuberculosis of the prostate and epididymis to invade the bladder than it is for vesical tuberculosis to encroach upon the epididymis.

The tuberculous process originates in the walls of the seminiferous tubules, which become converted into tuberculous tissue; owing to disintegration of these newly formed masses caseous foci are produced which may coalesce and form cavities. Later the testicle itself becomes the seat of such tubercles, which undergo the same changes as do all others, at first softening in the center and then becoming caseous toward the periphery. For a time the tunica vaginalis remains free, but sooner or later it generally becomes adherent to the surface of the testicle. Miliary tubercles may also be found on the outer surface of the tunic. Occasionally hydrocele occurs. [I have found fluid in the cavity of the tunica vaginalis in several cases.

Plate XVIII shows extensive destruction of the parenchyma of the testicle by tuberculosis.]

In regard to the symptoms and course of the disease, it may be stated that its onset and development are, according to my experience at least, usually painless. Rarely it may happen that a rapid eruption of tubercles may give rise to slight pain. The course is generally so slow that the patient does not notice the beginning of the disease; accidental pressure upon the testicle, or enlargement of the scrotum, may first direct his attention to the fact that something is wrong. Neither fever nor other constitutional disturbance is present.

It is not only enfeebled or phthisical subjects who are attacked by

this malady, but also strong young persons in whom no one would ever suspect tuberculosis. For this reason the disease may be purely local, and may, moreover, exist for many years without progressing or giving rise to metastases; this is a circumstance which is of great importance in regard to treatment. This does not mean, however, that in other cases extension of the morbid process does not take place nor metastases occur; as a rule, though, this is not the case.

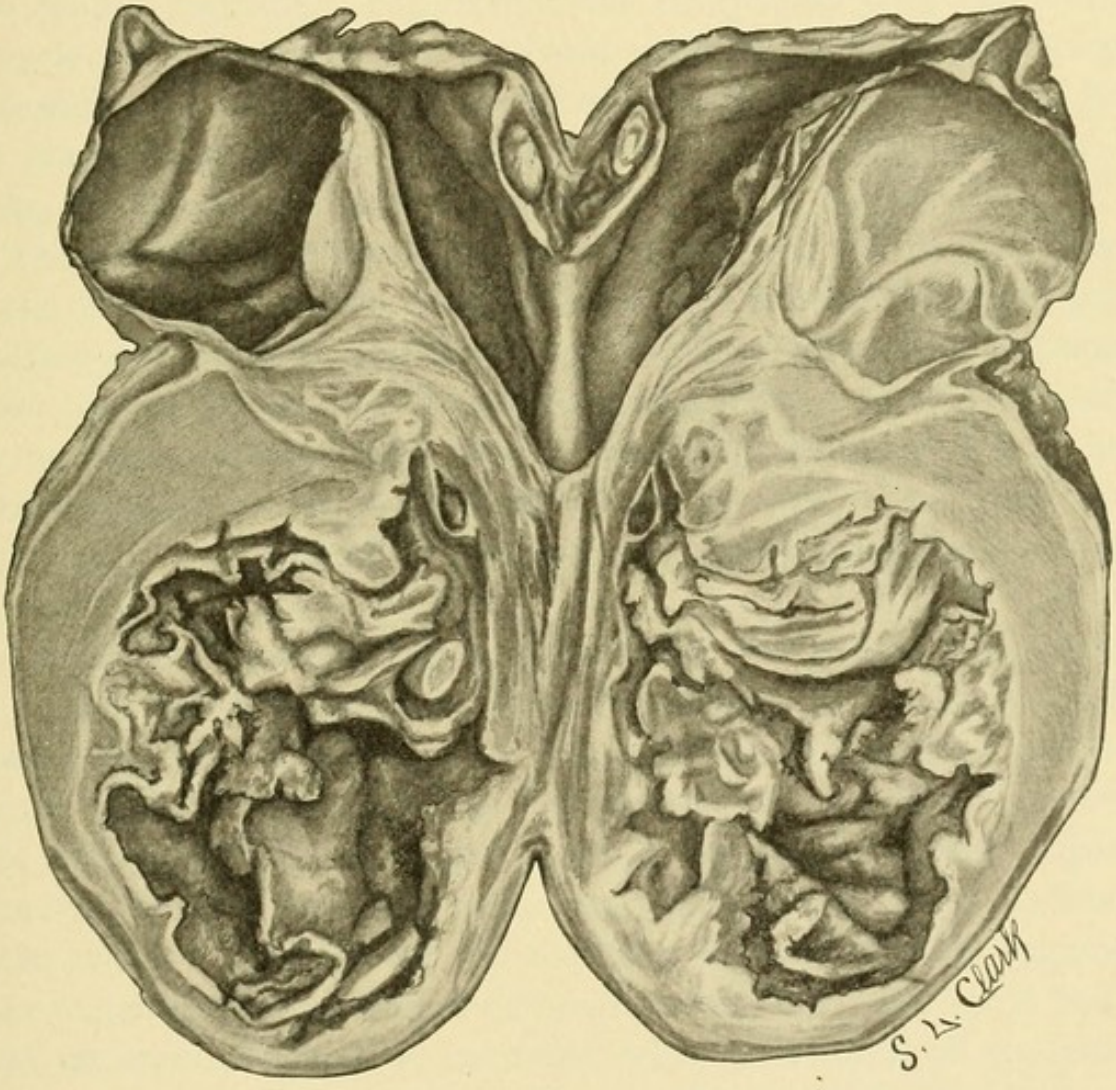
In regard to the objective symptoms, it may be stated that in the beginning one or more tubercles can be palpated in the head or tail of the epididymis. If the vas deferens be followed up toward the inguinal canal spindle-shaped swellings, representing tubercles, may perhaps be felt, although in some cases the vas will be entirely free.

The nodules, which gradually become adherent to the surrounding tissues may, as has already been stated, remain unchanged for years, but they may also soften slowly and finally break through the skin, which has gradually become thinner and thinner. In such cases fistulæ develop which show little inclination to heal, but, on the contrary, dissect their way more and more through the tissues, forming indurated tracts from their external orifice to the original site of the tuberculous foci from which they sprung. Very rarely these fistulæ close spontaneously, leaving a cicatricial cord behind; as a rule, however, tuberculous granulations grow out from them and they extend further and further into the neighboring parts.

The general health, as has already been stated, is often not affected, but it must not be forgotten that in many cases the lesion in the testicle is only one of several tuberculous foci which are present in the body. In such cases, of course, the severity of the constitutional manifestations will depend upon the vital importance of the organs affected and the extent of the morbid process in which they are involved.

Differential **diagnosis** between tuberculosis and other diseases of the testicle depends upon the slow course of the former; the presence only in slight degree, or perhaps the entire absence, of pain; the rough tuberculated surface of the gland; the primary involvement of the epididymis; the adherence of the testicle to the skin; the development of persistent fistulæ, and finally the presence of tuberculous foci in other parts of the body. [Pain and swelling of the scrotum may be the first thing to attract the patient's attention. So insidious is the evolution of the disease that it may attain an advanced stage before giving rise to any symptoms, and then, when the testicle becomes

PLATE XVIII.



Advanced Tuberculosis of the Testicle. (Drawing from a specimen in the Phipps Institute.)

adherent to the skin, soreness and pain will develop as the initial manifestations of the long-existing disorder.

In a patient whom I recently operated on acute hydrocele, together with acute, intensely painful inflammatory swelling of the superficial coverings of the testicle, were the first signals of trouble. Examination of the diseased gland, however, showed an advanced chronic tuberculosis; there were both caseated and calcified areas in the testicle and epididymis, and also an eruption of miliary tubercles on the tunica vaginalis. Yet, despite the long duration of the morbid process, no disturbance was produced until the parts became acutely inflamed and distended by the effusion of fluid. Therefore, it is to be remembered that, in exceptional cases, the first symptom may be pain, the first sign, acute inflammation.]

The **prognosis** differs greatly according to whether the epididymis is the only site of disease, whether there are foci present in other parts of the genito-urinary tract, or whether the lesion represents a metastasis from tuberculous areas in remote parts of the body. The prognosis is by no means unfavorable. If the disease is unilateral it may heal spontaneously or be entirely overcome by operation. Associated pulmonary or renal tuberculosis naturally render prognosis much less favorable.

As regards **treatment** it may be stated that the measures to be adopted in dealing with tuberculosis of the organs now under discussion depend upon a variety of circumstances. When there is an associated pulmonary or renal tuberculosis it is evident that treatment will be symptomatic and palliative. In cases in which the general health is good, however, it must not be forgotten that tuberculosis of the testicle is often merely a local disease, and that after it is overcome the organism may remain free from further tuberculous infection. So, too, if unilateral nephrotuberculosis be coexistent with tuberculosis of the testicle on the corresponding side, it may be possible to effect a complete cure by removing both the diseased organs. In cases where the disease is unilateral the chances of complete recovery are increased if no delay is tolerated in effecting the removal of the tuberculous organs, namely, the testicle, epididymis and greater part of the vas deferens. When both testicles are diseased the question becomes more difficult, for double castration is often followed by severe psychic disturbances. In these cases I have decided upon castration only when the disease was making rapid progress.

In other cases it seemed right to me to follow a conservative plan, that is, to order roborant general treatment, and if fistulæ were present to lay them open, curette them, cauterize individual foci, and treat the wound with iodoform. This plan is the more justifiable as cases no doubt do occur in which tuberculosis of the testicle and epididymis heal spontaneously. The cure may follow sloughing of the affected parts, calcification, or fibrous change.

Resection of the epididymis with preservation of the testicle, as proposed by Bardeleben, does not seem rational, because there is no means by which it can be determined whether tuberculous foci which cannot be palpated and recognized are not present in the parenchyma of the testicle.

[THE OPERATION OF CASTRATION.]

This operation varies according to the lesion for which it is performed. For the removal of tuberculous, gangrenous, or injured testicles an incision is begun at the external abdominal ring and carried downwards through the skin and subcutaneous tissues of the scrotum for a distance sufficient to make an opening which will readily permit the passage of the testicle. (Fig. 202.) The length of this incision will vary in different cases.

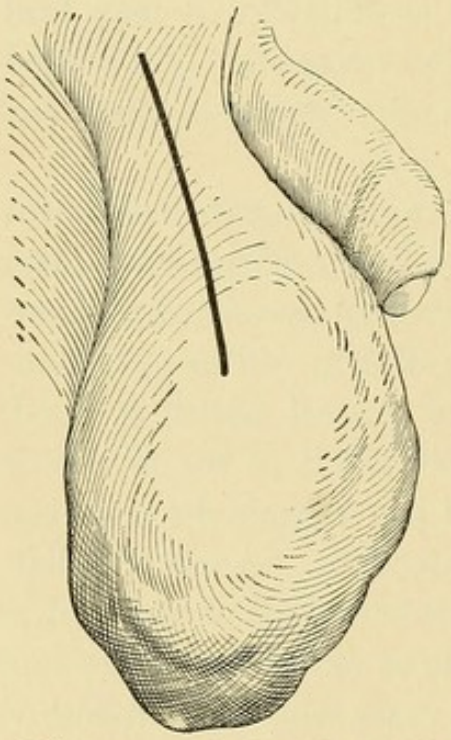


Fig. 202.—The incision in the operation of castration. (Veau.)

When fistulæ are present the incision should be so shaped as to include them in a portion of the skin which is to be removed with the testicle.

All bleeding points are caught with hæmostatic forceps, the testicle freed by blunt dissection, the cord likewise liberated, and the whole mass drawn out of the scrotum. The cord is now ligated in two portions with strong chromic catgut and divided below the ligature. (Fig. 203.) I use an aneurysm needle for separating the constituent structures of the cord, passing it through, then threading it and drawing it back. When operating for tuberculosis the cord should be ligated as high up as possible. Some surgeons crush the cord with strong forceps or the angiotribe before ligating it. A strong ligature,

firmly tied, has never failed me, so I do not practise the latter procedure.

Before closing the wound bleeding must be carefully arrested. The cavity within the scrotum should be irrigated with hot normal salt-solution, sponged dry with sterilized gauze, and any bleeding points caught with hæmostatic forceps and twisted or tied. It is essential to prevent the formation of a hæmatoma. The cavity should be drained for twenty-four hours with a small tube, or a few strands of silkworm gut inserted through the lower angle of the incision.

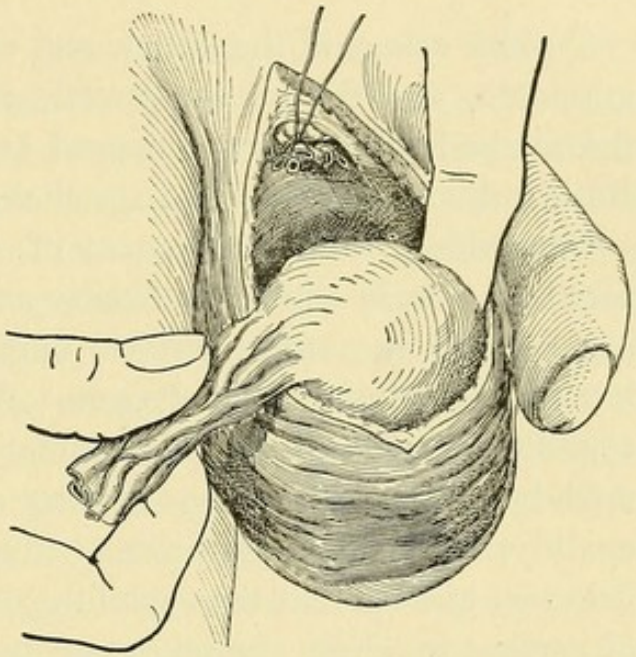


Fig. 203.—The cord has been ligated in two portions and divided below the ligature. The stump is seen at the upper angle of the wound. (Veau.)

In operating for **malignant tumors** of the testicle, particularly **carcinoma,** a more extensive procedure is absolutely necessary.

It will be remembered that the lymphatic vessels of the testicle accompany the spermatic cord as far as the lumbar region and then diverge to pursue their course to the juxta-aortic glands, into which they empty. Although it is impossible to reach them at their termination, every portion of them which is accessible should be removed. This is the only rational surgical procedure.

Following the method of Cumston and Rolfe, an incision is made parallel to, and about one-half or three-quarters of an inch above, Poupart's ligament, the inguinal canal laid open, the cord freed and lifted out. The iliac fossa is then entered by an opening made through the posterior wall of the canal. The vas is followed downward into the pelvis as far as possible, tied, cut, and the stump touched with pure carbolic acid. The spermatic vessels are then traced upward as far as possible, ligated in two places and divided between the ligatures. The cord is separated from its coverings from above downward to a point below the external ring. The testicle, if not too much enlarged, may be pressed upward and forced out through the opening above Poupart's ligament, where it is removed together with the cord.

If the growth be very large it will be necessary to make a longitudinal incision down the scrotum in order to remove it.

Whenever a malignant tumor is adherent to the scrotum the skin must be freely excised, and the inguinal glands also dissected out, as the lymphatics of the scrotum empty into them.

SYPHILIS OF THE TESTICLE AND EPIDIDYMIS.

Syphilis occurs in the testicle and epididymis in two different forms: gummata, and diffuse overgrowth of the connective tissue in which the seminal tubules are destroyed and extensive indurations formed. Both forms may be present simultaneously.

Concerning the development of this affection I shall ignore the rare instances in which the testicle and epididymis are involved at the outbreak of lues and consider only those in which it occurs as a late manifestation of the infection. As is often the case with localized syphilitic lesions, injury or inflammation, as for example, a gonorrhœal epididymitis, may act as exciting causes. Although orchitis and epididymitis are among the most frequent localized syphilitic lesions, it is well-known that the syphilitic virus may be present in the semen of persons in whose genital organs no signs of lues can be found.

The clinical picture of syphilitic orchitis is not very distinctly delineated. The disease develops insidiously, the testicle gradually becoming larger, but yet not attaining an excessive size. An important point of differential diagnosis is that, in contradistinction to tuberculosis, in syphilis the testicle is almost always affected before the epididymis, and that the vas deferens, as a rule, remains uninvolved. The swelling may be diffuse, or hard nodules of varying size may be detected; the former condition is the more common. The testicle is firm and elastic, and apparently fluctuates, so that the condition is not uncommonly confounded with hydrocele. In isolated cases the diffuse swelling may gradually subside and a small indurated testicle remain. When, as more frequently happens, owing to mistaken diagnosis, antisyphilitic treatment is not given, the nodules soften and perforate through the skin of the scrotum, thus forming ulcers. The testicle may prolapse, but the opening is generally diminished in size by the proliferation of granulation tissue which forms the so-called fungus syphiliticus. The disease is painless; sensitiveness is neither present nor can it be elicited by pressure.

Other manifestations of syphilis may be found, their nature depending upon the stage of the disease during which they occur. As little as the disease annoys the patient or affects the general health its results may nevertheless be most serious. When bilateral it may produce sterility. This does not usually happen, however, unless the diagnosis has been made very late and treatment delayed until destruction of the glands has become most extensive. As a rule, some functionally active tissue will remain.

In regard to diagnosis, which cannot always be easily made, the following points are to be observed: the history of the case; other signs of recent or tardy syphilis; gradual development of the swelling without pain; involvement of the testicle first; non-involvement of the vas deferens in contradistinction to its participation in tuberculosis; freedom of the lymph-glands in contradistinction to their implication in malignant growths. In cases in which diagnosis remains obscure despite the consideration of these data, the therapeutic test may be applied. A course of mercury followed by large doses of potassium iodide, will, if benefit follows its employment, enable one to conclude that the tumor in question was of syphilitic origin.

Prognosis as to life is good; prognosis as to recovery is also favorable provided that treatment be not too long delayed. It is only when the lesion is congenital that complete destruction of the testicle is wont to take place.

Treatment consists primarily in the energetic employment of mercury or potassium iodide, or of both. In recent cases mercury is the drug of preference, in the older ones potassium iodide. Mercurial plaster should also be applied to the testicle. As in constitutional syphilis these measures may be supplemented by bathing cures.

If perforation has taken place the resulting ulcer should be treated in accordance with the established principles of surgery, and an energetic antisyphilitic treatment instituted. Local applications of sublimate solution 1:3000, the dressing being renewed every two hours, act excellently. Under this treatment the necrotic portion of the testicle will usually slough away, the wound become healthy and healing take place, so that the greater part of the gland will be preserved. It is only in exceptional cases, where extensive destruction of the parenchyma of the testicle is rapidly taking place despite energetic treatment, that the surgeon will be compelled to perform castration.

It is not unusual to see recurrences of the disease after healing has

once taken place; they are to be treated in exactly the same way as was the previous manifestation of the disease.

ORCHITIS.

Acute inflammation of the testicle is exceedingly less common than inflammation of the epididymis. Both are produced by the same causes; sometimes it is an injury, sometimes extension of an infective process from neighboring parts, as for instance gonorrhœa, prostatic disease, or vesical catarrh, which gives rise to the inflammation. Orchitis of urethral origin may be accompanied by inflammation of the epididymis and vas deferens, but these structures may also escape, the inflammatory process being confined entirely to the testicle.

Rarely both forms may be of metastatic origin. In mumps acute orchitis may occur, and it is noteworthy that the complication may ensue after the inflammation of the parotid has subsided, and that the disease may affect the testicle first. Kocher found the typhoid bacillus in the testicle in a case of orchitis which occurred as a complication of typhoid fever. Finally there remain to be mentioned orchitis of rheumatic and malarial origin, the latter of which reacts to quinine.

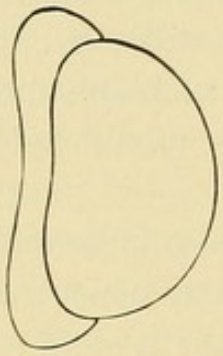


Fig. 204.—Orchitis. Testicle swollen, epididymis lengthened.

The symptoms consist of pain, tenderness upon pressure, enlargement of the testicle, and constitutional disturbance.

Pain may be severe. It is characterized by the fact that it persists while the patient remains in the dorsal position, and that it either may be confined to the testicle alone or radiate to the loins and back. These pains in the back are to be considered either as reflex neuralgia or as peripheral neuritis.

Upon palpation the testicle is found to be swollen and very sensitive to pressure. The epididymis lies behind the testicle and is lengthened by the swelling of the former, so that it feels like a thick cylindrical tumor. (Fig. 204.) The testicle may swell very rapidly, sometimes becoming as large as a goose's egg within twenty-four hours.

The general health is considerably disturbed; fever is present and the evening temperature may rise as high as 40° C. [104° F.]. The metastatic forms are the mildest. [In Sumatra, Martin observed an intense fulminating inflammation of the testicle occurring as a complication of malaria.] The majority of cases due to traumatism also

pursue a favorable course. Those due to urethral disease are of longer duration, owing, no doubt, to the fact that the urethral trouble often persists.

Orchitis is to be differentiated from epididymitis and hydrocele. Palpation furnishes a sure means of distinguishing it from the former, and, as a rule, will also serve to separate it from hydrocele. If doubt exists, it should be remembered that hydrocele is usually transparent, that the epididymis retains its normal form in hydrocele, but is lengthened in orchitis. Fluctuation is a sign of little worth, because in orchitis the swollen testicle may apparently fluctuate.

The intense swelling is due to serous infiltration and intense hyperæmia of the substance of the testicle. If the process advances further, the testicular tissue is seen to be of a yellow color when the gland is sectioned. Along the septa and albuginea, and in the substance of the gland as well, small circumscribed areas of suppuration are found which later coalesce. The albuginea is thickened, the septa are broadened. Under the microscope the connective-tissue stroma is seen to be infiltrated with small cells. Wall and seminiferous tubule and interstitial connective tissue are all infiltrated with leucocytes.

In regard to the course and termination of the disease, it may be stated that, as a rule, it lasts from two to three weeks.

After the swelling has reached its height and the pain consequently attained its maximum intensity, the fever begins to subside and the temperature soon reaches its normal level. The further course of the disease is unattended by material disturbance of the organism. In the majority of cases complete *restitutio ad integrum* results; nodular infiltrates do not remain behind as in epididymitis.

A somewhat less favorable termination is in atrophy of the testicle, which is caused by the excessive overgrowth of interstitial connective tissue. The most unfavorable ending of all is suppuration, which may either extend toward the periphery and rupture externally, or lead to gangrene before rupture occurs. The greatest danger, however, is extension of the suppurative process to the spermatic cord, with resulting peritonitis and pyæmia. Fortunately this occurrence is exceedingly rare.

Treatment consists in absolute rest, elevation of the testicle, applications of an ice-cold 2 per cent solution of acetate of aluminum, together with the internal use of antipyrin or salicylic acid.

This antiphlogistic therapy will suffice in the vast majority of cases. It may be necessary, however, to employ narcotics if the pain is very severe.

Although incision of the inflamed testicle causes relaxation of the distended tissues, and thereby lessens pain, it should not be resorted to for the reason that cure almost always follows without its employment, and, furthermore, because there is danger of prolapse and consequent gangrene occurring.

It is quite different when there is reason to believe that suppuration is present and that resorption will not take place. When high fever, chills, pain, and swelling persist beyond the usual time, and fluctuation makes it plain that pus is present, then no delay should be entertained in making a free incision. The danger of prolapse of the seminiferous tubules and consequent gangrene is the only one to be feared, but it is of such moment that incision should be resorted to only when marked indications exist. Small non-confluent foci of suppuration may be present and give rise to the severe symptoms above mentioned. When this is the case incision will afford relief by lessening tension, but it should not be employed for the reason that the suppurating foci may undergo resorption. Therefore, as a prerequisite to operation, pus should be obtained by puncture, unless the symptoms are so violent as to demand surgical intervention even though pus cannot thus be obtained nor fluctuation detected.

Chronic orchitis is a very rare disease, for the two affections in which chronic inflammation of the testicular substance occurs, namely, tuberculosis and syphilis, are considered by themselves as maladies due to specific causes. The term chronic orchitis is therefore reserved for a very few cases in which acute orchitis terminates in a manner different than any of those just described.

Instead of complete resolution, atrophy, or suppuration, chronic inflammation of the parenchyma of the testicle may result. Such an occurrence is so rare, however, that I am inclined to believe it represents exacerbations of latent inflammation which has remained after the subsidence of an acute orchitis.

Treatment consists in the long-continued application of tincture of iodine, or inunctions of iodine vasogen or compound iodine ointment, together with the use of Priessnitz's compresses and the wearing of a suspensory bandage.

EPIDIDYMITIS.

Inflammation of the epididymis is one of the most frequent affections of the genital glands. Although it does not endanger life its results may be of far-reaching consequence to the person who is affected. The disease is characterized by acute swelling of the epididymis. Chronic inflammation is always the result of a previous acute process.

As concerns the causes of the disease it may be stated that injuries, such as kicks, blows, or bruises are occasionally, though rarely, responsible for its development. It may also occur as a metastatic process in the course of infectious diseases, such as variola and pyæmia, for instance.

These are of minor importance, however, in comparison with its most frequent cause, namely, **urethral infection,** be it due to gonorrhœa, stricture, catheterism or litholapaxy. When caused by any of these conditions it is evident that the process is infective. In one case it may be the gonococci which give rise to the infection, in another the microörganisms which reach the urethra as the result of catheterism, or others which normally inhabit the urethra, but become virulent owing to the disturbed conditions produced by the mechanical interference incident to catheterization. It may happen that the suppurative inflammatory process extends to the epididymis by way of the ejaculatory ducts and vas deferens, and that it also involves these structures; it may, however, leave the vas unscathed and establish itself in the epididymis; and, finally, the agents of infection may be carried to the epididymis by the lymphatics.

Epididymitis is such a common complication of gonorrhœa that about 20 per cent of all men affected with the latter disease are attacked by it. Although it may occur in any stage of the disease, it is uncommon before the second week; from this period, however, there is no limitation to its incidence. I have seen cases of chronic urethritis which had existed for years, and in which no gonococci had been demonstrable for years, become exacerbated and suddenly give rise to an epididymitis. Strictly speaking it is not the gonococcus which leads to the development of the complication in this class of cases, but a post-gonorrhœal urethritis.

Symptoms and Course. The onset of the disease is announced by slight pain, or a dragging sensation extending from the region of the testicle to the groin. This pain gradually becomes more intense and extends to the region of the loins and pelvis. Very soon it becomes

exceedingly severe in the testicle, so that the patient can scarcely move without experiencing the most intense agony; he seeks instinctively to support the scrotum.

In view of the extreme painfulness of the testicle and epididymis it is not surprising that the general health becomes considerably affected. The patient is feverish, although the temperature may not be high, feels weak, and often experiences a sense of fainting; indeed, it is commonly stated that diseases of the testicle predispose to attacks of syncope. The health is also disturbed in other ways, anorexia being present and the patient looking pale and generally miserable.

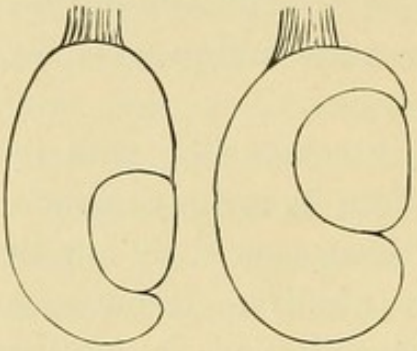


Fig. 205.—Epididymitis. The testicle is imbedded in the epididymis.

Upon palpation it is at once noticed that the epididymis is considerably enlarged. The testicle appears to be imbedded in the epididymis, whereas in health the epididymis lies upon the testicle (Fig. 205). At first either the head or tail may be affected, but in a short time, generally in the course of a few days, the entire organ becomes very much swollen, so that the testicle forms the smallest part of the scrotum. The skin over the swelling is usually somewhat œdematous and may also be reddened.

Pressure upon the inflamed epididymis, or even attempt to palpate it, gives rise to violent pain, which may cause the patient to swoon. For this reason examination should be made with the patient in the horizontal position. Palpation will also disclose the fact that the epididymis is much harder than normal; it feels hard, uneven and rough.

If the scrotum be lifted up, the patient experiences a sense of relief; the severe tugging pain extending well up toward the back is usually considerably diminished. This pain is probably produced by the increased weight of the inflamed epididymis. The connective-tissue bands between the seminiferous tubules, the connective tissue of the tunica albuginea, and the fasciculus of fibers which fasten the vas deferens to the epididymis are all affected with serous infiltration, and it is owing to this condition that the size and weight of the organ become increased, with the result that painful traction is exerted upon the spermatic cord, which is also usually inflamed.

In the cord, muscle, connective tissue, and especially the vessels, are all inflamed and swollen, so that it is as thick as one's finger, and can easily be followed up to the external abdominal ring.

Owing to the narrowness of the ring pressure is exerted upon the swollen plexus of the cord, and this, in conjunction with the traction, gives rise to peritoneal irritation and causes an inclination to vomit.

The pain in the loins, as has already been stated, may be explained by assuming that it is caused by traction upon the cord. It seems not improbable, however, that von Leyden is right in assuming it to be due to peripheral inflammation which extends along the nerves to the spermatic and renal plexuses. This view is corroborated by the circumstance, that in many cases the lumbar pain is not relieved by elevation of the scrotum and the consequent reduction of traction upon the cord, although the pain in the epididymis ceases.

The duration of the disease may be stated to be from ten to twelve days. At about the tenth day it is at its height, pain and swelling being then most intense; a gradual retrogression of the inflammation then begins, the thickening and induration of the epididymis subsides, so that at the end of two weeks more it has assumed its normal shape, with the exception of presenting small nodules which represent the remains of the previous inflammation. As resolution takes place pain and fever disappear, and by the third week, as a rule, the general health ceases to be disturbed.

This, the most frequent termination, is seldom reached without the incurrence of structural changes which may be most deleterious to the patient. In the vast majority of cases the thickening of the epididymis which remains is sufficient to lessen or even occlude the lumen of the vas deferens, so that the spermatozoa cannot pass through it, or if they do succeed in getting through, they have their vitality much impaired. If the affection has been bilateral complete **sterility** will usually result. **I can state that the majority of childless marriages in which the husband is at fault are dependent upon a double epididymitis.**

The nodular indurations which remain may also become acutely inflamed and thus give rise to relapses. Almost never is complete *restitutio ad integrum* obtained so that the disease disappears without leaving any nodules behind.

Among other complications acute hydrocele and involvement of the testicle may be mentioned. The former is not very rare; the latter, fortunately, is less frequently met with. The serous exudation into the cavity of the tunica vaginalis usually persists after the epididymitis subsides; as a rule, it does not undergo resorption. The inflammation

of the testicle, however, subsides simultaneously with that of the epididymis.

A more important matter is, that in feeble persons and those having hereditary predisposition, **tuberculosis** may be superimposed upon the original simple epididymitis. Therefore special precautions must be taken when such persons are affected.

In regard to the pathological anatomy, we find, according to Malassez and Terillon, that during the height of the process, the epithelium of the seminiferous tubules is swollen and deprived of its cilia, and that their walls are œdematous and infiltrated with small cells. As the morbid process advances swelling and small-cell infiltration of the connective tissue which surrounds and fastens the tubules together occurs, and the tubules themselves are filled with greenish yellow fluid consisting of an intermixture of pus and semen.

The nodules remaining after epididymitis consist of hard, cicatricial, contracting masses of connective-tissue infiltrate which surround the seminiferous tubules.

Treatment. The treatment of epididymitis is satisfactory. The aim of treatment should be to secure complete cure if possible, or at least obtain entire resolution except for the nodular infiltrate previously mentioned, and, above all things, to prevent termination in suppuration or tuberculosis.

Not enough attention has been paid to the supervention of tuberculosis in this disease; it is a matter, however, which requires the greatest precautions. In view of its likelihood all methods which interfere with the nutrition of the testicle and epididymis should be prohibited. For this reason I have completely rejected the Fricke dressing, which was formerly so much in vogue.

A patient with acute epididymitis should be put to bed, especially as he usually has slight elevation of temperature. The testicle should be elevated and an application of a 2 per cent solution of aluminum acetate, cooled with ice, kept on four hours every day, two hours in the forenoon and two hours in the afternoon. Ice should not be applied directly to the testicle because it might cause gangrene.

In weakly persons this antiphlogistic treatment should be continued until the swelling has completely subsided. The diet should be light and the bowels kept regular. Twice a day 0.75 [10 grains] of salicylic acid may be given, or small doses of antipyrin may be used instead, 1.0 [15 grains] being taken during twenty-four hours. Both of these

drugs exert a favorable effect upon the patient's constitutional condition. At night the testicles should be elevated by means of a bandage.

In other cases, especially in strong, robust persons, treatment by compression may be tried. For this purpose a properly fitting suspensory bandage gives the best results. There are many of these bandages on the market, but the Zeissl-Langlebert has proved best in my experience. I have had small hooks and eyes attached to it so that the testicle can be better elevated. [Martin's epididymitis bag, which is made by Lentz and Sons, of Philadelphia, is a very satisfactory American appliance.] Compression is not so useful as suspension, which secures both elevation and rest for the testicle.

After the skin has been lightly annointed with lanolin, the suspensory bandage is lined with soft cotton of good quality and so adjusted as to raise the scrotum slightly toward the abdomen. It is kept on for four or five days and then changed. As the swelling subsides the degree of suspension may be lessened; this is accomplished by adjusting the bandage more loosely and placing less cotton in it.

The results obtained by this method are excellent. Pain soon subsides, and in course of a few days, after the acute inflammation and swelling have abated and the slight fever disappeared, the patient may be allowed to walk around and fulfill the ordinary duties of his vocation. Fricke's adhesive-plaster dressing, as well as Gerson's bandage, are heroic appliances which it is better not to employ; moreover, they are rendered needless by the method of suspension which has just been described.

During an attack of epididymitis local treatment of the urethra must be discontinued. Neither the use of instruments nor the employment of injections is permissible. If the urethral discharge is florid, balsamics and diluent drinks may be given. Not until all inflammation of the epididymis has completely subsided should anti-gonorrhœal treatment be resumed.

The later stages of epididymitis, in which pain and swelling are no longer present, must not be allowed to go untreated, but an attempt be made to secure resolution of the nodules which have remained behind. Applications of iodine-vasogen—which acts better than tincture of iodine—or a lanolin ointment containing 2 per cent of iodine and 10 per cent of potassium iodide should be kept up for months. [I have obtained good results with oleate of mercury.] Warm moist Priessnitz's compresses applied under the suspensory bandage also have a good effect. I have never seen any good effects from the use of

electricity, which has been employed for the purpose of causing absorption of the remaining infiltrate.

DEFERENITIS OR FUNICULITIS.

Inflammation of the vas deferens seldom occurs as an isolated lesion, but is generally associated with gonorrhœal epididymitis or spermatocystitis. The vas can be felt as a hard cord resembling a quill; it can be rolled between the fingers and traced to the swollen epididymis. In this case the inflammation from the urethra extends by continuity into the ejaculatory duct and thence upwards into the vas deferens. In case of traumatic epididymitis complicated with deferenitis the reverse of this process obtains, the inflammation extending downwards from the epididymis into the vas.

It has often been observed that epididymitis may complicate gonorrhœa without the vas deferens being involved. In reality this freedom of the latter structure is, as a rule, merely apparent. A perceptible and palpable swelling does not always occur, but notwithstanding this the vas deferens is nevertheless involved, as is proved by the fact, that in those affections in which no symptoms of deferenitis are manifest objective changes are found in the vas.

Deferenitis requires no special consideration, because it almost always ends with the epididymitis, which with very few exceptions is an entirely benign disease. Swelling and induration subside simultaneously with the pain. It is only when symptoms of peritoneal irritation, such as colic and vomiting, develop that the disease becomes serious. Such symptoms are due to the compression to which the cord is subjected owing to its swollen condition. As the swelling subsides spontaneously we may rest at ease, and not be prevailed upon to operate by the fear that the condition is strangulated hernia, which, as is known, gives rise to similar symptoms.

Only when there is reason to believe that suppuration in the region of the peritoneum will follow, is there any ground for interference. Such an occurrence is to be feared when high fever, chills, and fluctuation of the cord are present, when pus is obtained by puncture, and when the symptoms do not yield to antiphlogistic treatment. Under these circumstances intervention must be practised, because peritonitis may result if the suppuration is allowed to extend. The focus of suppuration must be sought out, and if it is necessary to open the inguinal canal to reveal it, no hesitancy should be felt in so doing.

After the abscess has been emptied and an antiseptic dressing applied, the danger will be overcome.

ACUTE HYDROCELE.

Acute inflammation of the tunica vaginalis propria is generally caused by trauma; less frequently extension of inflammation from the urethra or bladder—usually gonorrhœa—is responsible, and in exceptional cases it is metastatic in origin.

According to the character of the exudate, we distinguish serous, fibrinous or plastic, and purulent acute hydrocele. The first is usually a complication of gonorrhœa; the last often follows injury, as for example, puncture of a hydrocele, but it also may develop in an old hydrocele without any apparent cause.

Owing to the rapid effusion of fluid between the layers of the tunic, swelling of the scrotum rapidly develops, so that a transparent fluctuating tumor is formed; considerable constitutional disturbance, such as fever, depression and pain, is present. The testicle lies behind the tumor. In the very rare fibrinous form, in which flakes and granules of fibrin are precipitated, crepitation can be plainly felt. The purulent form is characterized by severe pain, absence of translucency, and severe constitutional symptoms.

All these forms are benign. The serous form subsides in one or two weeks, the exudate being absorbed. Occasionally it becomes chronic. The fibrinous form leads to agglutination and adhesion of the two layers within a short time. The termination of the purulent form is less favorable. The tunica vaginalis almost always becomes adherent to the superficial layers of the scrotum, which become inflamed and suppurate, with the result tat the pus breaks through the skin.

The treatment of the first two forms consists in rest, elevation of the penis, cool applications, and, as soon as the most acute symptoms have passed, the employment of slight compression. Great care must be taken, however, in using compression. Fricke's plaster dressing is to be avoided for the reason that it may produce excoriation and eczema, and perhaps even gangrene of the scrotum. Pressure is best made by means of good soft cotton placed in a large suspensory bandage. For this purpose the well-known Zeissl-Langlebert suspensory, to which I have added hooks and eyes, is very satisfactory. Before it is applied the skin of the entire scrotum is greased with lanolin cream.

Puncture is seldom necessary in the serous form; the above mentioned measures are nearly always successful. If the exudate is not entirely absorbed then the hydrocele may be punctured and from 1 to 3 cm. [15 to 45 minims] of a mixture of equal parts of carbolic acid and glycerine injected. In the purulent form incision is to be preferred to puncture.

If any of the above named causes result in an effusion of fluid

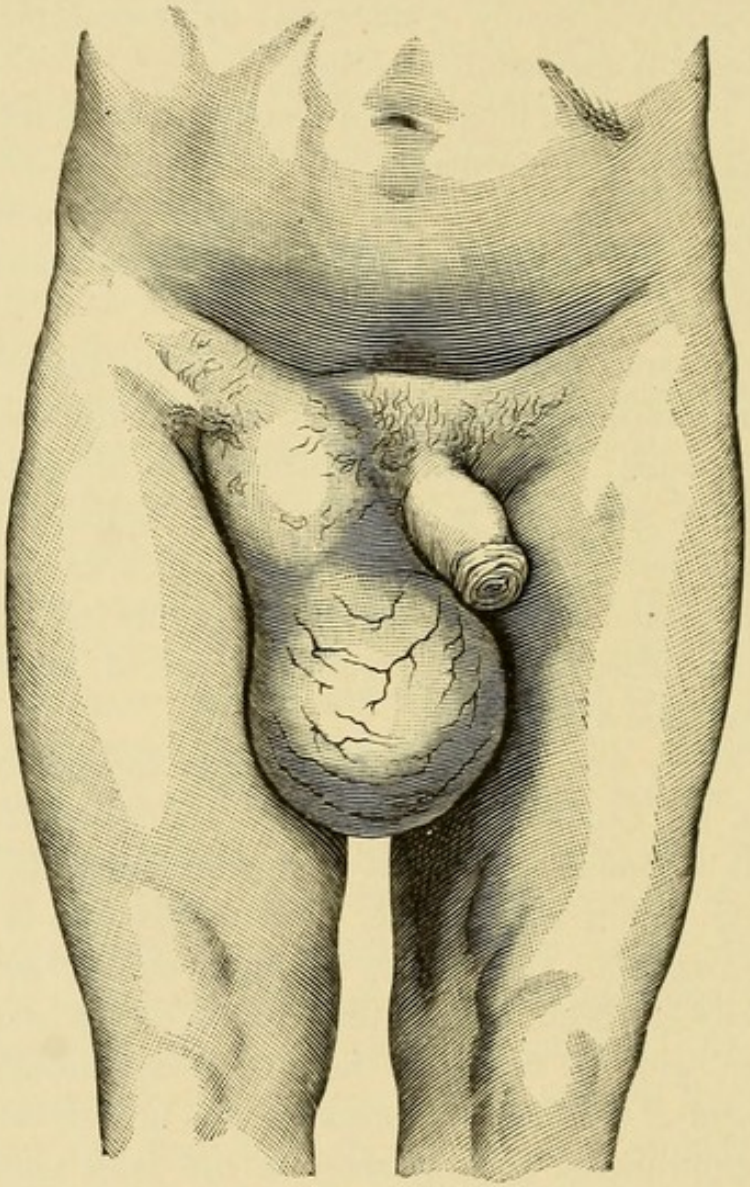


Fig. 206.—Hydrocele.

along the vas deferens, the condition is known as acute hydrocele of the cord. It is very rare, and when it does occur is usually due to acute inflammation of an already existing hydrocele of the cord. The exudate may be serous, fibrinous, or purulent.

CHRONIC HYDROCELE.

Hydrocele, also called periorchitis and vaginalitis, is the most frequent affection of the scrotum. It is a collection of fluid in the

cavity of the tunica vaginalis propria. As a cause we have already recognized the transition of acute into chronic hydrocele; we know, furthermore, that various injuries of the testicle are followed by a gradual outpouring of fluid into the tunica vaginalis; next to these causes gonorrhœa is the most common cause, a gonorrhœal epididymitis representing the connecting link between the two diseases. Other diseases of the testicle, for example, syphilis and new growths, act as predisposing causes, and, finally, it must be stated that there are cases in which no cause can be determined.

Hydrocele is characterized by its pear-shaped form. The stem of the pear lies at the inguinal ring and its body is directed downwards (Fig. 206). The tumor generally ends abruptly at the inguinal ring, only exceptionally entering the canal.

In size it may be as large as a man's head, and reach below the knee. It is said that as much as twenty liters [5 gallons] of fluid have been obtained from one hydrocele.

As the tumor is composed of fluid it is relatively lighter than solid tumors of the same size. The position of the testicle is determined by the collection of fluid. If it were not previously adherent to surrounding parts, it will lie in the lower and posterior portion of the scrotum (Fig. 207), the tunic rising above owing to its distention by the fluids.

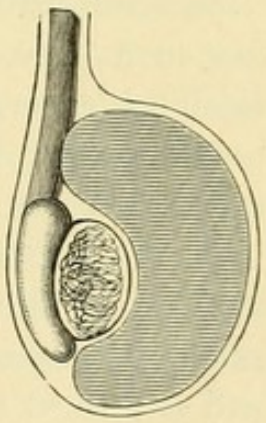


Fig. 207.—The testicle lies below and behind.

Other important characteristics of the tumor are its fluctuation and translucency. Fluctuation, however, may be indistinct if the tunic is filled very full or its walls thickened. At first the serous wall of the tunic is not changed, but in old hydroceles it becomes thickened and indurated, resembling a rind, and may be partly calcified or ossified.

The translucency is due to the fact that the contents of the tumor is ordinary serum, such as is found in ascites and hydrothorax. In this serum shining crystalline plates of cholesterin may usually be found; they contain a high percentage of albumen. Owing to discoloration of this fluid, as well as to thickening of the walls of the hydrocele, translucency may entirely disappear, a fact which it is important to know as regards diagnosis.

Discoloration of hydrocele fluid is often observed in cases of long standing. It then becomes dark yellow or brown, and loses its limpid-

ity. This change is particularly favored by repeated puncture of the sac, which allows the coloring matter of the blood to mix with the serum. Other non-translucent collections of fluid in the tunica vaginalis, namely, spermatocele and hæmatocele, will be considered later.

A process in which both discoloration of the serous fluid and changes in the wall of the sac occur, has been described under the name of fibrinous hydrocele. As the result of a peculiar inflammatory process a fibrinous exudation takes place, some of the fibrin being deposited upon the internal walls of the hydrocele and some being taken up by the fluid. When the connection between the wall and the fibrinous deposit becomes thinner, owing to shrinkage and contraction, a pedunculated tumor is gradually formed. The peduncle may become separated from the wall and thickening of the latter occur, so that upon palpation it may seem as though a solid tumor were present, but crepitation of the detached mass of fibrin will lead to a correct differential diagnosis.

As a rule, hydrocele does not produce any symptoms other than those due to its size. Thus it happens that as long as the tumor remains small it is generally not noticed by the patient, attention being attracted to it only when it becomes large and heavy enough to cause traction on the cord and so produce discomfort.

As the tumor grows the difficulty increases. The sac encroaches upon surrounding tissues, the space for the other testicle becomes too small, the skin of the penis is trespassed upon, so that the organ shrivels and is pushed to one side, with the result that cohabitation is often rendered impossible. During micturition wetting of the skin is unavoidable, and frequently gives rise to very troublesome eczema.

Other ill effects are gradual atrophy of the testicle owing to pressure of the fluid upon it, and the development of hernia. The latter occurrence is explained by the traction which the hydrocele exerts upon the peritoneum, with which the tunica vaginalis is adherent.

In regard to the course of hydrocele, it may be stated that the tumor seldom remains of the same size, but generally becomes larger and larger, attaining dimensions which cause it to become unendurable. In many cases, however, its progress is interrupted by periods of quiescence. Unless the greatly distended sac bursts, an occurrence which has been observed only a few times, the patient is forced to seek relief from the surgeon.

Occasionally, instead of being pear-shaped, a hydrocele may resemble an hour-glass, being constricted at the inguinal canal. Two sacs are then present, communicating with one another through a fine opening; both may be in the scrotum, or one may be in the scrotum and one in the abdomen. When the latter condition obtains we have a bilocular hydrocele. The fluid can be pressed out of one sac into the other. Both sacs are translucent. Less frequently there are several divisions of the tumor, constituting a multilocular hydrocele. Hydrocele may also be associated with cystoma of the testicle.

The most important complication is **hernia.** Serous effusion into a hernial sac may occur as well as hernia in association with true hydrocele (König). If the hernia reaches far down it usually lies behind the hydrocele.

In regard to **diagnosis,** it may be stated that while some cases are very easy to recognize others may be most difficult. Great care must be given to differentiating between hydrocele and scrotal hernia, a correct diagnosis being of the utmost importance.

If tympany be elicited upon percussion of the tumor, hydrocele is out of the question. Epiplocele as well as enterocele which does not contain gas may, however, emit a dull note. Palpation of a hydrocele reveals it to be a fluctuating tumor having a smooth regular surface, such as is never presented by a scrotal hernia. Hydrocele is usually translucent, hernia never. Cough has no effect upon the size of a hydrocele; when the patient is in the horizontal position its size is not altered; pressure is not painful, and the tumor cannot be reduced.

Between the highest part of a hydrocele and the inguinal ring is a space into which the finger can be inserted and its tip carried into the inguinal ring, where nothing but the cord will be felt; no protrusion will occur when the patient coughs. There are exceptional cases, as has already been stated, in which the hydrocele extends into the inguinal canal, but, as a rule, this is not the case; moreover, hydrocele, in contradistinction to hernia, develops from below upwards.

Hydrocele differs from tumors of the testicle and epididymis in that it has a fairly regular pyriform shape, whereas tumors form an irregular mass in the scrotum. With the exception of cysts tumors are also not transparent, nor are they so tense as hydrocele; moreover, they are sensitive to pressure, while hydrocele , as is well-known, may be pressed upon without any pain being caused.

The last characteristic is a valuable diagnostic point in distinguishing hydrocele from inflammatory diseases of the testicle and epididymis.

The consideration of all these circumstances will in most cases lead to the determination of a correct diagnosis. As a last resort puncture with a fine needle is permissible, and may be considered safe.

As concerns **treatment,** it is first of all important to understand that hydrocele will not undergo spontaneous cure, but, on the contrary, will be almost certain to become larger. It is only when the hydrocele remains unchanged in size—which is rare—and is not large enough to annoy the patient, that it may be allowed to remain untreated.

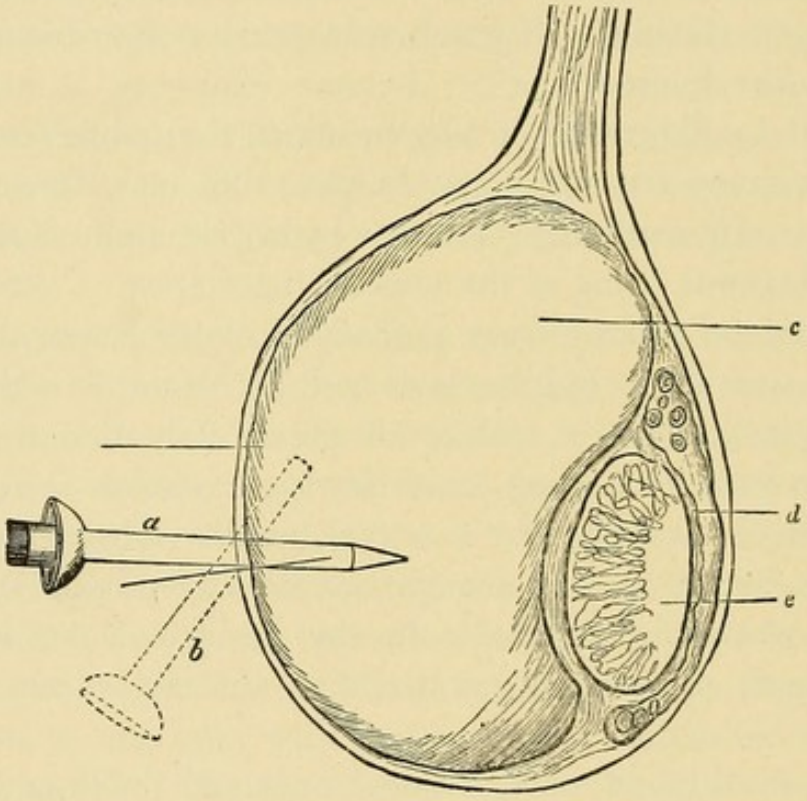


Fig. 208.—Tapping a hydrocele according to Kocher's method. *a*. Direction of the trocar when the puncture is made. *b*. Direction when the fluid is withdrawn. *c*. Hydrocele. *d*. Epididymis. *e*. Testis. (König.)

Internal medication and local applications of liniments and ointments are without result; therefore they may be dismissed from consideration without further mention. Treatment must be entirely surgical.

The simplest way is to tap the sac with a fine trocar. After being carefully disinfected, the scrotum is so held in the left hand that its posterior surface, together with the testicle, lies in the hollow of the palm.

The trocar is then plunged in perpendicularly to the long axis of the scrotum. This manner of making the puncture is important, for

if it be practised otherwise the needle may be carried between the tissues of the scrotum. After withdrawal of the stilet the canula is lowered (Fig. 208) and the serum begins to flow out. Tapping can be performed repeatedly without any damage. I have punctured a hydrocele twenty times for a patient who was unwilling to have a radical operation performed, tapping it once or twice every year.

From what has already been stated it will be understood that tapping is solely a palliative measure, and that the tunica vaginalis will slowly fill up again after its contents have been withdrawn. It is only in children—and exceptionally in adults—that the irritation of the puncture results in sufficient inflammation to cause adhesion of the layers of the tunica and thus obliterate the cavity so that the hydrocele cannot recur.

A procedure which may be combined with tapping is the injection of irritating substances through the canula after the fluid has been withdrawn. Among those which have been employed are alcohol, chloroform, ether, and tincture of iodine; recently a mixture of equal parts of glycerine and concentrated carbolic acid has been more commonly used than these other substances.

The procedure is very simple and in many cases results in cure, but it is not absolutely certain nor entirely without danger. A day or two after the injection the inflammatory process begins to manifest itself.

The patient complains of more or less pain in the testicle, and the tissues around the gland begin to swell; elevation of temperature is not uncommon. All these phenomena, however, usually subside within a few days, and within a week or two recovery is complete.

There may, however, be a different termination. Severe suppurative inflammation with liberation of the pus externally may occur, or the suppuration may invade the testicle. I have also seen recurrence of the hydrocele follow this method.

Therefore I favor the radical operation by means of open incision, and of the various methods, I prefer that of Volkmann. Skin and hydrocele-sac are incised, the tunica vaginalis sewed to the skin on each side with catgut, and then the edges of the wound, with the exception of a small cleft which is left open at the lower angle, are closed with a few interrupted silk ligatures, care being taken to bring the serous surfaces of the hydrocele walls into close apposition. When the tissues are cut through all hæmorrhage must be arrested, because otherwise a hæmatoma may form which may suppurate and retard

healing. This is the only danger of the operation. I never saw any accident happen except this one.

Cure is effected by adhesion of the two layers of the tunica vaginalis which are brought closely together. Recurrence is thus practically impossible, although now and then one may happen. In my own experience none have occurred.

Von Bergmann recommended the extirpation of the tunica vaginalis, either in its entirety or up to the cord, with suture of the cut edges over the testicle. I consider this method unnecessary; if the tunica vaginalis is very thick and large it may be well to cut off a piece.

Winkelmann's method [also known as Doyen's and Jaboulay's], in which the tunica vaginalis is incised, turned inside out and the edges united by suture, I have abandoned as being an unnecessary procedure.

GALACTOCELE, HÆMATOCELE AND SPERMATOCELE.

Galactocele differs from hydrocele in that the fluid contained in the cavity of the tunica vaginalis is milky instead of clear and yellow. It is such a rare affection that it merely requires to be mentioned. Vidal saw one case in a soldier who came to him from Africa. The essential feature of this case was the excessively fatty character of the fluid, which, when viewed under the microscope, looked like an emulsion. Accordingly we may consider galactocele as a fatty hydrocele.

In hæmatocele the fluid which is poured out into the tunica vaginalis is sanguinolent.

In regard to the origin of this affection, it is known that a large number of cases result from injury; thus, for example, it not uncommonly happens that hæmatocele follows repeated puncture of a hydrocele. Often, however, the causative injury passes unnoticed. Slight traction upon or bruising of the hydrocele, which may not produce pain, and therefore passes unobserved, causes slight hæmorrhage and inflammation of the tunic. Thickening of its walls and alterations in its blood-vessels may also give rise to bleeding. Thus, hæmatocele may merely represent a metamorphosed hydrocele.

Diagnosis is not difficult. It may be learned from the history of the case, or from a previous observation, that a translucent, fluctuating tumor was present in the scrotum. In the absence of such knowledge information must be obtained in regard to the development of the tumor—whether it was sudden, rapid, or gradual. Slow evolution is by far the most common. The smooth and sometimes tense tumor

lies anterior to the testicle exactly the same as a hydrocele. Translucency, however, is absent. On account of the thickening of the wall fluctuation is seldom demonstrable. Subjective symptoms may be absent, but in some cases dragging pain is present.

The affection is entirely devoid of danger, although the testicle may gradually atrophy. For the latter reason removal of the tumor is indicated.

This can be effected only by operation. Compression by means of a suspensory bandage lined with cotton will seldom accomplish anything, and I do not advise the use of Fricke's plaster dressing. The hæmatocele cannot be entirely emptied by puncturing it. Volkmann's operation for hydrocele is the appropriate measure. Precaution must be taken to empty the sac completely, and to this end the walls of the hydrocele must be most carefully examined.

Spermatocele is to be considered in a somewhat different light than galactocele and hæmatocele. It is a cyst-like tumor of the scrotum containing semen. Its development is to be attributed to the occurrence of any inflammatory process which leads to the partial or total occlusion of the seminiferous tubules, so that any semen which may continue to be secreted is retained, and thus gives rise to distention of the constricted tubules. The tumor is thus a typical retention-cyst.

These spermatoceles generally take origin at the site where the vasa efferentia empty into the epididymis, that is, at the point of union between the testicle and epididymis. The form and growth of the tumor is thus explained by its manner of development. It may be either extravaginal or intravaginal, according as it extends backwards and forwards or grows downwards into the tunica vaginalis. If growth occurs in an upward direction the tunica vaginalis is not disturbed, so that when the spermatocele is incised the former is not injured. If growth occurs downwards and forwards the tunica is carried before it, and in this case must be cut before the wall of the cyst can be reached. The extravaginal form of spermatocele is more common than intravaginal.

The fluid in the sac somewhat resembles soap-suds; it contains albumen and spermatozoa.

It may be impossible to diagnosticate the intravaginal form from hydrocele unless puncture be made; the testicle lies behind as is the case in hydrocele; fluctuation is present; translucency is wanting, but

as it may also be absent in hydrocele when the walls of the sac are thickened, this is a sign of minor value.

Extravaginal spermatocele is very likely to be confused with hydrocele of the cord. It forms a pyriform fluctuating tumor above the testicle, along the course of the cord. It may be distinguished from hydrocele of the cord by the fact, that the apex of the latter tumor is above and the broad base below, whereas in hydrocele the opposite condition obtains. Translucency of the hydrocele, or, if this be absent, puncture of the tumor, will assure diagnosis.

As concerns treatment, tapping followed by the injection of carbolic acid and glycerine in equal parts may be practised, or the cyst may be opened and the edges sutured to the superficial structures as in the radical operation for hydrocele.

HYDROCELE OF THE SPERMATIC CORD, OR CYSTIC HYDROCELE.

Hydrocele of the spermatic cord occurs if a portion of the vaginal process remains patent instead of becoming obliterated and a serous effusion takes place into its cavity. If the vaginal process be closed only above at the internal ring and below at the upper part of the testicle, the tumor will extend along the cord as far as the internal ring; in other cases when the vaginal process is partly obliterated smaller cysts are formed along the course of the cord.

If non-union exists at several places multiple cysts are formed, and the condition is known as multilocular hydrocele of the spermatic cord; if the cyst is divided into two parts it is termed bilocular.

Hydrocele of the cord is characterized by the fact that it forms a pear-shaped tumor the limits of which may be defined at the internal abdominal ring above and the testicle below. It is not reducible, undergoes no alteration when the patient changes position, is not forced out by coughing, sneezing, or vomiting, thus differing in all these respects from hernia, from which it will be readily distinguished.

Fluctuation cannot always be detected, because the sac may be so full that the tumor is tense and distended; its walls may also be too thick for the wave of fluid to be transmitted. For the same reason translucency is less marked than in congenital hydrocele.

Occasionally hydrocele of the cord descends behind the testicle, and in this case may easily be mistaken for an ordinary hydrocele with abnormal position of the testis. These relations are important

in regard to tapping; if the puncture should be made in the ordinary manner from before backwards the testicle would be pierced.

The cause of this affection is, in some cases at least, to be sought for in trauma, which may have been slight and therefore have passed unnoticed. More frequently, however, it is due to a congenital condition in which faulty coalescence of the vaginal process is present and is followed by traumatic or inflammatory effusion.

It causes little trouble, and one or more tappings will suffice to effect a cure. As an auxiliary measure a small quantity of Lugol's solution or the carbolic-glycerine mixture may be injected.

Incidentally we wish to mention the cysts which develop from the pedunculated and sessile hydatids of Morgagni. These small vesicles occasionally undergo cystic dilatation, becoming as large as cherries or perhaps even attaining the size of plums. According to König, these intravaginal cysts occasionally rupture, and being in communication with the tubules of the epididymis the result is an outpouring of semen into the cavity of the tunica vaginalis.

Different from these are the very rare cysts which develop in the connective tissue of the cord. They occur as single or multiple circumscribed cystic dilatations of the lymph vessels of the testicle and epididymis.

VARICOCELE.

Varicocele is a term applied to varicosities of the spermatic cord and testicle. Usually the distention is confined to the veins of the cord; more rarely those of the testicle are involved.

The affection develops in adult life and is essentially dependent upon anatomical conditions. The spermatic vein is formed by the confluence of the different branches of the pampiniform plexus, and ascends directly upwards as far as the second lumbar vertebra, so that when the body is in the upright position the pressure of a moderately high column of blood is brought to bear upon the plexus (Bardeleben).

The greater frequency of varicocele on the left side may be explained by the fact that the left spermatic vein empties into the renal vein at a right angle, whereas the right spermatic vein empties directly into the inferior vena cava at an acute angle. Owing to these conditions there is more resistance to the emptying of the blood from the left spermatic vein than from the right.

The pressure exerted upon the left vein by the distended sigmoid

flexure has also been designated as a causative factor. If, in addition to these conditions, it be remembered that the left testicle generally hangs lower than the right, as a result of which its vessels are longer, and that owing to sexual excitement there is a frequent afflux of blood to the veins of the cord, the origin of the affection will be understood without further explanation.

Symptoms may be entirely wanting or again may be of considerable severity. In the majority of cases I have not seen any great disturbance. The traction exerted upon the testicle is uncomfortable, and upon exertion the discomfort may amount to a dull, dragging pain. Rarely very severe pain may be present. The patient is usually at ease when he is lying down or sitting, the pain coming on after violent exertion or walking.

The disease may remain stationary for years, the patient experiencing no trouble except an occasional uncomfortable dragging sensation. The varicosity, however, does not become any larger. Distention of the vessels varies according as the upright or recumbent posture is assumed; they become filled when the patient stands and empty themselves when he lies down. They can also be filled by rubbing them in a downward direction and emptied by stroking them in an upward direction.

Inspection alone is usually sufficient for a diagnosis and palpation renders it certain in every case. There is diffuse swelling of the affected half of the scrotum and it is lengthened and thickened; the veins are tortuous and dilated, and when rolled between the fingers feel like a mass of earthworms. Periphlebitic areas with thickening of the vessel-walls may also be detected.

The course of the disease is entirely benign and does not endanger life. The condition sometimes requires to be remedied, however, as the pressure to which the testicle is subjected may cause it to atrophy. Interference is indicated particularly when the affection is bilateral. Otherwise it is only exceptional cases, in which unbearable pain annoys the patient, that will demand intervention.

In mild cases treatment consists in removing the traction which the testicle exerts upon the cord by having the patient wear a well-fitting suspensory bandage. In numerous cases of mine this has succeeded in entirely removing all the discomfort which my patients experienced. I do not consider it advisable to employ compression, and, moreover, deem it useless. There is, of course, no objection to padding the

suspensory lightly. The scrotum may also be frequently washed with cool water, which at all events can do no harm.

The bowels should be regulated and the rectum kept free from scybalæ, so that pressure will not be exerted upon the veins.

Cure is to be expected only by a radical operation. Many procedures which were formerly practised, such as galvano-puncture, compression even to the point of gangrene, removal of a portion of the scrotum with the idea that the resulting contraction would shorten the veins, and subcutaneous uncoiling and ligation of single veins have been entirely abandoned. If operation is indicated at all the only thing to be considered is to lay bare the veins and ligate them under the guidance of the eye.

The pampiniform plexus is exposed—and to this end it is better to operate with the patient in the sitting posture so that the veins may be well distended—and the arteries and vas deferens carefully and cautiously separated; the spermatic artery must be handled cautiously for the reason that even the slightest injury to it may result in gangrene of the testicle. The veins thus isolated are tied above and below and the portion between the ligatures cut out. At first reactive inflammation sets in, but it soon subsides. Healing of the wound always follows. I have never seen any complications ensue. As already stated, it is only in exceptional cases that operation is necessary. Usually the wearing of a suspensory bandage will suffice. [In operating for varicocele it is my practice to cover the divided ends of the veins with fascia, using the finest catgut for suturing, and then to bring them into apposition by tying the ligatures together. Varicocele may also be operated upon by making an incision over the external abdominal ring, drawing up the cord and then excising the veins in the usual manner. This method was introduced by Bloodgood.]

DISEASES OF THE SEMINAL VESICLES.

ANATOMY AND PHYSIOLOGY.

The seminal vesicles, which develop from the Wolfian bodies, are two sausage-shaped expansions of the vasa deferentia, placed symmetrically upon the floor of the pelvis. From the vasa deferentia they extend lateralwards and upwards on each side, forming an angle of about 45°. They are about 5 cm. [2 inches] long, 2 cm. [$\frac{4}{5}$ of an inch] wide and 1 cm. [$\frac{2}{5}$ of an inch] thick. They are enclosed in a sort of a capsule made up of strong connective tissue, and have a rough surface.

The seminal vesicles lie with their posterior surface placed against the rectum and their anterior against the bladder. Internally they are in relation with the vasa deferentia and below with the prostate. The peritoneum covers only their upper surface. It passes from the bladder to the upper part of the seminal vesicles, descends between the rectum and bladder and again proceeds upwards from the rectum. That portion of the bladder lying between the seminal vesicles and not covered by peritoneum, sometimes called the *trigonum interdeferentiale*, varies in size: the fuller the bladder the higher the peritoneum will rise, and consequently the greater the free surface will become.

The **secretion of the seminal vesicles** is golden-yellow in color, contains albumen and almost without exception spermatozoa. For a long time no uniformity of opinion has prevailed concerning the nature of this secretion and the function of the seminal vesicles. A few investigators have maintained that the semen is fully elaborated in the testicles and that it is merely stored up in the seminal vesicles, from which it is expelled when ejaculation occurs. Others have held to the opinion that the seminal vesicles are not only receptacles for the semen, but that they also produce a specific secretion, which comes from certain sinus-like depressions in the mucosa, known as glands, although Waldeyer and Kölliker do not consider them to be such.

This latter difference of opinion is not of importance, for, as is well known, the epithelium of the mucous membrane can produce a secretion. The seminal vesicles, then, may be said to elaborate a specific

secretion, which, according to Virchow, is a proteid compound; it is insoluble in water, but dissolves readily in acetic acid and a solution of potassium ferrocyanide; when warm it is liquid, but when cold it becomes gelatinous in consistency. That this secretion is derived from the seminal vesicles is attested by the fact, that it can be separated from the testicular secretion and its differences from the latter proved by chemical analysis.

Adopting the results of Rehfisch's diligent investigations it may be stated that the seminal vesicles produce a specific secretion; that the spermatozoa bear a definite though as yet unknown relation to this secretion; that a sufficiently large quantity of semen for an ejaculation is stored up in them, and that the musculature of their walls plays an important rôle in the production of ejaculation.

The arteries of the seminal vesicles are derived from the middle hæmorrhoidal, internal pudic, deferential, inferior vesical and internal iliac. The veins empty into the internal iliac vein. The lymphatic vessels discharge into the glands of the rectum and those at the inlet of the pelvis.

EXAMINATION OF THE SEMINAL VESICLES AND THEIR SECRETION.

Examination of the seminal vesicles is difficult because of their concealed position. If the surgeon's finger is long and the patient not too fat, rectal examination may reveal the presence of a gut-like, soft, doughy body about the size and length of a finger on either side of the prostate. They diverge upwards and may be distinguished from the prostate by their uneven surface. In numerous cases, however, they cannot be felt under ordinary circumstances, it being necessary to induce anæsthesia before the finger can be carried sufficiently high in the rectum to palpate them.

To obtain their secretion the seminal vesicles must be massaged. This can be done properly only when they can be palpated in their entirety, for if only the lower portion, just above the prostate, can be reached, they are not accustomed to empty themselves.

Their contents may appear at the external meatus or flow back into the bladder. In the latter case the patient is told to urinate and the product is then recovered from the urine; or, if this does not succeed, the bladder may be filled with sterile water and the contents then

withdrawn. The semen will appear in the water as sausage-shaped, translucent masses.

Microscopically many motionless spermatozoa may be perceived in a pellucid filamentous stroma.

If the contents cannot be expressed in this manner, there is nothing to do but anæsthetize the patient and then introduce the finger into the rectum, or better still to use Felecki's metal instrument, which is a pyriform bulb placed at a right angle upon a long handle. With this instrument pressure can be made upon the seminal vesicles without difficulty, so that their contents will be expelled.

Because of the inaccessibility of the seminal vesicles diseases affecting them are rarely diagnosticated. They are subject to malformation, injury, acute and chronic inflammation, tuberculosis, abscess, cysts and hydrocele, concretions, and, finally, sarcoma and carcinoma.

MALFORMATIONS OF THE SEMINAL VESICLES.

Absence of both seminal vesicles is due to an arrest of development. The testicles may also be absent or atrophied; in case they are well developed there are other defects in the urogenital apparatus. Thus, the bladder or prostate may be absent, a kidney may be wanting, the anus be imperforate, exstrophy of the bladder may be present, or the entire sexual apparatus may be absent.

Absence of one seminal vesicle is more common than absence of both. In such cases there are usually other defects in the same side of the genital apparatus, the corresponding testicle, kidney, ureter, or vas deferens being absent. Fusion of both seminal vesicles has also been observed; when this happens the single vesicle lies in the median line.

The most remarkable anomaly of the seminal vesicles is their **union with the ureters.** It is explained by the fact that the ureter and vas deferens, of which the seminal vesicle is a diverticulum, in the beginning of their development empty into an opening in the uro-genital sinus.

INJURIES OF THE SEMINAL VESICLES.

Injuries to the seminal vesicles are inflicted almost exclusively during operations. Formerly it was rectal puncture and lateral lithotomy which brought the surgeon into conflict with them; at present, how-

ever, these operative methods have become antiquated. It is only in the operation for perineal prostatectomy that any question of their injury can arise.

They occupy such a well protected position that they are seldom affected by traumatism. A few remarkable cases, however, have been reported. Velpeau saw one in which the seminal vesicles were injured by a fracture of the ischium, and Demarquay reports an instance in which a rifle-bullet perforated the bladder and seminal vesicle.

ACUTE INFLAMMATION OF THE SEMINAL VESICLES. (ACUTE SPERMATOCYSTITIS.)

Spermatocystitis occurs almost exclusively as a complication of gonorrhœa. The anatomical relation of the seminal vesicles and their ducts with the urethra sufficiently explains its occurrence. Rocher also believes in the existence of a traumatic form, having seen one case develop as the result of a kick in the perineum. Rapin considers sexual abuse to be a cause.

The symptoms of the acute form so closely resemble those of prostatitis that the two diseases can frequently not be distinguished from one another. Confusion occurs the more readily because both affections usually exist together.

The patient complains of a dull though shooting pain in the rectum, which may increase in severity. It radiates toward the perineum and testicles and becomes more intense during micturition and defecation, especially if the feces are hard.

Coitus is also painful, although the desire to copulate may be increased owing to frequent erections. Upon ejaculation the sensation of discomfort is increased to sharp pain. The urine contains pus and sometimes blood. In a case as well-marked as that just described diagnosis is not difficult, and if the clinical picture is at all obscure, palpation through the rectum will clear it up. The probability that an inflammatory infection of the seminal vesicles is present is increased if epididymitis or deferenitis can be discovered.

The course of acute spermatocystitis varies. Frequently complete resolution takes place; more rarely the inflammation advances to suppuration, the pus either perforating neighboring organs, or, what is more favorable, rupturing into the urethra. Fortunately the latter termination is the more common. Peritonitis resulting from rupture

of the abscess has been very rarely observed. Most frequently acute spermatocystitis passes into the chronic stage.

Chronic spermatocystitis is much more difficult to diagnosticate, as the symptoms are not so well pronounced as in the acute form. The history or existence of gonorrhœa or stricture; simultaneous involvement of the prostate (which is more easily recognized); an uncomfortable sensation in the region of the perineum, between the bladder and rectum; increased sensitiveness upon difficult defecation; occasional tenesmus; frequent erections and pollutions; and, finally, the presence of pus in the semen, and the findings upon rectal palpation;—these are the symptoms and signs which will serve to strengthen the diagnosis.

Occasionally colicky pains confined mostly to the lower segment of the rectum occur. They are due to narrowing of the ejaculatory duct caused by the inflammatory process, as a result of which the accumulated semen cannot gain free exit. The colicky pains, then, are similar in origin to those experienced in renal and rectal colic, all being due to occlusion. Finger and others state that they have been able to feel pear-shaped bodies, of the consistency of an air-cushion, on the posterior surface of the bladder above the prostate. I have seldom been able to do this without an anæsthetic.

Chronic spermatocystitis may be cured. It may also persist for a great many years without causing any serious difficulty or interfering in any way with the functional capacity of the individual. Apart from the unpleasant sensations just described, and which are usually experienced only at intervals, neither the general health nor the sexual activity is disturbed. I have fully convinced myself that the semen of men affected with this disease retains its power of procreation.

In regard to the pathological anatomy, hypertrophy of the walls may take place, or atrophy and chondrification may result.

The therapy of the acute form consists in treating the underlying causative affection (gonorrhœa), enjoining rest, regulating the diet, increasing the flow of urine, administering urinary antiseptics such as urotropin, and also laxatives, so that the feces will not become hard and produce new irritation. If abscess can be positively demonstrated it should be opened in order to prevent rupture at an undesirable site. Under complete anæsthesia a speculum may be introduced into the rectum and the vesicle incised. Proper disinfection of the rectum should be secured before the operation and the bowels should

be confined afterwards. The abscess may also be reached by a method practised in operations upon the prostate, namely, by freeing the rectum so that a space is made between it and the bladder, through which the vesicles may be reached.

Treatment of chronic spermatocystitis is not very satisfactory. It is practically the same as that of chronic prostatitis. I recommend massage of the seminal vesicles, which is best performed with Felecki's instrument, at intervals of two or three days, in conjunction with the use of the rectal thermophore on the other days. The latter instrument should be kept in the rectum for half an hour and should be as hot as the patient can endure. In addition, mild laxatives, diuretics and urinary antiseptics may be given, hot sitz-baths employed, the diet regulated, sexual excesses forbidden, and, if possible, the causative gonorrhœa or prostatitis cured.

As many patients become neurasthenic overtreatment must be guarded against; a too protracted course of treatment is particularly undesirable. Suggestive treatment, and perhaps eventually residence in a sanitarium where mild hydrotherapeutic measures can be employed, have an excellent effect.

[Belfield, of Chicago, has obtained good results in these cases by irrigating and draining the seminal vesicle through an opening made into the vas deferens. He exposes the vas by a half-inch incision through the skin and other coverings of the spermatic cord, incises it by a transverse or longitudinal cut, and injects the desired solution with a hypodermatic syringe. The point of the needle used is blunted, so that it may be inserted well into the lumen of the vas without producing injury. At first not more than thirty minims of fluid should be injected, as a larger amount is apt to produce spermatic colic. As the inflammation subsides the quantity of fluid may be gradually increased. The vas deferens may be stitched to the skin with a piece of fine silkworm gut, the suture being passed through each cut edge. By this procedure the opening is maintained and treatment can be applied daily if desired. The operation is done under local anæsthesia. A solution of one of the organic silver salts is generally employed in gonorrhœal infection.]

TUBERCULOSIS OF THE SEMINAL VESICLES.

This is a more common affection than it was formerly thought to be. It almost always occurs in association with tuberculosis of some other

portion of the genito-urinary organs. It is generally combined with tuberculosis of the testicle, epididymis, vas deferens, prostate, bladder, or kidney, or occurs simultaneously with tuberculous affections of other organs, especially the lungs. Primary tuberculosis of the seminal vesicles is very rare, or, more correctly speaking, it is very rarely diagnosticated; many cases of tuberculosis of the prostate or epididymis may have been preceded by a tuberculosis of the seminal vesicle, the existence of which was unknown owing to the difficulty with which diagnosis can be made.

Children are very seldom affected, the disease occurring during the period of active sexual life. Trauma and gonorrhœa constitute the predisposing causes. The frequent congestion of the generative organs induced by sexual excesses may also supply the cause for the development of the disease, if the individual be predisposed to tuberculosis.

In regard to the morbid changes which occur, it is found that the mucous membrane is first covered with tubercles, which gradually penetrate into the deeper structures, coalesce, and thereby become increased in size. As a result of the simultaneous inflammation the walls become infiltrated and thickened, the tubercles undergo caseous changes, and ulcerations develop which may either cause rupture into various surrounding structures or result in cicatricial contraction of the entire organ together with its excretory ducts.

Diagnosis is difficult. The patient may be entirely free from subjective symptoms. There may be merely a sensation of pressure around the anus or a feeling of heaviness in the perineum. At first sexual desire is increased, but with the destruction of the vesicles and the onset of constitutional disturbances depending upon the involvement of other organs it becomes diminished, and the power of copulation may be lost. If the vesicles can be palpated through the rectum, isolated, small, hard nodules may be felt above the prostate, similar to those which are detected in tuberculosis of the latter organ.

Symptoms depending upon tuberculosis of neighboring organs gradually come to the fore. If the prostate and ejaculatory ducts are involved, a yellowish-white discharge takes place from the urethra; this is of great diagnostic importance, for if such a secretion appears at the external urethral orifice of a man in whom gonorrhœa can be excluded and no other cause be determined, the suspicion that it is due to tuberculosis of the seminal vesicles will be well founded.

As the morbid process becomes further developed fistulæ may be formed; they may open into the rectum or perineum, or into the large veins of the pudic plexus, the latter occurrence being one which has resulted in death.

Diagnosis depends essentially on the findings upon palpation and the discovery of other tuberculous lesions.

In regard to treatment, results are to be expected only from surgical intervention, that is, from total extirpation of the seminal vesicles. It is not known whether tuberculosis of the seminal vesicles ever undergoes spontaneous cure; in view of the fact that localized tuberculous lesions of other organs become healed, it may be reasoned by analogy that the same thing may take place in these organs.

In consideration of this assumption the question as to whether a tuberculous seminal vesicle should be removed must be decided by the circumstances of the individual case. In general the principle should be adhered to that a tuberculous focus ought to be destroyed whenever it is possible to destroy it without greatly endangering the patient, provided, of course, that its destruction offers a prospect of protecting him from a dissemination of the disease. This is often the case in tuberculosis confined to the genital tract. Tuberculosis affecting the seminal vesicles alone, or associated with tuberculosis of the testicles or prostate, is therefore operable, whereas a simultaneous tuberculosis of the lungs, kidneys, or bladder renders it inoperable.

The seminal vesicles may be removed either through the prerectal incision of Dittel and Zuckerkandl or by the method of Fritz König, or, as Young has shown, they may be freed from the posterior surface of the bladder through a suprapubic incision. In the light of our present experience the perineal operations are to be considered the less formidable.

CYSTS AND HYDROCELE OF THE SEMINAL VESICLES.

The case of hydrocele of the seminal vesicles which is recorded in literature was cured by two tappings. If for any reason dilatation of the seminal vesicles and consequent stagnation of their secretion occurs, they become converted into cyst-like bodies. This condition may be caused by occlusion or narrowing of the ejaculatory duct, resulting from inflammation, or it may be due to mechanical interference with the outflow of semen depending upon hypertrophy of the prostate.

It is to be separated from true cysts such as Englisch has described

in his work on "*Cysts on the Posterior Wall of the Bladder in Man.*" A case has been reported by Smith in which a cyst of the seminal vesicle holding five liters [quarts] produced retention of urine.

Small unilocular and multilocular cysts develop as the result of isolation and occlusion of one or more alveoli. They are connected to the seminal vesicle only by a peduncle (Maisonneuve, Englisch).

CONCRETIONS OF THE SEMINAL VESICLES.

A distinction is made between **concretions** and **true calculi.** The first are small and produce no symptoms, so that they are not diagnosticated during life. Some of them correspond to the bodies formerly described by Trousseau and L'Allemand, consisting of round-cells and polyhedral cuboid epithelium which become infiltrated with inorganic salts. They are about a millimeter in length. According to Meckel, they are cadaveric products, although Fürbringer believes that they are formed during life. Other concretions are composed of mucus, spermatozoa, and inorganic matter. Robin has described this variety under the name of **sympexions.** They are insoluble in acetic acid. Their occurrence is not very rare, large numbers commonly being found.

Seminal calculi are different, being composed of 90% of phosphate and carbonate of lime and 10% of organic matter in which spermatozoa are frequently found. They grow as large as a cherry-stone, so that they may completely occlude the ejaculatory duct. Their number may also be considerable. It is supposed that their formation is due to stagnation of the secretion in the seminal vesicles. Stagnation occurs especially in advanced age, though it may also take place at an early period of life when inflammatory processes have narrowed the caliber of the ejaculatory duct so that there is an impediment to the outflow of semen.

If one or more calculi completely occlude the ejaculatory duct, severe spasmodic pain is experienced when orgasm occurs, to which the name *colique spermatique* has been given by the French. The semen may be completely retained, so that ejaculation fails to take place, or it may flow out slowly in small quantities. It is not positively known whether complete absence of ejaculation in cases in which one ejaculatory duct is occluded is due to reflex contractions of the other, or whether the congestive swelling produced by the stone causes simultaneous occlusion of the other duct.

Seminal calculi not infrequently give rise to pain upon micturition and defecation. In such a case where there is suspicion of seminal calculi an attempt should be made to palpate the seminal vesicles. Occasionally a stone can be felt, especially if a metal sound is introduced into the bladder and used as a guide in palpating through the rectum.

The pain is to be controlled by hot sitz-baths, and narcotics if necessary. An attempt may be made to crush the calculi through the rectum by pressing it against a sound introduced into the bladder.

TUMORS OF THE SEMINAL VESICLES.

Tumors are rare and are not often diagnosticated when they do occur. Zahn has reported a case of sarcoma which was not diagnosticated during life. The seminal vesicle was the primary seat of the disease and from it metastases to the lung, heart, and kidney had taken place.

Carcinoma of the seminal vesicles, which is somewhat more common, may be either primary, occur as a metastasis from a remote organ, or grow into the seminal vesicle from a neighboring structure. Usually it is found in association with carcinoma of the rectum, bladder, or prostate, and more rarely the testicle.

Owing to the inaccessibility of the seminal vesicles it will be readily understood that carcinoma affecting these organs is not easily diagnosticated. As a rule, the diagnosis is first made when severe disturbance of micturition leads to the making of a thorough examination. Frequent urination, lessened capacity of the bladder owing to infiltration of its walls, and even complete retention of urine have been observed.

I once had occasion to observe a case in which a hard nodular tumor was distinctly palpable above the prostate, from which it was separated by a furrow; this tumor destroyed the seminal vesicle and broke through into the rectum and bladder. Diagnosis was first made when fibers and fecal elements were discovered in the urine. Because of the lateness with which diagnosis is made, it usually being at a time when metastases have occurred, there is not much to be expected from radical treatment, so that we have to confine ourselves to a purely symptomatic therapy.

DISEASES OF THE KIDNEYS.

[ANATOMY AND PHYSIOLOGY.]

The kidneys are two bean-shaped glandular organs deeply placed behind the posterior parietal peritoneum, one lying on either side of the spinal column, approximately on a level with the last dorsal and first two lumbar vertebræ. Their position with reference to the vertebræ, however, is variable. Thus one or both kidneys may extend up as high as the summit of the eleventh dorsal vertebra and as low down as the fourth lumbar. The latter level is rare, although it is not unusual to find a kidney, especially the right one, extending as low as the third lumbar vertebra.

The long axis of each kidney is directed downwards, outwards, and somewhat forwards, so that there is a greater space between their lower than between their upper extremities.

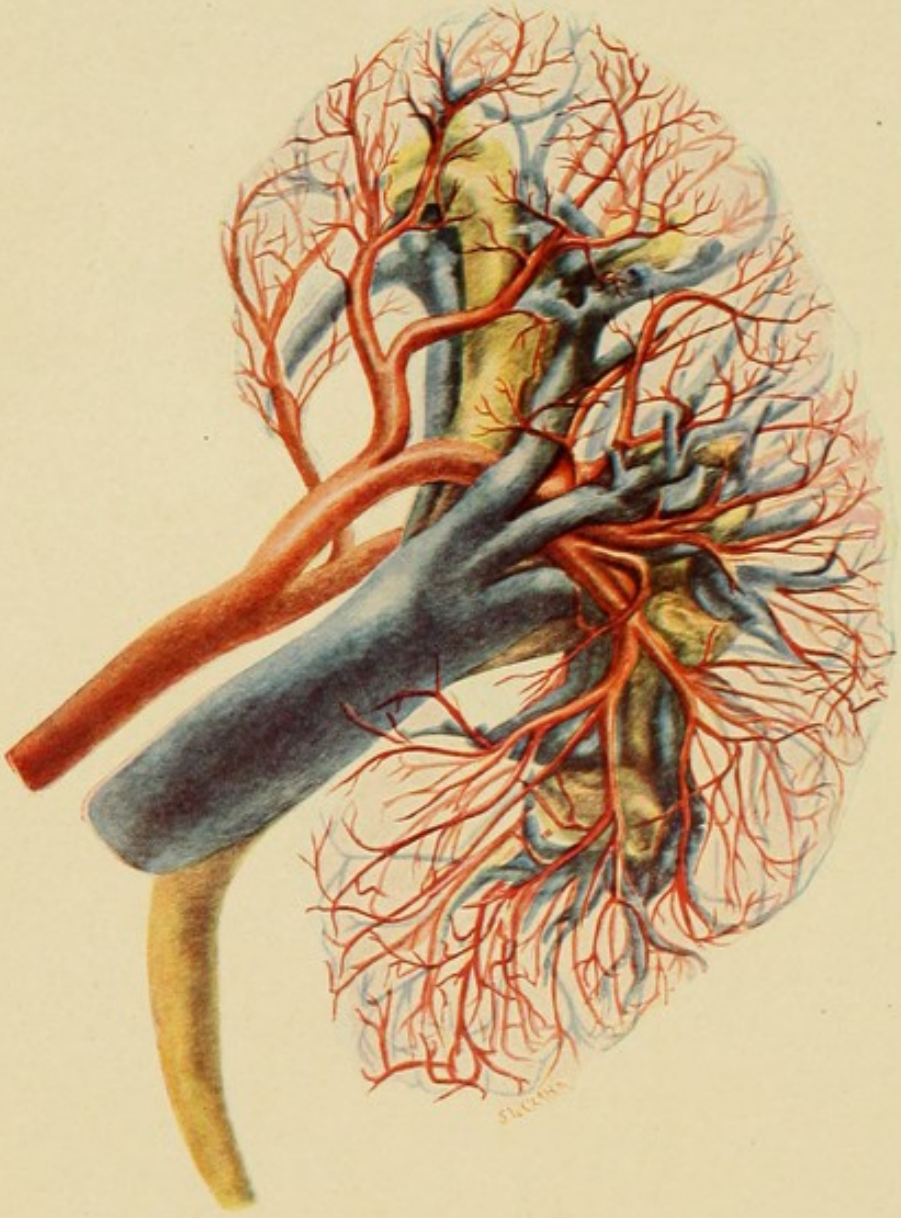
Each kidney has an anterior and a posterior surface, a superior and an inferior extremity, and an internal and an external border.

The anterior surface is convex, directed slightly outwards and forwards, and is covered by peritoneum. The posterior surface is flattened, and is intimately surrounded by areolar tissue and fat.

The extremities, or poles, are rounded, the superior ones being surmounted by the suprarenal glands.

The external border is narrow and convex. The internal border is wider and straighter than the external, and at its middle third presents a deep longitudinal fissure, known as the hilum, through which the renal artery and nerves enter and the veins, lymphatics and ureter emerge. These structures form the surgical pedicle of the kidney, and consequently it is important for the surgeon to be familiar with their relative position and the variations from the normal which some of them often present. The relative position of these structures is as follows: the vein lies in front, the ureter behind and the artery in the middle. The arterial blood-supply of the kidneys may be derived from single or multiple main arterial trunks. When there is but a single renal artery it divides into an anterior and a posterior branch, of which the anterior is much the larger. Consequently the anterior portion of the kidney is more vascular than the posterior.

PLATE XIX



BLOOD SUPPLY OF THE KIDNEY AND RELATIONS OF THE STRUCTURES SITUATED IN THE HILUM OF THE KIDNEY, AS SHOWN BY A CORROSION PREPARATION MADE BY PROF. E. A. SPITZKA. (COLLECTION OF DEPARTMENT OF GENERAL ANATOMY, JEFFERSON MEDICAL COLLEGE.)

This circumstance may be utilized to lessen hemorrhage in the operation of nephrotomy. Thus an incision made six millimeters behind the external border of the organ will open into its less vascular segment, whereas one made in front of this border will wound the highly developed plexus formed by the subdivision of the anterior branch of the renal artery.

Before the renal artery passes into the hilum it generally gives off a branch which ascends to the upper pole of the kidney to enter the suprarenal gland. Hence in ligating the artery in the operation of nephrectomy, care should be taken to place the ligature internal to this branch.

Multiple renal arteries are present in a considerable proportion of all subjects—according to my observations in the dissecting rooms of Jefferson Medical College, in about twenty-nine per cent. In some instances three, four, or more vessels are given off from the aorta; in others a short thick trunk derived from the aorta divides into several branches. In either case it is noteworthy that only a portion of these vessels enter the kidney at the hilum. Some may go to the extremities, others penetrate the gland on its internal border a short distance above or below the hilum, and occasionally one may be seen passing to the external border. It is exceedingly important that the possible existence of such anomalous blood-vessels be borne in mind during the operation of nephrectomy, and that any which are present be secured. Patients have bled to death from such vessels which were not ligatured.

Of the multiple arteries entering the hilum some pass in front of the ureter and some behind it.

In general the veins correspond to the arteries. The right one is much shorter than the left, however, so that in removing the right kidney greater care must be taken not to injure the vena cava. Frequently two or three small veins lie behind the ureter.

The blood-supply of the kidney and the relations of the structures in the hilum are shown in Plate XIX.

The nerves are derived from the renal plexus. They enter the hilum upon the arteries. They communicate with branches of the spermatic plexus, a circumstance which may account for the pain which is referred to the testicle in certain diseases of the kidney.

There are two sets of lymphatics, superficial and deep. The superficial set consists of two systems, one which perforates the

fibrous capsule and empties into the perirenal lymphatics in the fatty capsule, and one which enters the substance of the gland to unite with the deep set. The channels thus formed emerge at the hilum and empty into the lumbar glands.

The kidneys are covered by a fibrous capsule intimately adherent to the glandular substance. In addition thereto they are invested by the renal fascia and the fatty capsule.

The renal fascia is a special portion of the retro-peritoneal connective tissue, which descending from the lower part of the diaphragm, splits into two layers above the superior pole of the kidney, one passing anterior to the organ and the other posterior. The anterior layers of this fascia blend with one another over the lumbar vertebræ. The posterior layer on each side becomes attached to the vertebræ along the inner border of the psoas magnus muscle. By its attachment to the diaphragm above and the spine below, the renal fascia contributes materially to the fixation of the kidney. This fascia is stronger on the left side than on the right, being fortified by some fibrous bands remaining from the union of the descending mesocolon with the parietal peritoneum. Thus the left kidney is more intimately connected with the descending colon than the right kidney is with the ascending colon, a circumstance which perhaps may account for the less frequent displacement of the left kidney than of the right. (Fig. 209.)

The fatty capsule is composed of lobulated adipose tissue, which is more abundant around the posterior surface of the kidney than it is in front, where it is almost always scanty and sometimes absent, so that the true fibrous capsule of the organ may be separated from the peritoneum only by the renal fascia. Posteriorly some of this fat is found on either side of the renal fascia. Although the fatty capsule may contribute somewhat to the fixation of the kidney, it is probably of less importance in this respect than it was formerly thought to be. The abdominal walls, the peritoneum and surrounding organs also afford some support, but it is the renal fascia which acts most powerfully in keeping the kidneys in position.

The anterior relations of the two kidneys are different. The left one is in relation with the spleen, stomach, pancreas, descending colon and a portion of the small intestine. The right one is in relation with the liver, the duodenum, the ascending colon and also a portion of the small intestine.

Posteriorly the kidneys are in relation with the internal and external arcuate ligaments of the diaphragm, the psoas, quadratus lumborum and transversales muscles. The relation with the diaphragm brings the kidneys into close proximity to the pleura. The twelfth rib

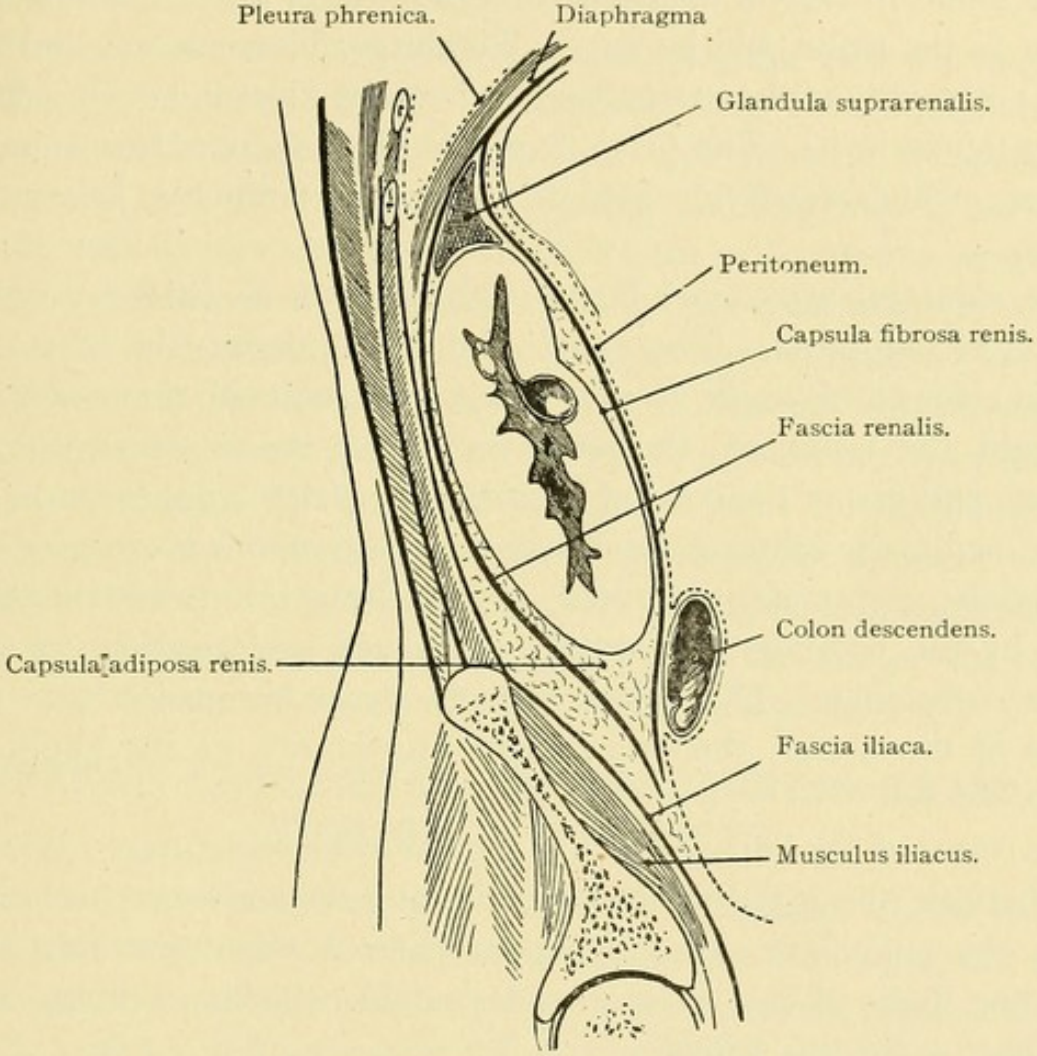


Fig. 209.—Longitudinal section through the kidney, suprarenal gland and renal fascia. (Gerota.)

crosses the posterior surface of the kidney, dividing it into a superior and an inferior segment, of which the latter is the larger. It is the upper segment which is in relation with the pleura, lying behind it and being overlapped by the costo-diaphragmatic sinus. These relations explain why a perinephric abscess may discharge itself into the pleural cavity, and also why an empyema is sometimes complicated by a perinephric abscess. In resecting the twelfth rib in operations upon the kidney care should be taken not to open the pleura. The experience of W. J. Mayo, A. J. Ochsner and others, however, show that this accident is not as serious as it was formerly thought to be.

Behind the inferior segment the twelfth dorsal, ilio-hypogastric and ilio-inguinal nerves pass outwards and downwards. They are to be avoided when exposing the kidney through a lumbar incision.

If the kidney be cut through from one border to the other its interior will be found to vary in appearance. Just within the hilum a cavity, known as the sinus, will be seen. The larger blood-vessels and the dilated extremity of the ureter, the pelvis of the kidney, as it is called, are contained in it. The pelvis is divided into two or three tubular portions, which subdivide into a number of branches known as calices.

The sinus is surrounded by the substance of the kidney, which consists of two parts. The outer third of the organ, the cortex, is dark in color and is made up of two distinct structures, the medullary rays and the labyrinth, the latter separating the former from one another, and giving the cortical substance its striated appearance.

The medulla is lighter in color than the cortex, and is made up of the Malpighian pyramids, separated at their bases for a variable distance by the columns of Bertini, which are prolongations of the cortical substance. The apices of these pyramids project into the calices of the ureter, their openings being known as the papillary ducts.

The cortex of the kidney contains the following structures: Within the labyrinth, the Malpighian corpuscles and the convoluted tubules; within the medullary rays, the upper ends of the descending and ascending limbs of Henle's loop and straight collecting tubules, and the arched collecting tubules.

The Malpighian corpuscles are formed by a little cluster of arterioles, the glomerulus, surrounded by a delicate double membrane, called Bowman's capsule.

The medulla of the kidney contains the lower ends of the descending and ascending limbs and the loop of Henle, the straight connecting tubules and the papillary ducts.

Thus it is seen that the uriniferous tubules, beginning in the Malpighian corpuscles, have a very irregular course, passing from cortex to medulla, then back to the cortex only to return to the medulla and finally terminate in the papillary ducts at the apices of the calices.

There are two principal theories of urinary secretion, namely, Ludwig's theory and Bowman's theory.

Ludwig maintained that the urine is produced solely by the physical processes of filtration and diffusion. He believed that all the constituents of the urine—water, inorganic salts, and organic substances—were filtered from the blood in the glomeruli, passing through them into the uriniferous tubules.

Bowman assumed that the water and inorganic salts are produced in the glomeruli by a process of secretion, and that the organic constituents are produced by a special secretory power in the epthelium lining the convoluted tubules. Without entering into a discussion of the various experiments which have been performed to verify each of these theories, or the arguments which have been made in support of each of them, it may be stated that the weight of evidence seems to be in favor of Bowman's theory. That it does not entirely explain the process of urinary secretion will probably be admitted by all who are familiar with the literature of the subject. The chemistry of living tissues is yet obscure, and much remains to be demonstrated in reference to the vital processes by which secretions so complex as the urine are elaborated. For further reference to this subject the reader is referred to modern text-books and journals on physiology.

GENERAL CONSIDERATIONS CONCERNING EXAMINATION OF THE KIDNEYS.

The successful diagnosis and treatment of diseases of the kidneys must rest on an adequate determination of their structural and functional condition, and for this reason the most important points concerning the methods of examination will first be considered. The questions which arise in regard to diagnosis are: (1) What is the nature of the renal disease? (2) Is it bilateral or unilateral? (3) Which kidney is affected? (4) If one kidney only is diseased, is the function of the other sufficiently good to permit an operation, be it nephrotomy or nephrectomy, upon the diseased organ?

Inspection is of little value; it does not enable the examiner to determine whether a second kidney is present, much less whether it is diseased.

Percussion is equally unreliable. According to my experience nothing can be learned from it regarding the absence or condition of the kidney.

Palpation is of greater value. It is practised in many ways. Bimanual palpation is employed with the patient in the dorsal posi-

tion, the legs being slightly flexed and a deep breath being exhaled just as the examiner palpates (Tuffier, Litten).

If the patient makes his abdomen tense palpation is of no use. Under these circumstances relaxation must be secured either by placing the patient in a warm bath or anæsthetizing him (Lennhof).

In conjunction with palpation Guyon employs *ballotement renal*, a procedure in which the kidney is carried forward by means of short sharp blows upon the lumbar region, so that it can be more readily felt by the other hand laid flat upon the abdominal wall. Morris has the patient lie upon the sound side with the legs drawn up and the body slightly inclined to the front. In this position the intestines fall forward, the lumbar region sinks in, and the kidneys are more easily felt. Israel's method of examination is similar.

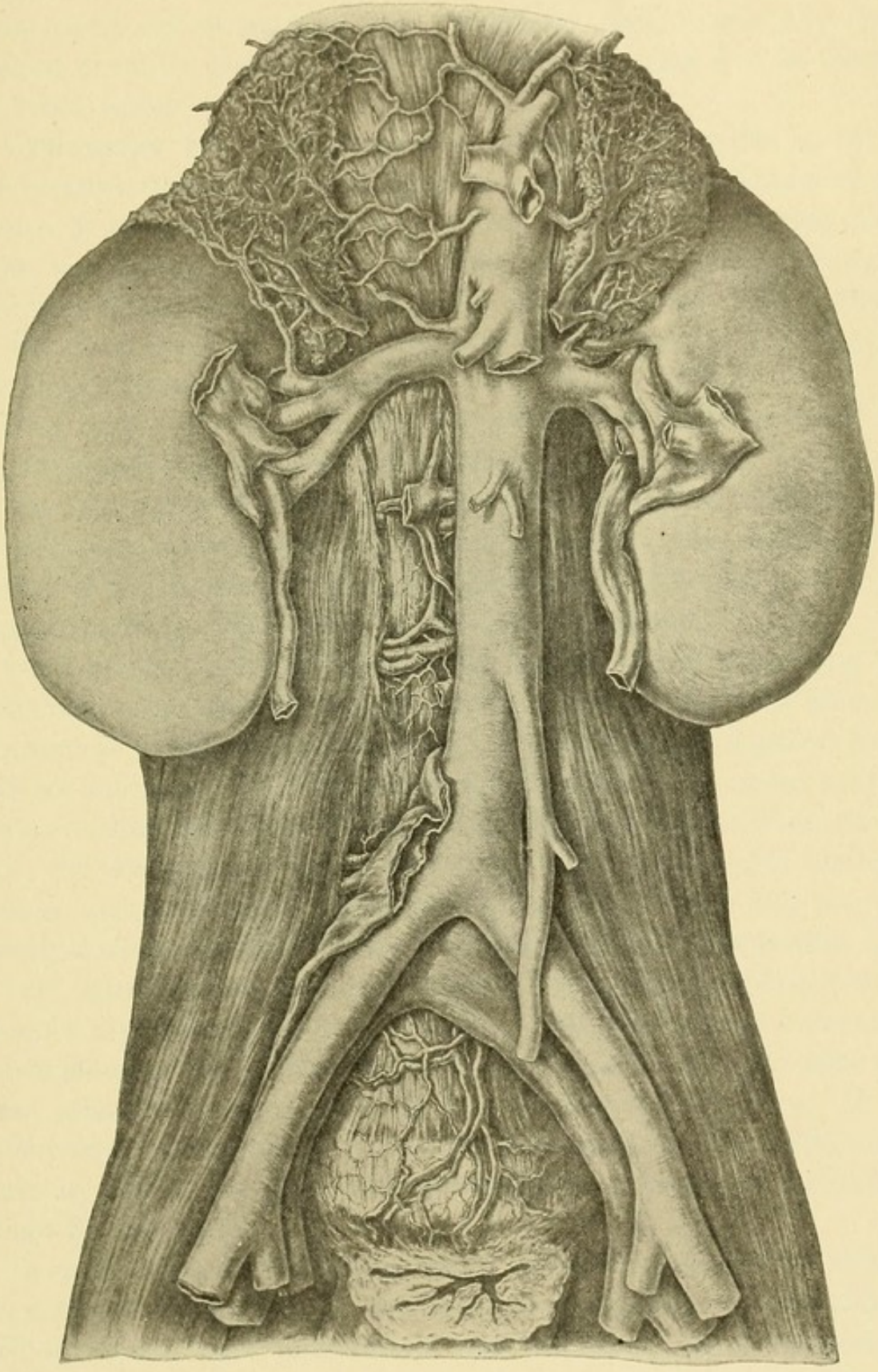
Finally there is the *procedé de pouce* recommended by Glénard. If the right side is to be examined the fingers of the left hand are placed behind, over the loin, and the thumb in front, over the region of the kidney; then the loin is pressed upon by the fingers so that the kidney is pushed forwards where it can be felt through the abdominal wall by the other hand.

These methods are all serviceable. It is well to combine them, using first one and then another.

It must not be forgotten, however, that in **many cases of diseased and enlarged kidney** due to stone, tumor, tuberculosis, or other causes **nothing can be felt.** It is the same with **very fat** persons and also thin persons in whom the kidney lies under the **arch of the ribs** and cannot be forced down by deep inspiration. Moreover, a kidney of normal or increased size may be palpated and the examiner yet be unable to determine whether it is healthy or diseased. Finally there is great difficulty in deciding whether a palpable tumor is the kidney. It is sometimes impossible to differentiate an enlarged gall-bladder from the right kidney. On the left side the spleen may feel exactly like the kidney. So, too, when the colon is distended it often happens that little can be accomplished, for although this portion of the bowel usually lies over the kidney and behind the lower portion of the gall-bladder, when it is distended it may become adherent to neighboring structures, and the normal relations be so distorted that it may not lie over the kidney but be placed anteriorly to the gall-bladder.

The modern method of examination with the Rœntgen rays has not

PLATE XX.



Kidney, Renal Vessels, and Ureters. (Deaver.)

added much to the diagnosis of renal disease. The only positive fact which has been learned from it is, that certain renal calculi, namely, those composed of oxalates and phosphates, and occasionally those formed of urates, make a visible shadow on the plate (*see the chapter on renal calculi*).

Cystoscopy has afforded great advantages. It enables us to see the ureteral orifices, and in many cases to recognize that disease of one kidney is present; moreover, pus or blood may be seen issuing direct from the kidney. Of course, in those cases in which hæmaturia or pyuria is slight, the method cannot be relied upon, for slight turbidity of the urine from the kidney does not differ materially from that of the fluid present in the bladder.

This defect has been supplied by **ureteral catheterization.** By introducing the catheter into the ureter it can be accurately determined whence the pus or blood has its source; it can be learned where the seat of the disease is, and whether one or both kidneys are affected. The exact nature of the disease will then be determined by the sum total of the clinical findings, which must be critically considered.

One question will still arise: what can be stated concerning the functional capacity of the second kidney, when one has been found so diseased as to necessitate operation? The anatomical diagnosis alone will not suffice to decide this question. For instance, let us assume that we are dealing with a tuberculous right kidney and that the urine coming from the left kidney is albuminous—now, then, is removal of the right kidney contraindicated? Not at all, for the albuminuria may be merely the expression of a remediable toxic disturbance depending upon a very restricted amyloid degeneration. This degeneration becomes arrested and the remainder of the kidney will be preserved if the other tuberculous kidney is removed. On the other hand, clear urine free from albumen may be obtained from a contracted kidney. If the tuberculous kidney should be removed in such a case, death would certainly follow the operation, whereas without operation the patient might live for years.

In view of these circumstances we are led to conclude that it is equally important to determine the functional capacity of the second kidney. Will it alone suffice to maintain the vital functions? Is it anatomically diseased? Some light has been thrown on these questions by the methods of functional examination introduced by myself and P. Fr. Richter.

If a catheter be introduced into each ureter and the urine from each kidney **simultaneously** collected for a short time, it will be found that the quantity of urine secreted by the two kidneys is not always equal, but that the nitrogen content (N), the salt content, the molecular concentration (△), and, if phloridzin (0.01) has been injected hypodermatically, the quantity of sugar excreted from the two sides, will be approximately the same. As the last two are the most certain it is sufficient to measure their value. △ = the freezing point, which represents the totality of molecules (without reference to their quality) contained in the urine, and the sugar artificially produced by the phloridzin and temporarily excreted by the kidneys.

Phloridzin-diabetes lasts about three hours. The two following examples will serve as illustrations.

Normal Case	R.	L.
Quantity	36 cm.³	35 cm.³
△	0.50	0.50
Sugar	1.4%	1.4%
N	0.213	0.206
Or Normal Case		
Quantity	22 cm.³	20 cm.³
△	0.9	1.0
Sugar	2.0%	2.0%

It is seen that the figures of the two sides are approximately equal. It is important to know that the absolute figures do not express anything. A kidney which secretes water abundantly, for example after free drinking, may excrete 0.2% of sugar at one time and 2% at another after exactly the same amount of phloridzin has been injected. **Only the comparative values have any significance.**

If, now, the function of one kidney be disturbed, less nitrogen will be excreted, fewer molecules will be elaborated from the blood, and less sugar will be produced than by the healthy kidney; therefore **the figures representing the output of the diseased side are always lower than those of the healthy side.** In cases of grave disturbance in which a considerable portion of the parenchyma of the kidney is destroyed, the freezing point of the urine from the diseased side is very low and sugar is entirely absent. A few examples may serve to illustrate this:

1. Right Pyonephrosis	R.	L.
Quantity	33.0 cm.³	25.0 cm.³
△	0.48	1.18
Sugar	0	1.0
N	0.322%	0.782%
2. Left Renal Tuberculosis	R.	L.
Quantity	16 cm.³	10 cm.³
△	1.5	0.91
Sugar	2.0	0.05
N	0.63	0.385

In this manner we obtain a picture of the functional power of the second kidney, and are in a position to decide, **after carefully weighing all the circumstances and results obtained by other methods of examination,** whether an operation is permissible.

If several examinations after phloridzin injections show that sugar is not excreted, and the undiluted urine is found to have a low freezing point, the kidney is functionally incapacitated. Removal of the other kidney might be followed by uræmia and death.

On the other hand, the presence of pus in the urine from the kidney which is not to be operated on does not contraindicate operation if it has a high freezing point and shows a considerable quantity of sugar after the injection of phloridzin. Such a finding would show that, although the kidney or its pelvis is diseased, its functional power continues to be good.

It is obvious that it may sometimes be difficult to fix exact limits, and that there is no absolute protection afforded against failure of the remaining kidney. Experience has already shown and will show further that deaths from renal diseases are becoming less frequent.

Our aim will be to ascertain to what extent the condition of the remaining kidney as shown at autopsy corresponds to the previously made diagnosis and prognosis.

It would exceed the scope of this book to enter into this matter in detail. It will suffice to state that the results have been accepted as correct by the best clinicians and recognized as the foundation of a precise method of renal diagnosis. The exception taken to them by a few authors cannot alter their value at all, since our experience is derived from hundreds of cases, while theirs is based upon only a few exceptional instances. Exceptions always occur, and, as is well known, prove the rule.

For more detailed information concerning this question the reader is referred to the monograph on Functional Diagnosis of Kidney Diseases by the author and P. F. Richter, and also to various articles

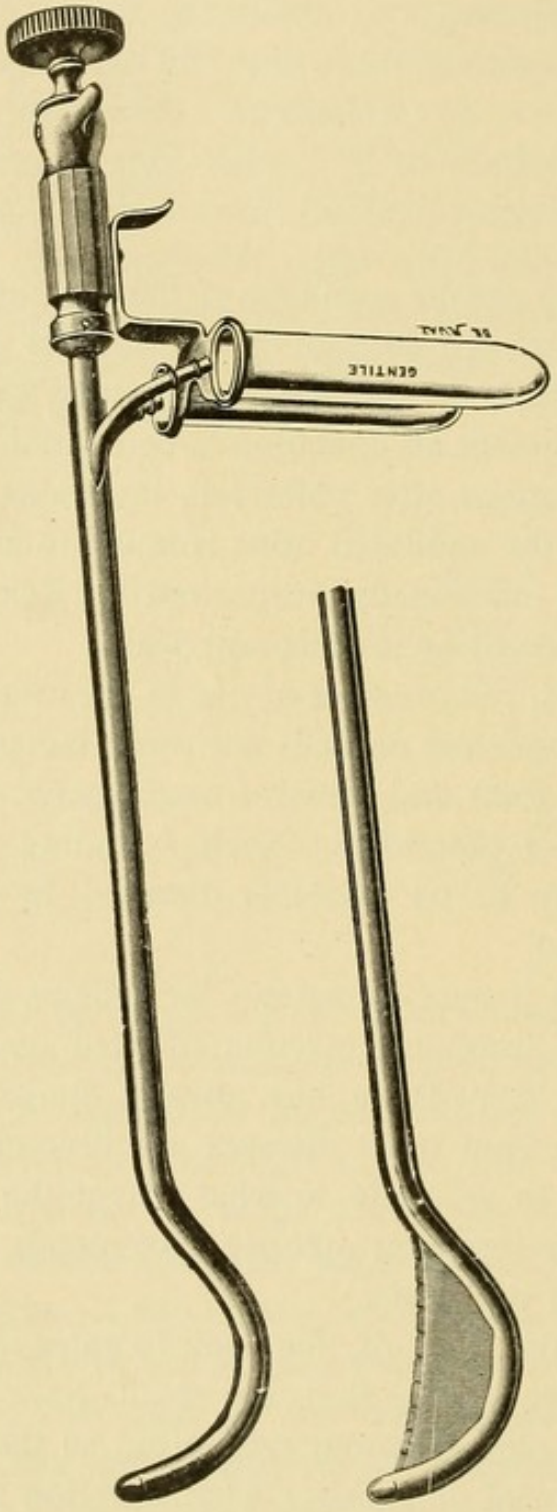


Fig. 210.—Luy's segregator. (Hartmann.)

which have appeared in the medical journals and archives during the last few years.

[Among other tests devised for determining the functional capacity of

the kidney may be mentioned cryoscopy of the blood and chromocystoscopy.

In regard to the former it is probable that the freezing point of the blood is influenced by many other and undeterminable causes aside from the action of the kidney.

Chromocystoscopy is of no value in showing the functional capacity of the kidney. It is useful, however, for finding the orifices of the ureters when they cannot be plainly seen.

Various urine segregators have been devised for the purpose of obtaining the urine separately from each kidney without invading the ureters. They are of two kinds, one attempting to form a water-tight

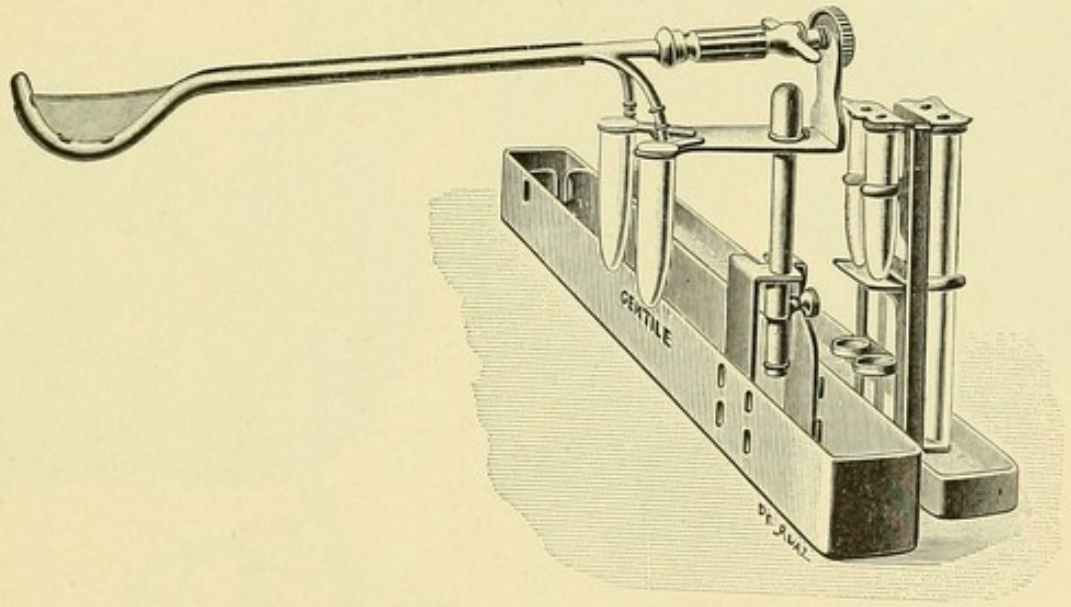


Fig. 211.—Segregator attached to its support. (Hartmann.)

septum between the two ureteral orifices which shall completely divide the bladder, and the other designed to elevate the posterior vesical wall, by means of an instrument introduced into the rectum, so as to convert it into a longitudinal fold which shall separate the bladder between the ureteral orifices.

Of the former kind are the instruments of Luys (Figs. 210, 211, and 212) and Cathelin, of the latter those of Neumann and Harris (Fig. 213).

That these instruments afford the accurate results offered by catheterization of the ureters is greatly to be doubted.

In a paper read at the surgical congress in Berlin, in 1905, Prof. Casper showed that the mortality of renal operations has fallen from

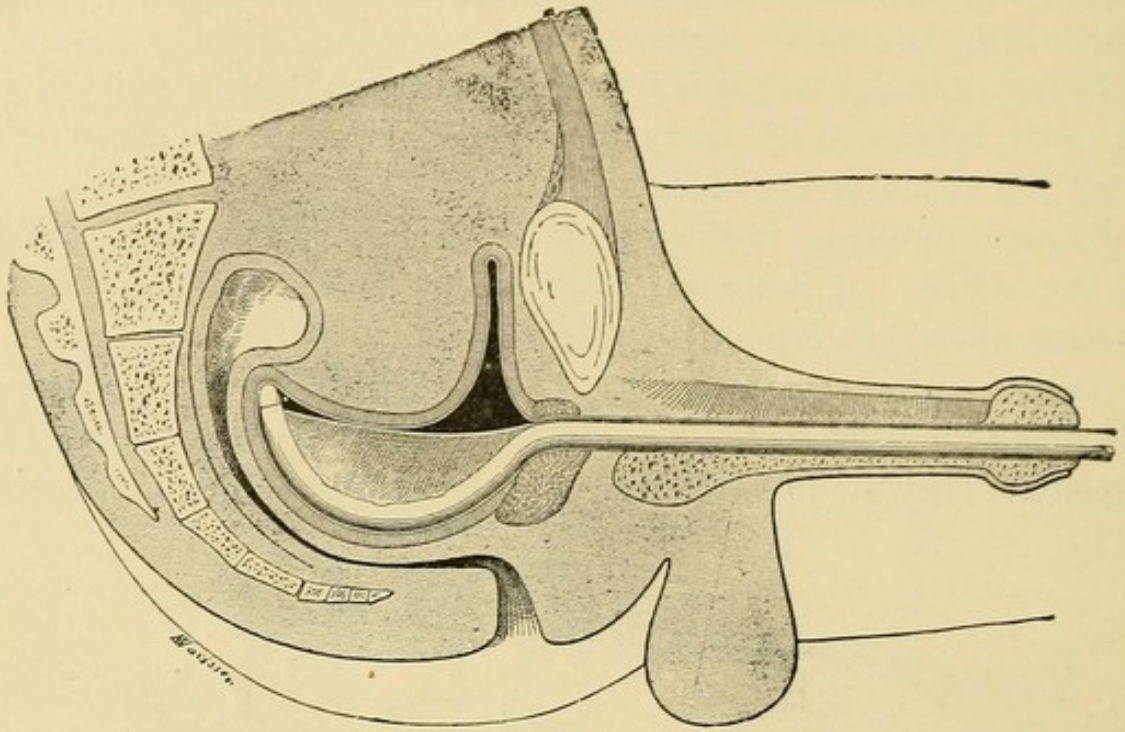


Fig. 212.—Section of the pelvis showing the segregator in position. (Hartmann.)

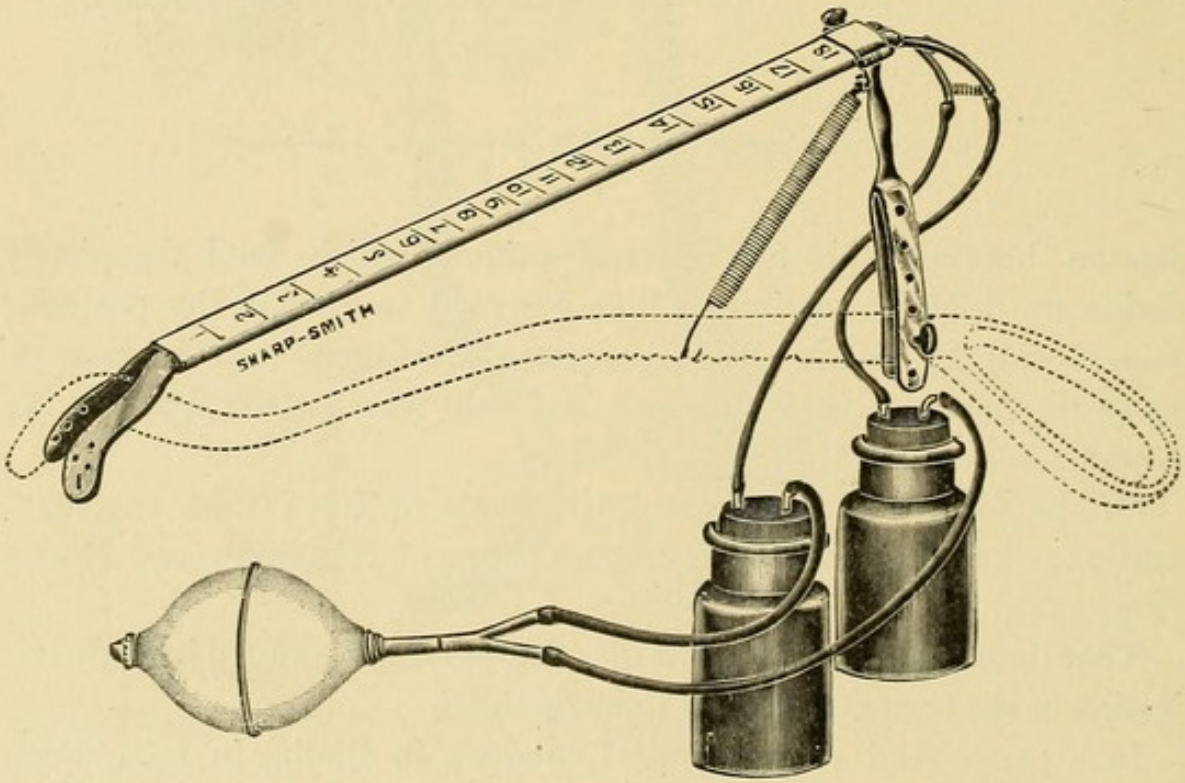


Fig. 213.—Harris's segregator.

26.9% to 17.4% in the last ten years. He attributes this decrease largely to improved methods of diagnosis.]

CONGENITAL MALFORMATIONS AND DISPLACEMENTS OF THE KIDNEYS.

Congenital absence of a kidney is a rare condition, but nevertheless it is one which has to be considered from a practical point of view. Another malformation comparable to this one is the rudimentary kidney, which is due to an arrest of development of the organ; such a kidney is entirely devoid of functional activity. Absence or arrest

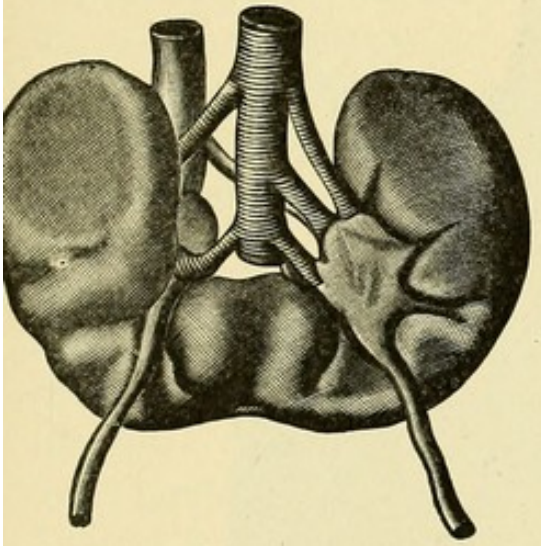


Fig. 214.—Horseshoe kidney with broad isthmus. (Anterior view.)

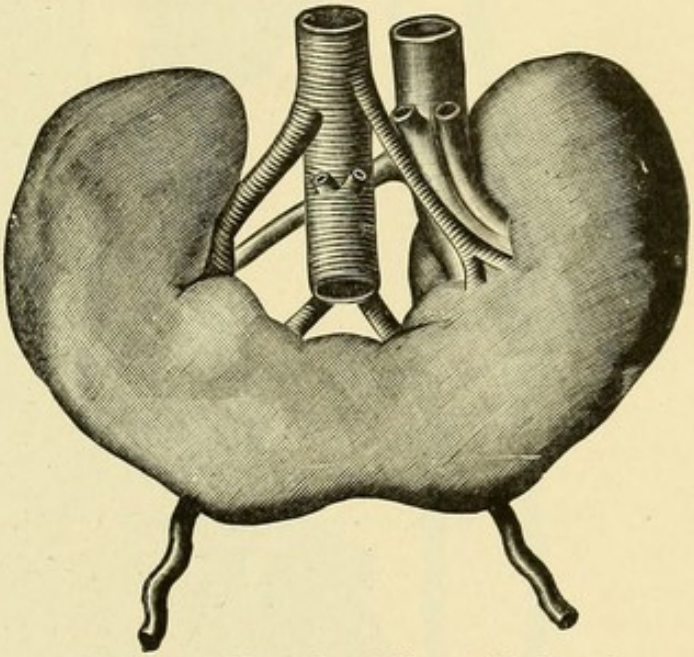


Fig. 215.—Horseshoe kidney with broad isthmus. (Posterior view.)

of development of one kidney may be the only malformation, but frequently others are present. They particularly affect the genitalia, atrophy of the testicle and atrophy or absence of the seminal vesicle on the same side often being found.

The occurrence of **supernumerary kidneys** is not fully recognized by Küster. He is of the opinion that the condition is generally one in which there are two kidneys with multiple pelves and ureters.

If the condition of fœtal lobulation persists in later life the term **fœtal kidney** is applied to it. The fœtal kidney is characterized by its special predisposition to tuberculosis.

If the poles of both kidneys are grown together the organ thus constituted is known as **horseshoe kidney** (Figs. 214 and 215). Most fre-

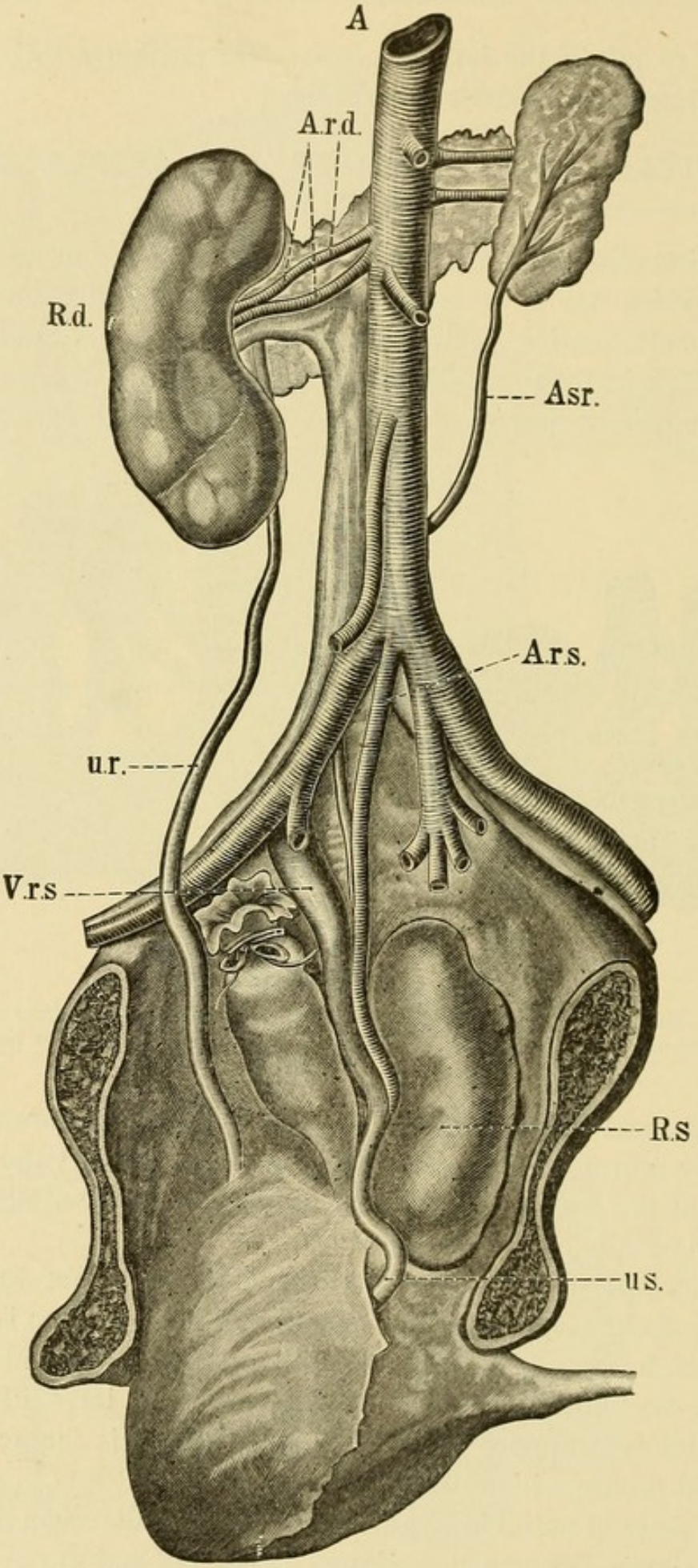


Fig. 216.—Displacement of the left kidney into the hollow of the sacrum *A*. Aorta. *A.r.d.* Right renal artery (double). *R.d.* Right kidney *u.r.* Right ureter. *V.r.s.* Left renal vein. *A.s.r.* Right suprarenal artery *A.r.s.* Left renal artery. *R.s.* Left kidney. *u.s.* Left ureter. (Rayer.)

quently it is the lower poles which are grown together, so that the concavity is above. The upper poles may be united, with the result that the concavity is directed downwards. The kidney is usually deeply placed. The bridge of union consists either of a fibrous cord or of kidney tissue. It is interesting to note that in this condition the number of ureters and renal vessels are much increased.

Again, both kidneys may be fused into a single disc-like mass having indentations on the border and lying in the median line and at a much lower level than the normal organ. To this malformation the Germans have given the name *Kuchenniere*.

The term **dystopia** is applied to congenital displacement of the organ. Displacements occur principally in association with the previously mentioned malformations, but a normal kidney may also be displaced. They are more common on the left side. The kidney may lie upon the lower lumbar vertebræ (pelvic kidney); once I found it on the sacrum. The ureters are shortened (Müllerheim). By establishing this fact by means of ureteral catheterization and the other considerations apposite to the case, Müllerheim was able in several instances to diagnosticate this condition during life. The renal arteries arise from the common iliac, the external iliac and the femoral (Fig. 216).

Displacement of the pelvis of the kidney may occur in an organ otherwise normally placed, the pelvis being at the anterior surface instead of at the mesial border.

Very interesting and of practical importance as well is the occurrence of two **renal**

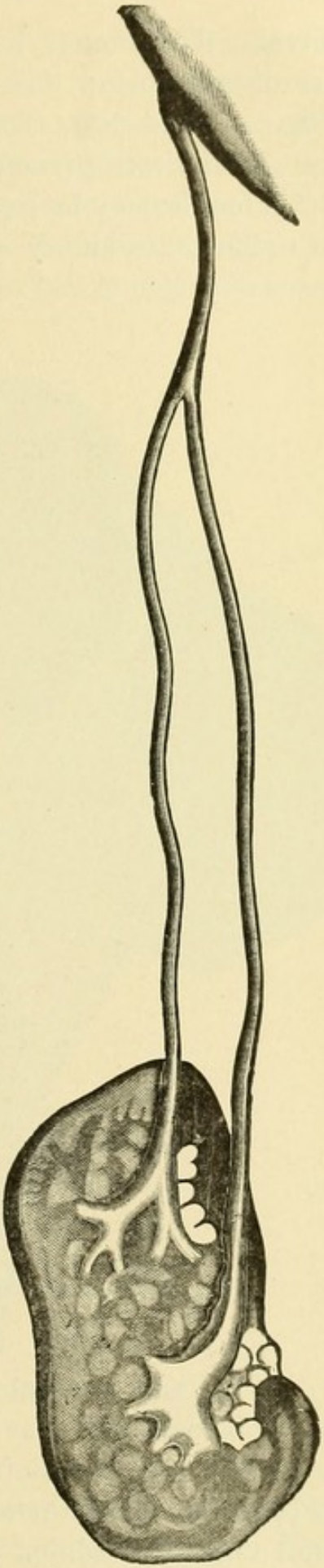


Fig. 217.—Double kidney and ureter. Kidney has been sectioned. (Rayer.)

pelves. The ureters issuing from them may unite at a greater or less distance below their origin or empty into the bladder separately (Figs. 217 and 218). A good specimen of a kidney having two ureters and affected with pyonephrosis is shown in Fig. 219.

The ureter may be wanting in cases in which the kidney is absent. In rudimentary kidney it is more common for the ureter of the corresponding side to end as a blind sac extending either above or below.

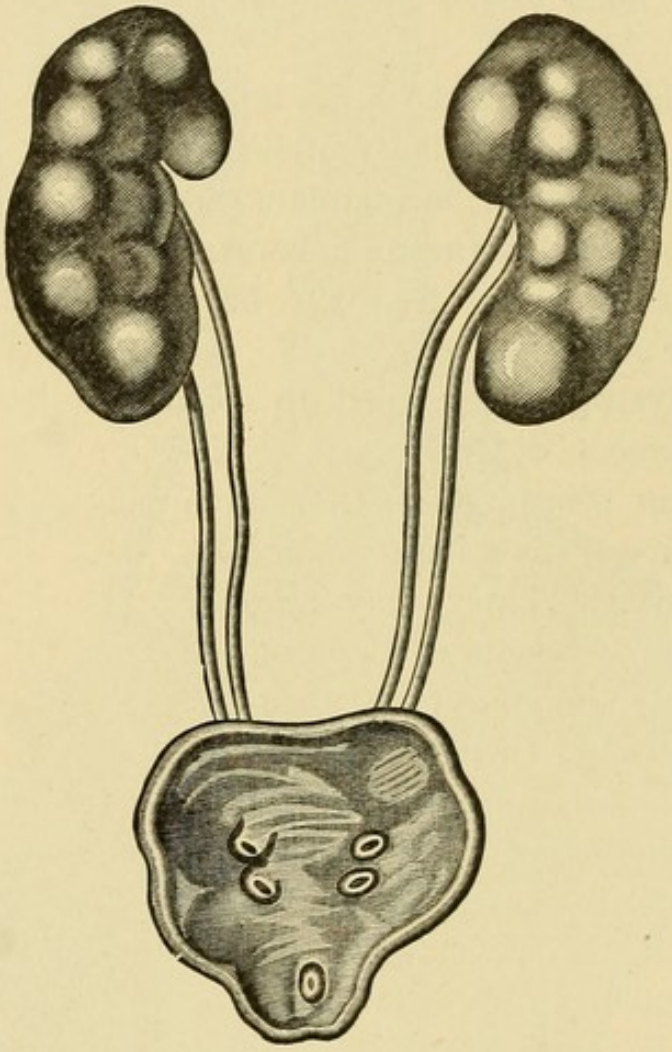


Fig. 218.—Kidney of a new-born child with two ureters and four ureteral orifices. (Rayer.)

It is not very unusual for the ureters to open in an abnormal place. In the bladder they may lie either toward the midline or lateralwards, or be displaced posteriorly. In rare cases the orifice has been known to open into the posterior urethra near the caput gallinaginis. The most unusual condition of all is union of the ureter with one of the seminal vesicles, the vas deferens, or the ejaculatory duct. Finally

the ureter may present variations in respect to length and width. The last is the most important.

There are points of predilection for **ureteral strictures;** one such is the line of transition between the pelvis of the kidney and the ureter, a place where kinking of the ureter also frequently occurs; the other point is where the ureter enters the bladder. In addition to narrowing

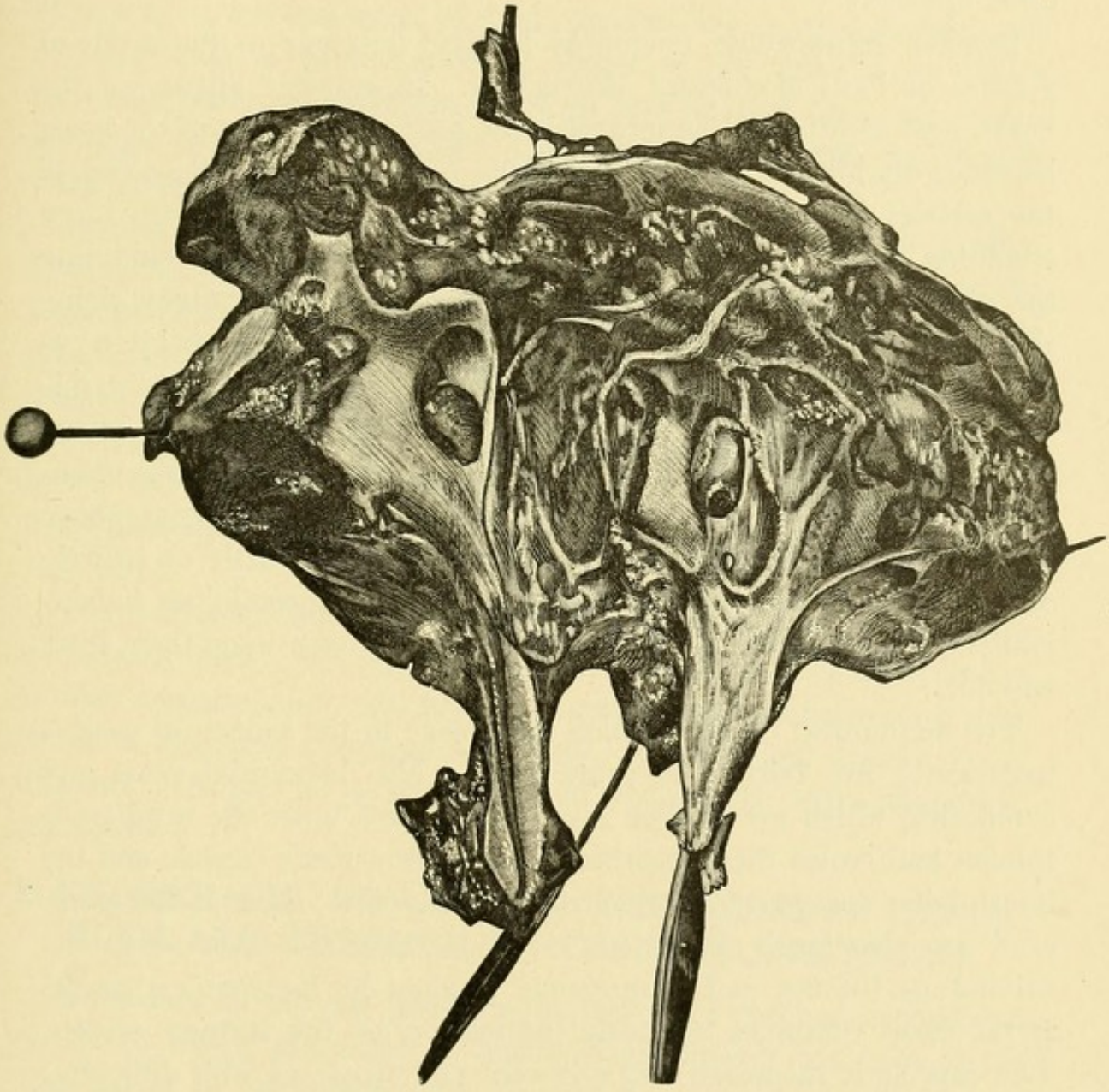


Fig. 219.—Pyonephrosis of a kidney having two ureters.

of the ureter, duplicature of the mucous membrane may take place and simulate stricture, and also give rise to the same symptoms. These duplicatures may have their seat in any portion of the ureter.

CIRCULATORY DISTURBANCES OF THE KIDNEYS.

HYPERÆMIA.

Hyperæmia of the kidneys may be active or passive. **Active hyperæmia** occurs as a result of increased cardiac action or because of distention of the renal vessels due either to beginning inflammation or to faulty innervation. Therefore it is merely a sequel of other disorders.

Passive hyperæmia (engorged kidney) develops as the result of general or local circulatory obstruction. In valvular disease of the heart, myocarditis and endocarditis the propulsive power of the heart becomes diminished after compensation fails, so that the distention of the arteries is lessened, while that of the veins is increased. Any condition which increases intra-abdominal pressure, thus hindering the outflow of blood from the abdominal organs and thereby giving rise to localized engorgement of the kidneys, may be considered as another cause of this disease. Among the causes which act in this way may be mentioned pregnancy, abdominal tumors and severe meteorism. A high degree of local venous stasis also occurs whenever the inferior vena cava becomes obstructed at any point above the renal veins, or when the veins themselves are partly or entirely occluded. Such an occurrence may be due to thrombi or inflammation of the vessels, or to tumors which encroach upon them from without.

The anatomical changes which take place in the kidney of passive hyperæmia are fairly well pronounced. The interstitial veins and capillaries, which are swollen and turgid, press upon the uriniferous tubules and crowd them together, while in Bowman's capsule and the intertubular spaces small hæmorrhages take place; some of the glomeruli are also much distended. Hyaline casts are observed in the uriniferous tubules and albuminous exudate in Bowman's capsule. If the stasis continues **cyanotic induration of the kidney** results. The capsule is thickened and adherent and strips off with difficulty; the epithelium is granular and fatty, the glomeruli are contracted or obliterated, and the interstitial tissue between the uriniferous tubules and vessels is increased.

Symptoms. Passive congestion of the kidney when caused by general venous stasis presents the signs and symptoms of general circulatory engorgement; namely, cyanosis, dyspnœa, cardiac and

respiratory disturbances, pleural or mediastinal disorder, gastric catarrh, and enlargement of the liver.

When the engorgement is merely local these phenomena do not occur. In either case, however, the urine shows characteristic changes, which are as follows. The total amount voided in twenty-four hours is less than normal; the specific gravity is increased, for the reason that the elimination of solid elements is not decreased in the same degree as is the excretion of fluid; the reaction is strongly acid and turbidity due to precipitation of urates is not uncommon. With increasing stasis albuminuria develops and hyaline casts are found, although both **red and white corpuscles are absent, or present only in very small numbers.**

Dropsy supervenes, or if it were already present increases in severity. During the period of transition from the stage of engorgement to the stage of contraction the urine becomes cleared, although the other symptoms of obstruction remain the same. From chronic nephritis passive hyperæmia may be easily differentiated by the mode of development, by the character of the urine (absence of blood), and especially by the fact that passive hyperæmia may almost always be traced to heart disease, while heart disease resulting from chronic nephritis is very rare.

The treatment should be directed, if possible, to the removal of the underlying cause. An endeavor should be made to restore the broken cardiac compensation, and for this purpose the administration of such drugs as digitalis, strophanthus, squill, camphor and caffeine is indicated. Dropsy is to be treated in accordance with established principles.

HÆMORRHAGIC INFARCT OF THE KIDNEY; THROMBOSIS AND EMBOLISM OF THE RENAL ARTERIES.

If the flow of arterial blood in the kidney is checked, a condition results to which the name of hæmorrhagic infarct has been given. This arrest of circulation may be caused by spasm of the vessels, which narrows or occludes the main branches of the renal artery, or it may be produced by thrombi or emboli which occlude these vessels. An arterial thrombosis resulting from disease of the vessel-wall, such as endarteritis or arteriosclerosis, is very rare. It usually results from displacement of clots or inflammatory products from the left side of the heart or aorta, or from particles of tumor which gain access to

the renal blood-current and are carried to the vessels of the glomeruli or other capillaries.

The infarct forms a gray or whitish wedge which is surrounded by a hæmorrhagic area. In the center of the wedge coagulation necrosis develops, the epithelium of the glomeruli losing its nuclei and being destroyed. This results from the cutting off of the blood supply, which is due to occlusion of the terminal renal vessels by emboli; the accessory vessels, those of the ureter and capsule of the kidney, are not sufficient to maintain the nutrition. The reddened border contains vessels filled with blood. The infarct finally becomes converted into scar-tissue.

The diagnosis of hæmorrhagic infarct cannot often be made. In order to make even a probable diagnosis a cause for emboli must be demonstrated after the occurrence of sudden pain in the lumbar region and the finding of albumen, blood and other morphotic elements in the urine.

DIFFUSED HÆMATOGENOUS NON-SUPPURATIVE INFLAMMATION OF THE KIDNEYS (BRIGHT'S DISEASE).

As numerous terms are met with in the literature on Bright's disease, such as acute, chronic, parenchymatous, interstitial and desquamative nephritis, glomerulo-nephritis, genuine and secondary contracted kidney, it is necessary first of all to obtain an adequate conception of the conditions to which the term Bright's disease itself should be applied.

It is applicable only to those affections in which the primary morbid process, caused by irritation of the altered blood, expresses itself as an inflammation involving all the tissues of both kidneys. There is not, as was formerly supposed, a purely parenchymatous form in which the epithelial elements only are affected, nor a strictly interstitial variety in which nothing but the interstitial tissue is the seat of disease. In all forms, in both the acute and chronic, but particularly in the latter there is a **diffuse process** which has its origin in the parenchyma and extends to the interstitial tissue, or, conversely, one which begins in the interstitial structure and later encroaches upon the epithelial portion of the organ.

The most that can be said in regard to this matter, is that according to the nature of the irritating substance producing the inflammation, the parenchyma will be affected in one case and the interstitial struc-

ture containing the blood-vessels in another. So likewise from the clinical standpoint it can only be said that this or that tissue is preponderantly affected, and not that one is exclusively involved. Weigert's investigations have abolished this artificial classification of inflammations of the kidney and proved that the process is always diffuse.

This does not mean, however, that every diffuse process affecting both kidneys is a nephritis. Thus, those affections resulting from circulatory disturbances and degeneration of the vessels, such as passive hyperæmia and amyloid degeneration, for example, are not to be considered as nephritis. It is self-evident, however, that those processes which are localized instead of diffuse cannot be included under the term. The diseases of the kidneys in which there are foci of suppuration, and which constitute the so-called suppurative metastatic nephritis, rightly belong in this category.

Accordingly, it is the object of this chapter to describe **acute and chronic nephritis,** and as a subdivision of the latter the special form known as **contracted kidney.**

ACUTE DIFFUSE NEPHRITIS.

Etiology. Inflammatory processes of the kidney depend upon a morbid condition of the blood, which in turn may be due to morbific agents of various kinds. These substances are carried to the kidneys by the blood, are excreted, and in their progress through the blood-vessels and epithelium exert an injurious or destructive influence. This toxic-hæmatogenous origin explains the circumstance that **both kidneys** are diseased and that the disease is diffused throughout the **entire organ.**

Unilateral nephritis in the sense that the term nephritis is used here, and, moreover, as it is generally accepted, is a condition which I have never seen, and did it exist I naturally would have soon encountered it in the numerous examinations which I have made of both kidneys by means of ureteral catheterization.

Furthermore I do not believe in inflammations of this type which affect only one pole of the kidney. It is true, however, that there are differences in degree, character and extent of the inflammatory processes. These are no doubt due to the circumstance that healing takes place more rapidly in some parts than it does in others, and that the involvement of the blood-vessels is not uniform throughout the kidney.

In regard to the nature of these toxic substances, it must be admitted

that we have not yet succeeded in finding out enough about them to state that the development of all the forms of nephritis is explained. The acute forms in which well-defined chemical poisons reach the body and are excreted by the kidneys are the ones which are best understood. To this class belong the cases of acute poisoning by the mineral acids, corrosive sublimate, carbolic acid, cantharides, potassium chlorate, the aniline preparations externally employed, extensive burns, etc.

In like manner it must be assumed that in the acute infectious diseases certain toxins are formed in the blood which produce disease in the kidneys. It is well known that scarlet-fever, septicæmia and diphtheria may give rise to severe nephritis; the same is true in lesser degree of pneumonia and erysipelas and even more rarely of typhoid fever. It is worthy of note that these sequelæ may first manifest themselves at a very late period.

Thus may be explained the many cases of nephritis in which no previous malign influence can be demonstrated. It is only too probable that in many of these cases there has been an undetected infection, for example, a slight inflammation of the throat, which although producing only trivial local disturbance nevertheless gave rise to the formation of toxins with consequent serious sequelæ. Therefore it need not be denied that exposure to cold and wet, as was formerly supposed to be the case, may cause nephritis, provided that we are inclined to consider it as a factor contributing to the development of inflammation insofar as it favors increase in the number of microörganisms circulating in the blood and impels them to assume unwonted activity.

Pathological Anatomy. The macroscopic appearance of the kidney varies. It may be of normal size although it is more often enlarged; in consistency it is soft, flabby and fragile; the surface is smooth; the color varies from pale red to dark red, the tissue here and there showing punctate or striate areas of deeper hue, which are due to hæmorrhages; the cortex is broadened and the glomeruli stand out as red or pale granules.

Microscopically hæmorrhages into the capsule of the glomeruli and uriniferous tubules are detected. Cloudiness and swelling of the epithelium of the uriniferous tubules and glomeruli, small-celled infiltration of the connective tissue, thickening of the walls of the vascular loops, swelling of the nuclei of the epithelial cells, together with a

crescent-shaped rim of coagulative albumen containing the detritus of the glomerular and capsular epithelium, will also be observed around the vascular loops.

Although these changes affect the entire substance of the kidneys, any one portion may be particularly involved. When the parenchyma is chiefly affected the condition is spoken of as parenchymatous nephritis, or to be more exact, as tubular nephritis when the tubules bear the brunt of the disease, and as glomerulo-nephritis when the glomeruli are principally involved; if the morbid changes in the interstitial tissue are also conspicuous, then the process is known as diffuse nephritis.

Symptoms. It is of the utmost importance for the physician to know that acute nephritis often begins without fever. When a patient complains of general weakness, gastro-intestinal disturbances such as constipation, loss of appetite, nausea and vomiting, suspicion should be aroused that renal disease may be threatening or already be developed, especially if there is a history of a malady or circumstances which are known to be capable of affecting the kidneys.

Alterations of micturition, changes in the urine, and signs of dropsy make an established nephritis manifest. The urine is voided more frequently, is diminished in quantity, and is of higher specific gravity. In color it is dark or red, resembling the juice of raw meat. It contains albumen in quantities varying from 0.1 to 1.%. Under the microscope it shows red blood-corpuscles, mononuclear and polynuclear leucocytes, casts of all kinds—hyaline, epithelial, blood, bacterial—cylinders composed of inorganic salts, and renal epithelium which is often filled with fat-globules.

The signs of dropsy usually show first in the face, beginning in the eyelids, then extending downwards and finally involving other parts of the body; it is characterized by its diverse character (œdema of the feet and legs, œdema of the scrotum, hydrothorax and hydropericardium).

Gastric disturbances, especially vomiting, are often the precursors of uræmia. Inflammations of parenchymatous organs and their serous coverings are frequent and dangerous complications of acute nephritis. Thus pneumonia, pleuritis, pericarditis, and peritonitis may occur.

Most cases of acute nephritis pursue a favorable course and one which is quite independent of the underlying causative affection. In cases of severe poisoning in which there is serious involvement of other organs the prognosis is of course less favorable. A fatal termina-

tion, however, is rare. The duration of the disease may extend over months. If after three, or at the latest six months, the symptoms have not disappeared chronic nephritis almost invariably results. It is only in exceptional cases that complete cure is obtained when the disease is prolonged beyond this period.

Treatment. Prophylaxis is of the utmost importance. Acute nephritis can often be prevented by avoiding the use of such drugs as are known to exert a toxic influence upon the kidneys. Patients suffering from an acute infectious disease may also be saved from renal complications by careful attention. They should not be allowed to get out of bed too soon, for the bodily effort which they then are forced to make, together with the possible exposure to cold, are injurious factors in their cases. Free elimination of toxins should be secured by the administration of diluents and the use of large quantities of carbonated waters.

In a disease which cannot be cured by drugs the *indicatio causalis* plays a great rôle. Rest in bed, a bland diet, large quantities of milk, and warm baths are the chief measures to be employed. For severe pain over the lumbar and sacral region the withdrawal of blood, dry cups, or Priessnitz's compresses are advantageous. If severe bleeding occurs a styptic such as ergot, tannic acid, or the solution of sesquichloride of iron may be prescribed.

CHRONIC NEPHRITIS.

As the duration of acute nephritis is indefinite a sharp boundary-line cannot be drawn between it and chronic nephritis. Therefore transition forms, subacute and subchronic nephritis, are sometimes spoken of.

The same malign influences which are recognized as the causes of acute nephritis, if long continued, may lead to the chronic form. As in the former, so in the latter, the noxious substance is always carried to the kidneys by the blood-stream, whether it be a drug introduced from without or a toxin generated within the body. The most common of these substances are alcohol and lead.

Alcohol may act directly by its irritating influence, or it may lessen the resisting power of the tissues, as a result of which the kidneys can no longer perform the work which they were wont to do without injury; or finally alcohol may produce disturbance of the vessels (arteriosclerosis) and thus lead to renal disease.

Lead acts in the same way. The form most frequently met with in saturnine intoxication is chronic contracted kidney. In many cases both of these poisons, alcohol and lead, are responsible for the development of the disease.

Owing to the gradual evolution of the malady it may, and in fact often does happen, that no cause can be determined. In such cases it must be assumed that many slight infections, such as sore throat for instance, which are scarcely noticed and at all events are forgotten, are the causative factors, although the resulting nephritis does not manifest itself until a time when a cause for its presence can no longer be found.

Furthermore there are two diseases of metabolism in which chronic nephritis occurs either as a sequel or as an associated phenomenon, namely, **gout** and **diabetes mellitus.** So, too, **arteriosclerosis** may be recognized as a frequent cause of contracted kidney.

Besides these exogenous forms of nephritis, cases of genuine contracted kidney occur in comparatively young persons which we must assume with Strümpell to be due to **congenital constitutional weakness** of the renal tissues, as the result of which the process of metabolism cannot be maintained. This hypothesis of renal weakness finds support in the well-known cyclic albuminuria, which occurs only when the patient is up and about or after severe exertion (Leube).

Symptoms. That which is most characteristic of this form of nephritis is the presence of **albumen** and **casts** in the urine. It must be borne in mind, however, that there are renal inflammations (contracted kidney and amyloid disease) in which both of these pathognomonic elements are absent. Without albumen and casts a diagnosis of nephritis cannot, as a rule, be made.

Whilst in health the renal epithelium excretes only the products of destructive metabolism, in nephritis it is so injured that it allows albumen, a substance useful to constructive metabolism, to escape.

The excretion of albumen has also been considered as an inflammatory exudation from the renal tissues, the exudate being composed of blood-serum, and leucocytes which have migrated through the walls of the blood-vessels, and which become mixed with the urine.

The casts are either exudation products, being formed by coagulation of the albumen exuded from the blood-vessels, or they develop from the union, fusion and degeneration of epithelial cells cast off from the uriniferous tubules.

In addition to casts **white and red blood-cells** are also encountered. The former migrate from the blood-vessels, the latter reach the uriniferous tubules either by diapedesis or as the result of capillary hæmorrhage. Furthermore, renal epithelium is found, the cells being somewhat larger than leucocytes, having large nuclei, and often showing fatty granules. Leucocytes may also take up granules of fat.

If the kidneys fail to excrete the products of retrograde metabolism, the retention of these substances in the blood soon makes itself apparent in the condition of the general health.

The diminution in the excretive power of the kidney cells, in other words, the accumulation of injurious substances in the blood, puts more work upon the heart, since it functionates more actively in an endeavor to flush the kidneys and thereby purify the blood.

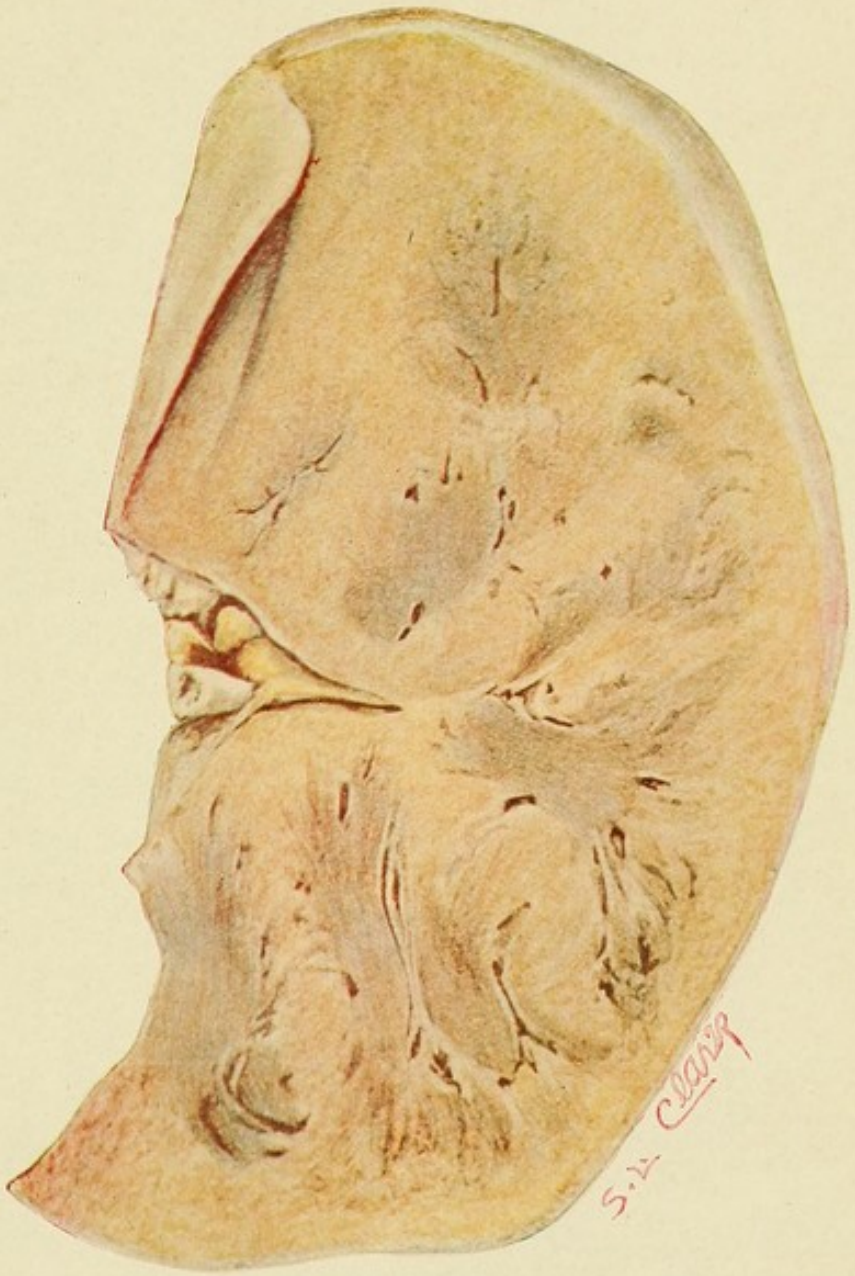
The expression of this increased work of the heart is a rise in arterial blood-pressure, **increased tension of pulse,** accentuation of the aortic second sound, **hypertrophy of the left ventricle,** and occasionally of the right as well. These cardiac changes are plainly shown by increase in the area of cardiac dullness toward the left (and also occasionally to the right) and abnormal accentuation and resistance of the apex-beat. As long as this augmentation in cardiac activity can prevent the accumulation of the toxic material in the blood, the term compensated renal disease, introduced by Strümpell, may be correctly used.

Among the general symptoms **uræmia** may be first mentioned; it is due to the accumulation of urinary elements, but what the exact nature of the poison is we do not know. The intoxication manifests itself by uræmic hæmiplegia, epileptiform convulsions, amaurosis, headache, vomiting, dyspnœa, stupor, convulsions and coma; coma generally supervenes gradually, but it may develop suddenly.

Another expression of the toxic substances circulating in the blood is the occurrence of degenerative changes in the mucous membrane of the stomach, intestines and respiratory organs, and in the pleura, pericardium and retina. Thus gastritis, enteritis, bronchitis, pneumonia, pleuritis, pericarditis and retinitis are not uncommon affections in those afflicted with nephritis.

It has not been positively determined whether **dropsy** is a result of nephritis, or whether the same poisons which produce the nephritis also give rise to changes in the blood-vessels leading to the development

PLATE XXI



LARGE WHITE KIDNEY, NATURAL SIZE. (DRAWING MADE FROM SPECIMEN IN THE MUSEUM OF THE JEFFERSON MEDICAL COLLEGE.)

of dropsy. It is characteristic for the subjects of nephritis to have localized œdema (for instance that affecting the face, eyelids, wall of the thorax and pleural cavities) in contradistinction to general dropsy such as occurs in cardiac disease, and which first manifests itself in the dependant portions of the body, for instance, the ankle-joints. The disturbances in the blood-vessels may also give rise to hæmorrhages from the most diverse parts of the body—the nose, the intestines, the brain.

If it seems from what has already been stated that the clinical picture of chronic nephritis is so characteristic that a diagnosis can be made without difficulty, the question will yet arise as to whether we are in a position to decide which form of nephritis predominates, a question which is of importance from the standpoint of prognosis and expectation of life.

As the various causes of nephritis produce the same structural changes it is not desirable to classify the disease according to its etiology, but rather according to its pathological anatomy, especially since the clinical phenomena are essentially dependent upon the anatomical changes.

Weigert has established the unity of the different forms of nephritis and shown that the differences in the anatomical picture, as in the clinical, are merely in the magnitude, rapidity of development and extent of the morbid process. For example, if the poison works with great intensity in equal degree upon all parts of the parenchyma, chronic diffuse nephritis develops; if the malady progresses slowly and the destruction of the parenchyma consequently takes place gradually, and in patches, genuine contracted kidney results.

In **diffuse nephritis,** owing to the swelling of the epithelium and the serous infiltration of the tissues, the kidney is enlarged and swollen; it looks red when the blood-vessels are equally distended, pale and yellow if the epithelium is fatty, variegated if infarcts are interspersed among the fatty portions. In accordance with these changes a **hæmorrhagic,** a **large white fatty,** and a **large variegated kidney** are spoken of.

There is never a genuine chronic parenchymatous nephritis, for wherever there is extensive destruction of renal epithelium there is likewise an increase of interstitial connective tissue, and this can be demonstrated early in the course of the malady. If the process advances slowly the kidney remains large for a certain length of time, perhaps

for years; the contraction which the newly formed connective tissue produces ensues very gradually, but results in the **secondary contracted kidney** with its granular surface. This kidney becomes constantly smaller and smaller.

If the disease comes on very insidiously the parenchymatous changes do not occasion any enlargement of the organ, but the **genuine contracted kidney** with its granular, nodulated surface is slowly produced

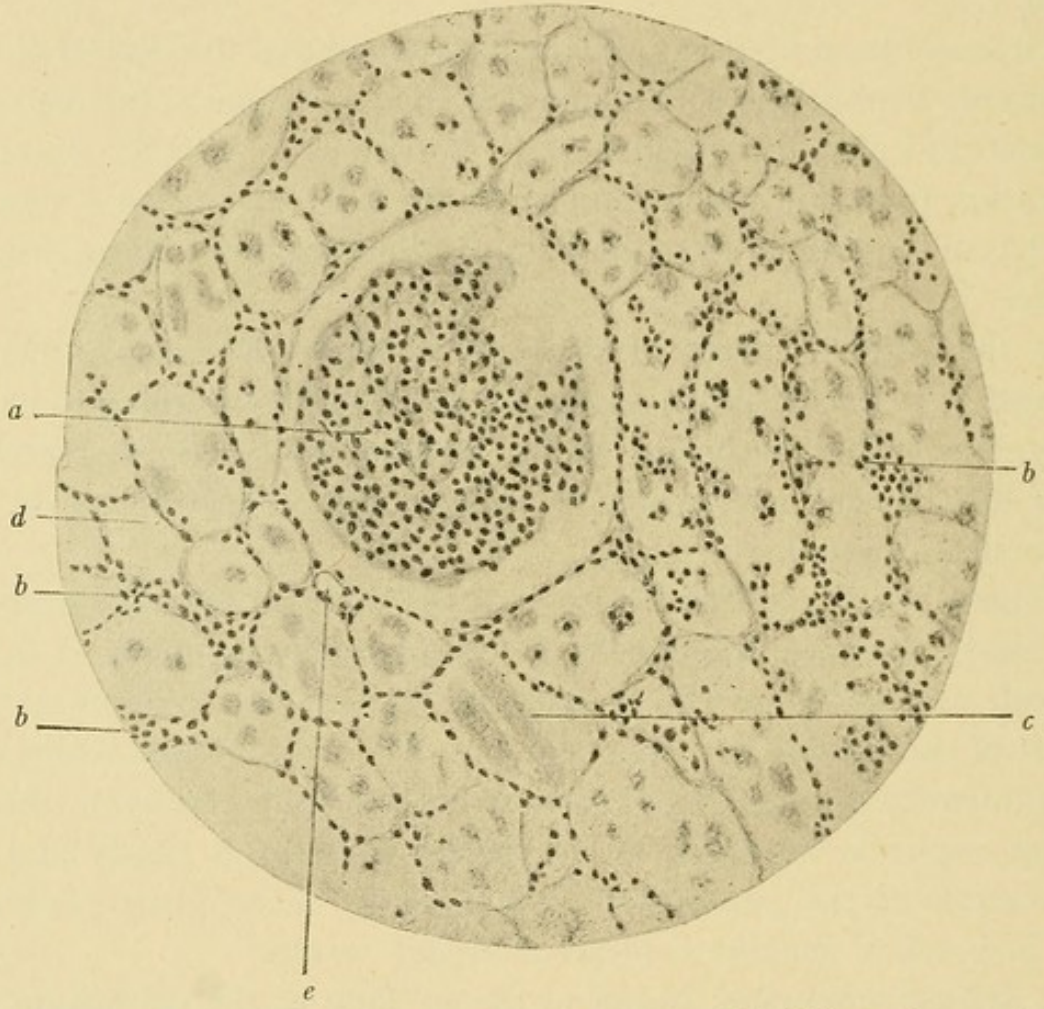
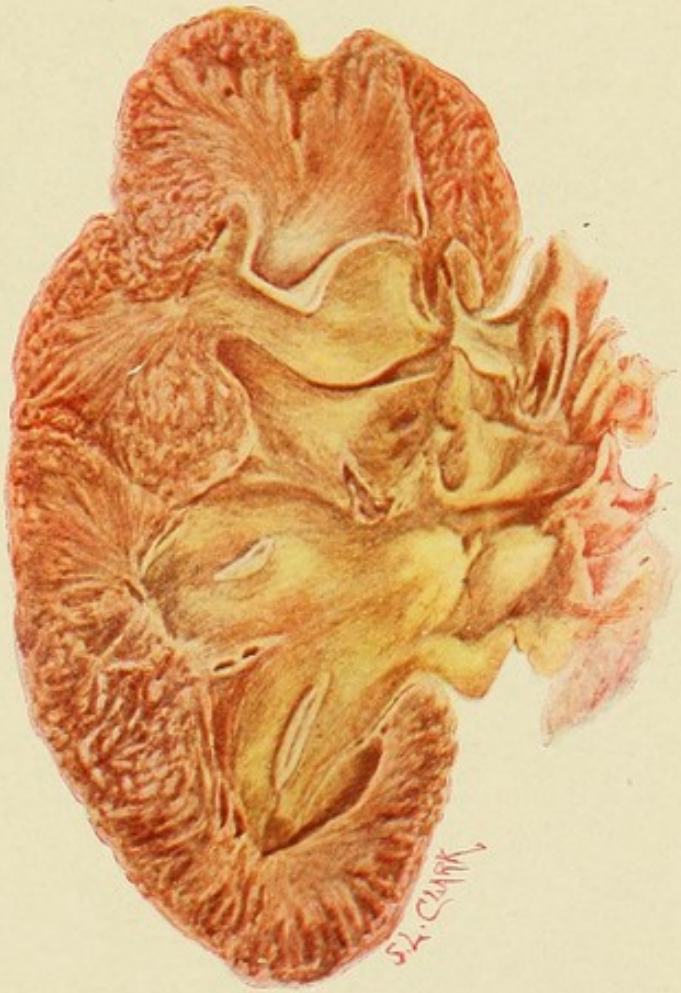


Fig. 220.—Chronic parenchymatous nephritis. *a*. Malpighian tuft containing an unusually large number of nuclei. *b. b. b*. Points at which there is slight increase in the interstitial tissue. *c*. Tubule containing granular, degenerating, epithelial cells, which have coalesced. *d*. Tubule from which all the epithelium has desquamated and been discharged. *e*. Blood-vessel. (Coplin.)

without any intervening symptoms of severe disease of the epithelium being present. It may be either hyperæmic, the **red contracted kidney,** or anæmic, the **white contracted kidney.** The presently accepted opinion as to the unity of the pathic process makes it seem desirable to me to differentiate, in common with Strümpell, the following forms of chronic nephritis.

1. The diffuse subchronic and chronic forms, which generally cause

PLATE XXII



CHRONIC INTERSTITIAL NEPHRITIS. (DRAWING MADE FROM SPECIMEN IN THE MUSEUM OF THE JEFFERSON MEDICAL COLLEGE.)

enlargement of the organ; their subdivisions are: (a) simple diffuse parenchymatous nephritis: large red kidney; (b) parenchymatous nephritis with pronounced fatty degeneration of the epithelium: large white kidney; (c) diffuse parenchymatous nephritis with hæmorrhages: large variegated kidney.

2. The later stages of diffuse parenchymatous nephritis with beginning contraction; the kidney is of normal size, or already somewhat smaller than in health; this is the secondary contracted kidney.

3. The genuine contracted kidney.

4. The arteriosclerotic contracted kidney.

Examination of the urine affords the best means of distinguishing these forms clinically. In **diffuse chronic parenchymatous nephritis**

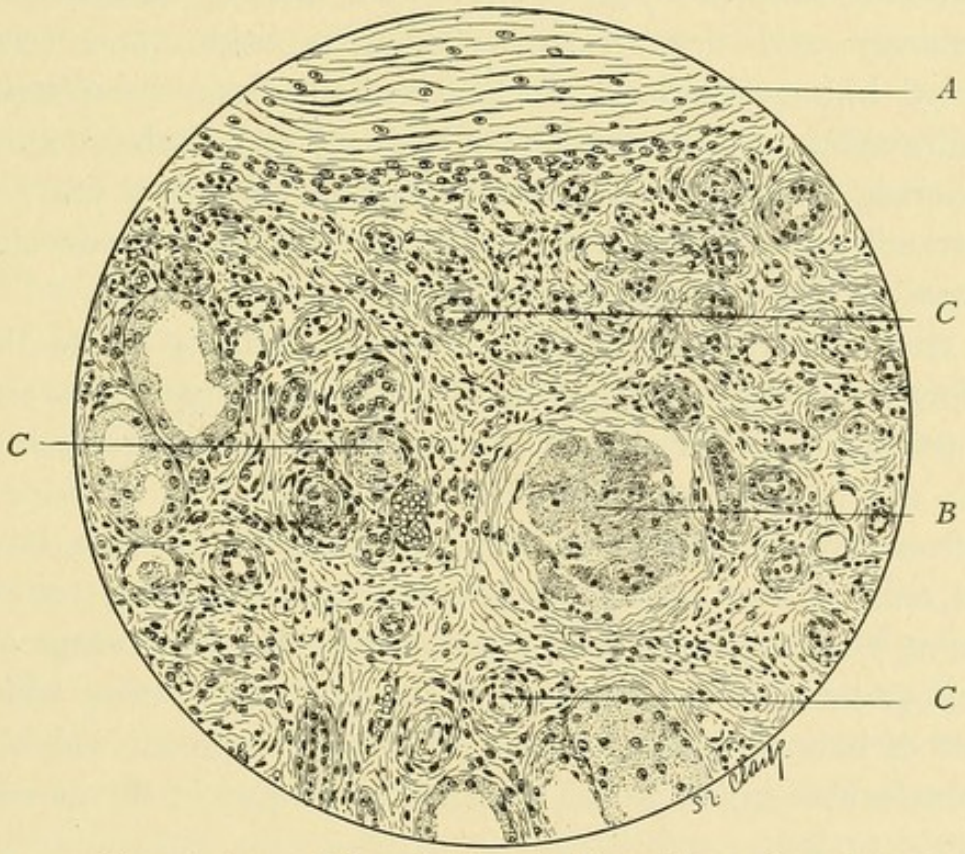


Fig. 221.—Chronic interstitial nephritis. *A*. Part of capsule. *B*. Malpighian body showing advancing granular and hyaline changes with marked thickening of the capsule. *C.C.C.* Tubules in the midst of newly formed connective tissue; epithelium wasted or absent and tubular wall notably thickened. The larger tubes on the left and below are somewhat dilated. (Coplin.)

there is a diminution in the excretion of urine, the same as there is in the acute form; the quantity may fall to 800 c.c. [about 26 fluid ounces] or even less; the specific gravity is high, ranging from 1015 to 1020; there is a considerable quantity of albumen, casts of all kinds, and an abundance of white and red blood-cells and epithelium. Numerous blood-

casts indicate capillary hæmorrhages; fatty casts and fatty granular cells are signs of marked fatty degeneration of the epithelium of the uriniferous tubules.

This condition of the urine is nearly identical with that which obtains in acute nephritis, because the morbid process, though differing in its duration, is essentially the same in character. A further differentiation is afforded by the general manifestations of the disease, the associated conditions, and the sequelæ. These consist in œdema of the subcutaneous connective tissue, collections of fluid in the serous cavities, uræmic symptoms such as headache and vomiting, retinitis, and hypertrophy of the heart, particularly of the left ventricle. The duration of the disease may extend over years. The patient may succumb at the end of a year or two, or the intense phenomena due to inflammatory and degenerative changes subside, and secondary contracted kidney develop. Such a remission may be mistaken for cure, although in reality the disease is slowly progressing. Cure may occur during the first months and perhaps even after a year. If the albumen still persists at the expiration of this period, the development of contracted kidney must surely be expected.

The clinical picture of **genuine contracted kidney** is also different. The slowly progressive process is such that the organism's power of resistance has time to establish compensation, and as a result of this there is neither marked diminution in the quantity of urine nor a marked excretion of albumen. On the contrary, polyuria is usually present, two or three liters of urine of low specific gravity (1005–1010), containing but little albumen and few formed elements, being voided in twenty-four hours. The increase in the quantity of urine will be understood if it is assumed that arterial pressure is already raised before any considerable injury to the secretive structures in the parenchyma occurs.

The general symptoms and sequelæ are quite in accord with the urinary findings, being very slight, in fact often so trivial that the disease may remain unnoticed for years. Headache and disturbances of vision not uncommonly lead to its discovery; later in its course dyspnœa due to cardiac insufficiency, weakness, loss of appetite, emaciation and pallor manifest themselves. Œdema is often wanting or occurs late in the disease. It is an expression of cardiac rather than renal insufficiency. Therefore it affects the dependant portions of the body, the legs and ankles.

In case the circulatory disturbances gain ascendancy over the renal, the clinical picture is converted into one of uncompensated cardiac disease; the urine is modified by the circulatory engorgement, being small in quantity, of a deep color, a high specific gravity, and containing much albumen; dyspnœa is also present. Signs of uræmia may be entirely absent, may come on suddenly, or may develop gradually. In the advanced stages of the disease complications affecting other organs are very common. Among them may be mentioned cardiac disease, hypertrophy and cirrhosis of the liver, arteriosclerosis, bronchitis, and gout.

The **arteriosclerotic contracted kidney** presents the same clinical picture as the genuine contracted kidney. The urine is pale and of low specific gravity, and polyuria and hypertrophy of the heart are present; the symptoms referable to the heart and vessels are more pronounced than those produced by the renal lesions.

Arteriosclerotic nephritis may be co-existent with general arteriosclerosis, the toxins simultaneously causing disease of the kidneys and blood-vessels; it may be a result of renal disease, the vessels being injured by changes in the blood depending upon faulty action of the kidneys; and conversely, the arteriosclerosis and obliteration of the smaller renal vessels may interfere with the blood-supply of the parenchyma and bring about necrosis. This condition is typical in old age.

The prognosis of chronic nephritis is unfavorable. The more diffuse the morbid process the sooner will dropsy, uræmia and other complications ensue and produce death. The transition into secondary contracted kidney is relatively favorable, as it leads to an apparent arrest of the disease, the general condition and functional capacity of the body often being such that they leave little to be desired. The anatomical changes may progress so slowly that complete destruction of the organ does not take place for years. Therefore, although every contracted kidney shortens life, the patients may live from ten to twenty years.

The therapeutic measures at our command have already been mentioned under acute nephritis. Prophylaxis is important. Everything known to injure the kidneys, for instance, certain drugs and alcoholic beverages, should be avoided. Care should be taken to prevent contraction of the infectious diseases, and exposure to cold should be guarded against. Furthermore regulation of the diet is important.

It should be unirritating, consisting of milk, vegetables, farinaceous articles and little meat; highly seasoned food, spices and alcohol are to be interdicted. The patient should be warmly clad and obtain as much fresh air as possible; it is also desirable that he should reside in a warm climate. The skin should be kept active by two or three warm baths every week and brisk rubbing with cool water or spirits. I know of no drugs which influence the process favorably. For dropsy diuretics such as potassium acetate and diuretin, together with sweating [the hot pack] may be employed; for cardiac insufficiency digitalis, strophanthus, and small doses of morphine; for chronic uræmia antipyrin and phenacetin; for acute attacks chloral, chloroform, and venesection. [In cases of chronic contracted kidney associated with high arterial tension and a greater or lesser degree of general arteriosclerosis, I get good results from the use of nitroglycerine in ascending doses. It is my practice to begin with $\frac{1}{100}$ of a grain four times a day and increase gradually as the patient becomes accustomed to the drug and the latter begins to lose its effect.

For the anæmia of chronic nephritis Basham's mixture, in the dose of two or three drachms three times a day, will be found useful. It acts both as a tonic and a diuretic. In uræmia the hot pack and free purgation with calomel may be employed in addition to the measures already mentioned; and hypodermoclysis or venous infusion of normal saline solution may be used in conjunction with blood-letting.]

THE NEPHRITIS OF PREGNANCY.

By the term "nephritis of pregnancy" is understood an affection of the kidneys caused by the gravid state, but which is not generally recognized as being inflammatory in character. It does not manifest itself before the third month of pregnancy, and its development is to be explained by assuming that there is an accumulation of toxic products in the blood; owing to the disturbed condition of the circulation these substances are not properly excreted. Thus there is a faulty elimination and the resulting toxæmia causes the inflammation. The nature of these toxins has not yet been determined.

The **kidney of pregnancy** is pale. There is extensive fatty degeneration of the epithelium and the convoluted tubules. The clinical symptoms usually consist in œdema, dropsy, and changes in the urine similar to those occurring in acute nephritis. The quantity is diminished, the specific gravity high, and the amount of albumen considerable,

although, as a rule, organized elements are not so abundant as in acute nephritis. There are cases in which casts are entirely absent throughout the course of the disease.

The disease occasionally has a rapidly fatal termination, but more commonly recovery takes place, the patient regaining health soon after delivery. Convulsions occurring before or during labor seriously threaten life; they constitute the condition known as eclampsia of pregnant or parturient women [commonly called eclampsia of pregnancy]. It is a condition concerning the causes of which no uniformity of opinion has yet been reached. The number of deaths from eclampsia is fairly large, although the affection often terminates in recovery. It is exceptional for the nephritis of pregnancy to lead to chronic nephritis. The treatment is the same as that recommended for the other forms of nephritis. Above all things, the prevention of eclampsia is to be sought. If the symptoms are so menacing that its supervention is feared labor may be induced. Eclampsia itself is to be combated by chloral hydrate, inhalations of chloroform, venesection, infusion and transfusion.

AMYLOID DEGENERATION OF THE KIDNEY.

Amyloid degeneration of the kidney does not of itself represent an inflammatory process. It depends much more upon the presence in the blood of some toxic substance which causes a disturbance of the protoplasm, particularly of the connective tissue.

The causes of this degeneration are known to be long-continued suppuration in any part of the body, bone-fistulæ, empyema, bronchiectasis, tuberculosis of the lungs, suppurative disease of the kidney itself, and tertiary syphilis. As a result of the disease, the tissue, especially the walls of the blood-vessels in the glomeruli, sustain such injury that they become highly permeable to albumen. Accordingly there is a severe albuminuria and also an increase in the quantity of urine, the renal capillaries allowing more fluid to filter through. The urine is bright yellow, but has a relatively higher specific gravity than that of contracted kidney, for the reason that it contains much more albumen than the latter. Organized elements are rare and generally are not met with at all.

Owing to the increased permeability of the kidneys there is no retention of urinary elements in the blood, so that symptoms depending upon such retention, namely. hypertrophy of the heart, secondary

inflammations and uræmia are absent. The severe œdema frequently met with is to be explained by the occurrence of alterations in the blood-vessels, it being probable that the toxins affect the vessels of the skin in the same deleterious manner as they affect deeper structures. It is typical for amyloid changes to occur simultaneously in other organs. Thus the liver and spleen are enlarged, and amyloid degeneration of the intestines takes place, giving rise to diarrhœa. The skin also has a striking yellow, waxy appearance.

Amyloid tissue gives a characteristic reaction with Lugol's iodine solution, turning reddish, mahogany, or nut-brown when brought in contact with this fluid, whereas the other tissues are colored yellow. It is colored red by the anilin dyes, methyl violet, gentian violet and methyl green, and blue by thionin.

Although the diagnosis is generally not difficult, it may become so when genuine nephritic changes are superimposed upon the amyloid degeneration, as the former affect particularly the epithelium. Under these circumstances there is first a combination of amyloid kidney and diffuse nephritis and later an amyloid contracting kidney, or if the nephritic process is very insidious in its evolution, a combination of genuine contracted kidney and amyloid kidney may be found. The clinical symptoms and the character of the urine then correspond to a combination of these two conditions.

The prognosis of amyloid disease is not absolutely unfavorable. Of course those portions of tissue which have been destroyed cannot be regenerated, but if the causative factors can be eliminated the tissue which is yet undamaged will remain healthy, so that there is only a partial ultimate defect. Therefore the first object of treatment is the removal of the source of suppuration, or perhaps the subjugation of syphilis.

FATTY KIDNEY.

The term fatty kidney is applied to a condition in which a collection of fat is found in the epithelium of the uriniferous tubules without the presence of an associated inflammatory process in the kidney. The condition is one of fatty degeneration in the sense that this term is used by Virchow, that is, the fatty destruction of renal epithelium is only a manifestation of a general fatty degeneration affecting the liver, the heart, the muscles, etc. It is usually the result of an intoxication. Among the poisons best known to produce this condition are phos-

phorous, arsenic and sulphuric acid. In rare instances it occurs in pernicious anæmia.

PYELITIS AND PYELONEPHRITIS, SUPPURATIVE NEPHRITIS, ABSCESS OF THE KIDNEY.

These four affections have much in common and are partly stages of one and the same morbid process. They all result from infection and are associated with suppuration in the kidney, be it macroscopic or microscopic in extent. There is, however, an essential structural and clinical difference between them.

Whilst pyelitis is exclusively a disease of the pelvis of the kidney, in pyelonephritis the tissues of the cortex are also involved. The term suppurative nephritis is used as long as miliary foci of suppuration are present in the kidney, but when these become confluent and form a focus large enough to be seen with the naked eye, the term kidney-abscess is applied.

Etiology. The form of suppuration which develops in the kidney and its pelvis depends, apart from the circumstances to be mentioned later, upon the kind of infection which takes place. Microörganisms may gain access to the kidney through the blood-stream or through the urinary tract. When infection occurs in the former way it is called **hæmatogenous,** when in the latter **urogenous.**

The type of hæmatogenous metastatic renal suppuration is such as occasionally develops in pyæmia, septicæmia, ulcerative endocarditis, pneumonia, measles, scarlet-fever, small-pox, typhoid fever and dysentery.

The urogenous or ascending infection almost always follows a cystitis with or without concomitant retention of urine. The cystitis of old persons, especially prostatics, is almost invariably associated with retention; in such persons long-continued disease very often leads to involvement of the renal pelvis. Young men suffering from gonorrhœal cystitis may also be attacked by unilateral or bilateral pyelitis, owing to extension of the infective process upwards.

A third way in which it is possible for infection to take place is directly from without, as in wounds of the kidneys.

Finally the infective microörganisms may wander to the kidney from neighboring organs, as for example, in inflammation of the liver, intestines and psoas muscle. The numerous cases of infection with the bacillus coli communis which have been observed must be considered

as hæmatogenous; for some unknown reason the system becomes flooded with these organisms and they are occasionally deposited in the kidney or its pelvis.

In like manner are to be understood those suppurative processes of the kidney which develop as the result of infection in other parts of the body, as for example, from a carbuncle. In this instance the microörganisms in the carbuncle are transmitted to the kidneys through the blood-stream.

Among the bacteria found in the secretion from the kidney are the colon bacillus (already mentioned), streptococcus, gonococcus, and proteus vulgaris. In one case the actinomyces was demonstrated to be the exciter of suppuration. The diplococcus pneumoniæ of Fraenkel and the typhoid bacillus are also, though rarely, found. It is yet undecided whether the diplococcus ureæ of Rovsing, the streptococcus ureæ, sarcina alba and flava, coccobacillus ureæ, bacillus longus liquefaciens, and bacillus crassus have any causative relation with renal suppuration; at all events they are of no great importance.

It is evident that circulatory disturbances of the kidney such as occur in pregnancy, and even in greater degree in certain diseases of the kidney, favor the development of infection.

Pathological Anatomy. The pelvis of the kidney shows a most variable condition according to the character, intensity and duration of the infectious process. It is slightly or not at all dilated, contains urine which may be merely a little cloudy, or purulent, malodorous, and swarming with microörganisms. The mucous membrane is swollen, varies in color from light gray to red, and is traversed by dilated vessels. If ecchymoses are present the condition is called hæmorrhagic pyelitis. The existence of large shreds composed of fibrin and bacteria, which during life are sometimes discharged in the urine, has led Rovsing to speak of a pseudomembranous pyelitis. If there is a coating similar to that found in the throat in diphtheria (fine granular masses containing bacteria and pus-corpuscles), the term croupous or diphtheritic pyelitis is used; if the coating is composed of gangrenous mucous membrane, the condition then might be called gangrenous pyelitis.

If in addition to these phenomena obstruction occurs, the pelvis and **calices** become dilated. In consequence of the pressure to which they are subjected the papillæ gradually become flattened, atrophy, and finally are destroyed. The pelvis becomes more and more dilated

at the expense of the renal tissue; the cortex becomes narrower and narrower, the sac wider and wider.

This form of extension of the process is, as a rule, peculiar to ascending pyelitis, in which the ureter is also involved. The latter structure is dilated in some places and constricted in others without there being any material thickening of the wall (*ureteritis interna*). The morbid process chiefly affects the inner layer of the ureter. If superficial cavities are present, which represent dilated mucous glands, the condition is known as cystic ureteritis. In external ureteritis or periureteritis, which is also associated with constrictions, the outer layers of the ureter, the musculature and its surrounding connective and fatty tissue are chiefly affected. The ureter becomes very much thickened, is adherent to its surrounding structures, and its lumen may become entirely occluded.

The morbid process may not pursue the course above described, leaving the kidney unimpaired except for the damage it sustains in consequence of compression, but it may early invade the kidney itself, giving rise to a true infectious renal inflammation. We then have to do with pyelonephritis.

In recent cases the kidney is generally swollen, soft, and fragile. Upon section the swelling is also plainly marked. If the disease progresses slowly, radiating gray striations, which can sometimes be traced to the cortex, are seen when the kidney is sectioned, and accompanying them red streaks or specks may be found; they are collections of leucocytes derived from the surrounding inflamed tissues and in later stages appear as minute abscesses.

Microscopically the epithelium of the uriniferous tubules, especially in the medullary portion, either undergoes proliferation leading to dilatation of the tubules, or else it undergoes retrograde changes. The cells are granular and some are replaced by fat-corpuscles. Areas infiltrated with leucocytes are seen here and there in the connective tissue, especially in the medullary portion, but also around the glomeruli. In the center of these areas the microörganisms are located and force their way out into neighboring parts. Softening of these areas leads to formation of the miliary abscesses already mentioned.

It is somewhat different with descending hæmatogenous pyelitis and pyelonephritis. In the course of an acute infectious disease, or a suppurative process in a remote portion of the body, genuine pyelitis may naturally occur as the result of metastasis, and present the same

structural picture as urogenous pyelitis. This, however, is exceptional. As a rule, pelvis and cortex are simultaneously involved, so that every metastatic pyelitis is also a pyelonephritis. In the acute forms, in addition to hæmorrhage into the parenchyma of the kidney, changes in the epithelium in the cortex are especially prominent. In the convoluted tubules the epithelial cells are granular or fatty and the nuclei stain poorly or not at all. Interstitial collections of leucocytes are present, particularly in the region of the blood-vessels. They contain microörganisms of all kinds.

If the process becomes chronic, these masses of leucocytes are slowly changed into circumscribed abscesses, which in contradistinction to those occurring in the ascending form, are located more in the cortex, so that the surface of the kidney has a rough, irregular appearance. Small foci of suppuration also occur in the medullary substance, but their arrangement is not so regular as that which characterizes those in the cortex. Microörganisms are found in the blood-vessels, especially when the latter contain emboli. In the previously described ascending form the microbes are contained mostly in the uriniferous tubules.

The longer the process lasts the more diverse are the anatomical changes, until finally alterations of the most different character are found side by side; thus a pyelitis of increasing severity may be associated with interstitial and parenchymatous nephritis and simultaneous pressure-atrophy of the renal tissue, or hæmatogenous infection may lead to severe suppuration in the pelvis of the kidney and consequent distention of the same, in addition to the interstitial and other parenchymatous changes already present.

Symptoms and Course. The clinical picture is different in the acute and chronic forms. Both, however, are generally preceded by some other disease of the kidneys or other organs.

Acute pyelitis usually begins with chills and high fever, which may reach 40° or 41° C. [104°–105.8° F.]. The ordinary phenomena accompanying high temperature are present; the tongue is dry, thirst is experienced, and there is some hebetude. The urine contains pus, bacteria and albumen, according to the degree of the nephritic process.

Death sometimes occurs within a short period; in other cases the fever subsides suddenly or assumes the remittent type; in still others it gradually becomes normal, and the acute process passes into the chronic.

The renal region is frequently sensitive. If this sensibility becomes pronounced, lasts for a long time, and if the chills and fever recur, it may be assumed that an abscess is forming in the kidney or that one is already present.

It is not uncommon for the acute form to become chronic. More frequently, however, the latter form develops insidiously without being preceded by an acute process. It must be borne in mind that pyelitis and also pyelonephritis may be entirely unaccompanied by fever. When of the secondary form, it is preceded by diseases of the lower genito-urinary tract, such as gonorrhœa, stricture, prostatic affections, tumors of the bladder, puerperal diseases, and vesical paralyses (tabes, myelitis, etc.). The excretion of pus, tenderness over the affected kidney, the development of a small swelling in the lumbar region, and constitutional disturbances are the most important symptoms.

In regard to the general condition, it may be stated that pyelitis may exist for many years without producing the slightest constitutional disturbances. Just as there are persons having chronic cystitis for years without impairment of the general health, so, too, there are others with pyelitis who suffer no constitutional trouble. Suppuration may be confined entirely to the pelvis of the kidney for a very long period of time without the kidney itself becoming involved.

More frequently, however, nephritis is superimposed upon the pyelitis. Pyelonephritis may also pursue so slow a course and the destruction of renal tissue which it leads to be so gradual that years elapse before the patient notices any trouble. This, however, is exceptional, considerable disturbance usually ensuing within a short time. The patients gradually lose flesh, the appetite becomes impaired, the tongue is coated, nausea and vomiting are present; in short, they show signs of being seriously ill, presenting a clinical picture similar to that of a protracted and advanced diffuse hæmatogenous nephritis.

This applies to unilateral as well as bilateral ascending pyelonephritis. Accordingly this condition of decline is to be attributed to a poisoning of the blood, a toxæmia, rather than to renal insufficiency. The more frequently attacks of fever occur during the malady the earlier is the supervention of the decline.

Tenderness in the region of the affected kidney is a totally untrustworthy symptom. It is occasionally present, and is then of some value, but it is as often absent, and its absence does not afford proof

that the kidney is healthy. Patients often complain of an annoying feeling of pressure in the region of the kidneys, which becomes intensified upon severe exertion.

The same statement may be made in regard to swelling. It may be present or absent. A pyelitis may exist without the pelvis of the kidney being markedly dilated; a pyelonephritis may be present in which the destruction of renal tissue leads to diminution in the size of the kidney.

When there is a copious secretion of pus it is not unusual for the ureter to become partly or entirely obstructed. This leads to obstruction in the pelvis of the kidney; the kidney itself becomes swollen and tender. During this time the urine may lose some of its turbidity or even become perfectly clear. The signs of retention are usually accompanied by fever and also occasionally by attacks of typical renal colic. These are conditions which resemble those encountered in intermittent hydronephrosis and pyonephrosis, concerning which more will be said later.

In consequence of this uncertainty in the symptoms, we are forced to depend upon the changes in the urine for the establishment of a diagnosis. The history of a previous malady is also of some value. Several peculiar characteristics have been attributed to pyelitic urine. It has been said that the quantity voided, its reaction, its albumen-content and the kind of epithelium it contains will supply sufficient data for the establishment of a diagnosis. This statement, however, is incorrect. **The only constant and trustworthy characteristic of pyelitic urine is the presence of pus.**

It is true that the urine of pyelitis and pyelonephritis is usually acid, but in the majority of cases of cystitis the urine is also acid. On the other hand, if ammoniacal decomposition of the urine in the pelvis of the kidney takes place, an alkaline reaction may be obtained in pyelitis. That club-shaped or tile-shaped epithelial cells placed one upon another must be derived from the pelvis of the kidney is an idea which formerly met with general acceptation, but at present it is generally agreed that the same forms may be derived from the deeper strata of the lower urinary tract; consequently their presence does not constitute a means of differential diagnosis.

Furthermore, as concerns the albumen-content, it is entirely wanting in true pyelitis. Only as much albumen is found as is contained in the pus which is excreted. Even when the latter is present in large

quantity the amount of albumen will scarcely exceed 0.1%. In pyelonephritis the albumen-content is naturally higher, as it corresponds to the amount of pus secreted and therefore increases *gradatim* with the involvement of the kidney. Pyelonephritis, therefore, may be differentiated from cystitis by means of the albumen-content, but simple pyelitis cannot thus be distinguished.

Casts are not present in true pyelitis, nor do they occur in pyelonephritis as a rule, being absent just as they often are in contracting kidney. Their constant presence points towards pyelonephritis, but their absence does not exclude the possibility of this disease.

The presence of pus in the urine is the only positive sign. As admixture of pus occurs in other diseases, for example, in certain affections of the bladder and prostate, the task of determining whether the pus originates in the kidney may be reserved for those cases in which its presence cannot be traced to some other source.

Moreover, if the diagnosis of pyelitis or pyelonephritis be accepted, it still remains to be determined whether the disease is unilateral or bilateral. In most cases careful observation of the course of the disease will enable one to make a differential diagnosis, or at least to determine whether cystitis alone is present, or whether there is an associated pyelitis.

For this purpose the effect of treatment is of assistance. All forms of cystitis except those due to malignant tumors and tuberculosis improve under proper local treatment. The subjective symptoms abate and the urine becomes clear. If the amount of pus fails to decrease despite careful treatment, and tuberculosis and malignant disease of the bladder can be excluded, one will seldom go wrong in assuming that the pus comes from the kidney or pelvis of the kidney.

The positive determination of the source of the pus, as well as knowledge relative to which kidney is affected, is afforded only by cystoscopy and catheterization of the ureters. The orifices of the ureters are revealed by the cystoscope, and the turbid, purulent urine can often be seen issuing from them. If the turbidity is so slight that it cannot be determined whether the fluid spurting from the ureters is cloudy or not, a ureteral catheter is introduced and the urine thus collected. If pyelitis is not present the urine will contain only epithelium, or perhaps only a few red blood-corpuscles, their presence being due to diapedesis resulting from hyperæmia. Otherwise it contains pus-corpuscles.

To determine whether the kidney itself is affected its functional capacity should be tested (see page 469). In simple pyelitis or chronic interstitial nephritis each kidney will give approximately the same value for △ and sugar, whilst in pyelonephritis the diseased kidney will give a value less than that of the healthy one.

The **prognosis** of suppuration in the kidney is variable. Simple pyelitis may exist for years without the kidney itself becoming involved and without producing any disturbance whatever. Pyelonephritis, as a rule, gradually leads to destruction of the kidney, and therefore must be considered as a serious malady. Pyelitis also not uncommonly invades the kidney and its importance is not to be underrated. Unilateral affections naturally offer a more favorable prognosis than bilateral.

Treatment. The treatment of acute pyelitis consists in the employment of antiphlogistic measures, the local abstraction of blood, the application of ice, narcotics for the relief of severe pain, quinine, salicylic acid and antipyrin for fever, urotropin for disinfection of the renal pelvis, and the use of moist warm cataplasms in the subacute forms. A bland diet and regular evacuation of the bowels are of course necessary. The patient should drink freely; Fachingen, Wildungen and similar waters are well suited to these cases. In the majority of cases these measures will overcome the disease, or at least allay its most violent manifestations, so that it passes into the chronic stage.

If threatening symptoms persist, such as high fever and chills, and if an exact diagnosis has been made as to which kidney is diseased, or at least as to which one is the more diseased, a brilliant curative effect can sometimes be obtained by splitting the kidney. This applies to pyelitis as well as to pyelonephritis. This procedure will naturally be of use only in the ascending forms, or in metastatic suppurative processes in which the primary disease with its localization in other organs has already or is about to become extinct.

In regard to the treatment of chronic pyelitis and pyelonephritis, the measures already mentioned for the acute form should be tried first. These consist in drinking-cures, rest, baths, diet, and the administration of urotropin. The chances of cure by these means, however, are slight.

For pyelitis of benign nature, or in other words one due to the gonococcus or bacillus coli communis, irrigation of the pelvis of the

kidney with silver nitrate solution 1 : 1000 is wonderfully effective. I have tried it in twelve cases (nine due to the gonococcus and three to the bacillus coli communis) which had resisted all other treatment and have obtained a perfect cure in every case. It is contraindicated in pyelonephritis, and when tuberculosis or renal calculi affect the pelvis of the kidney. If the tubercle bacillus cannot be found, it can be learned whether the suppuration is dependent upon tuberculosis by inoculating a guinea-pig with the secretion. The diagnosis of pyelonephritis can be accepted when the functional renal examination shows a considerable diminution in the value of △ and sugar in comparison with the urine from the opposite kidney. In suppuration due to calculi irrigation of the renal pelvis has a transitory, but not permanent, beneficial effect. The suppuration becomes less but does not cease.

In unilateral pyelonephritis good results may be obtained by nephrotomy, provided that the disease is not too far advanced. The kidney is laid open, washed out with 1 : 1000 silver nitrate solution, and the wound left unclosed. If the kidney has been destroyed by multiple foci of suppuration, nephrectomy is indicated, provided of course that the functional capacity of the other kidney permits it. It has not been positively determined whether cure can be obtained in bilateral pyelonephritis by operating first on one kidney and then later on the other. Before the question is decided information must be collected in regard to the degree of danger incident to such a procedure.

HYDRONEPHROSIS.

Etiology. Various names have been applied to those affections of the kidney in which fluid accumulates in the renal pelvis and causes it to become distended. Among these may be mentioned cystinephrosis, sacciform kidney, and hydronephrosis. I prefer the term hydronephrosis, which was first used by Rayer, and shall designate as such those dilatations of the pelvis of the kidney which are caused by obstruction to the outflow of urine.

There is a congenital and an acquired form of hydronephrosis. In the former either the condition itself or the causes leading to it may be congenital. Generally there is a partial obliteration or stenosis of the ureter; the points of predilection are the outlet of the ureter from the renal pelvis, and that portion which traverses the bladder.

Reduplications and valves, kinking and torsion, or abnormal inser-

tion of the ureter into the renal pelvis may have the same effect. If the ureter at its outlet forms an acute angle with the pelvis of the kidney, its opening will become closed much like a valve when the pelvis becomes very full; if its opening is high instead of low the urine will not have a proper outflow. In connection with the development of hydronephrosis those cases in which there is a double renal pelvis and double ureters are of special interest. When such conditions exist the renal pelvis whose ureter opens abnormally in the bladder and thus constitutes an obstruction to the outflow of urine is the one in which hydronephrosis develops. Among the acquired causes of hydronephrosis are inflammatory affections of the urinary organs and concretions which interfere with the outflow of urine. The first class is constituted principally by ulcerative ureteritis leading to stricture-formation, and peri- and para-metritic exudates which compress the ureters; furthermore tumors of the bladder, uterus, and ovaries, new growths of the pelvic bones, enlargement of the prostate, uterine reflexes occurring during pregnancy or independently thereof, kinking and torsion of the ureter resulting from displacement of the kidney, may all produce obstruction and thus give rise to hydronephrosis.

Floating kidney particularly predisposes to the so-called intermittent hydronephrosis (Landau), which is characterized by the fact that the distended renal pelvis is filled with fluid at one time and is empty at another. In consequence of the descent of the kidney, the origin of the ureter, which is normally situated at the lowest portion, reaches a higher or perhaps the highest level. If no cause for the development of hydronephrosis can be found at operation or autopsy, it must be assumed that the cause has been overlooked or rendered unrecognizable by the manipulations which have been practised.

Hydronephrosis is more often unilateral than bilateral, and the right side is more often affected than the left. The female sex is specially predisposed in consequence of the numerous diseases of their genital organs which produce compression of the ureters.

Pathological Anatomy. Total hydronephrosis, that is, one in which the entire kidney is converted into a sac, so that no renal tissue is left, is very rare, occurring mostly in kidneys with double ureters. If the obstruction in the ureter is high up near the pelvis of the kidney, the pelvis only is dilated, whilst the lower the impediment to the outflow of urine, the greater is the liability of the ureter also becoming dilated.

If the obstruction develops suddenly and the ureter is completely occluded, the renal pelvis will be only moderately distended, whereas if the obstruction develops more gradually, as is the case when a portion of the lumen of the ureter remains open, an enormous sac, which may attain the size of a man's head, is formed.

In the first instance it is not unusual for the functional power of the kidney to be lost, but when slow and only partial obstruction of the ureter occurs the kidney still continues to secrete urine, which stagnates and distends its pelvis. When there is permanent complete occlusion the term closed hydronephrosis is used to designate the condition, and when complete obstruction does not exist, so that some of the urine can escape, we employ the term open hydronephrosis.

It is upon these conditions that the reaction upon the kidney itself depends. Closed hydronephrosis rapidly leads to flattening of the papillæ and causes pressure atrophy of the medullary and cortical substance, so that finally nothing but dilated calices remain, forming, together with the pelvis, a large thin-walled sac in which a few ridges, the remnants of the calices, may be seen. Such complete destruction, however, is exceptional. As a rule, normal renal tissue or tissue showing interstitial changes will be found; in the latter case the epithelium of the uriniferous tubules will show degenerative changes due to pressure.

The contents of the sac is watery fluid having a uriniferous odor; in recent accumulations, or in the intermittent form of hydronephrosis, it possesses the properties of urine, whereas in older cases w th complete occlusion of the sac only a little urea is found.

Symptoms and Course. Small hydronephrotic sacs may not cause any symptoms. Larger ones are characterized by a swelling which may assume enormous dimensions. This swelling may be oblong or round, its surface is smooth, and occasionally a soft portion (the sac) and a hard portion (indurated kidney tissue) can be distinguished upon palpation. It shows more respiratory displacement on the right side than on the left. Fluctuation may or may not be detected. Percussion supplies information concerning many of the conditions present. There is generally a zone of tympanitic resonance between the area of liver dullness and that over the hydronephrotic sac. By inflating the colon it will often be found that the kidney lies behind this portion of the bowel, although this sign often fails owing to the fact that the intestine is pushed to one side by the tumor.

Another symptom is a feeling of pressure over the affected side. This may, however, be entirely wanting, but as a rule it is present, and may occasionally amount to severe pain, or even be increased to violent colic. Intermittent hydronephrosis, during the period of complete retention of urine, sometimes produces symptoms identical with those of nephrolithiasis.

The urine may be perfectly normal. Occasionally a remarkable variation in its quantity and properties is observed, which gives rise to the suspicion that there is a variation in the quantity contained in the pelvis of the kidney.

Even when a tumor is present it may be difficult to recognize it, as a hydronephrotic sac may be mistaken for other pelvic tumors, and other diseases of the kidneys may give rise to a similar tumefaction. Among such conditions may be mentioned cysts of the ovaries and spleen, echinococcus-cysts of the liver and kidney, and simple cysts or polycystic degeneration of the kidney. For the purpose of differential diagnosis an exploratory puncture may be made, if possible, by the extraperitoneal route; the result of this procedure, however, is by no means positive, for hydronephrotic fluid usually does not contain urea, and, on the other hand, urea has been found in the fluid of ovarian cysts.

In doubtful cases recourse should be had to catheterization of the ureters, although this method naturally cannot always lead to a certain diagnosis. If the hydronephrosis is closed nothing comes out of the ureteral catheter, and if this condition obtains upon a second trial diagnosis will be plain. If fluid flows out, pressure should be made upon the tumor after the catheter has been brought near to the pelvis of the kidney, whereupon the outflow may be seen to increase, although in some cases the opposite condition is observed, the stream stopping suddenly, the passage through which it flows being occluded by the pressure which is exerted.

The course of hydronephrosis is usually very slow, particularly when the affection is unilateral. The disease may last for decades. It is only when the outflow of urine is completely shut off and the kidney continues to secrete urine, that the distention becomes so great as to cause pain or possibly give rise to attacks of colic.

If infection of the sac takes place pyonephrosis develops, although in such a case it would be more correct to use the term infected hydronephrosis. When this condition supervenes it may cause violent

disturbances and thus transform the clinical picture into one of great severity.

The **prognosis** of hydronephrosis is bad as to cure, as it is seldom possible to remove the cause of the obstruction; as to life it is favorable, because, as has already been stated, the condition may go on for years, until so much of the renal substance is destroyed that the system begins to be affected. The other kidney then performs a vicarious function.

Treatment. As obstruction to the outflow of urine is the cause of hydronephrosis, the chief object of treatment is to secure the removal of the obstruction. This is a task, however, which cannot always be performed. Congenital hydronephrosis offers especial difficulties in this respect, since the nature of the obstruction is hard to diagnosticate.

In intermittent hydronephrosis caused by displacement of the kidney the prospects of cure are good, as in many cases nephropexy permanently removes the obstruction. The kidney should be fastened as high up as possible, so that the ureter may be stretched.

Instead of passing sutures through the substance of the kidney, as was formerly the custom, I now practise decapsulation of the kidney exclusively and find that it gives excellent results. A question will naturally arise as to whether milder measures will not afford relief. Occasionally the kidney can be retained in place by bandages so that kinking of the ureter will not occur, although this is exceptional.

Too much must not be expected from catheterization of the ureters. It has been attempted to stretch the ureter by leaving the ureteral catheter in situ, and in a few cases the undertaking has proved successful. I do not, however, favor the procedure, as it is very difficult to prevent infection of the hydronephrotic sac when a catheter remains in the ureter for a considerable time. Although there is little danger of infection when ureteral catheterization is quickly performed and completed, it is almost sure to take place when the catheter is allowed to remain in the ureter for a long time. Whether frequently repeated irrigation of the pelvis of the kidney will prevent infection, as is the case with irrigation of the bladder when continuous catheterization is being practised, can be learned only by experience.

In those cases in which an operable condition in the pelvis, for instance, retroflexion of the uterus, is causing compression of the ureter, the obstruction can be readily removed. In most other cases operation upon the kidney itself must be resorted to, as simple puncture of the

sac will not do any good. The injection into the punctured sac of irritating substances such as iodine, arsenic and alcohol is too dangerous to be used; it can easily lead to suppuration.

Before deciding upon operation the question as to whether operative interference is actually indicated must be carefully weighed. Many cases of hydronephrosis cause no trouble; they increase so slowly that the general health remains good for many years. Therefore such cases should not be operated upon, particularly if they are unilateral. When bilateral hydronephrosis is present the fact that the kidneys are being slowly subjected to pressure-atrophy must be taken into account.

In regard to the operation itself, it has been found that simply anchoring the kidney, as was formerly practised, will not produce a cure; we have to do with a large sac caused by distention of the renal pelvis and consequent destruction of renal tissue, and for this reason nephrotomy, combined perhaps with plastic operations on the kidney, is the rational procedure. Simple pyelotomy and pyelostomy should be entirely abandoned because they are too frequently followed by fistulæ, which are more annoying to the patient than the hydronephrosis for which the operation was performed.

Nephrectomy is usually not permissible; at present the tendency is not to sacrifice portions of renal tissue which are functionally active and therefore useful to the economy. The plastic operations on the pelvis of the kidney—pyeloplication, uretero-pyelostomy, resection of the ureter and anastomosis of the cut end into the pelvis of the kidney—are still in the stage of development, but they offer prospects of success and should usually be tried. Nephrectomy should be performed only when operation shows that very little renal tissue remains, or that the remaining portion is much diseased. It must, of course, be positively determined that the functional capacity of the other kidney is good. In such cases nephrectomy gives good results.

PYONEPHROSIS.

Owing to the multiplicity of terms applied to suppuration in the kidney it is necessary to have a clear conception of what is meant by pyonephrosis. In accordance with the mode of development, two forms may be distinguished, one of which has already been spoken of as **infected hydronephrosis.** If the urine in a distended renal pelvis,

which has been formed principally at the expense of the renal tissues, becomes infected, suppuration develops in the sac and slowly invades the parenchyma of the kidney. In the second group an ascending suppurative process involves the parenchyma of the kidney, which was previously healthy, and causes its destruction, without, however, producing distention of the renal pelvis; it is these cases which the French call pyelonephritis without distention (*pyelonephrite sans distention*) and which Israel terms primary pyonephrosis (*originare pyonephrose*). Finally, belonging to the second group are those cases in which primary infection of the parenchyma of the kidney takes place without involving the pelvis, and therefore without producing distention. Thus it is seen that infection is the result of hæmatogenous pyelonephritis.

Primary pyelonephrosis is generally a sequel of cystitis. The latter disease extends to the ureter and produces ureteritis with thickening of the walls, which causes loss or diminution of their contractility. As a result of these changes the caliber of the ureter becomes lessened, and consequently there is a tendency for the secretion in the pelvis of the kidney to become stagnant. If the ascending infection produces a pyelitis or pyelonephritis, pyonephrosis will develop in consequence of the changes in the ureter.

These ascending forms of urinary infection are met with very frequently in pregnant and puerperal women and may occur quite independently of catheter-infection; they also occur as the result of ascending gonorrhœa, although it has not yet been determined whether they are due to the gonococcus alone or to mixed infection. This form frequently affects only one kidney.

The form due to infection of retained fluid in the renal pelvis has been described in connection with hydronephrosis. These dilated aseptic sacs may become infected either by an ascending or a hæmatogenous infection. The first usually follows some obstructive condition in the urinary system, such as stricture of the urethra, hypertrophy of the prostate, paralysis or tumors of the bladder; the latter occurs in association with general infections such as pyæmia, typhoid fever, small pox, osteomyelitis, etc. As has already been stated, hæmatogenous infection may also give rise to primary suppuration in the parenchyma of the kidney without previously involving the pelvis.

Pathological Anatomy. Although the origin of pyonephrosis is most diverse and the appearance of the different forms about to be

described is very different, the presence of foci of suppuration within the substance of the kidney is common to them all; moreover, a greater or less degree of inflammation in the renal parenchyma not yet destroyed by the suppurative process is also invariably present.

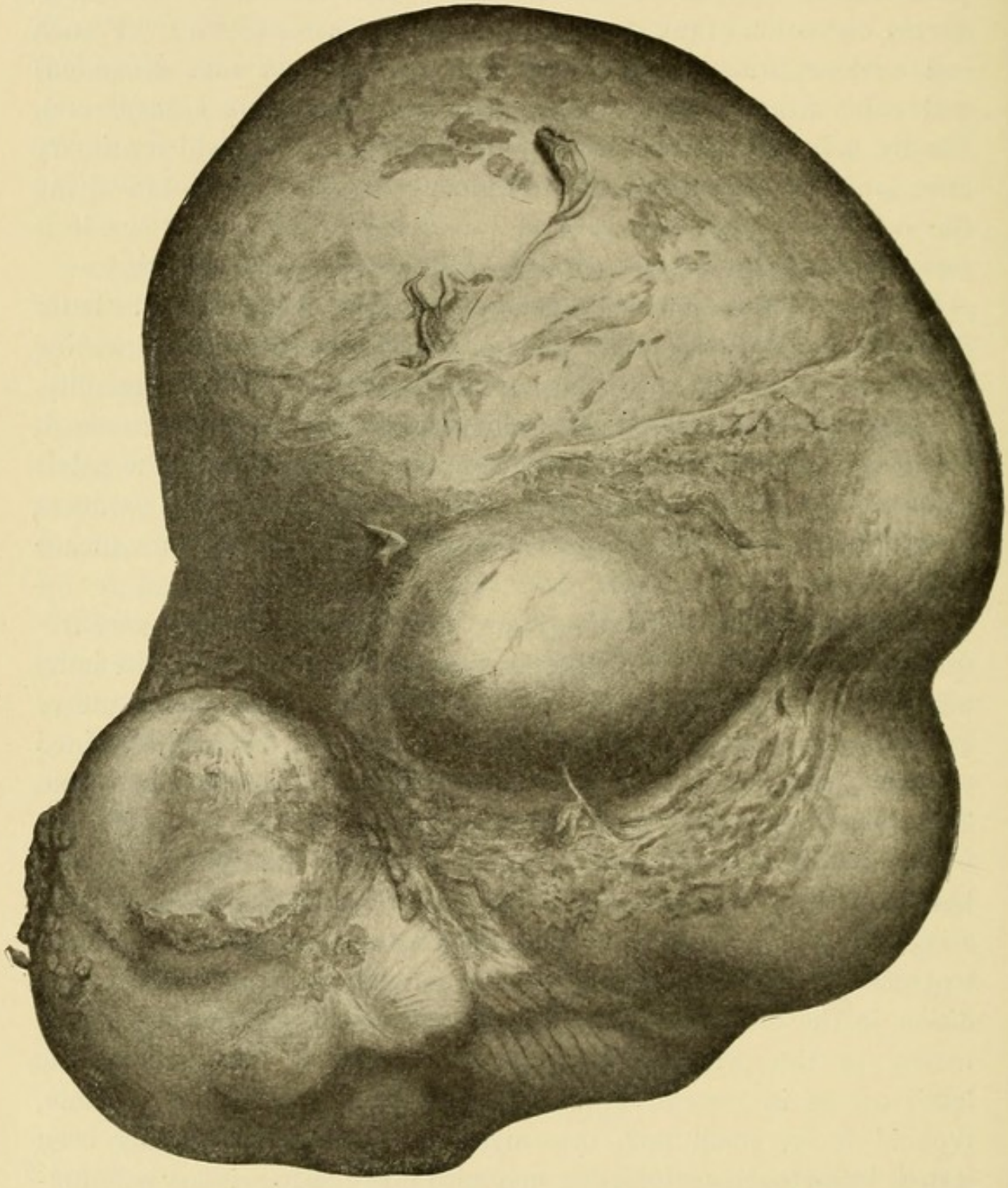


Fig. 222.—Pyonephrotic kidney weighing forty-five pounds. (N. T. Brewis.)

The size of pyonephrotic kidneys is most variable (Fig. 222). Infected hydro-nephroses are usually larger than the primary variety, and as a

rule are so deeply situated that they are not accessible to palpation; the latter variety also often lies concealed beneath the thorax.

The mucous membrane of the renal pelvis shows the changes of pyelitis. It is maculated or reddened, may be smooth or rough, and also œdematous, and is sometimes covered with fine miliary nodules which at first glance may appear to be tubercles, but which in reality are either collections of leucocytes or minute areas of fatty degeneration.

The kidney tissue itself is pale, cloudy and friable. It contains small yellow foci, which may attain the size of the head of a pin, and which represent either collections of leucocytes or minute abscesses. The latter may coalesce and form larger abscesses, containing creamy or perhaps sanious pus, in which are found sand, gravel, fragments of calculi, masses composed of pus, blood and epithelium, and others formed of triple phosphate; the latter may attain a considerable size.

According to the manner in which the disease develops, the pelvis of the kidney and the calices are dilated, or the cavity may encroach upon the substance of the kidney. The calices are often as large as apples, and their opening into the pelvis is frequently narrow, in contradistinction to hydronephrosis, in which the dilated calices are usually drawn into the pelvis. Around the hilus there often develops *pari passu* with the destruction of the substance of the kidney a thick accumulation of fat, which often is so extensive that it converts the entire kidney into one large fatty mass, in which remnants of the parenchyma and a few cavities filled with pus may be seen here and there.

If the process of granulation extends through the kidney to the fibrous capsule, **perinephric adhesions** are formed and suppuration may finally occur. The suppurative process may even invade the fatty capsule of the kidney and partly destroy it. The condition which then obtains is one of **paranephric suppuration.**

The condition of the **ureters** depends upon whether the disease ascended from below or began in the kidney. In the ascending form ureteritis is always present, and if it develops simultaneously with obstructive conditions leads to thickening of the walls, particularly the outer layers, and converts the ureter into a thick tough cord which becomes adherent to the peritoneum.

If no obstruction exists, an ascending ureteritis having produced pyelonephritis, extensive thickening of the ureter does not take place,

although circumscribed areas of stenosis due to plastic exudate are present. In infected hydronephrosis the ureter is usually dilated and may be as large as a coil of intestine.

It is of practical importance to remember that the vessels in the pedicle of large pyonephroses often have an abnormally narrow lumen. This is partly due to functional adjustment—the vessels having less tissue to nourish—and partly to endarteritis.

Symptoms, Course and Diagnosis. The clinical picture of pyonephrosis is most variable, thus corresponding to the heterogeneousness of the underlying morbid anatomical process. Purulent urine is common to all open pyonephroses. This **pyuria** exists as long as there is an open channel from the suppurating renal pelvis. It may cease temporarily or permanently—temporarily if an obstruction develops in the kidney or ureter, permanently if this obstruction persists, or if the kidney has been destroyed by suppuration, so that nothing but a fatty and fibrous mass remains.

Sudden occlusion of a pyonephrosis almost always produces a constitutional reaction. Although the patient may feel perfectly well as long as the pus has a free exit, fever, weakness and anorexia develop as soon as its outflow is impeded. Fever, however, may be present in open pyonephrosis, although I have found it absent as often as present. It evidently depends upon the acuteness of the inflammatory and suppurative process going on in the parenchyma of the kidney. On the other hand, occlusion of a pyonephrosis may occur without producing fever. The urine clears up and remains clear as long as the pyonephrosis is closed, provided that the second kidney is not secreting pus.

Even an open pyonephrosis, however, may occasionally fail to produce purulent urine. This is especially true of infected hydronephrosis. Owing to copious discharge of pus there are periods in which the sac becomes so well cleansed that clear urine is secreted for some time; then after another obstruction (twisting of the ureter, etc.) occurs, accompanied by symptoms of colic, pus appears again. These cases have been rightly called **pyohydronephrosis.**

A further symptom of pyonephrosis is pain in the renal region. This pain may develop spontaneously or first manifest itself upon pressure. Spontaneous renal pain is absent as often as it is present. There are persons having a large suppurating kidney-sac who are not at all troubled by it. Less often pressure over the kidney fails to cause

pain. Usually an uncomfortable feeling is experienced which is transformed into pain when pressure is made.

Palpation is not to be relied upon. A greatly distended renal sac can usually be felt when it lies below the arch of the ribs, or when it is brought out under the arch by a deep inspiration. But all pyonephroses are not very large and all do not lie under the costal arch. I have often seen cases in which the kidney lay concealed under the thorax and was absolutely inaccessible to palpation.

If all the symptoms are taken together, namely, the pyuria which persists despite all internal and local treatment, the absence of vesical symptoms, the pain upon pressure, the development, perhaps, of a tumor, the constitutional reaction, and in addition to these the evolution of the malady, diagnosis can usually be made: under such circumstances there is suppuration in the kidney.

Further examination must then be made to determine which kidney is suppurating and to ascertain if the other kidney is in a condition to permit operation. Ofttimes the cystoscopic picture will show which kidney is secreting clear and which purulent urine. If it cannot be determined in this manner ureteral catheterization should be tried. A catheter should be introduced into the ureter on the presumably diseased side and an ordinary urethral catheter passed into the bladder so as to collect the urine from the other kidney. This method of examination shows precisely which kidney secretes clear and which cloudy urine. It also shows whether the second kidney is healthy and how it is working. The question as to how healthy it is and whether it is working with sufficient activity can be determined by the functional examination (*quod vide*).

A typical example of unilateral pyonephrosis with well preserved functional activity of the other kidney is the following:

Ureteral Catheterization. Phloridzin 0.01.

	R.	L.
Urine:	Cloudy with thick flocculi.	Cloudy; acid.
Sediment:	Pus.	None
Albumen:	Corresponding to the Pus.	None
△	—0.48	0.96
Sugar:	0	0.8

Finally, as concerns the differential diagnosis of pyonephrosis from other tumors in the abdominal cavity, it may be stated that the great

difficulties which formerly prevailed have been overcome by ureteral catheterization. The ureteral catheter shows the source of the pus to be directly from the kidney.

The prognosis and course of the disease usually depend upon the rapidity with which the suppuration advances and whether it is bilateral or unilateral. In the latter instance the prognosis is much better than in the former. Such cases may last for years without affecting the general health. It happens more often, however, that some disturbance is produced; the principal one is toxic nephritis of the other kidney, caused by the resorption of pus.

It has already been stated that cure may occur without intervention, the whole kidney suppurating and being converted into a fatty, fibrous mass; such a termination, however, is exceptional, and is not to be expected. It is much more common for the suppuration, if left to itself, to invade the tissues around the kidney and cause perinephritis or paranephritis (*quod vide*).

The **treatment** of pyonephrosis differs with the nature of the morbid process present, its extent, and whether it affects one or both kidneys. Internal treatment is not to be thought of unless both kidneys are so diseased that operative treatment cannot be employed. In cases suitable for operation internal treatment should be entirely discarded, for it will never succeed in rendering an infected renal sac aseptic. The exceptional cases of spontaneous cure above mentioned are excluded from this rule.

Accordingly the focus of suppuration must be attacked. This can be done in two ways, either by irrigating through a ureteral catheter introduced into the pelvis of the kidney, or by incising, or perhaps removing, the kidney.

In regard to the irrigation method its usefulness is very limited, and it is applicable only in cases of infected hydronephrosis. I have cured two such cases in which the renal pelvis was converted into a large pus-sac by irrigating with nitrate of silver solution (1–1000). In these cases the method may be tried.

In cases in which the substance of the kidney is involved and permeated with abscess cavities, which perhaps do not communicate with the pelvis of the kidney, or at most open into it by very narrow outlets, irrigation is useless. Hence before the irrigation method is employed it is necessary to make an exact diagnosis, so that one may be sure that he is dealing with an infected hydronephrosis and not a primary or

secondary pyonephrosis; this can usually be done by functional renal examination.

If irrigation fails to give prompt results no time should be wasted with it. It can soon be learned whether a case is suitable for this treatment, as the pus begins to diminish after a few irrigations. In case no benefit is derived nothing but operation (nephrotomy or nephrectomy) will suffice.

The former is particularly indicated in infected hydronephrosis in which a great deal of renal tissue is still preserved, whereas when typical abscesses are present in the parenchyma, nephrectomy is to be preferred on account of the danger of fistulæ incident to nephrotomy, provided always that the condition of the second kidney warrants intervention.

If the second kidney is seriously diseased and its function poor I also consider nephrotomy contraindicated, for it is also a serious operation; in addition to the danger it involves it offers little advantage, because very annoying fistulæ are apt to remain after its performance. Such cases, therefore, are to be considered inoperable.

TUBERCULOSIS OF THE KIDNEY (NEPHROPHTHISIS).

Tuberculosis of the kidney may be one of many localizations of general tuberculosis. As such it is naturally not subject to special treatment. The disease may also affect the kidney only, or be confined to it and a few other organs.

It was formerly believed that most cases of renal tuberculosis were due to ascending infection, but this is not the case, such a manner of development being decidedly exceptional. **The rule is primary hæmatogenous nephrophthisis.**

In simultaneous localization in the genital system, for example, in the epididymis, tuberculosis may ascend from the bladder, but it is important to know that both epididymis and kidney are favorite sites for the localization of hæmatogenous tuberculous infection. In this case the bladder is not involved.

In women the ascending form has rarely been observed; in men it is more common, but it occurs much less frequently than the hæmatogenous form. In men it is not unusual to find associated tuberculous disease of the sexual and urinary organs. Renal tuberculosis is most common between the twentieth and fortieth years; before twenty and after forty it is rare.

Pathological Anatomy. In primary renal tuberculosis cavities are generally found, which are formed by softening and liquefaction of masses of caseated tubercles. Occasionally a kidney is found at operation presenting numerous isolated nodules that have not yet undergone liquefaction. The cavities are characterized by their ragged walls and irregular size. Surrounding them is an area of granulation tissue. In the columns of kidney tissue which separate the cavities there are many fresh or perhaps already caseated tubercles; they are also present on the surface, both above and beneath the true capsule, where they appear as fine nodules. It is worthy of notice that the disease is sometimes distinctly isolated, being confined to one pole of the kidney. Zondeck thinks this is due to the fact that the pole of the organ receives a separate blood supply.

As time elapses the tubercles in the kidney encroach upon contiguous structures. Both true and fatty capsules are converted into thick connective and lardaceous tissue, or else a suppurative perinephritis is produced owing to extension by continuity of the liquefactive tuberculous process to the capsule; in some cases the connective tissue between the kidney and its capsule may escape, the infection being carried to the capsule through the lymphatics. More rarely the parenchyma of the kidney remains free, tuberculous ulceration of the surface of the papillæ being the only lesion present.

In primary tuberculosis of long duration the ureters invariably become diseased. Simple or tuberculous inflammation is produced, with the result that the walls become thickened, the canal stenotic, and converted into a firm cord which is adherent to the surrounding tissue. This condition is known as **sclerosing periureteritis** (Fig. 223). If the process is tuberculous lenticular ulcers and nodules are frequently seen on the ureteral mucosa.

In like manner the bladder may also be affected with tuberculous or simple inflammation. Unfortunately the latter form is rare. When the bladder is tuberculous, swelling, redness, displacement and ulceration of the ureteral orifices are seen. The surrounding tissue is also inflamed. Occasionally disseminated tubercles are found in this region, whereas in simple inflammatory cystitis the changes are more diffuse, extending over the whole bladder.

Of great importance is the circumstance that renal tuberculosis is often **unilateral,** and that when it is bilateral it has frequently been transmitted to the second kidney from the first. In addition to tuber-

culosis other pathic processes are even more frequently met with, particularly amyloid degeneration, chronic nephritis, or granular atrophy.

It is evident that in primary renal tuberculosis other organs, such as

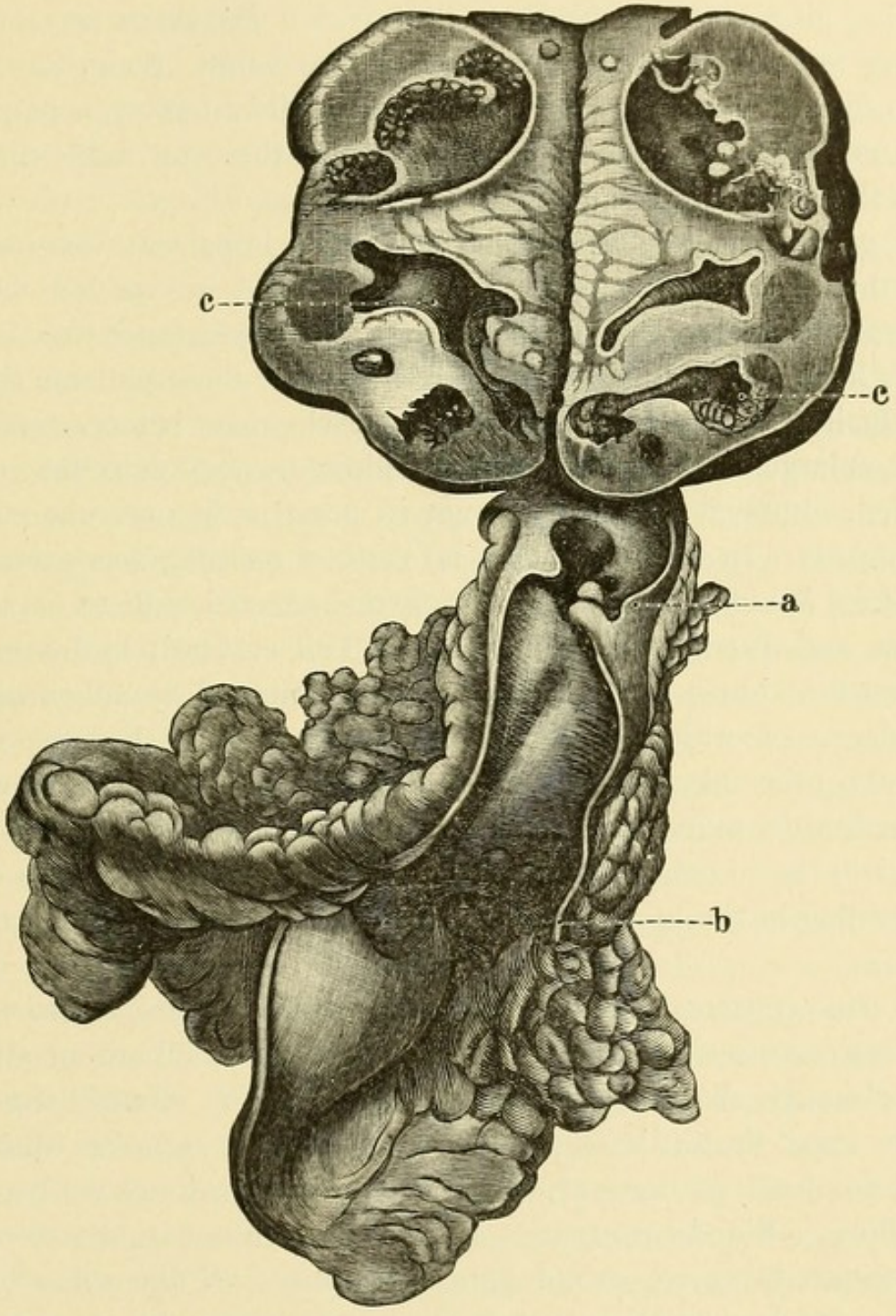


Fig. 223.—Tuberculosis of the kidney and ureter. *a*. Cicatricial narrowing of the ureter. *b*. Lower end of the divided ureter. *c.c*. Dilated calices with tubercles.

the epididymis, prostate, seminal vesicles, lungs, joints, and vertebræ may also be diseased. It must not, therefore, be assumed that an associated genital tuberculosis signifies an ascending renal tuberculosis.

In the latter case genuine tuberculous disease of the bladder and ureter will always be found.

Symptoms and Diagnosis. As in other localizations of tuberculosis, so in the renal form, every symptom may be wanting in the beginning stages of the disease. It does not betray its presence in any way whatsoever, not even by a phthisical habit. Soon, however, it makes itself plainly evident; constitutional disturbances, a palpable renal tumor, and unmistakable alterations in the urine make the nature of the affection plain.

The general health becomes considerably impaired; the patient may either be free from fever or suffer with the intermittent hectic fever typical of tuberculous infection. In the first instance emaciation and the livid sallow appearance characteristic of these patients comes on gradually, whereas in the latter their development is more rapid.

The enlargement of the kidney seldom escapes detection upon palpation, although it usually is not so great as in non-tuberculous pyonephrosis. In cases in which no distinct swelling was present I have often found the renal region on the affected side to be more resistant and distended than in health. This evidently is due to the fact, that the kidney and its capsule are surrounded by adhesions, in consequence of which it becomes increased in size. For the same reason the tuberculous kidney is frequently found to be less movable than the healthy kidney and other renal tumors. The enlarged kidney either gives rise to pain spontaneously, the patients experiencing a dull, heavy feeling in the lumbar region, or distinct pain is produced upon pressure.

The urine contains pus in varying quantities, and also occasionally crumbling caseous masses in which many tubercle bacilli are sometimes found, although they may be entirely absent. The albumen-content depends upon the ofttimes simultaneous nephritic process which is present in those portions of the kidney which have not yet become tuberculous. Blood-corpuscles are seldom absent; macroscopic hæmorrhages, however, are of rare occurrence. If the tuberculous foci have not broken through into the pelvis of the kidney, or if the ureter is obliterated or obstructed, the urine may be **perfectly clear** and thus cause errors in diagnosis.

If the bladder is involved typical symptoms, dysuria, strangury and tenesmus, are present, although it is noteworthy that these vesical manifestations may also be caused by the renal disease, particularly

when the pelvis is affected, the bladder being neither tuberculous nor highly inflamed.

Thus it is seen that the diagnosis of renal tuberculosis may present great difficulties. In order to make it clear auxiliary measures may have to be employed.

A very careful history should be obtained, and evidences of tuberculosis sought for in other parts of the body, in the glands, lungs, joints, epididymes, seminal vesicles, etc. It must be remembered that tuberculosis may be superimposed upon an old, uncured gonorrhœa. I have seen many cases of gonorrhœal pyelitis develop into tuberculosis of the kidney.

On the other hand renal suppuration for which no cause can be found represents one type of renal tuberculosis. Pyuria which fails to improve under appropriate treatment should arouse suspicion that the trouble is not in the bladder but in the kidney. The determination of the seat of suppuration is a step in advance. Whether it is tuberculous naturally has to be learned by other methods of examination. Tubercle bacilli are found in 70% to 80% of all cases in which thorough examination is made. If they are not found and suspicion that the disease is tuberculous still remains, guinea-pigs should be inoculated in the peritoneal cavity with some of the purulent urinary sediment. After five or six weeks postmortem examination of the guinea pigs will reveal in positive cases the presence of an acute miliary tuberculosis.

Of material assistance in diagnosis are cystoscopy and catheterization of the ureters. If there is purulent urine which fails to become clear under proper treatment, and if cystoscopic examination reveals a comparatively healthy bladder, it may be concluded that the pus comes from the kidney. If the orifices of the ureters are then observed, turbid fluid will often be seen issuing from one or both of them.

Occasionally characteristic changes are present in the ureteral papillæ. It is highly vascular and its edges are distorted, being either inverted or everted, and covered with minute ulcers or areas of capillary hæmorrhage. In order to remove all doubt and to determine whether the affection is unilateral or bilateral, the ureteral catheter may be employed; this will clear up the situation at once, though it naturally will not reveal the nature of the suppurative process unless tubercle bacilli are found in the urine obtained by its use.

The following are characteristic examples of the urine obtained by

catheterization of the ureters in unilateral and bilateral renal tuberculosis.

1. TUBERCULOSIS OF THE RIGHT KIDNEY. CATHETERIZATION OF THE URETERS. (0.01 PHLORIDZIN.)

	Right.	Left.
Urine turbid.		Clear.
Albumen:	A heavy ring upon addition of nitric acid to the filtered urine.	None
Sediment:	Pus and tubercle bacilli.	None
△	0.94	1.44
Sugar:	2.4	4.0

This is a case of *beginning* tuberculosis, as is shown by the relatively good functional power of the right kidney.

2. BILATERAL RENAL TUBERCULOSIS. CATHETERIZATION OF THE URETERS. (0.1 PHLORIDZIN.)

	Right.	Left.
Urine turbid.		Urine turbid
Albumen:	0.01%	0.15
Sediment:	Pus and tubercle bacilli.	Pus and tubercle bacilli
△	0.5	0.43
Sugar:	A trace.	0

This was a case of advanced and inoperable bilateral renal tuberculosis.

In general the **prognosis** of tuberculosis of the kidney is unfavorable. It depends materially upon the stage in which the patient comes under treatment. If the affection is bilateral and other tuberculous foci are present in the body, the prognosis is considerably worse than it otherwise would be. On the contrary, unilateral cases which come under observation early offer a good prognosis, the patients usually regaining their health after the diseased kidney has been removed. The course of inoperable cases is rather slow. They last a long time, often for many years, before the parenchyma of the kidney is so destroyed that signs of renal insufficiency manifest themselves. As a rule, metastases and general dissemination of tuberculosis occur and cause death.

Extension of the tuberculous process to the perinephric and paranephric tissues is not uncommon. It extends along the fibrous and

fatty capsule, perforates these structures and advances toward the exterior, producing suppuration limited only by the superficial tissues. This course usually produces acute symptoms, consisting of painful swelling in the region of the kidney, high fever, and general constitutional disturbance.

In severe cases in which both kidneys are tuberculous or in which one is tuberculous and one nephritic or amyloid, or in those cases in which numerous other tuberculous foci exist, **treatment** may be merely symptomatic, and confined to the relief of the patient's suffering. Nutritious food, avoidance of all injurious influences, occasional irrigation of the bladder, and the administration of urotropin and narcotics are the proper measures.

If tuberculosis of one kidney is detected early enough I recommend removal of the diseased organ in its entirety. Operation has been advised against in cases in which the disease was recognized and in which signs of tuberculosis could not be detected in any other organ, for the reason that spontaneous cures occasionally occur; they are so unusual, however, that they should not be relied upon. In the great majority of all cases it is rather to be expected that the disease will advance, that the kidney will become more and more destroyed, and that other organs, particularly the opposite kidney, will become involved. It is inflammation or amyloid degeneration of the second kidney which renders prognosis unfavorable. Therefore operation should be done before these complications become established. Moreover, I have obtained very gratifying results from early extirpation of the kidney.

Moderate involvement of the bladder or lungs is not a contraindication to operation; experience has taught that the bladder will heal, or at least improve, if the source of the tuberculous material, which in this case is the kidney, be removed.

I advise against partial resection of the kidney. Our knowledge of the results obtained by this procedure is insufficient. Furthermore, it is often impossible to determine whether a destroyed tuberculous focus is the only one present in the kidney. Section of the kidney will not solve the question, for although it may appear healthy, multiple concealed tuberculous foci may be contained within the parenchyma.

Perinephric suppuration originating from a tuberculous kidney always requires surgical intervention, which, however, must often be confined to opening the abscess.

RENAL AND URETERAL CALCULI (NEPHROLITHIASIS).

We know as little about the causes of renal calculi as we do concerning those of stone in the bladder. If normal or abnormal constituents of the urine fail to remain soluble, but are precipitated upon an organized stroma, the prerequisites for the development of a calculus are supplied (Ebstein, Posner).

If the precipitate is very fine and meal-like it is spoken of as renal sand, while if it is larger, like wheat or millet-seed, it is known as gravel. If it occurs in the form of large masses it is called renal stone. In size these stones vary from that of a lentil to a pigeon's egg. If tooth-like prolongations project into the calices, the so-called coral stones are formed. As a rule, the larger the calculi the fewer their number. Small calculi from the size of a lentil to that of a bean occur in large numbers in the pelvis of the kidney.

The stones may be either primary or secondary. To the first class belong those composed of uric acid, urates, or a combination of the two, which are characterized by their red color; those made up of oxalate of lime, which vary in color from gray to blackish-brown and have rough spiny surfaces; and finally the rare soft cystin calculi and the even rarer hard xanthin stones.

The secondary calculi are composed of phosphate and carbonate of lime and phosphate of magnesia, these salts being deposited upon a foreign body (mucus, pus, blood). In exceptional cases these stones may also be primary.

Mixed stones are those which contain several of these substances. Thus there are some having a deposit of oxalates around a nucleus of urates, and others with a layer of phosphates superimposed upon a nucleus of oxalates.

Nephrolithiasis is most common in advanced age and early childhood. Persons in middle life are comparatively free from it. Men are affected more often than women. Heredity and diet have some influence, but exactly what it is has not yet been determined. Thus in many respects the disease rests upon an unknown foundation. (*Compare with the remarks on the causes of vesical calculi.*)

Pathological Anatomy. In a few exceptional cases renal calculi do not produce any changes in the kidney and its pelvis. They lie as aseptic foreign bodies in the pelvis of the kidney, and if they occlude the opening of the ureter give rise to an aseptic retention of urine, which upon long duration or frequent repetition may produce hydro-

nephrosis. In the majority of cases, however, they lead to chronic inflammation of the interstitial tissue of the kidney and to hyperplastic changes in the capsule and hilus.

Israel recognizes the large firm calculous kidney, in which hyperplastic fibrinous overgrowth of the capsule, periglomerulitis and perivascular thickening are responsible for the enlargement of the organ; and the contracted calculous kidney, in which the epithelium atrophies

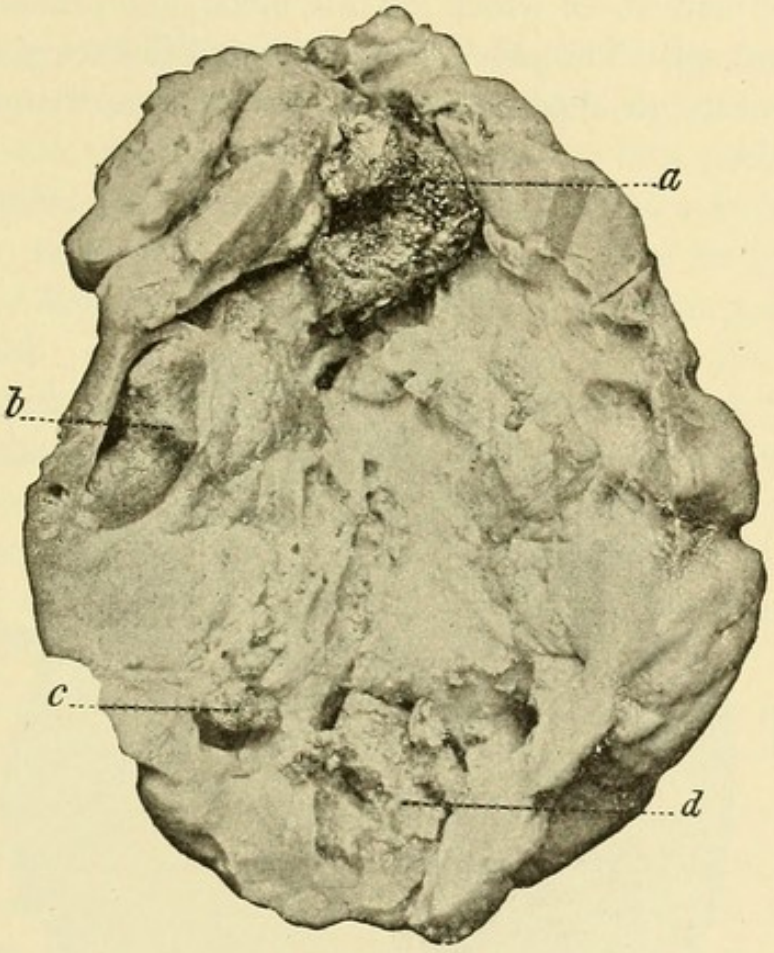


Fig. 224.—Calculi in a kidney which has undergone complete fatty-fibroid degeneration.

and connective-tissue formation predominates (Fig. 224); the hydronephrotic calculous kidney, which seldom attains a large size and is exceptionally associated with diminution in size; and finally the lipomatous calculous kidney, in which the atrophy and contraction of the parenchyma is accompanied by proliferation of the fatty tissue proceeding from the hilus.

Entirely different from any of these forms is the infected calculous kidney, in which there is a suppurative and often ulcerative inflam-

mation of the renal pelvis and calices, which may extend to the medullary and later to the cortical portion of the kidney and give rise to small foci of suppuration. In the early stages of this condition the kidney is usually enlarged, but later in its course, owing to cicatricial contraction in the suppurating tissue, a reduction in the size takes place. (Fig. 225).

If in consequence of obliteration of the ureteral opening, obstruction is superimposed upon pyelitis and pyelonephritis, a pyonephrosis develops, the contents of which are pus, blood, and primary, secondary and mixed calculi. The pelvis of the kidney becomes more and more distended and the renal parenchyma is destroyed partly by liquefaction

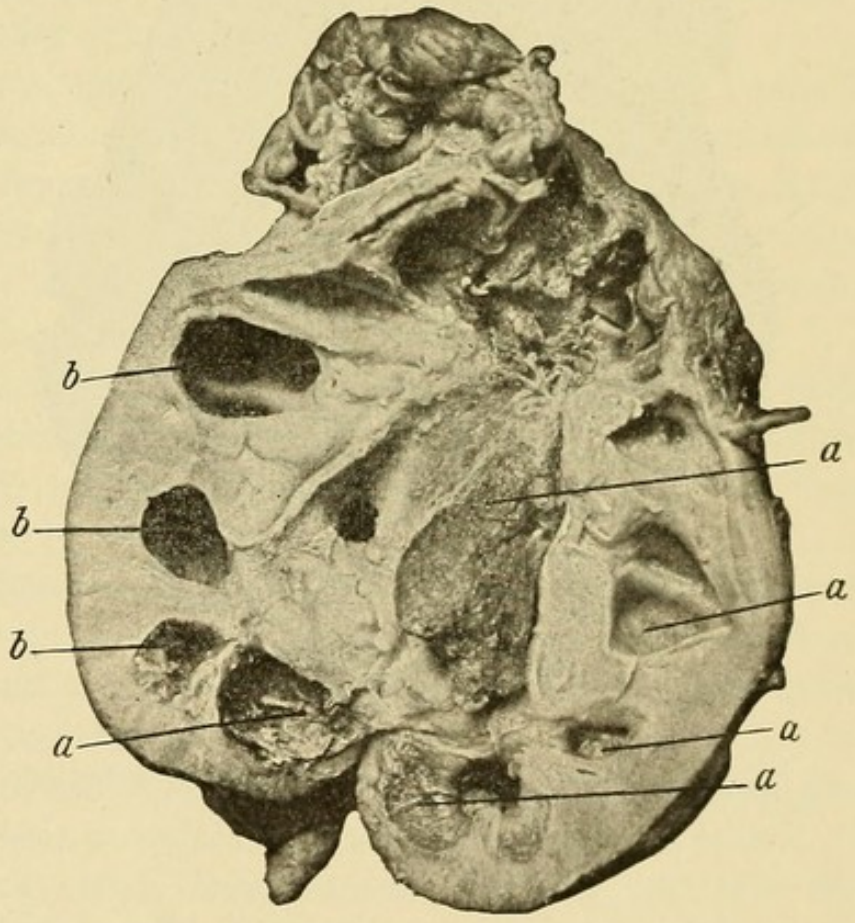


Fig. 225.—Pyonephrotic kidney containing calculi. *a*. Calculi in cavities. *b*. Spaces filled with pus.

and partly by pressure. It is not unusual for the morbid process to break through the kidney and invade the neighboring tissues. If this occurs gradually, adhesions form between the fatty and fibrous capsule and the superjacent soft parts, producing a chronic perineph-

ritis and paranephritis, whereas if the extension is rapid and an area of suppuration is quickly formed, a perinephric or paranephric abscess is the result.

In regard to the nature of the infection, it may be stated that aseptic calculi are usually infected through the blood, in which case it is rare for the source of infection to be determined. It may also occur from below. This does not depend alone upon the transmission of infection by instrumentation, but may be due to extension of gonorrhœa or cystitis.

Symptoms and Diagnosis. Stone in the kidney presents such a variable clinical picture, to which are added the manifestations of disease in other organs, that the establishment of a positive diagnosis may be attained with the greatest difficulty, or may even be impossible.

Moreover, there are cases in which calculi may be present in the kidney for a long time without causing any symptoms, although this is exceptional.

The passage of gravel or sand usually gives rise to a burning or pricking sensation in the urethra, which is due to the irritation produced by the sharp crystals of the salts. On the other hand, I have frequently seen cases in which large bean-shaped calculi passed along the urinary tract to the external urethral orifice without causing any pain whatever.

The majority of cases, however, are characterized by pain, changes in the urine, and a palpable renal tumor.

The **pain** in nephrolithiasis may be either constant or periodical. When constant it occurs as a feeling of pressure in the region of the kidney, which annoys the patient but little or not at all, although it is prone to become worse upon motion, and particularly upon certain kinds of movement, such as bending or stooping, for instance. Pressure upon the kidney or upon the lumbar region below the last rib also increases it.

The periodical pain occurs in the form of **renal colic**. It is caused by incarceration of a stone in the ureter which hinders the outflow of urine, and also by the contractions which the ureteral walls make in an endeavor to expel the urine in the pelvis of the kidney or first portion of the ureter.

This colic is usually typical. The patient writhes with pain, becomes pale, is nauseated or vomits, and is covered with sweat. A chill may usher in the attack. The pain radiates along the inguinal region down

to the testicle or glans penis; it may also extend upwards to the thorax as far as the shoulder-blades.

In regard to the urinary changes, deposits of the salts of which the calculi are composed are often found; if pyelitis is present pus and epithelium are also found. All of these, however, may be absent. Only one substance is invariably present, and that is **blood.** Sometimes it can be plainly seen with the naked eye, and with the microscope fresh or old blood-corpuscles never fail to be revealed. There is only one exception to this rule, namely, when the passage of the calculus is completely arrested so that no urine can escape. It must be borne in mind, however, that blood may appear in the urine in other renal diseases, or, indeed, as the result of congestion in some portion of the urinary tract other than the kidney, the latter being perfectly healthy.

A total occlusion of the ureter results in excretion of urine from the sound kidney only. A normal urine, therefore, does not mean that both kidneys are healthy. Occasionally it happens that both kidneys are stopped up with calculi at the same time, or that when one is obstructed the other becomes closed through reflex spasm. We then have to do with anuria, which, unless it subsides or is overcome by artificial means, will certainly lead to uræmia and death.

The third symptom enumerated, namely, the presence of a palpable tumor, is very untrustworthy; in many cases the kidney is not enlarged, in others the abdominal wall is too thick to permit accurate palpation, and finally there are numerous cases in which the kidney is placed so deeply under the ribs that it itself, much less a calculus within it, cannot be felt. If a hydronephrotic or pyonephrotic calculous kidney has developed, palpation yields the results mentioned in the discussion of those maladies.

In addition to this uncertainty and variability of symptoms there is another circumstance which is liable to increase the difficulty of diagnosis, namely, that the affection may be easily confounded with many other diseases.

First in regard to **renal colic,** it must be remembered that attacks having exactly the same characteristics may occur in the absence of calculi. Gall stones, appendicitis and intestinal obstruction may cause very similar attacks of pain. A floating kidney or an intermittent hydronephrosis by suddenly causing occlusion of the ureter may produce a true colic. Thick blood-clots in renal tumors, plugs of pus

in pyonephrosis and tuberculosis, and parasites may all occasionally give rise to colic if they occlude the ureter.

Moreover, cases have been observed in which there was absolutely no disease of the kidney. These have been designated as nephralgia. There are also cases of chronic nephritis in which exacerbations suddenly occur and cause typical unilateral renal colic. Finally it must not be forgotten that certain gynecological affections (distorsion, adhesions and kinking of the ureters after gynecological operations) may also be responsible for attacks of renal colic.

All these conditions must be carefully weighed in the making of a diagnosis, and all the diagnostic measures which we possess must be employed. The history of the case, palpation, and examination of the urine must be made use of. Radiography will often though not always be of help. Catheterization of the ureters has proved itself to be the most valuable aid in diagnosis. From cystoscopy alone not much can be learned. Inspection of the ureteral orifices will not show whether there is a stone in the ureter unless, as very rarely happens, it is revealed in consequence of prolapse of the mucosa or a large gaping ostium.

On the contrary, ureteral catheterization combined with functional examination of the kidney enables us to differentiate renal colic from gall stones, appendicitis and intestinal obstruction. In these affections the functional capacity of both kidneys will be good and the value of $\triangle$ and sugar approximately the same. I have been able to diagnosticate with certainty cases of this kind in which all other methods had failed.

In nephrolithiasis, particularly in cases of long duration, these values will also be lower in the urine from the diseased kidney than in that from the healthy one. If the kidney is otherwise healthy, however, the differences will be slight. Examples:

1. LARGE CALCULUS WITH PYONEPHROTIC RIGHT KIDNEY. CATHETERIZATION OF THE URETERS (PHLORIDZIN 0.01).

	Right	Left
Urine:	Cloudy, pus moderate, Albumen.	Clear, no albumen.
$\triangle$	0.57°	0.92°
Sugar:	0.3%	1.1

2. ASEPTIC CALCULOUS KIDNEY WITH MEDIUM SIZED CALCULUS. CATHETERIZATION OF THE URETERS (PHLORIDZIN 0.01).

	Right	Left
Urine:	Cloudy, red blood corpuscles, no pus, albumen corresponding to the amount of blood.	Clear, no sediment, no albumen
△	0.95°	1.06°
Sugar:	0.8%	1.2%
N.:	0.24	0.38

In large hydronephroses and pyonephroses the difference in these values is much greater (*see under these diseases*). In chronic nephritis unequivocally low values will be obtained from both sides, and in nephralgia the functional activity of both kidneys will be equally good. The certainty of diagnosis under these difficult conditions has been materially advanced by ureteral catheterization and functional examination of the kidneys.

The mistake of relying solely upon these methods must not be made, for errors may occur. Thus, for example, a chronic nephritis associated with attacks of colic may be so mild that fairly good functional results may be obtained from both kidneys. The totality of symptoms must be considered in connection with the findings of ureteral catheterization and the functional examination, in order for trustworthy diagnostic results to be obtained.

The **course** of nephrolithiasis is chronic. In common with the **prognosis** it depends largely upon treatment. If a calculus is allowed to remain undisturbed, it may in exceptional cases be expelled spontaneously through the natural channels. It is very rare for a stone to break through the kidney and give rise to fatal peritonitis. Furthermore, spontaneous cure, in the sense that the stone permanently occludes the kidney and causes gradual pressure atrophy of the parenchyma to the point of complete obliteration without producing infection, is also rare. The supervention of complete anuria, which in the majority of cases results in death unless intervention is practised, is also unusual. Most frequently the kidney becomes infected in the course of time, with the result that pyonephrosis develops. The

earlier nephrolithiasis is recognized and interference practised the better will be the prognosis.

Treatment. The same measures recommended for the prevention of vesical calculi are appropriate in the prophylaxis of renal stone. **There are no remedies which dissolve calculi.** I have tested those reputed to do so, namely, lysidin, urezidin, lysetol, urotropin, urosin, chinotropin, sidonal, and others and have found that none of them possess their reputed action. **The most that can be done, therefore, is to guard against the formation of new calculi.**

In this respect the manner of living is first to be considered. The diet of persons having the uric-acid diathesis should not be rich. An excess of meat and the use of beer are to be avoided; foods containing a high percentage of nuclein, such as thymus, spleen, liver, brains and kidney are to be strictly interdicted, as are also strong tea and coffee. A mixed diet consisting of a moderate amount of meat, eggs, and an abundance of fruit and fresh vegetables is to be recommended. Sufficient exercise and warm baths should be taken for the purpose of securing assimilation and elimination of the food ingested.

In order to increase the solvency of the urine for uric acid it is well to administer alkalies in the form of carbonates and vegetable acid compounds, alkaline earths, and mineral waters. Lithium citrate and acetate in doses of 0.1–0.2 [15–30 grains] several times a day, carbonate of lime, borocitrate of magnesia in teaspoonful doses, or a mixture of all of these drugs, may be used, as may also the alkaline earthy mineral waters, such as Wildungen, Contréxeville, Vichy, Offenbach, Assmannshaus, Bilin, and Neuenahr, as well as the simple carbonated waters like Apollinaris, Harzer Sauerbrunnen, Elster, and Franzensbad. They are useful not only because of their alkaline action, but also because they increase diuresis, with the result that a larger quantity of uric acid can be held in solution.

For patients of less means the artificial Sandow Salts may be prescribed instead of the natural mineral waters.

The diet in oxalate calculi is practically the same, although food rich in lime salts, as well as tea and a few vegetables such as spinach and sorrel, which are rich in oxalic acid, must be avoided. Some caution must be employed in the use of fruits. Apples are contraindicated. The simple carbonated waters are better than the strongly alkaline. Apollinaris, Harzer Sauerbrunn, Krondorf, and Wernarz in Brückenau may be used.

For the pressure-pains of nephrolithiasis I have found that glycerine is the only drug except the narcotics which does any good. It was recommended by Hermann in doses of 50 to 100 cc. [approximately 1½ to 3 fl. ounces]. I have given as much as 150 cc. [5 fl. ounces] twice a week and have been well pleased with the results. It is best given with 20 cc. [5 fl. drachms] of syrup of orange peel, because otherwise it may produce nausea. I have never seen any ill effects, particularly hæmaturia, follow its use, although slight diarrhœa is sometimes produced.

Renal colic must be combated by means of hot applications to the lumbar region, free use of drinking water to increase diuresis, and especially by the administration of narcotics. The surest remedy to arrest contractions of the ureter is a hypodermatic injection of morphine. The dose must be full and commensurate with the degree of tolerance which the patient has established. If vomiting ensues the drug may be given per rectum with a small glycerine syringe.

By all these remedies and procedures it will only be possible to cause the expulsion of relatively small stones in fragments or in their entirety. Once a calculus attains a size larger than the lumen of the ureter its spontaneous expulsion is not to be expected.

Operative treatment then has to be considered. Three operations are practised, namely, nephrolithotomy, nephrotomy, and nephrectomy.

In nephrolithotomy the kidney is freed, incised, the calculi removed and the kidney then sutured. In nephrotomy, after the stone is removed, the kidney-wound is packed with gauze and left open. The first operation is suitable for aseptic calculous kidneys, the second for those in which suppuration is present in the pelvis or parenchyma of the kidney. After the stone has been removed suppuration of the open wound continues until healing and cicatrization gradually occur. If the kidney is mostly destroyed, if a large pyonephrotic sac is present, or if the remaining kidney-tissue is highly inflamed, then nephrectomy is indicated.

It might justly be asked if it is necessary to operate on every calculous kidney.

Cases in which an indication is manifestly present cannot enter the question. If the attacks of colic recur, if a persistent unbearable sensation of pressure which interferes with motion exists, if the hæmorrhage is uncontrollable, and if suppuration is present, there is no doubt that an operation is required. Which one is indicated has to

be determined by the nature of the case and the condition of the other kidney.

Anuria, unless it can be relieved by catheterizing the ureters, also necessitates immediate surgical intervention, because if it persists it will lead to uræmia and death. Ureteral catheterization should always be attempted before operating. I once succeeded in freeing an incarcerated stone by injecting oil into the ureter. In another case due to reflex spasm the anuria was relieved by introducing a catheter into the unobstructed ureter, with the result that the spasm was overcome and the flow of urine established. If the anuria can be relieved the prognosis after the removal of the stone by operation is much better.

Even in cases in which none of these urgent indications are present I believe in operating whenever the presence of a calculus can be positively determined. In aseptic calculous kidney the danger of operation is slight, although it may well be said that the sword of Damocles hangs over the patient's head if his malady is allowed to take its course. Anuria develops in consequence of incarceration of a calculus, or the renal substance is destroyed by pressure, or, what is more frequent than either of these conditions, the kidney becomes infected, pyelonephritis or pyonephrosis develops and necessitates operation later, when the chances of cure are not so good as they are in uncomplicated aseptic nephrolithiasis.

TUMORS OF THE KIDNEY.

The most common as well as the most interesting of renal tumors are hypernephroma, carcinoma and sarcoma. Concerning the causes of carcinoma and sarcoma nothing is known. Hypernephroma, also called epinephroid, struma suprarenalis, and Grawitz's tumor, originates from misplaced elements of renal tissue. (Plate XXIII.) Primary tumors only will be considered here, as those of metastatic origin are not subject to treatment. In contradistinction to metastatic growths, which usually affect both kidneys, primary cancer and sarcoma are almost always unilateral. Cancer is more common than sarcoma. Both may occur at any time of life, although they are most common after fifty.

Pathological Anatomy. [The hypernephromata are sharply defined from the surrounding tissue, being enclosed in a capsule derived originally from the renal tissue itself, which undergoes atrophy. The tumor substance is usually yellow in color, owing to its abundant

fat content, although Steorck believes it to be due to the presence of protagon instead of fat.

Microscopic examination shows that these tumors have a glandular structure. Muscle fibers and giant-cells have been found in them.

Hypernephromata may undergo cystic, carcinomatous or sarcomatous degeneration.]

The majority of renal carcinomata are of the soft medullary variety, which may attain a considerable size. The rarer hard scirrhus cancer is nodular and is not so large (Fig. 226). The tumor is usually kidney-shaped, has either a smooth or rough surface, and sometimes extends into the pelvis of the kidney or even into the ureter. Thrombosis of the renal vein or inferior vena cava may occur. In the substance of the tumor areas of softening and hæmorrhage are found. Metastases are comparatively rare. Cancer may extend to the neighboring parts, to the peritoneum, intestine or liver. The retroperitoneal lymph glands are involved the earliest.

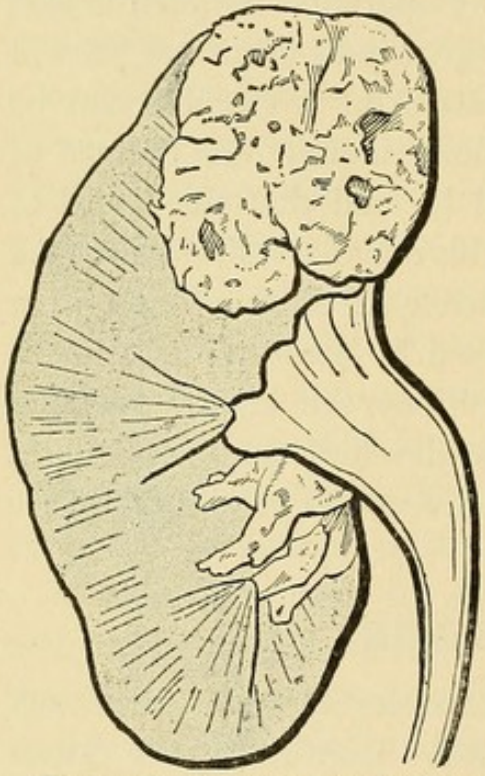


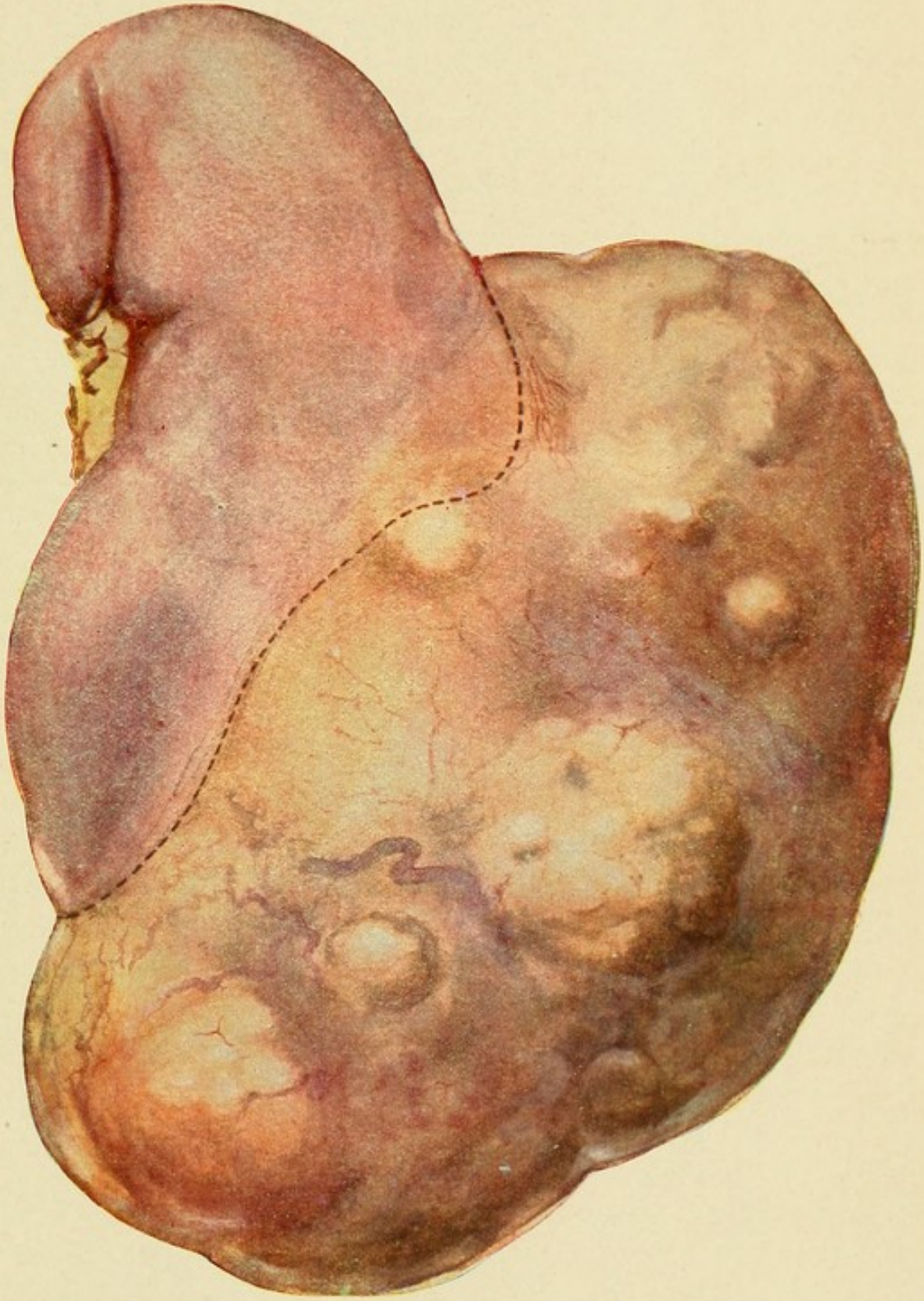
Fig. 226.—Scirrhus carcinoma of the kidney.

While carcinoma originates from the epithelium of the uriniferous tubules, sarcoma, both spindle and round-cell, develops from the capsule of the kidney or the perirenal connective tissue. Small round-cell sarcoma is more malignant than the large-cell variety, although even in the former metastases occur comparatively late in the disease.

Symptoms and Diagnosis. The symptoms of tumor of the kidney are pain over the affected side, changes in the urine, cachexia, the formation of a mass, and pain in other parts of the body when metastases occur. Unfortunately these symptoms are seldom present together. As a rule, the majority of them are absent, or they are first noticed when it has become too late for operative interference.

First, as regards the pain in the lumbar region, no reliance whatever is to be placed upon it. Although it is sometimes present I have more often found that it was absent, the patient even not having experienced the slightest sensation of discomfort in the diseased part.

PLATE XXIII



LARGE HYPERNEPHROMA. (DRAWING FROM A SPECIMEN REMOVED BY MR. C. H. GOLDING-BIRD, OF LONDON.)

The only change in the urine which is of any importance is the presence of blood. Pus-corpuscles are of no significance, as their presence always depends upon secondary changes. There is a double reason why the possible presence of tumor-cells is not to be depended upon. In the first place the normal epithelium of the urinary tract may closely resemble these cells and, secondly, the latter are very rarely found in the urine. Albumen is of no importance as it is due to secondary causes. Casts are merely the expression of a coexistent nephritis.

Hæmaturia may be very severe or so slight as to be detected only by the microscope. It must of course be determined that the source of the blood is from the kidney. This is nearly always possible by means of cystoscopy and catheterization of the ureters. It is no longer necessary to depend upon the highly untrustworthy means of differentiation formerly in vogue, namely, whether the blood is red or brown, whether the corpuscles are old or fresh, and whether the blood occurs in the form of worm-like masses. These phenomena are of value when present, but they are frequently absent. It must be remembered, however, that the bleeding kidney might not be the one in which the tumor is situated, as the other one might bleed owing to congestion or the presence of calculi. Such a condition must of course be exceedingly rare.

Much has been written concerning the kind of hæmorrhage characteristic of renal tumors. It is true that the hæmorrhage is usually profuse and of long duration, that it occurs suddenly and ceases in the same manner, and that it is not influenced by treatment. All this, however, may occur in vesical tumors without producing tenesmus. Therefore such bleeding cannot be considered a means of differential diagnosis.

There is yet a greater difficulty than this. **A tumor may exist for years before it causes hæmorrhage** even though in many cases bleeding is an early symptom. So, too, years may elapse between the first and second hæmorrhage.

A more constant symptom is **cachexia.** I have observed that nearly all patients having renal tumor enter upon a decline, become markedly emaciated, and upon first sight give one the impression that they are seriously ill. It would be more important, of course, to recognize the disease before cachexia developed. Its presence may well cause fear that the disease is far advanced.

The most positive sign, **the presence of a tumor,** is one of the most importance, as it is less commonly absent than the others. Upon

palpation a mass may be felt under the costal arch when the patient breathes deeply; it can often be learned whether the growth is smooth or rough, how large it is, and whether it is distinct from the kidney.

Of course it is not always easy to tell whether a tumor thus palpated is in the kidney; confusion with other organs, such as the liver, gall-bladder, intestines, spleen, ovaries, uterus and enlarged retroperitoneal lymph-glands, has occurred. Moreover, there are tumors which produce only small nodules, are placed deep in the kidney, and therefore cannot be felt, and others which together with the kidney are so concealed under the costal arch that they are not accessible to palpation. Finally it must be stated that the disease is usually well advanced before the tumor can be plainly felt.

It is the same with the "rheumatoid pains" which are felt in different parts of the body and which are to be attributed to metastases in the bones. If they prove to be caused by metastases diagnosis is then of no practical value. Other metastases, for example, glandular involvement, make it difficult, particularly at first, to establish a diagnosis.

From this sketch of the symptom-complex it is seen that malignant tumors of the kidney are not difficult to diagnosticate at a certain period of their evolution, and, moreover, that an **early diagnosis** is of the utmost importance.

Therefore the greatest attention must be given to every urinary hæmorrhage. Reliance must not be placed on the fact that hæmorrhage may occur from a healthy kidney, but every renal hæmorrhage must be most carefully investigated. Every patient should be immediately subjected to catheterization of the ureters and functional examination of the kidneys. The functional capacity of a kidney in which the normal tissue has been replaced by the elements of a new growth is always lower than that of the other kidney, and this is true in a stage of the disease when all other symptoms and signs may be absent. An example may illustrate this fact.

CASE L (OPERATION).

CATHETERIZATION OF THE URETER (0.01 PHLORIDZIN).

	Right.	Left.
Urine:	Clear, only a few erythrocytes, no albumen.	Clear, free from all abnormal elements.
△	0.21	0.45
Sugar:	0.4	1.0

In this case the examination was made in the interval of freedom from hæmorrhage and other symptoms. The patient had a hæmorrhage weeks before. A diagnosis of tumor of the right kidney was at once made, and it was confirmed by the operation. This case shows the importance of the examination. Without the functional test one would have been obliged to wait until another hæmorrhage had occurred in order to determine the source of the bleeding, as there was no palpable tumor, and other symptoms, such as marked emaciation, were entirely absent.

Therefore, in the early diagnosis of malignant tumors of the kidney, the functional renal examination is very valuable, although it must be remembered that care is necessary in forming a conclusion, inasmuch as in tumors of the renal capsule and suprarenal gland, which may give rise to the same symptoms as renal tumors, although the substance of the kidney is only slightly or not at all attacked, the functional examination may yield the same or approximate results.

From this the following conclusion is to be drawn: if a mass can be felt on one side or a hæmorrhage from the kidney on this side be determined, and if the values for $\triangle$ and sugar in the urine from this kidney are considerably lower than in that from the opposite one, then a tumor of the kidney certainly exists, provided that the symptoms present are such as occur in tumor and not in other affections, as tuberculosis, for instance; if a mass can be felt and the values are high, tumor cannot be excluded, for one of the above mentioned forms may be present.

In comparison with the great advantages which this examination offers, the other signs, although they should never be disregarded, are of minor importance. According to Guyon the sudden development of a varicocele upon the diseased side should arouse suspicion of a renal tumor. This may be true, but there are tumors enough in which varicocele is absent.

Concerning benign tumors of the kidney, which are very rare, and of which adenoma, fibroma and lipoma are by far the most common, it may be said that they are considerably smaller than malignant growths, that they increase in size less rapidly, and that cachexia does not occur. It is very difficult to diagnosticate them during life.

The **prognosis** of malignant tumors is bad—bad without operation and bad with operation. In the minority of cases death results directly from the operation; in the majority, however, it is due to metastases.

The earlier the diagnosis the better the prognosis as regards both immediate and remote results.

As to **treatment,** nephrectomy is the only procedure to be considered. Operation is indicated when the functional capacity of the other kidney is good and the general condition, particulary the cardiac action, leads one to believe that metastases have not occurred.

Stress should be laid upon the fact that the previously mentioned **capsular tumors** (of which the fibroma and sarcoma generally originate in the fibrous, and lipoma and myxosarcoma in the fatty capsule), may attain large dimensions, and that they are characterized by their retroperitoneal location, displacement of the colon, slight mobility, and absence of urinary hæmorrhage.

Great caution must be employed in basing a diagnosis upon displacement of the colon, because the colon may push a renal tumor upwards, or a tumor may displace the colon lateralwards. I have often seen both these conditions. These tumors of the capsule are therefore very difficult to diagnosticate. **Treatment** consists in their removal, which necessitates the sacrifice of the kidney.

TUMORS OF THE PELVIS OF THE KIDNEY AND URETER.

Tumors of the renal pelvis and ureter are exceedingly rare. There are two kinds, both of which have a papillary structure; one is true **papillary carcinoma,** the other **simple papilloma,** such as often occurs in the bladder. The latter form cannot be considered as strictly benign because it often extends into the ureter and bladder. Although its structure may appear benign under the microscope its multiplicity makes it of a severe and serious nature.

The recognition of this affection is beset with great difficulties. Little can be learned by palpation, for the tumors are small and do not cause enlargement of the kidney. If the kidney becomes enlarged it is generally owing to obstruction of the renal pelvis by the tumor. The mass then has the characteristics of hydronephrosis.

From the latter, however, the affection may be distinguished by a marked tendency to hæmorrhage, which does not exist in hydronephrosis.

James Israel has called attention to an important symptom. He has noticed that in consequence of the great vascularity of the tumor, its size varies with the degree of distention of its blood vessels. If

hæmorrhage occurs the tumor becomes smaller, as does also the engorged, enlarged kidney, which remains small until another attack of congestion and interference with the outflow of urine causes it to enlarge again. As Israel has aptly said, the clinical picture is one of **intermittent hæmatonephrosis.** Rarely fragments of the tumor may be found in the urine; their source can be determined by cystoscopy.

Up to the present time, owing to the rarity of the disease, functional examination has been made in only one case. In this one there was a great difference in the urine of the two kidneys, a circumstance which was due to the fact that the kidney was also affected with interstitial inflammation. In absence of such inflammation there is no reason why the function of the kidney should be materially impaired. The values for both sides should be good and practically the same.

Treatment consists in complete extirpation of the kidney, together with removal of as much of the ureter as is possible, because, as has already been stated, the tumor frequently invades the ureter.

CYSTS OF THE KIDNEY (BENIGN CYSTS AND POLYCYSTIC DEGENERATION).

Small multiple cysts are found in perfectly healthy kidneys, especially in the cortex. They are of no practical importance, being due, no doubt, to constriction of the uriniferous tubules.

Small and large cysts are also found in genuine contracted and arteriosclerotic contracted kidney, in which the constricting, contracting connective tissue has caused occlusion of the uriniferous tubules.

Unless they attain considerable size they are likewise of no practical importance.

In contradistinction to these, that rare condition known as **cystic degeneration of the kidney, which develops in both organs simultaneously,** is fraught with special interest. Either massive cysts or a number of sacs separated by remnants of parenchyma are found in the kidney, which is much enlarged owing to their presence. (*Rein gros polycystique* of the French). (Fig. 227.)

Their surface is bosselated, their contents composed of serum, mucus and blood. The congenital forms will not be considered here as they are of no importance except that they constitute a hindrance to birth. They are due to constriction of the uriniferous tubules, to atresia of the

papillæ occurring in intrauterine life, and to dilatation of Müller's capsule following hæmorrhage.

Of practical importance is polycystic degeneration occurring at a later age, which is due to abnormalities that originate during fœtal life, although they manifest themselves at a later period of existence. (Victor Steiner believes that the condition is hereditary.)

The **diagnosis** of this condition is uncommonly difficult. The cysts often remain entirely latent, are frequently not palpable, and when

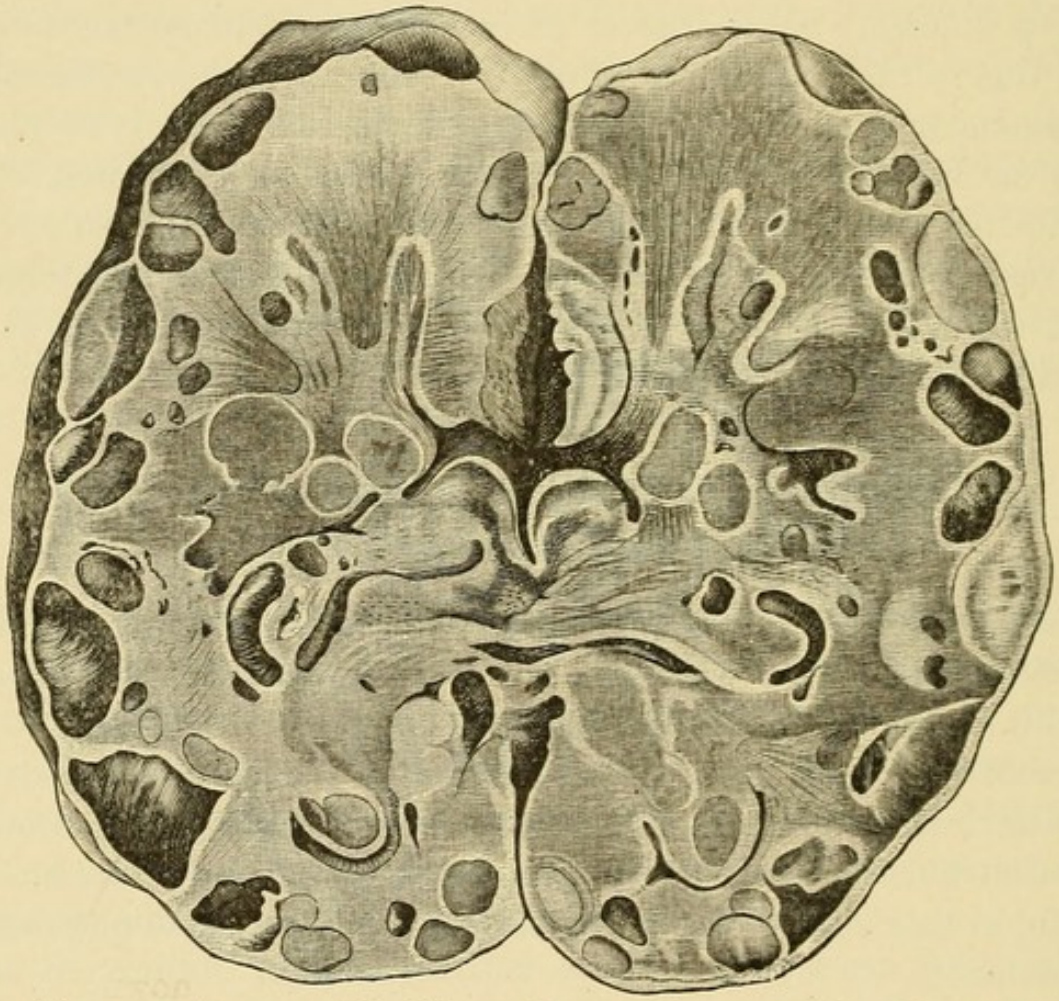


Fig. 227.—Cystoma of the kidney. Removed from an adult. (Küster.)

they can be felt are very difficult to distinguish from other renal tumors. Their bosselated surface may cause them to be mistaken for malignant tumors, although this attribute serves to distinguish them from the hydronephrotic kidney, which has a smooth surface. The most important characteristic is that they occur bilaterally. If a mass which is apparently cystic is felt on both sides this disease must be thought of. Naturally, under certain conditions, a palpable mass may be found on one side only, and then this sign fails.

Another important diagnostic sign is the frequent simultaneous occurrence of hepatic cysts. The latter also often escape detection. Changes in the urine are likewise unconstant; they may be present or absent. The urine is similar to that of contracted kidney, being very pale, of low specific gravity and very copious in quantity. In both affections there is destruction of renal tissue. Israel also found the circulatory changes characteristic of contracted kidney, namely, increase in arterial tension and hypertrophy and dilatation of the left ventricle.

Functional examination of the kidney will afford the best means of diagnosis, for the reason that diminution in the functional power of the organ is bound to be expressed by figures, although as yet the examination has not been made.

It is remarkable how long persons affected with the malady may live without experiencing any difficulty. It shows with how little renal tissue a patient may live, as long as the transient equilibrium of the organism remains and is not disturbed by surgical interference. Therefore, the diagnosis of this condition is most important, because it will prevent interference which will destroy the patient. As the affection is bilateral operative treatment is out of the question.

MOVABLE KIDNEY (REN MOBILIS SEU MIGRANS).

A movable kidney is one which is abnormally situated and unduly mobile. The degree of mobility is variable; in some cases the kidney may be displaced only a short distance, while in others it may be freely moved upward under the costal arch or downward apparently as far as the small pelvis. A kidney which is deeply situated and easily palpable, but not mobile, is not to be considered as a movable kidney.

Movable kidney may be congenital, although it is more frequently acquired. It is more common on the right side than on the left, and affects women oftener than men. Its development is due to loosening of the attachments of the kidney (Landau), which may be caused by pressure of tumors in neighboring organs or by growths in the kidney itself which make traction upon the attachments; by traumatisms sustained during violent fits of coughing, severe straining at stool, heavy lifting, etc.; by severe diseases which lead to rapid shrinking of the paranephric fatty tissue; by relaxation of the pelvic organs, such as occurs in the puerperium when involution of the genital organs takes place; by tight lacing which produces dislocation of the liver and consequent pressure upon the right kidney; and possibly also by

frequently repeated congestion of the renal plexus produced by the afflux of blood to the communicating ovarian plexus during menstruation. Occasionally movable kidney is only a part of a general enteroptosis.

In consequence of inflammatory adhesions a movable kidney may become firmly fixed in an abnormal position. As a rule, the parenchyma of the organ is perfectly healthy, although other affections such as cystic degeneration and pyonephrosis may occur. An associated hydronephrosis is exceedingly common, the mobility of the kidney causing the ureter or outlet of the renal pelvis to become compressed, thus producing a retention of fluid.

Symptoms and Diagnosis. In a large number of cases movable kidney does not give rise to any symptoms. In a minority of cases symptoms are present, although it is doubtful whether they all depend upon the movable kidney or whether they are not due rather to the condition produced by general enteroptosis.

The most pronounced symptoms are a series of **severe nervous disturbances** caused by pressure and traction upon the nerves of the kidney. Neuralgic pains radiate to the sacrum, back and groin. They are more acute during menstruation and are also increased by bodily exertion and violent exercise. Digestive disturbances are also marked; they consist in anorexia, nausea, vomiting, constipation, and distention of the abdomen. Nervous palpitation of the heart has also often been observed.

Disturbances of micturition may be present, although in the majority of cases the urine is normal as to quantity and quality. When alterations occur they are the same as those of intermittent hydronephrosis.

The occasional occurrence of renal colic in hydronephrosis has already been mentioned. Even without the supervention of hydronephrosis, movable kidney may sometimes give rise to typical colic owing to a sort of strangulation and closure of the kidney produced by its abnormal position, torsion and kinking of the vessels, and occlusion of the ureter. The attacks of colic thus produced differ in no wise from those previously described as occurring in nephrolithiasis.

The **diagnosis** of movable kidney can be positively made by palpation, which is easily performed by the bimanual method, and which reveals an abnormally mobile and dislocated kidney and enables the examiner to recognize its typical form and consistency. Pressure over the kidney usually fails to elicit pain. Percussion gives

forth a dull note, but upon inflation of the colon the dullness generally disappears.

The **prognosis** of movable kidney is favorable. As a rule, the condition persists for years unless intervention is practised; in a few cases infection of the kidney takes place in consequence of the circulatory disturbances and intermittent distention of the renal pelvis with urine. Cases of spontaneous cure have been observed, particularly in persons who have taken on flesh rapidly, and it has been endeavored to produce this condition artificially by means of Weir Mitchell's rest-cure.

Treatment. First of all our attention must be directed to the prevention of movable kidney. For this purpose a strict veto must be placed upon tight lacing and great care employed in the hygiene of the puerperium. Puerperal women should not be allowed to get up too soon, and should wear a wide abdominal binder, which acts as a support to the pelvic organs during involution.

If a movable kidney causes trouble it should first be treated by means of bandages, of which there are many serviceable kinds. Good results are sometimes obtained in the case of emaciated persons by a rest-cure, from which it may be assumed that absorption of fat caused the development of the movable kidney.

If these measures do not afford relief and severe symptoms arise which make the patient's life miserable, nephropexy should be resorted to; as it is now performed it is without danger and offers a certain cure. I have completely abandoned suture of the kidney, fixation to the ribs, etc., and now do merely a decapsulation.

The capsule of the kidney is split on the convex border of the organ from one pole to the other, stripped off on each side, and then cut completely away near the pelvis. The kidney thus bared is replaced upon the fatty capsule, which is fastened as high as possible to the underlying muscle with a few strong catgut sutures. Firm adhesions then form between the fatty capsule and the muscle on one side and the kidney and fatty capsule on the other. This operation is devoid of the dangers incident to the earlier operations in which sutures were passed through the substance of the kidney, and I have found it thoroughly reliable in a series of cases.

If there is a complicating hydronephrosis, together with frequent attacks of renal colic, treatment is to be conducted in accordance with the rules prescribed for the management of that affection.

PARASITES IN THE KIDNEY.

The Echinococcus.

The **echinococcus,** the embryo of *tænia echinococcus*, which inhabits the intestine of the dog, is found in the kidney, as in other organs, in the form of a large round or ovoid gelatinous cyst containing a clear watery fluid in which numbers of daughter-cysts are floating. On the inner wall of the smallest cyst scolices are found having a rostellum provided with hooklets, which are important, as they also float free in the fluid and thus contribute to the recognition of the disease.

If the ovum of the *tænia echinococcus* gains access to the stomach of man, it is freed from its investing membrane and enters the blood-vessels of the intestine, whence it passes into the portal vein and thence direct, or perhaps through the lymph-channels, into the right side of the heart. From the heart it is carried by the arterial blood-current to different organs of the body, particularly the liver and kidneys.

The kidneys are attacked much more frequently than the liver, and, as a rule, only one kidney is affected. The echinococcus works its way from the cortex to the pelvis of the kidney. The cyst becomes adherent to other organs (spleen, liver) and may rupture into them; simultaneous rupture into the bronchi and renal pelvis has been observed.

The disease first becomes recognizable when it leads to the formation of a renal tumor. This mass occupies the position of the kidney, may be very large and even reach to the brim of the pelvis. It has the characteristics of a renal tumor, fluctuates, and occasionally gives forth the so-called hydatid thrill, although the latter sign is not of much value because it may occur in simple hydronephrosis. It may be very difficult to elicit fluctuation, and also to determine whether the tumor is in relation with the kidney. The difficulties which obtain in the diagnosis of renal tumors have been repeatedly described.

The affection becomes easily recognizable if the contents of the cyst rupture into the pelvis of the kidney. Before this happens the urine may be absolutely normal. If blood or pus are present they are due to secondary changes. When rupture occurs, however, the vesicles reach the pelvis of the kidney and bladder and are voided with the urine. Diagnosis is then readily made by finding the vesicles and characteristic hooklets. The urine then also usually contains pus and albumen.

The discharge of the cyst through the ureter may be accompanied by colicky pains owing to temporary though complete occlusion of the ureter by the large vesicles.

Vesical tenesmus and strangury have also been observed when a large number of cysts were passed or when they occluded the outlet of the bladder. As a rule, however, their passage causes no trouble.

It is important to remember that the presence of echinococcus cysts in the urine does not mean that they come from the kidney, for the location of the primary cyst may have been the liver, from which it perforated the renal pelvis, or a cyst between the rectum and bladder may have broken into the latter viscus.

The **prognosis** is generally favorable. The disease may last for years without giving rise to any trouble. Rupture of an echinococcus cyst into the lung may prove fatal; its rupture into the pelvis of the kidney, however, constitutes a natural method of cure. It is evident that the parenchyma of the kidney will suffer pressure-atrophy, and that it may be completely destroyed if sufficient distention of the sac takes place.

Treatment. As soon as the disease has been positively recognized operation is indicated. Exploratory puncture and the finding of vesicles and hooklets will make diagnosis positive. The kidney should then be laid freely open, its contents evacuated, and the sac cleansed and drained. Nephrectomy is permissible only when practically no renal tissue remains. Kümmel succeeded in resecting the diseased portion of the kidney and leaving the healthy part intact.

Of the remaining animal parasites found in the kidney the *eustrongylus gigas*, the *distoma hæmatobium* and *filaria sanguinis* are of some importance.

The **eustrongylus gigas,** a nematode worm, is often found in the kidney of the horse, ox and dog, but is very rare in man. Its site of predilection in the human kidney is the pelvis. The symptoms which it causes are dysuria, hæmaturia, chyluria and pyuria. A patient from the tropics whom I had the opportunity of examining, and in whose urine ova were found, was operated upon after I had determined by ureteral catheterization that the milky, purulent masses came from one kidney. The urine from the other kidney was clear. At operation the worm was not found in the kidney. It must have been in the lymph-vessels near the kidney

The **distoma hæmatobium** (Bilharzii) is a trematode parasite

which is common in Egypt. It gets into the intestine by means of contaminated drinking water or food (dates, fish and other food) and thence passes into the kidney, its pelvis, and the bladder. It causes occlusion of the blood-vessels, inflammation and hæmaturia. The diagnosis can be made only by finding the ova in the urine. Treatment must be preventive, the use of contaminated food being prohibited.

The **filaria sanguinis** is a nematode worm indigenous in the tropics—in Brazil, the East and West Indies and Egypt. It gets into the intestines and occludes the lymph-vessels, as a result of which they become dilated and the lymph from the accessory channels is poured into the bladder or kidney. As proof that this explanation of the development of chyluria is correct, it has been cited that the thoracic duct is found dilated at autopsy.

Incidentally it may be mentioned that Israel once diagnosticated a case of primary actinomycosis of the kidney. The diagnosis was made by finding actinomyces in the granulations of the scar of a previous exploratory puncture and in the urine. With the exception of this case actinomycosis has been observed only as a secondary process.

SYPHILIS OF THE KIDNEY.

Renal syphilis is still an obscure subject. Until within a short time syphilitic disease of the kidney was considered exclusively as a manifestation of general syphilis, which occasionally affected both kidneys and produced a diffuse parenchymatous and interstitial nephritis. All the cases which I have seen were of this form. Israel also describes such a case in which the fatty capsule was thickened and very fibrous and the fibrous capsule was converted into a lardaceous rind. Upon section the kidney showed yellow wedge-shaped areas and marked interstitial and parenchymatous changes (small-celled infiltration of the interstitial tissue, degeneration and complete destruction of the epithelium). Thus far his observations are fully in accord with my opinion, that diffuse nephritis may develop in syphilis, but Israel believes that his case was one of unilateral syphilitic nephritis, for the reason that after extirpation of the kidney the patient recovered and gained forty pounds.

I question the correctness of his opinion. According to my experience there is no such a thing as unilateral nephritis. I have never seen a

single case, and this alleged one of Israel's only strengthens my belief that it does not exist. Five years after the operation the patient still had albumen in his urine, so it is much more probable that he had a bilateral nephritis, which perhaps was more severe in the kidney extirpated and became arrested in the other kidney after he was operated on.

The second case, one in which a kidney which was extirpated chiefly on account of a fistula was found to have shiny yellow nodules on its surface and to be much contracted, seems to me to be considerably more important. Upon section map-like yellow areas were found. The adjoining tissue was yellow in color and not at all like normal kidney substance; it proved to be composed of connective-tissue cells having spindle-shaped nuclei, and was not sharply demarcated from the yellow necrotic tissue. This case was one of diffuse gummata. The kidney was removed and the patient recovered.

The case offers striking proof that gummata may affect one kidney. The diagnosis will always require evidence of syphilis or a history of this disease. It may be confirmed by treatment *ex juvantibus*.

It has long been known that mercury has an unfavorable influence upon diffuse nephritis occurring in syphilis and that potassium iodide has scarcely any effect. Occasionally the albumen is somewhat diminished. It may be expected, however, that gummata will eventually undergo complete absorption under the use of mercury and the iodides, just as they do in other organs. These drugs should always be tried.

Extirpation of the kidney is permissible only when these remedies have failed, and then only after the functional capacity of the other kidney has been tested and found to be adequate. In diffuse nephritis, which can be diagnosticated by catheterization of the ureters, operation is contraindicated.

[The existence of a genuine syphilitic diffuse nephritis was formerly denied, but so many cases of undoubted authenticity have been reported that its existence is now generally recognized. Cases occur in which no etiological factors other than syphilitic infection can be determined, the renal involvement manifesting itself suddenly early in the course of the disease, even before mercurial treatment has been instituted. I have observed two cases of this kind in young and previously healthy persons who had neglected to take treatment owing to the benignity of the secondary manifestations.

True syphilitic nephritis is to be differentiated from the albuminuria which is so common in beginning constitutional syphilis. Like the latter, however, it usually occurs early in the course of the disease, according to Fournier, almost always within the first year after infection. Probably the majority of cases occur during the first four months after infection. In one patient of mine it came on simultaneously with the early secondaries, which were unusually severe.

This affection is characterized by its sudden onset, by the large amount of albumen in the urine, and by its rapid progress. In suddenness of onset it resembles the nephritis complicating other infectious diseases. The œdema of the eyelids, ankles, scrotum and other parts is present, and likewise the asthenia, anorexia and oliguria so characteristic of acute renal inflammation.

As already stated, the quantity of albumen is large. Fifteen to fifty grammes per diem is not an unusual amount. Casts, at first hyaline and light granular, and later dark granular and epithelial, are also present in the urine.

The tendency is for both objective and subjective symptoms to progress rapidly. The localized œdema may be widely diffused within a few days or a fortnight, and diarrhœa, vomiting, suppression of urine, uremia and pulmonary œdema may lead to an early fatal termination. Fournier found that ten out of thirty cases which he studied ended in death.

Recovery may take place or the morbid process may become chronic.

In regard to treatment, it would seem that in some cases mercury is entirely without effect, as stated above, whereas in others it is almost specific. My own experience is entirely in accord with that of Fournier, Widal, Mosny, Le Gendre, Siredey and others, who have obtained excellent results in a certain proportion of their cases by the liberal administration of mercury.

In cases in which mercury is ineffectual, Siredey advises that its use be discontinued temporarily, the patient confined to bed and put upon a milk diet for a week, and that at the expiration of this time hypodermatic injections of a soluble mercurial salt be tried.

If the patient's general condition improves, or if the quantity of albumen excreted in the urine diminishes, the injections are continued. If the patient becomes worse, or the amount of albumen

increases, they are stopped. I have had the opportunity of trying this plan in one case, with the result that the patient improved.]

PERI-, EPI-, AND PARANEPHRITIS.

Owing to the multiplicity of terms it is first necessary to get a clear conception of their meaning. Perinephritis refers to inflammation of the fibrous capsule, epinephritis to inflammation of the fatty capsule, and paranephritis to inflammation of the retroperitoneal mass of fat behind the kidney. These conditions often occur together, or at least all the structures are frequently affected when diagnosis is first made, although in the beginning of the disease one or another was primarily affected.

As an independent and isolated affection **perinephritis** is the most common. It produces thickening of the capsule and causes it to become adherent to the parenchyma of the kidney, with the result that small subcapsular areas of suppuration develop. The fibrous capsule can then be stripped off from the kidney only with difficulty, or perhaps not at all. If it be torn off with force small pieces of the kidney are brought away with it.

This perinephritis, which is frequently though not always associated with other renal affections, gives rise to pain which may sometimes be so severe as to resemble typical renal colic. It is due to traction exerted upon the kidney and its nerves by the adhesions. The condition is important because it offers an explanation of many obscure cases of renal colic in which no abnormalities are found at operation.

Epinephritis and paranephritis develop primarily from wounds and contusions in the region of the kidney and secondarily from metastases or extension of inflammation from neighboring parts. In the latter respect it is not merely inflammation of the kidney which invades the epinephric and paranephric tissue; suppuration in the pelvic cavity, parametric and paratyphlitic suppuration, ileopsoas abscess, and burrowing abscesses in organs higher up, such as the liver, spleen and lungs, as well as subphrenic abscess and empyema, may lead to suppuration in the fatty and fibrous tissue around the kidney.

The entire part is then the seat of a more or less extensive circumscribed or diffuse suppuration. A typical phlegmon is formed which may rupture into neighboring organs. Rupture has taken place into the kidney, ureter, peritoneal cavity, intestine, bladder, diaphragm, and also through the ileopsoas muscle onto the hip.

Recognition of the disease in its beginning is very difficult or even impossible, owing to the concealed situation of the lesion and to predomination of symptoms referable to other affections, such as suppuration in the kidney and liver, for instance. It is only as the disease progresses that its nature becomes clear. Pain, fever and tumefaction are the cardinal symptoms. The pain is located in the affected part, becomes more severe upon motion and when the body is shaken or jolted, and particularly when pressure is made over the kidney. It may be so severe as to prevent all motion and even force the patient to refrain from coughing.

Fever may be high or low, or may be altogether absent. It is generally intermittent or remittent. Tumefaction becomes more perceptible as the morbid process advances toward the surface. It differs from renal tumors in that it is more diffuse. While the former can usually be well-defined and their limits determined, the latter gradually becomes continuous with the normal tissue, no distinct line of demarcation existing. In consequence of this intimate connection with the surrounding tissues, the mass does not move so freely with respiration as do renal tumors. If the inflammation reaches the skin the phlegmon becomes apparent. The skin is reddened, tense and swollen. Pressure is painful. The symptoms of rupture depend upon what organ is perforated.

The urine usually shows no change unless the kidney is involved.

The course of this disease is most favorable when early external rupture takes place. Otherwise it depends upon the organ into which rupture occurs.

Treatment consists in making free incisions into the phlegmonous area and evacuating the pus. Internal and local antiphlogistic measures are not to be relied upon, as the infected areas will not be influenced by them. If the kidney is also diseased, as is often the case, it should be incised, and if it is found to be mostly destroyed it should be removed.

INJURIES OF THE KIDNEY.

Injuries of the kidney are not very common. They are divided into wounds and contusions. Wounds are caused by gunshot injuries, stabs and blows. A renal wound may be simple or may be complicated with wounds of other organs, such as the intestine or peritoneum. It is plain that the latter are the more serious.

The chief danger of a kidney wound is hæmorrhage. The blood

may escape from the wound or flow into the renal pelvis and thence through the ureter to the bladder, or it may be poured out into the perinephric tissue.

Infection is also to be feared. It may be caused by germs introduced from without, or take place within the kidney. If the hæmorrhage is profuse clots may occlude the ureter and cause typical renal colic. Hæmaturia then suddenly ceases. Clots too large to pass through the urethra or a catheter may cause retention of urine and great distention of the bladder, and thus give rise to vesical spasm.

The **prognosis** of wounds of the kidney depends upon their severity. Many heal kindly and many become infected and suppurate. A part or the whole of the kidney, together with the perinephric tissue, may suppurate and cause pyæmia.

Treatment. In small wounds treatment should be confined to washing out the wound and applying an antiseptic dressing. In severe wounds in which there is danger of hæmorrhage the injured kidney must be freely exposed. If bleeding cannot be arrested by packing extirpation of the kidney is indicated. If suppuration occurs before the surgeon sees the case, incision and drainage must always be practised. Vesical tenesmus is treated according to established rules. If the clots cannot be removed through the catheter, and if vesical tenesmus persists, suprapubic cystotomy must be performed.

CONTUSIONS OF THE KIDNEY.

A contusion of the kidney is an injury of the organ in which the superjacent soft parts are not divided. They are usually caused by direct force, such as blows, kicks or crushes. The extent of the contusion is variable. It may be confined to the capsule, involve a portion of the kidney, or extend into the pelvis and ureter.

The unmistakable symptoms of contusion of the kidney are urinary hæmorrhage and the formation of a tumor in the region of the kidney. If the peritoneum is torn blood may be effused into the peritoneal cavity and produce peritonitis. Sometimes, particularly when the injury is slight, the bleeding ceases of its own accord. If it has been slight from the beginning one may wait a little while, but unless it ceases, or if signs of anæmia appear, delay is not permissible. The injured organ must then be exposed. If possible, the wound should be closed with sutures, otherwise it should be packed with gauze; if packing fails to arrest the bleeding nephrectomy must be performed.

The **prognosis** of contusions of the kidney depends entirely upon their severity and the quickness with which help is secured. In severe cases death may result from hæmorrhage.

ANEURYSM OF THE RENAL ARTERY.

This very rare affection depends, the same as aneurysm of other vessels, upon arteriosclerosis, and accordingly is observed only in elderly persons, often being associated with similar disease in other vessels. Diagnosis during life is very difficult and has been made in only a few cases.

A tumor, hæmaturia and pain are the principal symptoms. They may be absent, and as they also occur in other renal diseases they afford no positive information.

Hæmaturia is a symptom of multifarious significance, and, moreover, in aneurysm it generally occurs late in the course of the disease. Finally, the tumor is of diagnostic import only when it pulsates. This it does not always do, as for example, when it is filled with clots. A pulsating tumor might also be a mass lying upon the aorta, or an aneurysm of some other branch of the abdominal aorta. In addition to all this a palpable tumor is not always present. Thus it is seen that diagnosis is most difficult, and, indeed, usually impossible. It is only when a pulsating tumor is associated with hæmaturia that we have a right to assume the existence of aneurysm.

As concerns treatment Hahn's case is of interest. His patient recovered after ablation of the aneurysmal sac together with the corresponding kidney. [Albert and Keen have also operated successfully for this condition. In 1900 Dr. Keen was able to collect only thirteen cases including his own; later in the same year Henry Morris reviewed the literature of the subject and brought the number up to nineteen. In 1903 Paul Zeigler, of Munich, in a still more exhaustive review of the literature, found three other cases, thus making the total number twenty-two. Since the publication of Zeigler's paper, so far as I have been able to determine, only one case has been reported, namely, one by Dr. C. W. Higgins, of Providencé, R. I. Thus it is seen that the condition is rare, although many cases may have occurred in which a correct diagnosis was not made either before or after death.

In thirteen of the twenty-three recorded cases there was a history

PLATE XXIV



ANEURYSM OF THE RENAL ARTERY. (W. W. KEEN.)

of injury, in seven no injury had been sustained, and in three no history was obtainable.

It is interesting to note that recovery took place in the three cases in which operation was performed. Those due to injury naturally offer the most favorable prognosis.]

NEURALGIA OF THE KIDNEY (NEPHRALGIA, NEPHRALGIE HÆMATURIQUE, ANGIONEUROSIS RENIS, ESSENTIAL HÆMATURIA, HÆMORRHAGE FROM HEALTHY KIDNEYS).

In preceding sections mention has been made of a series of affections which are associated with pain, especially with proxysmal attacks of colic. It is known that any obstruction in the ureter may cause renal colic. Thus it may be due to renal and ureteral calculi, kinking of the ureter owing to low position of the kidney, movable kidney, hydronephrosis, occlusion due to blood-clots or pus resulting from new growth, parasites, tuberculosis and pyonephrosis.

For many years, however, cases of typical renal colic have been recognized in which none of these affections were demonstrable nor could be found upon operation or at autopsy.

The complaint under discussion is characterized either by violent pain in the region of the kidney, resembling true renal colic and recurring at variable intervals, or by **colic associated with more or less severe hæmorrhage,** which is also of variable duration. In a third class of cases the only symptom observed is **renal hæmorrhage,** which at times is of long duration. It is self-evident that affections in which other symptoms are present, for example, pus and blood in the urine, cannot be placed in this category.

How are these cases to be explained? In view of the fact that hæmorrhage of great severity and long duration has been observed independently of any of the recognized causes of renal bleeding, and particularly for the reason that persons thus affected have enjoyed good health for years afterwards without the supervention of other hæmorrhages, it has been assumed that the trouble is due to disturbances of the vasomotor and sensory nerves, or in other words that the **hæmorrhages are angioneurotic** (Klemperer).

Senator explained one case by the hypothesis of **renal hæmophilia.** Israel is of the opinion that this case depended upon the structural changes in the kidney. He believes that in such cases there is a pre-

existent circumscribed or diffuse inflammation, which produces no changes in the urine, but gives rise to paroxysmal attacks of congestion. Naunyn has also reported **violent hæmorrhages in contracting kidney.**

Harrison, Guyon, Albarran and Legueu are likewise of the opinion that the condition is due to congestive swelling of the kidney resulting from old inflammatory foci and leading to tension of the capsule. They also believe that the condition can be cured by splitting the capsule of the kidney.

Senator and Rovsing think that there are always adhesions between the kidney and fibrous capsule and the fibrous and fatty capsule, and that the pain is caused by traction. They believe the curative effect produced by splitting the kidney to be due to the fact that the adhesions are broken up when the organ is freed from its investing layers. Therefore, Rovsing advises against incising the kidney and recommends that it be merely freed from its surrounding membranes, to which operation he applies the term **nephrolysis.**

As concerns my own experience, I have seen cases of typical renal colic which differed in no wise from those due to calculi except that no red blood-cells were present in the urine, cases in which no discernible lesions were found upon operation and in which microscopic examination of sections of renal tissue removed at the time of operation showed no abnormalities. In these cases, moreover, the patients recovered and experienced no return of their disease.

In one of these cases just before each attack the kidney became so swollen that it could be easily palpated under the costal arch; after the attack the swelling disappeared. At operation (nephrotomy) neither hydronephrosis nor dilatation of the pelvis was found. In this case there could have been nothing but congestion and increase in the volume of the kidney. No cause for this condition was ascertainable; one is forced to accept the hypothesis of spasm of the ureter. This theory is corroborated by another observation. In two other cases I merely decapsulated the kidney and in both perfect and permanent cure was obtained. I have never seen a nephritis cause typical renal colic unless some other condition was also present. I have often seen cases in which there was severe pain in the back, but it was not sufficiently violent to constitute renal colic. I have yet to see a case of unilateral nephritis.

It is true that profuse hæmorrhages may occur in nephritis and that

the resulting blood-clots may occlude the ureter and thus give rise to colic, but this is quite another thing than the one now under consideration. Stenosing ureteritis, which also occasionally gives rise to colic, must likewise be excluded.

I have seen three cases of severe hæmorrhage from both kidneys in apparently healthy persons. In the beginning these cases were puzzling, as the patients presented no symptoms after the bleeding subsided. Upon continued careful examination, however, I found intermittent albuminuria and casts in all three. These, then, were cases of **chronic nephritis with paroxysmal attacks of profuse hæmorrhage.**

The following case is also important. I once relieved a patient suffering from complete anuria and violent renal colic by passing a catheter into the ureter on the affected side. The anuria was immediately overcome and the colic disappeared. No stone was passed nor was any seen upon subsequent cystoscopic examination.

Having thus reviewed this somewhat obscure subject I will now express my own views in regard to it.

There are cases of renal colic without any obstruction in the ureter which are caused by firm adhesions between the true capsule of the kidney and the surrounding fatty capsule. For these decapsulation is the proper treatment. Splitting the kidney should be abandoned.

It has not yet been determined whether there is a local renal hæmophilia or bleeding from healthy kidneys, nor whether circumscribed nephritic areas may produce renal colic. It is well-known, though, that severe hæmorrhage may occur in chronic nephritis.

There are spasms of the ureter for which no cause can be found. They are comparable to the cramps occurring in hysteria and to the gastric crises of tabes, for which reason they have been called *crises nephrétiques*. They may lead to typical renal colic. As a rule, they are cured by simple catheterization of the ureter.

If the attacks of colic are associated with severe hæmorrhage, there is in the majority of cases an underlying structural change acting as the cause. The circumstance that no bleeding occurs for years after does not prove the contrary, for we know that hæmorrhage from malignant tumors may cease for years at a time.

Whether there is an underlying structural cause or whether the bleeding is angioneurotic (the existence of which form I do not consider proved) would be determined by catheterization of the ureters, together

with functional examination of the kidney. It is natural to suppose that a kidney with structural lesions will not work as well as its fellow. Unfortunately I have had the opportunity of examining only one such case. Experience must teach whether the differences in the functional values of both kidneys are so great that positive conclusions can be drawn from them.

[THE OPERATIONS OF NEPHROTOMY AND NEPHRECTOMY.]

To expose the kidney through the lumbar route, the patient is placed on the sound side with a sand-pillow or an inflated cylindrical rubber pad beneath the loin, and an incision commencing half an inch below the twelfth rib, close to the outer border of the erector spinæ muscle, is carried obliquely downwards and outwards towards the crest of the ilium for a distance of three inches or more, perhaps being made to curve slightly forward at its lower extremity toward the abdomen, parallel with and about a half inch above the crest of the ilium. The latter modification will be found serviceable in the case of obese persons. The first cut divides skin, superficial fascia and fat, thus exposing the muscular layer formed by the latissimus dorsi behind and the external oblique in front. This layer is then cut through and the internal oblique, the lumbar fascia, and perhaps also some muscular fibers of the serratus posticus inferior, are brought into view. The divided tissues are now drawn back with retractors so as to give a good exposure of the field of operation.

The twelfth dorsal nerve, which emerges from beneath the quadratus lumborum muscle, pierces the aponeurosis of origin of the transversalis abdominis, and then passes onwards between this latter muscle and the internal oblique, should now be sought for and drawn away from the line of incision through the lumbar fascia.

The ilio-hypogastric, which lies below the twelfth dorsal, must be avoided. Occasionally a portion of the ilio-inguinal may be exposed.

It will usually be necessary to prolong this incision into the substance of the internal oblique. The incision should be begun a little anterior to the erector spinæ mass so as to avoid opening the sheath of this muscle. Care must be taken, however, not to begin it too far anteriorly lest the peritoneum be divided. Hæmorrhage from the branches of the

subcostal and lumbar arteries, if of any moment, should be arrested by tying the vessels.

The perirenal fat bulges through the incision in the lumbar fascia, and is to be divided with the knife or separated by blunt dissection, whereupon the kidney can be forced out of its position into the wound by making pressure upon the abdominal wall.

There are two points concerning the fatty capsule of the kidney which it is well not to forget; one is **anatomical,** the other **pathological.**

As regards the first, bear in mind that there is a distinct layer of fascia embedded in the substance of the fatty capsule which may be mistaken for peritoneum unless its existence be thought of when it is exposed. (See also under *anatomy of the kidney.*)

The second has reference to the changes produced in the capsule by inflammation, as the result of which it becomes converted into a dense, firm mass difficult to break through and adherent to the true fibrous capsule. The separation or removal of such a mass is tedious, and considerably prolongs the time required for operation.

If sufficient room is not secured by this method to bring the kidney into full view, various modifications may be employed according to the exigencies of the individual case. Thus, the quadratus lumborum muscle may be divided at right angles to its fibers, the original incision prolonged further downwards, or the twelfth rib may be divided or resected.

Instead of the oblique incision a longitudinal one may be made along the border of the erector spinæ mass from the twelfth rib down to the crest of the ilium. Edebohls, who employs this incision, places the patient in the prone position with an inflated cylindrical rubber bag beneath his abdomen. When the cutaneous and muscular layers have been divided, the patient is pulled by the legs toward the foot of the table, the pad thus being brought under the thorax. The abdominal breathing which results from this manipulation serves to force the kidney out of the wound.

After the kidney has been exposed the method of treating it will depend entirely upon the morbid condition present.

When operating for the removal of calculi (**nephrolithotomy**) an effort may be made to detect the stone by palpating the kidney with the finger or exploring it with a needle. If calculi are detected they are to be cut down upon and removed with the fingers, forceps or scoop. There is always a possibility, however, of leaving small calculi

behind unless the interior of the kidney—the calices, pelvis and origin of the ureter—be thoroughly explored. Therefore it is better to lay the kidney freely open and explore the depths with a probe. In doing this the manner of making the incision is of some moment.

Brödel's study of the blood-supply of the kidney has taught us that the anterior half is much more vascular than the posterior. Hence the first-named portion is to be avoided when the organ is incised.

An incision made six millimeters behind the convex border of the kidney will pass between the anterior, highly developed plexus and the posterior plexus, thus considerably lessening division of blood-vessels (Kelly). (See also under *anatomy of the kidney.*)

The renal artery must be compressed before the kidney is cut into, and the compression must be maintained until the renal wound is closed. For suturing this wound two or three rows of catgut are to be used, so that both its deep and superficial portions may be brought into good apposition.

If suppuration exists to any degree, the wound should be drained, and not closed.

Under such circumstances the respective indications for nephrotomy and nephrectomy have already been stated (*see Nephrolithiasis, Pyonephrosis, etc.*).

In operating for pyonephrosis the surrounding tissues must be protected from contamination. It often happens that adhesions have firmly fixed the kidney to the superficial structures, thus obviating the necessity of packing off with gauze or suturing the fatty capsule to the external wound before evacuating the pus.

After the abscess cavity is opened and the contents evacuated, the finger should be passed into it and any bands or partitions of tissue which divide it into separate compartments, or project from its walls, broken down so as to make a single large cavity.

When this has been done the cavity is irrigated with hot normal salt-solution, a large drain properly surrounded by gauze introduced, and a few sutures put in at either end of the external incision.

It is often advisable to suture the walls of the renal wound to the opening in the muscular layer. This effectually fixes the kidney.

Irrigation of the abscess cavity should be frequently employed. The tube is gradually withdrawn as healing takes place.

Nephrectomy, or the removal of a kidney, may be performed either through a lumbar or an abdominal incision.

For lumbar nephrectomy either of the incisions already described will usually suffice, although various others have been devised. For the removal of very large growths that of König may be employed. This incision is carried along the border of the erector spinæ mass nearly down to the crest of the ilium and then curved forwards and upwards towards the umbilicus, stopping at the border of the rectus.

After the kidney has been exposed and separated from the peritoneum, it is lifted out of the wound, the structures forming the pedicle are isolated and ligated separately with strong silk, and the pedicle then divided close to the hilum of the kidney. If it is difficult or impossible to isolate the constituent structures of the pedicle, a clamp is placed upon it close to the kidney and it is then cut through, after which the divided vessels and ureter are ligatured in the stump.

Care must be taken to arrest all hæmorrhage. If the bleeding vessels cannot be caught with hæmostatic forceps and tied, the wound must be firmly packed with gauze. More than one patient has died of hæmorrhage from an anomalous artery which was not included in the primary ligatures.

When the ureter is much diseased, as for instance when a suppurative process has extended to it from the kidney, it should be fastened into the edges of the wound instead of being ligated. In some cases it will be possible to remove a portion of the ureter and draw the end into the wound. This procedure permits the ablation of an additional amount of diseased tissue.

In operating for malignant growths any remnants of the fatty capsule must be scrupulously removed, as it has been shown that this tissue often contains neoplastic cells (Israel, Lecène).

The wound is closed in the usual manner, space being left, however, for a drainage tube.

Abdominal nephrectomy is suitable for the removal of very large growths.

The incision is made through the linea semilunaris, being four inches long, with its center corresponding to the umbilicus. The opening thus made may be enlarged above or below if necessary.

After the abdominal cavity has been opened the hand is introduced and the opposite kidney felt for; if it be present and not grossly diseased the operation is continued.

The intestines are pushed toward the median line and the field of

operation surrounded with gauze. The peritoneum covering the kidney is then incised, dissected up, and drawn away from the kidney on either side by means of hæmostatic forceps applied to either edge.

It is important that the peritoneum be incised external to the colon, so that the blood-supply of the latter may not be interfered with.

After the kidney is exposed it is freed mostly by blunt dissection with the fingers, scissors being used only to liberate confining bands of fibrous tissue; the structures forming the pedicle are then isolated and tied separately, the pedicle divided and the kidney removed. All bleeding is arrested, the wound in the peritoneum closed with catgut, all gauze removed from the abdominal cavity, and the opening in the parietes closed in the usual manner.

In **partial nephrectomy,** which is permissible only for the removal of benign growths, cysts, strictly circumscribed areas of suppuration, fistulæ, and portions of tissue destroyed by injury (Hartman), ablation of the diseased tissue is practised and the margins of the resulting wound approximated with catgut.

EXAMINATION AND DISEASES OF THE URETERS.

The ureters connect the kidneys with the bladder. It is very seldom that we have to do with isolated diseases of these organs, there generally being an associated lesion of the kidney or bladder and perhaps of both. The ureters lie concealed in the true pelvis and abdomen and under normal conditions cannot be felt through the abdominal walls. When diseased they can sometimes be palpated through the abdomen and rectum, and in the female through the vagina.

Palpation of the upper portion of the ureter through the abdominal wall, however, is most uncertain. It is only in thin persons, and when the rectum is empty and the ureter much thickened, that they can be accurately palpated.

Favorable conditions are also necessary for palpation of the lower segment through the rectum. The patient must not be fat, the examiner's fingers must be of good length and the ureter somewhat thickened. It can then be felt internal to and above the seminal vesicle as a cord which rolls under the finger. In the female this examination is comparatively easy through the vagina. All in all, however, these methods of examination remain difficult, untrustworthy,

and mostly without result, as one can seldom reach a definite conclusion which will permit operation.

For this reason other methods of examination have long been sought for. Their object is to secure the urine from each kidney separately and thus determine which side is diseased. It is unnecessary to describe all of these methods, for although some of them are very ingenious none are of practical value. This problem remained unsolved until I succeeded in placing catheterization of the ureters upon a practical basis.

It has already been stated that there are few isolated diseases of the ureters. Catheterization of the ureters, therefore, affords an adequate means of diagnosticating diseases of the kidney as well as offering material assistance in the recognition of affections of the ureter. It is indicated, however, only when the simpler methods fail.

The principal affections of the ureters are injuries, fistulæ, inflammation, stricture, calculi and tuberculosis.

Injuries may be simple contusions, ruptures or wounds. The first two are very rare. The most common are wounds inflicted during an operation, for example, during vaginal and also abdominal hysterectomy. The diagnosis is generally easy, but occasionally there is some doubt as to which ureter is injured or in what portion the injury is located. The passage of a catheter will at once clear up the difficulty.

[If the ureter is divided close to the bladder the proximal end may be implanted into the bladder.

If the division has occurred higher up, the distal end may be ligated and an anastomosis made between the proximal end and a longitudinal slit in the distal end below the point of ligation (Van Hook).]

It is the same with **ureteral fistulæ,** nearly all of which are of traumatic origin. An ulcerating tumor or tubercle in the ureter may rarely lead to the spontaneous formation of a fistula.

Inflammation of the ureters, **ureteritis and periureteritis,** occur only in association with an ascending process from the bladder or a descending one from the kidney. The symptoms, therefore, are identical with those of the respective renal and vesical affections.

A distinction of more practical importance exists between the isolated forms, as some are associated with dilatation of the ureter and others with narrowing and kinking. The last two conditions can be positively diagnosticated by catheterizing the ureters. If the

catheter repeatedly becomes arrested at the same place, the existence of one or the other of these conditions may be assumed unless symptoms of obstruction due to some other cause, such as tumor or stone, are present.

[The late Christian Fenger, of Chicago, applied the principle of the Heineke-Mikulicz operation of pyloroplasty to the treatment of stricture of the ureter, making a longitudinal incision over the strictured portion and then uniting the wound transversely.]

Ureteral calculi are caused by the descent of a calculus from the pelvis of the kidney. They have three points of predilection, namely, at the junction of the renal pelvis and ureter, in the lower third of the ureter where the sacrum bends forward, and in the intravesical portion of the ureter.

The symptoms vary according as the stone partly or completely obstructs the flow of urine. In the latter instance typical renal colic and anuria are not uncommon, whereas in the former no symptoms whatever may be produced. A calculus may remain impacted for years.

If the history and symptoms of the case be carefully studied and the results of palpation and catheterization of the ureters be considered, diagnosis will not be difficult. If the symptoms persist extraperitoneal ureterectomy is the proper procedure.

[The upper portion of the ureter may be exposed by either of the two principal incisions described for exposing the kidney.

If the oblique incision be prolonged around the iliac crest, parallel with Poupart's ligament, to a point corresponding to the external abdominal ring (Henry Morris), nearly the whole length of the ureter can be brought into view. The abdominal portion of this incision is carried down to the peritoneum, which is then separated and displaced inwards so as to expose the ureter.

A longitudinal incision is then made in the ureter, the calculus extracted, and the wound closed with catgut. In cases where the ureter is greatly distended with foul decomposed urine and pus drainage is to be employed.]

Tuberculosis, according to my experience, does not occur as an isolated disease. The process either descends from the kidney or ascends from the bladder, the former being its more common mode of propagation. The diseased ureter is usually markedly thickened, and the appearance of its vesical orifice generally betrays its condition.

The orifice is either irregular, as though ulcerated, or it is œdematous and swollen; in some cases it is surrounded, or perhaps occluded, by an area of bullous œdema. Attempts at catheterization sometimes fail in consequence of the changes which have taken place in the ureter. These consist in thickening of the mucous membrane (œdema), stricture and kinking. The complete clinical picture, the inefficacy of treatment directed to the bladder, and the finding of tubercle bacilli in the urine make diagnosis certain.

For further details concerning these affections the reader is referred to the articles on the diseases with which they are associated.

FUNCTIONAL DISTURBANCES OF THE SEXUAL ORGANS.

PHYSIOLOGY.

In the male puberty begins at about the fifteenth year. The first signs of its development are changes of voice, growth of hair on certain parts of the body (pubes and face), and awakening of the sexual impulse. At the same time, or occasionally before, erections of the penis begin to occur; they constitute the most essential attribute of masculine potency.

ERECTION.

Erection is under control of the nervous system and it may be evoked by stimuli affecting the brain, certain peripheral nerves, and the spinal cord. These nerve-tracts influencing erection have been demonstrated on dogs by Eckhard. There is no reason to believe that the conditions in man are any different than in the higher animals. According to Eckhard the nerves controlling erection originate in the spinal cord; he succeeded in exciting erections with electrical stimulation of the cervical as well as the lumbar portion of the cord. Irritation of the pons at the point of entrance of the crura cerebri into the cerebrum likewise produced rigidity of the penis. From these experiments he concluded that the impulses necessary for the production of an erection originate in the cerebrum and are transmitted through the pons and crura cerebri to the cord.

Furthermore, Goltz found that after separation of the lumbar portion from the remainder of the cord, erections could be produced by irritating the glans penis. This led to the conclusion that there is an independent center of erection in the lumbar cord.

Goltz also showed that this lumbar center may be inhibited by impulses from the medulla and brain. He found that reflex stiffening of the penis occurred much more quickly when the cord was divided between the thoracic and lumbar portions, that is, when the putative inhibitory influence of the rest of the cord and brain is eliminated.

Clinical observations in man are in accord with these statements. The influence of the brain upon erection is shown by the circumstance that certain sights and mental impressions are quite sufficient to

produce an erection; indeed, this is the most frequent mode of origin; the sight of certain women, a lewd conversation, obscene pictures, or even the mere thought of such things, will cause rigidity of the penis.

That erections may be generated in the spinal cord is also proved by clinical observations. It is known that in the primary hyperæmic stage of certain chronic diseases of the spinal cord, frequent erections or even priapism are among the usual symptoms. So, too, erection and ejaculation have been observed in certain forms of irritation and concussion of the cord, particularly in the upper cervical portion (Oliver), and in fractures and dislocations of the vertebræ; they are often the first sign of a beginning ataxia (Erb).

In regard to reflex stiffening of the penis, it is well-known that friction or even touching the organ may cause it to become turgid. In acute gonorrhœa, prostatitis, and vesical calculi frequent painful erections are one of the most constant symptoms. They are reflex and are due to irritation of the peripheral nerves resulting from inflammation in the urethra, prostate, or bladder. The usual morning erection is due to irritation of the peripheral nervi erigentes by a distended bladder.

In regard to the **phenomenon of erection** itself, it must be admitted that its mechanism is not perfectly clear, although the works of Kölliker, Kohlrausch, Eckhard, Goltz, Loven and Frey have materially advanced our knowledge of it. The existence of an erection is dependent upon an increased afflux of blood to the corpora cavernosa and a lessened outflow from the same, so that they contain more blood when the penis is rigid than at other times. It is not entirely clear, however, in exactly what manner this change in the circulation is effected. That it is entirely dependent upon interference with the outflow of venous blood is doubtless false, for a good erection cannot be produced by simply tying the veins of the penis. There is a simultaneous increase in the flow of arterial blood; in animals the manometer shows a fall in blood-pressure in the arteries near the penis during erection, and Eckhard proved that it extended to the femoral artery.

How does this increased afflux of blood occur? It is practically certain that it is not due to increased cardiac action; at least this is a very subordinate factor in the production of the necessary afflux of arterial blood. It is much more probable that the arteries of the penis are dilated during erection so that more blood enters the organ.

In answer to the question as to whether the vessels become dilated by direct action of the muscle fibers in their walls, or whether the walls become relaxed and the caliber of the vessels thus increased, Goltz made the following statement: "I am of the opinion that the relation of the nervi erigentes to the penis is the same as that of the vagus to the heart or the chorda tympani to the submaxillary gland. When the penis is flaccid its small arteries, and perhaps other vascular spaces as well, are in a state of moderate contraction, in consequence of which the blood-current in the penis is subjected to considerable pressure. It is probable that this tonicity of the vessels is maintained by the small ganglia which Lovén discovered on the penis. Now when the nervi erigentes are stimulated to activity, the contracted arteries of the penis relax and forthwith become dilated under the pressure of the blood, which is copiously poured into the retiform spaces of the corpora cavernosa, distending them to the utmost. I am inclined to agree with Lovén that the peripheral ganglia in the penis are the center of vascular tonicity and believe that they may be inhibited by the nervi erigentes, just as it is supposed that the vagus inhibits the ganglia of the heart."

Whether this explanation is true or whether direct muscular action is the cause, or whether both relaxation and muscular action are responsible, has not yet been determined.

There is less difficulty in explaining how the venous reflux is prevented. Part of the veins which carry the blood from the corpora cavernosa empty into the dorsal vein of the penis and the remainder pass to the under surface of the organ through interstices in the cortical plexus. If the corpora cavernosa are filled with blood, pressure of the cortical plexus upon the veins will hinder the outflow of blood from these bodies.

In addition to this there is the action of a muscular apparatus by which the reflux of blood is completed. The bulbo-cavernosus [accelerator urinæ] arises from a tendinous raphe, from which the transversus perinei and sphincter ani externus also take origin. Its fibers extend along both sides of the bulb to bifurcate above and be inserted into the fibrous sheath of the corpora cavernosa. When this muscle contracts the penis is constricted in the region of the symphysis and the return of blood from the corpora cavernosa thereby impeded. At the same time the penis is elevated and pressed against the symphysis by the ischio-cavernosus, which also assists in preventing the reflux of blood from the corpora cavernosa.

COHABITATION AND ORGASM.

Cohabitation is a term applied to the act of copulation, through which the sperm is implanted in the ovum. For the fulfillment of this act rigidity of the penis is necessary, so that it can be introduced into the vagina of the female. By friction upon the vaginal walls it is so stimulated that orgasm and ejaculation occur, the latter being reflex. Orgasm is the crisis of voluptuous sensation which is experienced when the semen escapes through the urethra, or to be more exact, when it is expelled from the ejaculatory duct into the urethra.

LIBIDO SEXUALIS.

The sexual impulse peculiar to the healthy adult male, and comparable to the sexual instinct of certain animals, is excited by those causes which we have recognized in the production of erection, only they are so intensified that they impel the individual to the performance of the sexual act.

It is very difficult to draw the line between normal and abnormal sexual impulse; it must be remembered that the sexual feeling is not so highly developed *per se*, but that it is rather aroused by occasional causes. It is generally greater in men than in women. It is also influenced by individual disposition, regimen of living, food and occupation. Persons who work little and eat heartily of stimulating food are much disposed to eruptions of the sexual feeling, while those who are engaged in mental or physical work find that their passions are kept subdued.

EJACULATION.

Ejaculation is the term applied to the reflex process by which semen is discharged into the urethra and carried out of the body. When the crisis of sexual excitement is reached the musculature of the seminal vesicles and ejaculatory ducts force the semen into the urethra, whence it is forcibly ejected by a spasmodic contraction of the bulbo-cavernosus and the sphincteric portion of the prostate [sphincter vesicæ]. Ejaculation is under the influence of reflex excitation of the ejaculatory center (genito-spinal center of Budge), which lies in the cord on the level of the fourth lumbar vertebra. This center sends fibers to the bulbo-cavernosus, which accordingly is the true muscle of ejaculation.

THE SEMEN.

By semen or sperm is meant the fluid which under normal conditions flows out of the male urethra at the termination of coition. This fluid is not a simple product, but is composed of the secretion of the testicles, vasa deferentia, seminal vesicles, prostate and mucous glands of the urethra.

The testicular secretion as it is found in the seminiferous tubules is a thick, white, viscid mass, consisting principally of spermatoblasts, the mother-cells of spermatozoa. The spermatozoa are first seen in the rete Halleri. Here and in the following segment of the seminal passage, in the epididymis and vas deferens, they are non-motile, in consequence, no doubt, of the density of the surrounding medium, which is a tenacious fluid containing nucleated epithelial cells of various shapes, and irregular, highly refractive granular cells. In the vasa deferentia the spermatozoa become thoroughly mixed with this fluid and are carried to the seminal vesicles with it.

The secretion of the seminal vesicles which is now added to the mixture is tenacious, odorless and colorless, of a higher specific gravity than water, neutral in reaction and non-coagulable. It contains nucleated polyhedral epithelium, isolated leucocytes and shiny bodies resembling grains of sago.

The secretion of the prostate is also added to the semen. It is alkaline or neutral and of a milky, opalescent color; it contains very fine granular cells, droplets of lecithin and hyaline flakes, to which isolated epithelial cells are almost always added when the prostatic secretion is expressed by pressure through the rectum. It is this secretion which gives the semen its white, half translucent, opalescent property, which differentiates it from the secretion found in the seminal vesicles. If several ejaculations occur in succession, the opalescence of the semen becomes less and less; it becomes thinner and more like the contents of the seminal vesicles. This is due to the absence of prostatic fluid.

Occasionally the so-called prostatic corpuscles, stratified bodies having an amber or brown center usually surrounded by light concentric layers, are found in the prostatic fluid. These corpuscles vary in size from minute specks to masses as large as a hemp-seed. They are colored blue by iodine and green by substances rich in albumen.

The next ingredient added to the seminal fluid is the secretion from Cowper's glands, a tenacious, ropy, hyaline mass which is alkaline

in reaction and serves to lubricate the parts with which it comes in contact. It is secreted during erection, at the moment of ejaculation, and is analogous to the secretion of Bartholin's glands in the female.

Let us now consider the semen as a whole, as it appears after an emission. It is a tenacious, grayish, opalescent fluid of alkaline reaction having a higher specific gravity than water and a peculiar odor resembling that of boiled starch. The quantity discharged at a single emission varies in different men from 5 to 20 g. [1½ to 5 fl. drachms].

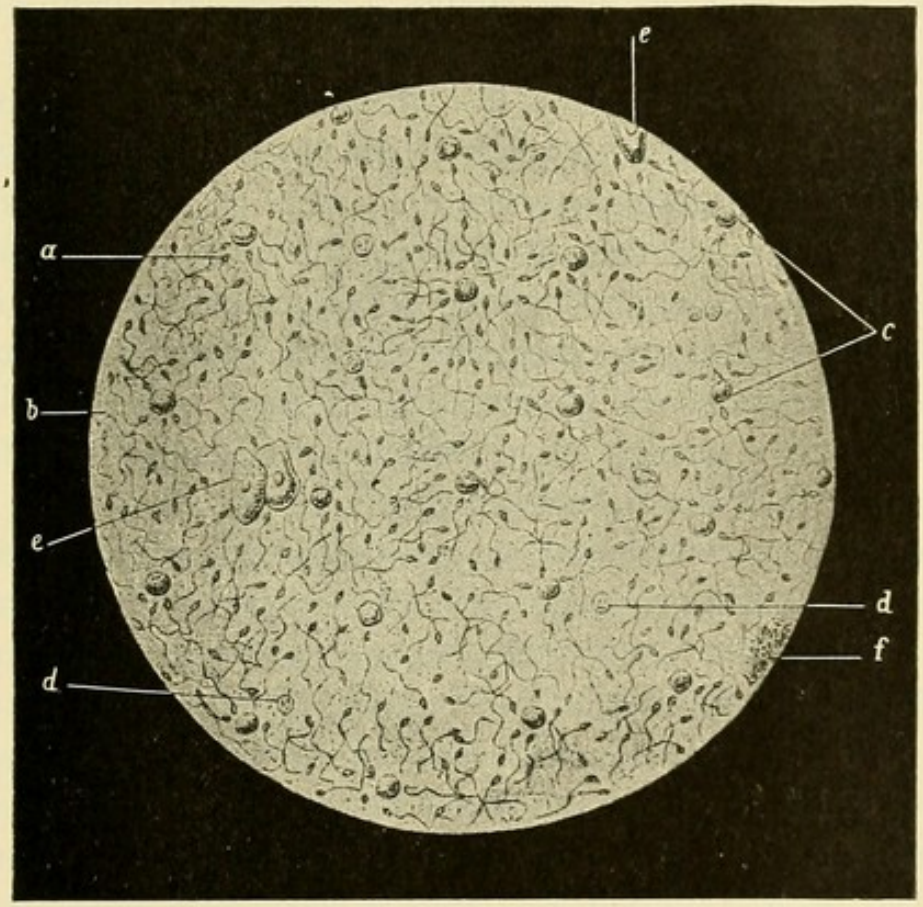


Fig. 228.—Normal Semen. *a*. Spermatozoa. *b*. Molecular detritus. *c*. Spermatoblasts. *d*. Leucocytes. *e*. Epithelium. *f*. Specks of pigment.

If coitus is repeated at frequent intervals, the quantity decreases with each ejaculation until finally only a few drops are expelled.

Immediately after it is voided the seminal fluid becomes converted into a gelatinous mass, although the air soon causes it to liquefy again. According to Vauquelin it is composed of 10% of solids and 90% of water. One-half of the solids are organic elements. An albuminoid substance called spermatin can be extracted from the semen; it is probably formed in the seminal vesicles. About 3% of the solid

elements is phosphate of lime, and 1% sodium salts; traces of ammonio-magnesium phosphate are also found.

If a drop of seminal fluid is examined under the microscope all these elements are found (Fig. 228).

The most important and most striking are the actively motile, undulating spermatozoa. Not always, though occasionally, leucocytes, the concentric stratified prostatic corpuscles, and the sago-like particles known as Lallemand-Trousseau corpuscles are found. The fecundating power of the semen depends upon the life of the spermatozoa. The only sure sign of their vitality that we yet possess is their motility.

If semen is allowed to stand in a reagent glass for a few hours, it separates into two layers, the upper of which is thin, white and translucent, somewhat resembling whey, while the lower is a thick, white, opalescent mass. If a drop of the upper layer be examined microscopically, it will be found to contain epithelium and molecular detritus (the seminal granules); the under stratum is composed of spermatozoa. From the thickness of this layer and the rapidity with which it forms an idea as to the quantity of spermatozoa in a given specimen of semen can be obtained (Ultzmann).

In normal semen their number is very great, many thousands being contained in one drop. Under the microscope they are seen to be actively motile. They consist of a flattened pyriform head, a neck and a long thread-like tapering tail. The tail is from ten to twelve times as long as the head and makes incessant undulating, lashing movements, by which the head is pushed forward between other spermatozoa and cells. This vivacity of movement caused the spermatozoa to be called seminal animalcules. The semen soon dries under a cover glass and the most active spermatozoa lose their power of motion after a few hours; if the semen be guarded from light and cold, however, living spermatozoa may be found at the expiration of thirty-six or forty-eight hours. Dead spermatozoa differ in no wise from the living except that their tail is extended or its extremity perhaps coiled up in spiral form.

Water destroys spermatozoa immediately, whereas normal saline solution prolongs their power of motility for some time; alkalies, such as solutions of potassium and sodium, also favor their motility, whereas acids, metal salts, and acid secretions, as urine, for example, at once kill them.

This leads us to consider the significance and importance of the different components of the semen. As some urine remains in the urethra after each act of micturition, and as the semen passes through this canal, its contact with the acid urethral walls would impair the vitality of the spermatozoa had not nature provided a means to prevent this evil. The remedy is provided by the secretion of the prostate, Cowper's glands, the urethral mucous glands and the sinus pocularis. During erection and at the moment of ejaculation the last three secrete an alkaline fluid which greases, lubricates, and makes the urethral wall alkaline.

It has already been stated that the secretion of the seminal vesicles acts chiefly as a diluent of the testicular product and thereby causes the spermatozoa, which are previously motionless, to become motile.

The prostatic fluid is of equal importance. Marris Wilson long since showed that the secretion of the prostate is necessary to maintain the vitality of the spermatozoa. He believed that it was the neutral phosphate of lime in this fluid which preserved them from the destruction to which they would be subjected by contact with the acid secretions of the urethra.

Percy proved that spermatozoa soon perish in the uterine secretions unless the latter are mixed with prostatic fluid; when prostatic fluid is present, however, they remain active for three, four or even eight days. More recent investigations have confirmed this view. Fürbringer, who by the way believes the prostatic fluid to be acid, added fresh prostatic secretion to the semen of a man affected with spermatorrhœa and found that previously sluggish spermatozoa became active; he therefore concluded that the prostatic secretion exerts a specific vitalizing action upon the spermatozoa which are dormant while in the seminal vesicles and spermatic ducts.

The relation of the prostatic secretion to the power of impregnation is shown by another observation, if not with certainty at least with probability.

If semen is dried on a glass slide and examined after a certain time, varying from a few hours to three days, peculiar crystals having the form of rhombic prisms and ending in fine points or rhomboid margins, are found lying alone or arranged in layers. If one of these plates lies upon another a cross is formed, and if several are placed across each other a rosette is produced (Fig. 229). The composition and significance of these crystals, which were described by Van Deen and

Böttcher, and named after the latter Böttcher's spermatic crystals, is still a subject of dispute.

Böttcher thinks that they are albuminoid bodies, Schreiner considers them to be phosphatic salts having an organic base, Ultzmann believes that they are composed of phosphate of magnesium, and Gross that they are made up of ammonio-magnesium phosphate. Others believe them to be identical with Charcot's crystals, which are said to occur wherever profuse mucous secretion exists. Fürbringer proved

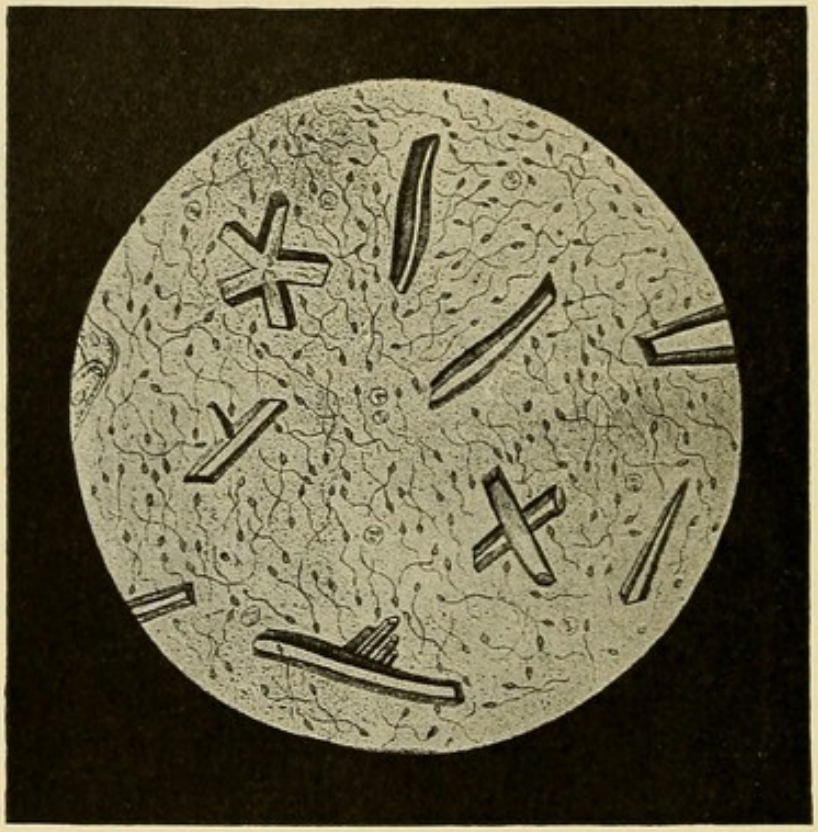


Fig. 229.—Spermatic crystals.

by examination of the contents of the seminal vesicles and the prostatic secretion of a large number of corpses, and also the prostatic fluid of the living, that these crystals are found only in the prostatic fluid. He attributes the peculiar smell of the semen to these bodies. It is certain that they do not originate in the testicular secretion, for they are found most abundantly and best developed in azoöspermia, a condition in which spermatozoa, the characteristic element of the testicular secretion, are absent.

It may be said that the relation of the spermatozoa to the spermatic crystals is one of inverse proportion; the more numerous the latter and the more quickly they are formed, the fewer the spermatozoa

or the less their activity. Therefore they are almost always found in azoöspermia. The thinner and poorer in spermatozoa the semen, the earlier the appearance of these crystals and the greater their number.

While they are found in normal semen only when it has been dried, and then perhaps only after several days, in the semen of azoöspermia they are seen a few hours after ejaculation. A drop of 1% solution of ammonium phosphate renders them more distinct (Fürbringer). Ultzmann explains the late occurrence of these crystals in normal semen by assuming that crystallization cannot take place in a fluid so full of motion. It is only after the spermatozoa die and the semen becomes still that crystallization can begin.

According to these statements the presence of spermatic crystals is of value in determining the impregnating power of the semen.

The time at which semen is produced varies in different persons. Generally speaking it begins to be secreted at puberty and may continue until an advanced age. Liegeois found spermatozoa in the semen of two boys of fourteen, four of sixteen and two of eighteen years. In respect to the age limit, it may be stated that Wagner found them in the semen of men sixty and seventy years old, Curling in that of a man aged eighty-seven, and Casper (the medico-legal expert) in that of one aged ninety-six. Out of twenty-three cases in which death resulted from the weakness of old age or from affections common to this period of life, and in which no serious organic lesions were present, Dieu found them six times. Therefore it is seen that semen capable of causing impregnation may be produced under normal physiological conditions until an advanced age, but that its fecundating power dies out under the influence of severe diseases and a high degree of cachexia.

FUNCTIONAL DISEASES OF THE SEXUAL ORGANS.

Having discussed the physiology of the sexual apparatus we will now consider its functional disturbances. We will first study the so-called abnormal loss of semen, secondly impotence, and thirdly sterility.

THE ABNORMAL LOSS OF SEMEN.

Under normal conditions the adult male loses semen only upon cohabitation, or if this is not indulged in for a long time, it escapes spontaneously at intervals, this loss constituting what is known as pollutions. The occurrence of pollutions is somewhat physiologic.

They take place during sleep and are usually accompanied by lascivious dreams and a sense of erection. They are due to irritation produced by distention of the seminal vesicles with semen; this irritation is transmitted by sensory nerve fibers to the spinal cord, especially to the ejaculatory center, and when its maximum is attained it sets up a reflex contraction of the seminal vesicles and vasa deferentia.

Accordingly pollutions are most common in the bloom of sexual life, when the semen is most abundantly produced. Physiological pollutions are not characterized so much by the frequency of their occurrence as by the manner in which they take place. If a strong young man who lives on rich food has an emission about once a week without any bad reaction on his health, it is to be considered entirely physiological.

The production of semen, and therefore its evacuation, varies in different persons; it is greater in those who lead an active sexual life, whose mind is occupied with sexual matters, than in those who live moderately and engage in active mental pursuits. In the first class the increased production of semen (*plethora seminalis*), in consequence of the reflex action produced by distention of the seminal vesicles, leads to frequent desire to empty these organs and to increased irritability of the ejaculatory apparatus.

Nocturnal pollutions, then, become pathologic only when they exert a bad reaction upon the general health. They are pathologic when they occur with undue frequency, as for example, on several nights in succession or several times in one night, and when the characteristic accompaniments, erection and voluptuous feeling, are absent or considerably diminished. The patients feel weak and debilitated, are tired, disinclined to work, and morose or irritable. Pollutions having such after effects are naturally pathologic.

Pollutions occurring during the day and resulting, as is usually the case, from slight mechanical or psychical irritation, are to be considered as a symptom of disease. It must be borne in mind that abnormal pollutions do not constitute a disease, but that they are only a symptom of some morbid condition. If a loss of semen occurs without voluptuous feeling, without orgasm, without erection, the fluid escaping gradually instead of being forcibly ejected, the condition is then known as **spermatorrhœa.**

This spontaneous and persistent loss of semen is very rare. It generally follows defecation and micturition.

If morbid pollutions are considered as due to a motor neurosis of the sexual apparatus, a spasm of the musculature of the seminal vesicles, then spermatorrhœa represents a paresis of the ejaculatory ducts. It is conceivable that there may be various transitional forms between pollutions and spermatorrhœa; thus, for instance, pollutions may be associated with imperfect erections, and there are cases of spermatorrhœa in which slight rigidity of the penis supervenes, together with some pleasurable sensation.

In order to understand the significance of pathologic pollutions and spermatorrhœa it is essential to know from what causes they arise and in what diseases they occur.

Both occur in **neurasthenia,** a disease of most diverse manifestations, but which will be considered here only in its relation to the sexual system. In this disease there is an hereditary or acquired debility of the entire nervous system, a nervous cachexia, so to speak. The nervous system's power of resistance, especially that of the affected centers, is so slight that the most trivial stimulation produces the maximum of irritability, as the result of which ejaculation ensues; or, conversely, the normal tonicity of the ejaculatory duct is raised to the highest point, so that the semen flows away spontaneously or escapes upon the slightest pressure.

Thus, sexual excesses may cause this symptom, either directly or by inducing neurasthenia. Of the sexual excesses **masturbation** occupies the first rank; it is immaterial whether it be physical, that is, practised by frictioning the penis, or only psychical, an ejaculation being induced by conjuring up voluptuous fancies.

At present we do not believe in the dreadful results of masturbation described by Lallemand and Tissot, but yet it must be conceded that if the habit is persisted in for years it will impair the soundness of both body and mind, that it will result in enfeeblement and hyperæsthesia of the nervous system. It is not so much the numerous losses of semen as it is the effect of the frequently repeated stimulation upon the nervous system which brings about this condition. The frequency with which masturbation is practised explains why abnormal pollutions result more frequently from this habit than from sexual excesses.

That *coitus interruptus*, or coition terminated before its completion, for the purpose of preventing conception, may cause spermatorrhœa if it be persisted in for years, is no doubt correct, although such a result is exceptional. I have seen a general nervous condition follow this

practice much more frequently than the symptoms now under discussion.

The same is true of sexual abstinence. It is true that men who have been accustomed to regular sexual intercourse, but have been forced by circumstances to become continent, have frequent pollutions, although these emissions are not pathologic because they have no injurious reaction. They are rather an effort of nature to relieve seminal plethora.

All the etiologic factors which have been mentioned do not cause pollutions and spermatorrhœa as often as they produce certain local affections of the urinary and sexual organs: chronic urethritis, which has extended to the ejaculatory ducts, and chronic inflammation of the seminal vesicles and prostate are conditions which I have frequently found in cases of abnormal loss of semen. If the former can be cured the latter will usually subside. It is in these cases that loss of semen during or immediately after defecation or micturition is the most common.

Finally, frequent pollutions may occur in certain organic diseases of the spinal cord, in the early stages of tabes and myelitis, for instance.

The diagnosis of pollutions and spermatorrhœa is usually readily made from the statements of the patient, although it must be remembered that there are discharges from the urethra which resemble semen and may be mistaken for such by the patient. These are the discharges occurring in prostatorrhœa and urethrorrhœa. As they are far less important than spermatorrhœa it is necessary to distinguish them from the latter disease, which is easily done by examining a drop of the discharge with the microscope.

The characteristic picture of a drop of semen has already been described. Prostatorrhœa shows the characteristics of prostatic fluid, namely, lecithin corpuscles, small refractive specks, rings and flakes, epithelial cells, and a varying number of leucocytes if prostatitis is present. Rarely stratified corpuscles are found.

In urethrorrhœa only a few leucocytes and pavement and cylindric epithelium from the urethral glands, together with long slender shreds of mucus are seen. Lecithin corpuscles and spermatozoa are absent.

Urethrorrhœa has no pathologic significance. It occurs in highly sensitive persons when an afflux of blood to the penis causes a partial erection and forces the secretion of the urethral glands out into the urethra.

Prostatorrhœa is often a sequel of prostatitis. The excretory ducts of the prostate are rigid and have lost their tonicity, so that slight pressure exerted by scybalous masses suffices to press the prostatic secretion into the urethra, through which it passes to the external meatus.

In regard to the significance of abnormal pollutions and spermatorrhœa, it has already been stated that they do not represent independent diseases, but that they are a single member of a complex group of symptoms which owe their existence to the conditions previously enumerated. They may be symptoms of general neurasthenia, which is called sexual neurasthenia when it chiefly affects the genital organs; or in consequence of the reaction which they produce they lead to this disease of the nervous system. A knowledge of them is of the greatest importance and therefore we will consider them more in detail, following for the most part Krafft-Ebing's views.

SEXUAL NEURASTHENIA.

Sexual neurasthenia is one of those forms of nervous weakness which express themselves as functional disturbances of the genitalia. These may be the only symptoms of disease, although, as a rule, a multitude of others are present. Krafft-Ebing has analyzed the symptom-complex and given us a better understanding of it.

He recognizes three stages of the disease:

1. A local neurosis of the genitalia, causing frequent pollutions and premature ejaculations. 2. A neurosis of the lumbar cord, characterized by neuralgia of the lumbo-sacral plexus, frequent nocturnal emissions, diurnal pollutions and impairment of sexual vigor. 3. Cerebro-spinal neurasthenia, in which the disease has advanced to general neurasthenia.

Not all cases of sexual neurasthenia, however, pass through these typical stages. Thus, for example, there are cases of general neurasthenia which have been preceded by sexual excesses or local sexual neurasthenia. Severe general neuroses may result from sexual excesses without involvement of the genital apparatus, or the most violent sexual debauchery may produce only local disturbances, no symptoms referable to the cord and brain being present. In this respect, too, there are many variations and combinations. In general it may be stated that masturbation is more prone to produce cerebral neuras-

thenia, while excessive sexual intercourse tends rather to cause the spinal form.

The symptoms of sexual neurasthenia consist in cerebral manifestations, or sexual cerebrasthenia; in spinal manifestations, or sexual myelasthenia; in lumbar and local genital manifestations; and, finally, in circulatory and digestive disturbances.

As **cerebral manifestations** we recognize dizziness and a feeling of oppression which may amount to violent headache, conditions which are detrimental to the development of mental activity. The patients cannot work as they formerly could nor apply themselves continuously to labor; they begin to sleep poorly and become more or less ill-tempered and irritable. They are fully aware of their mental apathy and want of energy, and this knowledge increases their moodiness, so that they may become confirmed hypochondriacs. They cannot concentrate their mind upon one subject. Weakness of memory and sensory disturbances supervene; the latter consist of increased sensibility to light, weakness of vision (asthenopia neurasthenica), tinnitus aurium, auditory hyperæsthesia and disturbances of speech. Melancholia as well as hypochondria may ensue.

The **spinal manifestations** of neurasthenia, or sexual myelasthenia, usually occur in association with cerebral neurasthenia, just as the latter is frequently accompanied by spinal symptoms. The spinal symptoms are weakness and fatigue upon walking, pain over the back, loins and extremities, paræsthesia in these parts, a sensation of itching, coldness and numbness of the legs, together with a feeling of weight and heaviness. Lancinating pains like those of tabes also sometimes occur. The objective symptoms of spinal irritation are observed, namely, localized sensitive areas in the spinal column, fibrillary spasm of the fingers, tremor of the extremities and exaggerated patellar reflex.

The **local manifestations** of sexual neurasthenia affect both the urinary and sexual organs. Pain over the bladder before and after micturition, urgency of urination and dribbling of urine are complained of, although the urine itself is found absolutely normal. These symptoms are due in part to increased irritability of the detrusor and in part to diminished tonicity of the sphincter.

The disturbances of the sexual organs consist of pain in the testicles and epididymes, hyperæsthesia of the glans penis, and occasionally involuntary contractions of the cremasters, causing a jumping or

dancing of the testicles, to which the Germans have given the name *Hodentanz*. Abnormal losses of semen also take place, and according to the frequency with which they occur may lead to weakness and exhaustion or result in spermatorrhœa.

Finally the **disturbances of the circulatory and digestive systems** have to be considered. Among the well-recognized neuroses of the heart are stenocardia, palpitation, tachycardia, pseudo-angina, pain radiating from the cardiac region to the scapula and accompanied by a feeling of oppression, and increased cardiac action after exertion, excitement and the use of strong drink. The objective signs of organic heart disease are absent.

The digestive tract is in a condition of nervous dyspepsia. After each meal a feeling of pressure and pain develops in the region of the stomach, and retching or even vomiting may also be present. It is characteristic of this condition that the patients sometimes experience violent pain in the stomach after partaking of small quantities of easily digestible food, while at other times they can eat a good dinner of heavy food without feeling the worse for it.

Less commonly nervous cardialgia, irregular attacks of vomiting and gastralgia, peristaltic agitation of the stomach and intestines, distention of the abdomen and constipation are present. Both palpation and examination of the stomach contents give negative results. It is well-known to what extent this nervous dyspepsia may produce disturbances of nutrition and thus simulate severe organic disease of the digestive tract.

The **prognosis** of abnormal losses of semen and sexual neurasthenia is not so unfavorable as the patients themselves, and many physicians as well, are inclined to consider it. My experience leads me to believe that nocturnal pollutions and loss of semen during defecation usually subside under appropriate treatment, while losses occurring during micturition, and diurnal emissions occurring without any exciting cause are difficult to influence.

If the condition is due entirely to natural sexual excesses the prognosis is good if a more moderate regimen of living is adopted. Pollutions due to local disease of the sexual organs can also frequently be improved or cured. Cases due to masturbation are difficult to help because the patients cannot relinquish their bad habit, or if they do give it up for a time, fall into it again. The most unfavorable cases of all are those in which there is an hereditary neurotic taint. The duration of the

disease is always considerable. It requires many months, or perhaps years, to put these patients in order.

The **treatment** is to be directed partly to removal of the cause and partly to relief of symptoms, although the former is naturally the more important.

As **masturbation** plays a rôle, even though it be not a great one, in the etiology of the disease, all possible means should be taken to guard against this evil. As far as children are concerned the task of preventing its acquirement devolves upon parents and teachers rather than upon the physician, although the latter may be of assistance by vouchsafing proper advice. The appropriate means of prevention consists in careful observation of the child, the avoidance of obscene literature, care in the selection of his companions—as the habit is frequently taught by others—avoidance of arduous mental application, and encouragement in the practice of physical exercises such as gymnastics, swimming, riding, fencing and gardening.

For older persons, be they married or unmarried, who have continued to practise this vicious habit, it is first of all necessary to make them understand that the evil results are generally exaggerated. This may keep them from becoming neurasthenic or hypochondriacal. As much exercise and physical labor as possible, with a light, easily digestible diet are indicated.

Patients who have acquired their disease by overindulgence in sexual intercourse do not require much counsel; they have generally become sensible, their condition forcing them to lead a different life. It is important, however, to make them understand that the evil results of their excesses, for example spermatorrhœa, are of no great significance and are of only temporary duration.

If an organic disease such as tabes or myelitis is the cause, the manifestations of the general disease are so much more pronounced than the local symptoms that treatment of the latter may not be indicated. The local disturbances, however, may annoy the patient very much and therefore they must be watched.

The bromides, cold affusions to the back and genitals, and galvanization and faradization of the spinal cord are the appropriate remedies. The results are slight and seldom permanent. Relapses require treatment.

The prospects of improvement and cure are best in those cases of frequent abnormal pollutions and spermatorrhœa dependent upon a

localized lesion in the sexual organs. Of such lesions by far the most common are those due to chronic gonorrhœa, which almost always extends to the posterior urethra and invades the prostate and seminal vesicles. The measures recommended for chronic gonorrhœa (*quod vide*) may be used with advantage in this condition, according to the indications of the individual case.

One maxim though must always be observed: **ne nimis!** As advantageous as is a definite and cautious local treatment, just so bad is it to carry this form of therapy too far. My experience has taught me that those who carry local treatment too far make just as great a mistake as those who completely discard it.

If remnants of a gonorrhœa remain, the usual measures, particularly cauterization of the colliculus seminalis with a few drops of a 2% solution of silver nitrate, may be tried. It should be done at intervals, so as not to increase the already existing nervousness of the patients; if prostatitis is present, the gland should be massaged, the rectal thermophore used, and electrization of the prostate practised, one pole being placed in the rectum and the other over the symphysis. The metal sound, the psychrophore, and applications of cold water to the genitals may be used in conjunction with a few internal remedies and hygienic and dietetic measures. The bromides alone or in combination with ergot, or with iron and arsenic, according to the indications of the individual case, are useful drugs. Hygiene consists in regulating the diet and the general regimen of living and above all in securing a copious daily evacuation of the bowels. Under this treatment the pollutions almost always become fewer and the spermatorrhœa entirely disappears.

Some of these therapeutic measures are identical with those which I use in sexual neurasthenia, as abnormal losses of semen are often only a symptom of neurasthenia.

It is evident that the employment of the local measures just mentioned will have to be more restricted in the case of patients of neuropathic taint. They are only permissible for the purpose of inspiring the patient with confidence that he will be cured. The disease being one in which the greatest desideratum is an alteration of the patient's mental condition, treatment naturally must be psychical. This gives results only when the physician possesses great authority and has the complete confidence of his patient.

The first object of suggestive treatment should be to impress the

patient with the idea that his disease is not so severe as he believes, and that he will soon get better and be cured within a conceivable time.

The best results are obtained by hygienic-dietetic treatment in a sanitarium. The same measures employed at home do not have the effect that they have when the patient is removed from his usual surroundings and vocation. Therefore it is best for well-to-do patients to go to a suitable sanitarium and take a systematic course of treatment. Regulation of the bowels; light, non-stimulating food eaten at regular intervals; the interdiction of alcoholic beverages and the restriction of tobacco; prescribed exercises together with physical labor in the intervals when possible; gymnastics, massage, galvanic or faradic electrization; hydrotherapeutic measures, such as full baths, half baths and sitz-baths, douches at first luke warm and then gradually reduced in temperature, together with friction;—these are the remedies with which the institution-physicians obtain such surprising results.

Change of air, a sojourn in the country, sea baths and traveling also have a beneficial effect upon the mental and physical condition. Those who are not able to go to a health-resort or travel should be treated according to the same principles at home. As to medical treatment I recommend the various bromine salts, ergotin and strychnine, with or without the addition of iron and arsenic, according to indications.

IMPOTENTIA VIRILIS.

By impotentia virilis is understood a condition in which the power of having normal sexual intercourse is entirely lost or considerably diminished.

This disease is more accurately called *impotentia cœundi* in contradistinction to *impotentia generandi*, which implies a defect in the semen, or in other words in its impregnating power. Both render the individual incapable of propagating his kind, unless artificial methods of fecundation are resorted to in the former condition. With few exceptions, which will be referred to later, those who are unable to copulate are also unable to procreate; on the other hand inability to procreate does not imply incapacity to copulate.

There are many men whose power of impregnation is lost, but yet who are able to have intercourse in a normal manner; and, *vice versa*, there are many others whose testicles produce an entirely normal secretion, and who therefore are not sterile in the strict sense of the word, although their inability to secure intromission of the penis

renders them incompetent to procreate. Those exceptional cases in which emission takes place although the penis is only partly or not at all rigid are to be excluded from this class, as conception may occur if the seminal fluid gets into the vagina.

Impotentia cœundi, the more important of the two affections, will be considered first. Apart from the existence of normal genital organs, the indispensable condition for the performance of the sexual act is a good erection, so it naturally follows that absence or insufficiency of erection constitutes the cause of impotence. This defect may relate to the time during which the penis remains rigid, to the degree of rigidity which it attains, or to faulty direction of the perfectly rigid penis.

According to the cause upon which impotence depends we recognize:

1. Organic impotence.
2. Psychical impotence.
3. Nervous impotence.
4. Paralytic impotence.

1. ORGANIC IMPOTENCE.

In this form the inability to copulate depends upon malformation or defect of the genital organs or neighboring structures. Among these are absence or rudimentary formation of the penis and exstrophy of the bladder with very short penis. Epispadias and hypospadias do not always cause impotence. I know a great many men afflicted with one or the other of these conditions who are able to perform the sexual act very satisfactorily, even though the semen is not ejected into the vagina, but escapes above or underneath. It is only in the extreme grades of this abnormality that coitus is impossible.

When the penis is completely or mostly retracted into the scrotum in consequence of scrotal hernia, hydrocele, elephantiasis or tumors of the scrotum, it is useless as far as the sexual function is concerned. In reducible hernias a truss, and in the other abnormalities proper operative procedures, will afford relief.

Mutilation or abnormal size of the penis may also hinder cohabitation. Elephantiasis of the glans or body of the penis, tumors of the glans, urethral or preputial calculi may interfere with or completely prevent intromission.

The **prognosis** of these cases is usually favorable. Sometimes the

abnormalities can be removed by operation without destroying the form of the penis. Even when it is necessary to cut off the anterior portion of the organ enough often remains for the patient to have connection.

Impotence may be caused by congenital or acquired shortness of the frænum, so that it bends the end of the penis downwards. In such cases even though cohabitation is possible it is usually so painful that the individual is compelled to abstain from it. Cure is readily obtained by dividing the frænum.

It has also been stated that varix of the dorsal vein of the penis may prevent connection.

If the penis is deflected to one side or upwards or downwards when it becomes erect, this deformity may prevent or at least render intercourse difficult. The trouble depends upon the degree of deviation, which in turn is due to circumscribed infiltrations or indurations of the corpora cavernosa or their fibrous sheath. These infiltrations may be multiple or single, they may be limited to one corpus cavernosum, as is generally the case, or they may surround the whole penis. They may also extend into the corpus spongiosum. In consistency they may be soft or as hard as cartilage.

When erection occurs **deviation of the penis** results, as the spaces within the corpora cavernosa are obliterated at the site of the infiltrations so that they cannot expand. The deviation occurs toward the side on which the indurations are situated.

The etiology of this affection, which occurs most frequently in middle life, is not clear in all cases. The gouty diathesis, injuries during coitus, violent erections, and gonorrhœa have been specified as causes.

Verneuil found diabetes mellitus in nine out of ten cases and therefore believes that there is a causal relation between the two affections. Tuffier and Pousson also found them associated. In several of the cases which I have observed gonorrhœa and injury seemed to be the cause. I have not seen any cases in which the other supposed causes were operative. The tumors found in diabetes are usually in the corpora cavernosa, while the callosities resulting from long-standing gonorrhœa are usually first situated in the corpus spongiosum, from which they may occasionally extend to the corpora cavernosa. They are most common in the bulb and resemble urethral stricture; they are also often found in the pendulous portion of the urethra.

Periurethral abscesses producing obliteration of the affected parts

may have the same effect. Johnsohn saw distorsion of the penis follow an abscess in the right corpus cavernosum.

When of considerable extent or rightly situated, ossification of the septum or fibrous sheath of the corpora cavernosa may have a similar effect. They are much less common than the previously mentioned affections (Velpeau, Malgaigne).

Gummata of the corpora cavernosa may also cause deviation of the penis during erection (Ricord). Differential diagnosis between these growths and callosities and bony growths will seldom be difficult.

Gummata offer the best prognosis of all these affections; regular antisyphilitic treatment or potassium iodide alone, together with local inunctions of mercurial ointment, will generally prove efficacious.

Curvature of the penis due to laceration of the corpora cavernosa, commonly called fracture of the penis, offers no chance of cure.

Ossifications in the septum, the so-called horns of the penis, may occasionally be removed by operation.

The nodules occurring in diabetes offer a good prognosis. They are no doubt caused by this disease, as they become smaller when it responds to treatment.

The most difficult to cure are those due to gonorrhœa. Boyer and Gross recommended the excision of such indurations. This procedure is good, although it is subject to restriction. Before resorting to operation other measures should be tried, among which I recommend the use of sounds of increasing size. If there is a stricture it should be dilated with soft bougies. After the urethra will admit a 16 F., metal sounds may be employed and their size constantly increased. Local applications of mercurial ointment, warm sitz-baths, and potassium iodide internally may be employed as auxiliary measures. Under this treatment I have seen many infiltrations become smaller and the curvature of the penis thus become less. It is only when this procedure is ineffectual and the infiltrations are multiple or large that excision should be undertaken.

2. PSYCHICAL IMPOTENCE.

Psychical impotence is the most important of all the forms of impotence and, moreover, is one of the most interesting subjects in medicine. Its clinical picture presents unusual diversities. The impairment of virility varies greatly, being less at certain times than it is at others.

Although the conception of potency may be relative, it is nevertheless constant insofar as it implies capability to have connection at certain intervals of time. It cannot be positively stated just how many times a man should be able to copulate within a given period of time. The age of the man, his disposition, his sympathy for the female, and many other things exert an influence. There is, however, a certain physiological measure. If this is diminished we speak of impotence, although we call it partial impotence in contradistinction to absolute, in which the individual is no longer able to perform the sexual act.

As regards the age at which a man is able to copulate and the time of life at which this power ceases, it naturally varies, depending upon many different circumstances. The time at which it becomes extinct is even more variable than the period at which it begins. Many men retain their virility until an advanced age, while others lose it comparatively early, or at least find that their power is becoming impaired. Sometimes this senile condition follows an exhausting disease, at others it supervenes as the result of physiologic processes. In the latter instance the transition from potency to impotency is gradual. A diminution of sexual power is noticed; while it was possible for him to have connection every day, such a person now finds that intervals of constantly increasing duration must elapse between the acts; or a longer time may be required for the consummation of coitus; or, whereas formerly any erotic excitation sufficed to produce an erection, unusual and complicated means are now required.

It is also a reduction of potency when a man is able to cohabit only with certain women. This form of impotence, which comes under the heading of psychical, is called **relative.** It usually affects married men who cannot have intercourse with their wife, although they are potent with other women.

Just as virility varies in different men, so likewise does it vary in the same individual according to external conditions and physical and mental disposition; it is to the latter that we will now particularly direct our attention.

It has already been stated that the prerequisite of potency is an erection, which is under the control of the brain; therefore the mind exerts a notable influence upon the sexual functions. Impotence due to mental alterations is the most interesting as well as the most frequent and readily curable form. Only those cases in which mental impression is the exclusive cause can be placed in this category.

I cannot agree with those authors who consider frequent attacks of gonorrhœa, prostatic disease and inflammation of the bladder or testicles to be causes. These troubles are responsible for psychical impotence only as far as they produce mental alterations. As long as they do not give rise to such changes they do not influence sexual power, a fact which is attested by thousands of cases of gonorrhœa. They do occasionally give rise to mental impressions which disturb the sexual capacity, but this is quite another matter.

Upon investigation of the etiological factors of psychical impotence it is found that they are many and diverse.

Persons who have led a most moderate sexual life or who may even have lived continently are sometimes affected, and, conversely, those who have given themselves over to the wildest excesses, who have indulged excessively in natural intercourse from their earliest youth and thus overtaxed their power, may also be subject to it. There are also cases in which the quality of coitus does not correspond to physiological laws, in which unnatural situations and subtle means on the part of the female are required for the production of sexual excitement. Furthermore persons who have been or still are addicted to masturbation are sometimes affected, and, indeed, they constitute the largest number of this class. Finally fear, superstition, hypochondria, or even a slight mental impression may render a person incapable of performing the sexual act.

It is exceedingly rare for persons who have practised sexual intercourse very moderately or not at all to suffer from psychical impotence; they constitute the largest contingent of those who are afflicted with nervous irritative impotence, which will presently be described. Such cases, however, do occur in the former class and depend upon absence of the sexual impulse. The sexual impulse leads to sensual excitation, which in turn leads to the performance of the sexual act. Therefore, if this impulse is absent, the desire and possibility of intercourse is wanting.

Absence of the sexual impulse may be congenital or acquired. The former is certainly very rare, although there are perfectly healthy persons who have never experienced sexual desire.

Such sexual anæsthesia is of cerebral origin. It is not dependent upon absence or defect of the external organs of generation or the spinal mechanism, for Ultzmann and myself have observed cases of congenital aspermatism in which virility was intact. Only those cases in which

sexual life is wanting, despite normally developed and functionally active organs of generation, come under this category. According to Krafft-Ebing this form generally occurs in persons who are affected with other functional cerebral disturbances, or who show signs of mental and perhaps also physical degeneration.

Closely related to these cases of defective sexual impulse are the so-called *naturæ frigidæ*, which are encountered more frequently in the female than in the male sex. Women thus constituted have only slight inclination for connection, derive no pleasure from it, and submit to it only from a sense of duty.

In regard to acquired absence of the sexual impulse, mental overwork or diversion is most to blame. When the mind is absorbed in thought sensual excitation is not experienced. In most of these cases the impotence is only temporary; as soon as the cause is removed the effect disappears. Cases have been reported, though, in which the mind was so engrossed in other subjects that the sexual impulse dwindled away and failed to develop again after the excessive activity had ceased. It is said that Sir Isaac Newton never had sexual intercourse, and it may well be believed that he, who was occupied with problems requiring the most assiduous and profound thought, never felt the sexual impulse.

It is different in those cases in which the first cause of an unsuccessful coitus was a mental impression, the recollection of which occasioned still further failures upon subsequent attempts.

An interesting explanation of the manner in which distrust or fear influences potency is afforded by Goltz's theory of inhibitory centers in the brain. It will be remembered that Goltz ascribes an inhibitory power to the brain by means of which the center of erection in the spinal cord is controlled. Although the latter may endeavor to send out impulses for the production of an erection, it is prevented from so doing by the irritated inhibitory center. The two centers are in conflict; the inhibitory center in the brain is the stronger and conquers the center of erection in the cord.

It is true that no proof of the correctness of this theory can be adduced, but I place some value upon it as it explains how it is possible for anxiety to prevent the occurrence of erection; I believe that a large number of cases of psychical impotence are attributable to this cause, which not only lends weight to the theory, but also determines the method of treatment. As we shall see later, in the majority of cases

it is not weakness of the genitalia or nervous system resulting from excesses or masturbation which leads to impotence, but rather lack of self-confidence and fear that these digressions may have inflicted harm. The stronger this fear the more remote the cure.

The frequency with which cure is obtained, however, confirms this view. As soon as the patients' anxiety is removed, a thing which cannot always be easily accomplished, they regain their virility. In order for the patient to be freed from his fear it is necessary first of all for him to trust his physician and hope that he will be benefited by the treatment prescribed.

For this reason I lay great stress upon prescribing a detailed plan of treatment for these patients.

I either send them to a watering place and have them take a thorough course of treatment under the supervision of a physician, or treat them at home by means of general electrization, local faradization of the genitals, which produces erections, artificial carbonic acid baths, sounds of increasing size, cold rubs, cold baths, and the internal administration of placebos. It is very advantageous to employ several of these measures at the same time; the less the patient's time is occupied the greater the number which should be used. The patient will then believe that a great deal is being done for him and gain hope that the treatment will be beneficial.

It is most essential for the patient to abstain from coitus for a long time. He must not be allowed to attempt it every week for the purpose of testing his power, for a failure will greatly retard his recovery. I have my patients abstain for months at a time; they then get the idea that this long rest has so fortified their genital organs that they are again fully able to have connection.

In like manner fear of failure is responsible for many cases of psychical impotence following excesses in natural coitus or masturbation.

There is a general impression among the laity that excessive venery leads to early loss of sexual power, and it is certainly well that they think so, as otherwise excesses would be even more common than they are. As it is, many are restrained from the dissolute practices to which their nature impels them through fear of the consequences.

Others, however, are reckless or their desires conquer their discretion. Then it comes to pass that coitus goes amiss, be it that erection does not occur when it is needed or subsides too soon, be it that an unusual

length of time and unusual effort are required for the consummation of the act; in short, it is noticed that coitus is not performed as it formerly was.

This need not result from excesses, there being many other causes which explain its occurrence. The affected person may be physically or mentally exhausted or his thoughts diverted to other subjects. He may have been under the influence of drink or his feeling toward his female companion have been very slight; finally uncleanliness, disagreeable odor, or vulgar conduct may have produced a feeling of disgust or aversion. Any one of these suffices to explain why connection is not as satisfactory as it formerly was.

The patients, however, naturally attribute it to their sexual excesses and look upon it as a form of punishment. When we come to consider atonic impotence we shall see that they are often right, although it is often only one of these accidental causes, together with transitory weakness, which produces the failure. If this once comes to pass, fear ensues that it may happen again, and it is this thought of failure more than anything else which prevents the occurrence of erection.

Of minor importance are those temporary forms of impotence which sometimes immediately follow excesses. If a man has connection several times a night for several nights in succession, it is only natural that he should fail when he tries again after a short lapse of time, as sexual energy is in relation with the amount of seminal fluid and nervous energy which is stored up. If the former is spent and the latter exhausted, coitus naturally cannot take place. These conditions are so well understood by the laity that they do not give rise to the fear previously mentioned. It is known that proper rest will put things in order again.

In many cases, too, marital conditions are the cause of relative impotence. Thus a married man may have no trouble in having connection with other women although he is not able to with his wife. Such cases have been observed in men, who in course of time have taken an aversion to their wife, in those whose wife aged early, and in those who found relations with other women so congenial that they no longer derived pleasure from intercourse with the woman to whom they are wedded. Under these circumstances it is naturally difficult for the physician to effect any change.

We now come to a group of cases of psychical impotence which are caused by an aberration of mind relative to sexual matters, namely,

perverse sexual feeling. These cases have received more attention from writers on medical jurisprudence, but they are nevertheless of particular interest and great importance from our point of view. The normal man feels the sexual impulse under circumstances which are too well-known to require detailed description here. The sight of nude or partly disrobed women, contact or lewd conversation with them, obscene pictures and the like awaken ideas which produce sexual excitement, as the expression of which an erection of the penis occurs.

It is different with persons having perverse sexual impulses. That which arouses the physiological sexual feeling in normal men has no effect upon them; their sexual nature is excited by circumstances which have no influence whatever upon normal men. For example, the sight of women's hose or shoes makes no impression upon a normal man; I have a patient, however, who experiences sexual excitement only when he looks at the former article of apparel.

It is easily explainable how such perverse feelings may result in impotence. Persons thus afflicted cannot get an erection when they try to have connection, because those things which excite them sexually are absent. The *libido sexualis*, however, is strong, indeed it is often too well developed.

A large number of such persons are masturbators, that is, contemplative masturbators [Gedanken-Onanisten] in contradistinction to those who produce orgasm and ejaculation by frictioning the penis without further voluptuous fancies; they picture unto themselves the most marvelous relations with women. This arouses their lust and erection and ejaculation follow. When they come in contact with women and try to have connection, they remain unmoved; they fail to find in reality that which their fantasy had depicted; no erection occurs, they are impotent.

Perverse sexual impulse, then, may express itself as a mere imaginative proceeding, as in the case of the contemplative masturbators, or in the actual performance of an unnatural sexual act with other persons. These persons may be of either sex; it matters not so far as the result is concerned.

The perversity of the conception often relates to secret things which are usually concealed from the eyes of men, although it may concern matters which bear absolutely no relation to anything ordinarily capable of arousing sexual excitement, or relate to objects which are seen everywhere and have nothing whatsoever indecent about them. Thus

Charcot and Magnan report a case in which the thought of a night-cap aroused sexual desire.

It is interesting to note that in those cases in which an inadequate stimulus evokes sexual desire, although adequate physiological stimuli remain without effect, the inadequate stimulus may be used to render coitus possible. This supplies the basis upon which treatment must be founded.

Thus there are persons who satisfy their sexual cravings by mere contemplation or conception of inanimate objects at one time, and by perverse acts upon their own person at another. To this class also belong those who seek to appease their lust by perverse practices upon persons of their own or the opposite sex, or upon animals.

The perverse acts which are practised with persons of the same sex merely represent an increase in the perverse ideas relating to persons of the opposite sex upon which the mind of the afflicted individual is concentrated. Just as in some cases sexual enjoyment is derived from the sight or conception of women's shoes or similar objects, in others it is obtained by acts of the most disgusting, horrible and criminal nature. Among these are the terrible deeds committed for the purpose of satisfying sexual passion, the acts of the sadists.

As difficult as it is to understand this combination of sensuality and cruelty there are nevertheless certain weak analogies to it in physiological life.

Thus there is some relation between these acts and the well-known fact that very sensuous women not uncommonly bite the man with whom they are having connection when the climax of coitus is reached.

If the conception productive of sensual pleasure attain a higher degree and assume a murderous or criminal trend, deeds of violence result.

The adequate sexual stimulus in the case of such perverts is the conception of the pain suffered by their victim. From this conception is generated the impulse to commit such deeds for the gratification of lustful desire.

The principal form of sexual perversion, however, is love for those of the same sex. Here we encroach upon a domain to which the criminal judge lays claim; nevertheless the treatment of human weakness which devolves upon the physician comprises psychical as well as physical conditions, and as pæderasty is a form of mental aberration it should for this reason receive our attention.

Love for one's own sex, or pæderasty, may be congenital or acquired.

In the first case the sexual disturbances depend upon a psychopathic or neuropathic constitution, that is, they occur in persons of bad heredity. These persons experience no sexual excitation through physiological stimuli, as for example, the sight of a naked woman, although the nude male figure is an adequate stimulus. If they try to have connection with a woman they fail, and unless they are morally degenerate, so that they cannot realize the abnormality of their condition, the failure increases their despondency and mental suffering.

Masturbation must have an especially unfavorable influence upon the sexual life of a person of such a bad heredity. It acts as a predisposing cause for the development of pæderasty. When such an individual who was addicted to masturbation in his early years attains a mature age, he does not possess, writes Krafft-Ebing, "the æsthetic, ideal, pure and natural feeling which attracts him to the other sex. Thus the ardor of sensual feeling is extinguished and affection for the opposite sex very much reduced. This defect has an unfavorable influence upon the moral and mental condition, upon the character, disposition, impulses and emotions of young masturbators of either sex, and under certain circumstances causes the desire for the other sex to die out, so that masturbation is preferred to the natural method of appeasing sexual desire."

In acquired pæderasty it is generally misguidance on the part of others and the impossibility of satisfying the sexual impulse which makes otherwise normal men pæderasts. Therefore it is no wonder that the vice is particularly common in closed and guarded institutions, such as boarding-schools, monasteries and prisons, and also on board ships. It more rarely happens that married persons practise it in order to avoid increase in the family. It most commonly originates in educational institutions where one boy with perverse sexual feelings seduces other pupils. Under the influence of example and the desire which is uppermost in the mind the children conquer their disgust, inflame their imagination with obscene pictures, and indulge in pæderasty.

Homosexual propensities are also often observed in old people, mostly old rakes whose senses have become dulled to natural stimuli. They find no pleasure in normal sexual intercourse, sink morally lower and lower, and finally abandon themselves to the loathsome vice of pæderasty.

In this category also belong the so-called Sodomites, persons who practise lustful acts with animals. Sodomy was an element of religious cults among many ancient peoples, notably among the Egyptians. There are different causes which lead men to rape animals. It is generally weak-minded cretins or insane persons who commit these acts during their periodical outbursts of sexual passion. It is only exceptionally that persons of apparently sound mind, who have not the opportunity of satisfying their lust in the natural manner, will abuse animals if they get the chance; it is an exceedingly rare occurrence for a man or woman to conceive a passion for an animal. In such cases the persons are usually neuropaths whose sexual inclinations are toward animals and whose passion is aroused by the revolting deeds which they commit upon them.

3. NERVOUS IMPOTENCE.

This form of impotence, which is also known as **impotence due to irritable weakness,** and is often associated with sexual neurasthenia, resembles the two principal forms already described, in that it is not caused by organic lesions of the central nervous system. The genital organs and the nervous mechanism controlling them are anatomically sound, but functionally deficient. All cases in which anatomical lesions are demonstrable or probably present do not belong to this group, but come under the last division, namely, paralytic impotence.

In the present class of cases there is a functional defect the nature of which is not always easily determinable. To draw a comparison for the purpose of illustration let one imagine a lighting apparatus consisting of an electric battery connected by conducting coils to a platinum wire. The power of the battery, however, is so great that when the current is turned on the platinum wire soon glows through, so that a lasting light is not given off. Here all is sound, battery as well as wire, and yet the apparatus does not work as it should. If the disproportion between the two parts is removed, and they are adjusted one to the other, the whole will then act properly.

Similar conditions may be assumed in impotence due to irritable weakness. In this condition ejaculation takes place at the moment intromission of the penis occurs or even before it can be inserted into the vagina. At the moment when coitus should begin the penis becomes flaccid; men thus affected must naturally be considered impotent.

Just as the battery in the lighting apparatus was too strong, so here are the nerves too strong; they occasion orgasm and ejaculation too soon, with the result that coitus cannot be continued.

I have chosen this comparison because in irritative nervous impotence there is an excessive nervous activity. According to my experience those who suffer from this complaint are mostly young men who have indulged in sexual intercourse very rarely or not at all.

The report of a case may serve as an illustration. A young man, twenty-three years of age and of a well-to-do family complained that it was impossible for him to have connection, as ejaculation always took place before he could secure intromission of the penis. He could obtain a good erection, but it would subside too soon. He considered his condition humiliating and unendurable, and feared that it would keep him from marrying.

This young man was the only son of his parents, who had watched him with unremitting care, so that it had been impossible for him to indulge in sexual intercourse. When he became somewhat freer he made the attempt but failed, and the fiasco was repeated upon each subsequent trial. His statement that he had never masturbated was accepted, as he was upright and truthful. He had had an emission once or twice a month.

The present trouble had existed for three years without changing much, although he had become able to secure intromission, whereupon ejaculation occurred at once. The case was cured by marriage.

The condition here was evidently due to hypersensitiveness. In consequence of the long repression of his sensual desires the otherwise perfectly healthy man became so excited that the orgasm occurred sooner than in other men. The excessive irritability became tempered in wedlock, an occurrence which I have had the opportunity of observing in other cases.

Two other cases may be cited as representing certain types. One is that of a young lawyer, and is worthy of notice on account of its termination. The patient, a strong, handsome man, was not watched so closely as the one previously mentioned, so that he early had the opportunity of entering into sexual relations.

During his student days he developed, from what cause is unknown, a general nervous condition which expressed itself in the form of great agitation, restlessness, inability to work and sleeplessness. In addition he experienced a tickling sensation in the urethra, which gave rise to

frequent erections and caused precipitate ejaculation whenever coitus was attempted.

The patient was not of bad heredity and had masturbated very little during his youth; the genital organs were well developed and the urethra as revealed by the endoscope was entirely normal; its sensibility was diminished rather than increased.

His illness, particularly the sexual disturbance, caused him to become hypochondriacal. I sent him to a hydrotherapeutic institute where he took a mild course of treatment. Upon his return he did not feel much better. He was afraid to marry because he thought he might not be able to fulfill his marital obligations. I endeavored to quiet his fears and convince him that such would not be the case; indeed, I even recommended marriage as a cure.

He did as I advised him. I had forewarned him that in the beginning of his married life matters would go even worse than with members of the demi-monde, but that he should not be disturbed by this. I tried to make him understand that his trouble was one which would diminish day by day. Three months after his wedding I saw him again. He stated that matters went exactly as I had predicted. At first ejaculation took place before intromission, then he gradually became able to secure intromission before the semen was discharged, and at length got so that he could have normal coitus.

If we now consider a third case we shall have had an example of all the forms of impotence belonging to this class. It is that of a school-master who had masturbated considerably in his youth. Neurasthenic symptoms were not long in manifesting themselves. The patient was restless, unsettled in mind, and suffered from insomnia, a sense of pressure in the head, and irritation in the posterior urethra and at the external meatus. Emissions occurred three or four times a week, and were followed by great weakness, depression and ill-humor. Now and then a spontaneous discharge of prostatic fluid took place. Coitus was impossible because ejaculation occurred before the patient could secure intromission of the penis.

Upon examination I found the patient highly nervous, the genitals well developed, the urethral orifice reddened, the urethra of normal caliber, but excessively sensitive in the posterior portion. In this case, therefore, there was sexual neurasthenia, prostatorrhœa, and irritative nervous impotence.

I placed the patient upon treatment and made a favorable prognosis.

I sent him to a hydrotherapeutic institute where he received tepid baths followed by cold douches, together with general faradization and a partial rest-cure. When he returned home I undertook to reduce the hyperæsthesia of the urethra. For this purpose I applied a five per cent solution of silver nitrate to the entire posterior urethra once a week. On the last three days of the week large sounds of ascending sizes were passed. I used cocaine at first, but was soon able to dispense with it. The meatus was large enough readily to admit a number 30 French. Potassium bromide and ergotin were administered internally.

Under this treatment the patient, who had not attempted to have intercourse for three months, improved considerably, the pollutions becoming less frequent and the annoying tickling in the urethra subsiding. Thereupon I advised marriage. The patient, although somewhat doubtful, followed my advice and married, with the result that he was completely cured of his nervousness and impotence.

These three cases represent the forms of irritative nervous impotence commonly met with in practice.

In the first case it was complete abstinence which led to a condition of excessive irritability, in the other two general neurasthenia existed, the cause being unknown in one instance and attributable to masturbation in the other.

I would not venture to decide whether the urethral irritation present in the last case was a manifestation of the general neurasthenia or whether it was the cause of the latter. This is the question which invariably presents itself in these cases. Many incline to the opinion that the redness and swelling of the colliculus seminalis caused by masturbation produces nervousness in the form of priapism and precipitate ejaculation.

This theory, which presupposes the existence of a peripheral neuritis affecting the sexual nerves and emanating from the colliculus seminalis, has something attractive about it, inasmuch as it affords a firm working-basis of treatment, but as a matter of fact it may not be correct; anatomical proof has not been adduced in every case. It is, however, certain that local treatment of the inflamed parts generally relieves not only the local trouble, but also the general nervous condition.

In every case of this form of urethral inflammation, whether it be the cause or concomitant of impotence, it is the duty of the surgeon to endeavor to reduce the hyperæsthesia.

Indeed, blunting of this urethral sensibility is indicated in those

cases in which the erection is perfect, intromission successful, and coitus therefore possible, but the time required for ejaculation too short. In certain men of vivacious temperament precipitate ejaculation is normal, and it also sometimes occurs in men of less brisk disposition who have not had intercourse for a long time. If this condition is transitory it is not important, but if it is of long duration it requires consideration by reason of its action upon the procreative power.

According to the views now accepted the manner in which the semen reaches the generative passages is of some consequence. It is believed that certain reflex movements of the cervix and os uteri favoring reception of the semen take place during coitus. If coitus be inopportunely terminated by early ejaculation, the female fails to reach that degree of excitement requisite for the production of these reflex movements. Therefore precipitate ejaculation bordering upon impotence demands treatment because of its influence upon conception.

4. PARALYTIC IMPOTENCE.

This, the fourth form of impotence, differs materially from the others.

The first three forms are alike in that the sexual apparatus so functionates that coitus would be possible were it not for certain hindering circumstances which are present. In the first form it is absence or malformation of the genital organs or disease of neighboring parts which renders the performance of the sexual act mechanically impossible. In psychical impotence it was seen that sexual power is often strong, but that it manifests itself at the wrong time or in the wrong way. In the third class also the sexual organs were functionally active, only their activity was too great. It was hypererethism which prevented the consummation of coitus.

In **paralytic impotence** all is different. In consequence of structural lesions in the muscular and particularly the nervous apparatus which are in relation with the genital organs, the patients are deprived of the first prerequisite for the performance of coitus, namely, erection. This is not the case in any of the first three forms; erection occurred, but could not properly be made use of.

The genitals of such patients sometimes show no greater changes than are observed in the other forms. Occasionally they have a withered, senile look. Sometimes the testicles show signs of atrophy, being small, soft and flabby and having lost their peculiar sensitive-

ness to pressure, as well as being more or less unresponsive to electricity; at least it is often observed that the thigh is much more sensitive to the current than the testicles. Relaxation of the scrotum is another sign which is sometimes present. Sensitiveness of the penis to the electric current is also considerably diminished. In many instances, too, the sexual impulse is entirely destroyed or very much impaired.

In these cases there is an organic change in the center of erection or in the paths of conduction. The exact nature of this change has not been determined, but it may be assumed that in well-advanced cases there is complete degeneration of the nerve-tissue. In others it is probable that there is only a partial degeneration or a temporary exhaustion of the nerve-cells, constituting the condition known as atony.

Accordingly we distinguish two subdivisions in this fourth form; one with complete and permanent loss of sexual power, **true paralytic impotence,** the other with more or less serious disturbance of power, **atonic impotence.** In the latter condition erection occasionally though rarely takes place, but it is usually of short duration and is not adequate for the performance of satisfactory coition. Proper treatment and rest, however, may cure the atony. In contradistinction to those who suffer from true paralytic impotence, those affected with this form may recover and retain their virility for years.

To this fourth main division also belong such cases as are not included in the other three groups, namely, those due to malformations or defects of the genitals, mental abnormalities, and excessive nervous irritation.

The etiological factors in the fourth group are excessive venery, masturbation, exhausting general diseases, affections of the spinal cord and brain, and, finally, the effect of certain drugs.

In regard to **excessive venery** it has already been stated that the meaning of excess is difficult to define, varying with the individual. That which is excessive for one is only moderate for another. The state of the general health is valuable in deciding this question, for the reason that with few exceptions men who indulge immoderately in sexual intercourse become weakened and grow thin, although their appetite remains good. The final result of extravagance is impotence. There are a few men, however, who can give themselves over to such pleasure with impunity, but the number is very limited.

With the means now at our disposal it is usually impossible for us

to determine just how continued excesses injure the organism, and what changes they produce. It is frequently impossible to detect any changes; the patients feel perfectly well, but nevertheless they are impotent.

At the present time it is known that impotence has not the injurious results formerly attributed to it. All possible diseases were ascribed to excessive sexual indulgence, whereas it is very probable that the loss of sexual power in such cases was due to the general diseases themselves.

It is true that extravagance in sexual intercourse generally results in emaciation, but in many cases the affected persons feel perfectly well. In this connection it is to be remembered that excess in natural coitus is not so common as is generally believed, for the simple reason that the very nature of the thing itself prevents great excess.

After every sexual excess, it matters not how strong the man, there is a period of weakness which has to pass away before sufficient nerve-force is collected to enable the performance of the sexual act again; desire is also obtunded. As a rule, both man and woman become more moderate irrespective of any intervening external influence. In the case of the unmarried it is difficulty of opportunity and other circumstances which raise a barrier before these over-ardent devotees of Venus.

It is altogether different in **masturbation.** Conditions favoring success are much better, so that loss of bodily strength and the supervention of impotence are much more frequently observed.

The most injurious of all is the straining of an organ still in the process of development. Sexual excesses cannot be practised before maturity, as both means and opportunity are absent; masturbation, on the contrary, is often practised in earliest youth. The effect of excessive straining upon the undeveloped sexual organs, such as results from masturbation, is far more injurious than greater excesses indulged in after maturity.

For coitus two persons are necessary, for masturbation one is enough. Therefore it is clear that a masturbator will exercise his sexual organ oftener than a person who has sexual intercourse; the latter requires a special time and opportunity, the former can always find both time and opportunity. There are persons who masturbate while lying in bed or upon a sofa, while sitting, riding in a carriage, attending the theatre, or when engaged in their work, and children who indulge in it during school hours. The greater the sexual propensities the oftener is the act committed.

While roués are of gay and cheerful disposition, proud of their conquests, and try to make up by good living the strength which they lose in debauchery, masturbators almost without exception become hypochondriacal as soon as they learn that masturbation is a vice, or at least injurious to the health. They know that the habit is wrong and injurious yet they do not abandon it. There is often a struggle between the sexual impulse, which they have gratified by masturbating, and their resolve not to defile themselves. For a time the latter may prevail, but eventually the former gains the mastery again. It is not surprising when this conflict is kept up for many years, as I know it is with many patients, that the nervous system suffers.

It is not necessary to refer again to the evil results of masturbation which were mentioned in connection with psychical impotence; that which has been said explains how long-continued masturbation may produce atony and also degeneration of the centers of erection, and thus cause temporary or permanent impotence.

As concerns further etiologic factors, certain exhaustive constitutional diseases have been named as causes of paralytic or organic impotence. Severe acute febrile diseases, during the course of which the spermatozoa become diminished or entirely disappear, will not be considered here, because this form of impotence is of no importance. Exhaustion and impotence persisting during convalescence are likewise of no consequence, sexual power almost invariably returning as strength is regained.

Among the chronic diseases in which impotence occurs may be mentioned morphinism, phthisis, diabetes mellitus, obesity, anæmia, and cachexia of various forms. Diphtheria, when followed by paralysis and muscular atrophy, also occasionally produces impotence.

I have never observed it in phthisis. According to many authors sexual desire and power is increased in phthisis. Others, however, contend that it is decreased.

It is certain that diabetes reduces sexual strength; indeed, impotence often figures among the first symptoms, before loss of bodily strength occurs.

It is almost universally believed that obesity diminishes potency. Although there is no rule without exceptions, it may be stated that very fat persons are usually more devoted to Bacchus than to Venus, their sexual desire being slight, their capacity usually deficient. In such cases it is not improbable that there is fatty disease of the testicles similar to that which affects the heart.

Nothing specific is known concerning the influence of anæmia upon potency.

If the relations existing between the genital organs and the brain and nerves are remembered, it is not surprising that impotence often results from diseases of the latter organs. Certain diseases of the brain and cord first cause increased sexual excitation, which is followed in the latter stages by weakness and finally absolute impotence.

Thus, in tabes dorsalis sexual desire is usually first increased in consequence of irritation of the nerve tracts supplying the sexual apparatus, although it later becomes diminished and eventually entirely disappears. Cases have been known, however, in which advanced tabetics have retained a high degree of sexual power. Injury or disease of certain regions of the brain may also affect potency.

The relations between the cerebellum and the genital system are best understood. By irritating the cerebellum Budge produced movement of the testicle. Concerning this he writes: "By a fortunate accident I made the surprising discovery that the testicles of an old cat, which were retained in the abdomen, moved immediately after death as soon as the cerebellum was irritated with the scalpel or caustic potash. When the right half of the cerebellum was irritated the left testicle moved, and *vice versa*. Even superficial irritation produces this effect. The movements were so plain that their reality could not be doubted. I hastened to open the entire skull and peritoneal cavity and found the testicles absolutely immobile; not a sign of motion was present. As soon as one side of the cerebellum was irritated the testicle on the opposite side of the body became intumescent and moved from its position in such a manner as to form a right angle with the vas deferens. When I stopped the irritation it assumed its original position, and as soon as the irritation was renewed began to move again. The experiment was continued half an hour and always with the same result. After the first stimulus scarcely three seconds elapsed before the testicle began to move. Gradually the interval between stimulation and reaction became longer. The movement lasted only a short time and became weaker and weaker. I also irritated the cerebrum, the corpora quadrigemina, the thalami optici and the corpora striata, but no movements of the testicles were produced."

A case bearing on this observation came under the notice of Dr. Wittemore and was reported by Dr. Fischer. It was that of an old

man, aged seventy-five, who in forty years of married life had begotten eleven children. Soon after his marriage he began to complain of dizziness and ringing in the head, from which he suffered more or less until his death. In addition to this he had ringing and severe pain in the left ear, together with difficulty of hearing, as well as several hæmiplegic attacks which were followed by morbidly increased sexual desire. This lasciviousness partly disappeared three months before his death, so that he had a desire to copulate not more than once or twice a night. He was unable to satisfy his desires, however, for the reason that erection was imperfect, and emission had not taken place for a year.

On the day following his death the brain was examined. The dura was adherent to the skull, the arachnoid thickened and the pia very œdematous. The arteries were calcareous. In other respects the brain was healthy with the exception of the cerebellum. The right lobe was normal, the left about one-fifth smaller and having a cavity of considerable size within its substance. The walls of this cavity were in contact. The cavity contained serum which flowed out when it was opened.

This case is remarkable in that strong desire was present which could not be satisfied on account of defective potency.

Finally certain drugs which are reputed to lessen or even destroy potency must be considered. I shall not discuss the influence of riding because nothing definite is known in regard to it.

It is also very difficult to judge the effects of medicines, for the reason that their action varies greatly in different individuals both in regard to the effect produced and the quantity required. Thus it happens that the most contradictory statements concerning this subject are found in literature.

The least contention obtains in regard to the effects of strong drink, which is generally acknowledged to be unfavorable. It is a well-known fact that coitus is unsatisfactory or even impossible during intoxication. This condition not uncommonly occasions a form of psychical impotence depending upon a feeling of anxiety and uncertainty. Constant drinkers suffer from sexual weakness, and therefore are prone to indulge in masturbation.

It is not certain whether this action is due to the alcohol or to other substances contained in the liquors. Beer has a decided retarding influence upon ejaculation (Curschmann, Gyurkovechky); the same

cannot be said of wine, for when taken in moderate quantities it is rather a stimulant and excitant. It was not without reason that the old Latins said: *Sine Cerere et Baccho friget Venus.* Brandy also seems to have a temporary stimulant action upon the sexual power.

Thus we must conclude that strong drink used in moderation does not have an unfavorable influence upon sexual power; it is excess which is injurious, and this corresponds to our knowledge of the effects of alcohol in other respects. It is known that alcoholic intoxication impairs the function of certain parts of the brain, so that it is quite possible for the center of erection or the conducting tracts to be paralyzed during acute or chronic alcoholism.

Tobacco has a similar reputation. It was long since known as the "divine weed" because the priests often used it to dull their sexual passion. We have daily opportunities of witnessing the effect of chronic nicotine poisoning upon the nervous system. The tremor of the hands so common in excessive smokers is an indubitable nervous symptom. It is not permissible, however, to do more than consider the possibility of an injurious effect of nicotine upon the sexual power; convincing observations have not been made.

The action of morphine is better understood. According to Levinstein it first increases and then lessens sexual power. Sexual excitation and increased strength almost always follow an injection of morphine, particularly in those who are not accustomed to its use.

Rosenthal states that moderate doses of morphine (0.03 to 0.06 a day) produce cheerfulness, loquacity, acuteness of the tactile sense and sexual excitement, the latter being an important symptom and one which is not generally known.

Opium is said to be used in Persia as an aphrodisiac. This is in accord with the experiences of opium smokers, who at first are exceptionally strong sexually, but lose their power of copulation when continued action of the drug has produced marasmus.

Gyurkovechy is of the opinion that the primary stimulating effect is due to paralysis of the cerebral centers which inhibit erection.

Many other drugs are also supposed to diminish potency, among which may be mentioned lead, antimony, arsenic, carbon bisulphide, conium and camphor, but as nothing definite is known concerning their action I shall not discuss them in detail.

Iodine, bromine, salicylic acid and potassium nitrate are certainly anaphrodisiacs, and therefore must be considered.

Four cases of impotence accompanied by more or less atrophy of the testicles are known to have developed during or immediately after a course of iodine-inhalations employed in the treatment of phthisis. In one of these cases desire was preserved and the testicles retained their normal size, although the power of erection was lost. In the other three cases sexual indifference and atrophy of the testicles were both well marked. The patients had neither desire nor power, and sought medical advice because they wished to perform their marital duties and desired children.

Roland mentions two cases in which impotence and atrophy of the testicles developed after long-continued use of potassium iodide.

Hammond also observed diminution of sexual desire after long use of large doses of the iodides, but never knew atrophy of the testicles to occur. Desire was restored after the drug had been stopped.

Bromine is known to be a quickly acting anaphrodisiac. In many patients afflicted with frequent pollutions I have obtained good results by administering large doses of the bromine salts just before bedtime. I generally order two grammes (thirty grains) of potassium bromide at a dose. Persons who are forced by nervous disturbances to take these salts for long periods of time suffer a diminution of sexual desire and power. As a rule, however, both return after the drug is discontinued.

Concerning salicylic acid Gyurkovechky states that it produces a temporary though certain impairment of virility. He relates that a Slavic society remained away from a certain Paris beer saloon because the members found that the consumption of a relatively small quantity of beer incapacitated them for coitus. Later it was learned that the beer contained salicylic acid. After this he investigated the matter and found that more or less temporary impairment of potency occurred during a course of salicylate of sodium, a drug now extensively used.

The investigations of Kolbe and Lekmann in Munich, though proving the harmlessness of the protracted use of salicylic acid, have not contributed anything to our knowledge of its action upon the sexual power. No other works are known which confirm the theory that it exerts an unfavorable influence upon the sexual organs. [I have prescribed salicylic acid and the salicylates in a vast number of cases and have yet to hear a patient complain that it impairs his sexual vigor.]

Potassium nitrate is considered by Hammond, Grimmaud de Caux

and Martin Saint Ange to be a powerful anaphrodisiac. The first named author saw a case of impotence after six months' use of the drug in the treatment of epilepsy.

TREATMENT OF IMPOTENCE.

From what has already been stated it is seen that the various forms of impotence differ greatly from one another. Apart from the four groups which we recognize there are differences in the forms of the same group. In psychical impotence it was first anxiety, then diversion of thought, and again deviation from normal physiological feeling which gave rise to virile weakness. In irritative nervous impotence both complete abstinence and general nervousness were blamed as causes.

From these facts it is seen that the treatment of impotence cannot be routine, but that it must be directed to the cause.

If it be due to deformity of the external genitals or neighboring parts, nothing short of an operation will afford relief. Not all malformations are remediable by operation, but there are certain deformities interfering with coitus, as for example, those due to hydrocele, hernia, infiltration of the urethra, and tumors of the scrotum, in which good functional results can be obtained by the proper operative procedures.

If diabetes be the cause of the sexual weakness our therapeutic measures should be directed primarily against this disease. It is to be hoped that with improvement of the constitutional disease the special disturbances will disappear or become less.

Although the cause of the disease must always supply the basis of our therapy, the treatment of impotence may nevertheless be divided into psychical, general hygienic and special medicinal.

First, in regard to **psychical treatment,** it will be remembered that attention has already been directed to its extraordinary importance. Many persons suffering from impotence are timorous, dissatisfied with themselves and hypochondriacal. They often struggle with a feeling of shame and distrust; only rarely does a ray of hope pass through their mind. They have lost confidence in themselves and in others. They think that nothing can help them, that they are lost for this world. Their mind is constantly occupied with their disease, and consequently they are unable to concentrate their thoughts upon their occupation.

This nervous depression has to be contended against above all things else, and it is the task of psychical treatment to do this; the patient

must be made to take courage, to acquire confidence in himself and hope in the treatment employed. This cannot be attained in any better way than by causing the patient to acquire confidence in his physician. He must "swear to the statements of his physician," he must believe that which his physician says to be irrefutable.

How is the physician to attain this? This question is difficult to answer; however, material help will be afforded by an energetic manner, a careful examination of the patient, and the evincement of a kindly, active interest in his case.

The unfortunate subjects of impotence generally have no one in the world whom they trust; they are ashamed to confide in their best friends. The physician becomes their father-confessor. Even the privilege of relating their trouble somewhat relieves their mind; if they find in the physician one who takes interest in their welfare and shows them sympathy, they usually begin to gain hope. The nervous depression yields to a more cheerful frame of mind begotten of hope, and thus much is won.

We have seen how many cases of psychical impotence are caused by want of self-confidence, a certain feeling of anxiety. In such cases a cure will be obtained if the physician can restore his patient's self-confidence. This cannot be done, however, by merely telling him that he is well, that there is nothing the matter with him. Such statements produce the opposite effect. By diverting the patient's thoughts from himself, improving his general health, and forbidding him to have connection for a long time his confidence will be won and cure often obtained.

Psychical treatment must be adapted to the patient's range of thought. I well remember a case of sexual perversion in which the patient experienced orgasm only at the sight of a woman's shoe. By having him place a shoe above his bed and look at it during coitus he was able to complete the act, and later became able to do so without it.

An important element of psychical treatment is to free the patient's mind from his morbid thoughts and get him to think of something else. For this purpose various amusements are of use. I direct those whom I do not send to a sanitarium to divide the day so that each part shall be given over to certain diversions or exercises. They must be constantly engaged in company, or employed in some physical work or exercise, as for example, gardening, gymnastics, bathing, swimming, walking, visiting in the country, or traveling.

This has the additional good effect of keeping them free from sexual excitement, which is beneficial in two ways: it exerts a favorable influence upon the mind, causing the patient to think that his long abstinence will strengthen his genitals, and also increasing sexual desire and really resulting in an accumulation of nervous energy.

Hypnotism must also be incidentally mentioned. Although only little is known in regard to its effect upon this class of cases, it may be reasoned from analogy that its action might be favorable. I do not doubt that suggestive treatment may exert a salutary effect.

Hygienic treatment is a valuable adjunct to psychical.

The patient's habits of life must be so regulated that his body will be strengthened without the sexual organs being unduly stimulated. To this end diet, baths, sleep, regulation of the digestion, and physical exercise require special consideration. The diet must be nourishing but non-stimulating; spices and spiritous liquors in large quantities are particularly contraindicated.

In regard to the latter a half bottle of red wine a day, and also a little cognac, may be allowed, but too much drink is decidedly injurious; for in that state of stimulation intervening between sobriety and intoxication the sexual impulse is usually aroused, and patients are then prone to break our rule of abstinence, and, what is still worse, masturbators then relapse into their old habit. On the other hand, a little wine stimulates the appetite and enables the patient to take large quantities of food. For this reason wine may be allowed with the meals; beer, however, is permissible only in small quantities. I forbid any to be taken for at least two hours before bedtime. I have repeatedly observed that pollutions occur after beer-drinking late at night and that masturbators are wont to yield to their habit after similar indulgence.

In regard to food, fat and substances which are bulky and yet contain but little nourishment are to be avoided. Meat, fish, eggs, and a moderate amount of farinaceous food should form the principal articles of diet; the patient should not eat heavily, however, nor at too late an hour. Repletion causes insomnia, which in turn is apt to give rise to erotic thoughts that may result in pollutions or lead masturbators to indulge in their habit.

The same principles underlie the rules governing sleep. The patient ought not to lie upon a warm feather-bed, nor should he be too warmly covered. A quilt or blanket will suffice, although an extra coverlet may be placed over the feet. It is well-known that the softness and

warmth of a feather-bed tend to cause pollutions and incite masturbators to indulge in their evil practice.

The patient should not sleep upon his back, but lie on the side instead, because the former position tends to produce emissions. Furthermore, precautions should be taken to prevent the patient lying in bed too long with a distended bladder. Morning erections are reflex manifestations of irritation exerted upon the principal nerves by the distended bladder. Patients who have emissions toward morning should be awakened by an alarm-clock an hour before the time the emission usually occurs, in order that they may urinate.

No rule can be given in regard to the amount of sleep required, as it varies in different persons. Sleep is a great restorer of vitality. Eight hours I consider the minimum. Many patients, especially men who have lived extravagantly, are accustomed to retire very late, and it is essential for them to go to bed early.

Constipation is also an evil. I know cases of prostatorrhœa and spermatorrhœa which manifest themselves only when the bowels are constipated. The vascular congestion of the pelvic organs produced by sluggish bowels acts as a stimulus to the sexual organs and has to be combated. Therefore when regular bowel movements do not take place, laxatives in the most varied forms possible should be regularly used.

Hygiene also includes a rational activity of all the organs and parts of the body. In many cases it will not be necessary to prescribe special physical work, as the daily occupation of the patient affords enough; in others, however, physical work is wanting or deficient, or is of such nature that it develops only certain parts.

For such patients gymnastics, Swedish movements, massage and swimming are of material benefit. Apart from the favorable influence of these measures upon the mind they constitute one of the best means of promoting metabolism. This augmented activity of the vital processes ought also to have a favorable effect upon the sexual vigor. The opposite effect, however, will be produced if exercise be carried too far, so that undue fatigue and lassitude ensue. The fact that athletes generally have, or at least are considered to have, but slight sexual power may be due to the fact that they overtrain.

The amount of exercise must be regulated according to the indications in the individual case; too little is better than too much. The exercise must be of such a kind that all parts of the body will be equally strength-

ened. Walking is not enough; it must be combined with gymnastics, swimming, rowing, etc. The indications are best fulfilled by those forms of exercise employed in the mechano-therapeutic institutes, because here attention is directed in a systematic manner to the individual parts of the body. In cases in which for any reason active gymnastics are not permissible, massage forms a valuable substitute for the promotion of metabolism.

In addition to those measures directed to the mind and general health of the patient, and which should always be considered in every case of impotence, there are special measures which are of service.

Of these there are four:

1. **Baths.**
2. **Electricity.**
3. **Local applications.**
4. **Medicines for internal use.**

I consider baths to be one of the most important remedies which we have in the treatment of impotence. They may be employed in the most diverse forms, as simple washing, sponge baths, sitz-baths, half and full baths; as rubs, douches and shower-baths; as river, sea and brine-baths, and as light and Roman baths.

Our knowledge of their effect is mostly empirical. We can, it is true, agree with Winternitz that the irritation produced by the action of heat or cold sets the muscles into activity, contracts the vessels and stimulates the peripheral nerves; the influences of these actions upon the body, however, have not been followed in detail nor determined by experimentation. We do know from experience, which usually is by no means a bad teacher, that nearly all the various baths mentioned may be advantageously employed in the treatment of impotence.

I consider the most effectual form to be the tepid or cold full bath followed by a cold douche to the spine. In large cities such baths may always be had. Natural sea baths are better, as the impact of the waves against the spine acts the same as the douche.

The mildest form is simple washing. Similar to this is the sponge bath, a form which is often acceptable because it is cheap and requires little time. Not all patients have a bath-room nor means to visit a bathing establishment every day. The collapsible rubber tub, however, can be obtained at a slight cost and can be closed and laid away after it has been used, thus taking up little room.

In addition friction with a cold wet cloth may be employed, followed

by a brisk rubbing with a course towel. This constitutes the best substitute for the cold bath in cases in which the latter cannot be endured or obtained.

Frequent and protracted warm baths are contraindicated in impotence as they are weakening. Cold sitz-baths of short duration are to be used only under certain conditions, as their action upon the genitalia is too stimulating; during the first part of the treatment these organs should be given rest and not stimulation. Cold baths of long duration have rather a depressing effect.

Exceptionally exciting and stimulating are carbonic acid baths, and full, half and sitz-baths. In all cases in which the sexual organs seem to have been strained these baths are counterindicated; in those in which no weakness is present they afford a valuable means of favorably influencing the mind. I have seen patients get a strong erection in a carbonic acid bath, and thereby gain new courage and confidence.

Natural or artificial brine-baths act as powerful promoters of metabolism, although as is the case with many other thermal baths, particularly those containing sulphur, their mode of action in impotence is not thoroughly understood.

Electricity in the form of galvanism, faradism and Franklinization goes hand in hand with baths. Our knowledge of the action of this agent rests entirely upon experience. We know, however, that all three forms can be used with advantage.

The constant current is the best. The parts to which it must be especially applied are the spinal column, the penis, testicles and perineum. There are many different methods of applying it, of which one alone or several in succession may be employed. The one which I usually use first consists in placing one electrode upon the left side of the vertebral column and then running the other upwards and downwards just to the right of the spinous processes; the order is then reversed, the right being made stationary and the left passed up and down along the spine. The poles consist of a wet sponge or a metal disk covered with leather. The strength of the current is determined by the sensibility of the patient; it should be increased until a sharp tingling is produced. The application is followed by redness of the skin over the parts. As a rule, not so strong a current can be used upon the perineum as upon the other parts. One pole is placed over the sacral vertebræ and the other on the perineum and allowed to remain one or two minutes. Finally I pass the constant current through the

penis by placing one electrode upon the perineum and running the other along the anterior and posterior surface of the penis. I very rarely use the galvanic current within the urethra. It has often been recommended in cases of frequent seminal losses occurring either with or without erection. For this purpose a bougie having an electrode running through it and provided with a conical metal tip is used. This instrument is introduced into the urethra so that the tip lies in the prostatic portion; it is then attached to the negative pole of a constant battery, the positive pole, covered with a sponge, being placed upon the perineum, and a current of not more than five milliampères turned on. The negative pole is supposed to lessen the sensitiveness of the colliculus seminalis and ejaculatory ducts, to which the pollutions are due.

If it is desired to galvanize the testicles a very weak current must be used as these organs are particularly sensitive to electricity. Strong currents impair rather than improve their nutrition.

While the constant current is generally employed in cases where there is actual weakness of the genitals, especially in paralytic impotence, in the psychical forms of the disease the induction current is useful. It has an irritating, stimulating effect which is sometimes ocularly demonstrated to the patient during its application. If he sees an erection follow an application of the induction brush he is greatly encouraged.

By means of a metal brush the testicles and especially the penis can be considerably irritated. The sponge is placed upon the perineum or over the spinal column, while the brush, attached to an induction apparatus, is used upon the penis. The glans is especially sensitive. Therefore the current must be increased very slowly. Under its influence the skin becomes reddened, so doubtless stimulation of the circulation is produced as well as irritation of the peripheral nerves. I increase the current until slight smarting is produced and then continue its application through the penis for two minutes. The procedure is repeated every three days. The results are very gratifying, particularly in psychical impotence.

Many authors attribute great value to Franklinization.

"The patient sits upon an insulated plate, being stripped down to the thighs, and by means of a copper sphere sparks are carried along the entire length of his spine, thus producing counterirritation and reflex excitation such as cannot be elicited by any other form of elec-

tricity. Every spark leaves a slight elevation upon the skin, and the entire surface is reddened. The penis is also often affected by the current, and if sparks from the sacral region reach it erections are often produced, even in cases in which no sexual excitement has occurred for months."

We now come to the consideration of the so-called local applications which are commonly employed, and which consist principally in the use of metal sounds and caustic applications to the urethra.

The sound-cure is conducted by passing a sound through the urethra every three or four days and allowing it to remain in situ for a few minutes. To begin with No. 18 F. is used and the size increased up to 26, or even 28 or 30. The object of such treatment is to dull the sensibility of the urethra. If the instrument is allowed to remain longer, for a quarter or half an hour, an erection will often be produced.

Winternitz's psychrophore may also be employed with advantage. It is really a double current catheter, the vesical end of which is closed.

To the distal end of the double tubes long rubber pipes are fastened, one being connected to a vessel of cold water above and the other to a receiving vessel on the floor. If the water now be allowed to flow out of the jar above, an uninterrupted stream will pass through the catheter in the urethra. Cold and pressure of the instrument combine to exert a favorable influence upon the urethra and the different organs communicating with it. If it be desired to produce erections, warm water up to 50° C. [122 F.] is more effectual.

Cauterization of the prostatic urethra may be done in various ways.

A very pleasant method is by means of Guyon's syringe.

This instrument consists of a syringe to which a hollow, nodular-tipped rubber bougie is attached. The syringe is filled with nitrate of silver solution (1 to 10%) and the latter is injected through the hollow bougie by turning the piston around; each turn forces a drop of fluid out of the knob. After the syringe has been filled and the bougie lubricated the latter is introduced into the urethra; at a distance of about 14 cm. [$5\frac{3}{5}$ inches] the knob will be felt to enter the bulbous urethra; by slight pressure it is then carried 2 cm. [$\frac{4}{5}$ of an inch] onward, whereupon the resistance experienced as the instrument goes through the bulb will be felt to subside. After the membranous urethra has been passed, which can be determined by rectal palpation, a drop of fluid is injected, the bougie pushed a half centimeter further onwards and another drop injected. In this manner the whole

prostatic urethra up as far as the internal sphincter of the bladder can be cauterized. It is even better to begin at the vesical sphincter and make the application from within outwards.

This application is less painful than that made with Ultzmann's syringe; the latter instrument is used in the same way as Guyon's.

Minute rods of cocoa butter containing nitrate of silver may be used for the same purpose. They are applied by means of a hollow tube and stylet.

Thus it is seen that methods of cauterizing the urethra are not wanting. I am of the opinion, however, that there is rarely occasion to resort to any of them. I consider that they are indicated and permissible only when there is inflammation of the colliculus seminalis and neighboring parts or when the prostatic urethra is congested.

The hyperæsthesia of the urethra upon which so much stress is generally placed is really a trivial matter. Nearly every urethra is sensitive when an instrument is introduced into it. It is at least very difficult to determine what degree of sensibility is normal, particularly as the manifestations of pain on the part of the patients when the same manipulations are practised vary upon different occasions.

Simple hyperæsthesia can be very much reduced by the use of sounds, and it is only in very severe cases of this kind that I would consider the application of a weak silver solution permissible.

If we pass now to the consideration of internal remedies, there is a large number which have been reputed to cure impotence. As the reader will not be curious to know about all which have been recommended and used, only well-established facts will be stated.

Of the many recognized aphrodisiacs I shall mention cantharides, atropine, phosphorus, johimbine, ergotin and strychnine. The supposed action of the two latter drugs has frequently been mentioned, but the observations are too few and not accurate enough to be accepted as positive. The first four in the list, moreover, exert an irritating action upon the genital organs.

This is especially true of cantharides, which are given in the form of the tincture in the dose of 3 to 8 drops three times a day. An increased afflux of blood to the genitals is produced, which causes frequent erections and a pronounced desire to indulge in coitus or masturbation. It must always be remembered, however, that these phenomena may progress to severe inflammation; cases of strangury, cystitis and nephritis due to cantharides have been reported.

In like manner it has been endeavored to explain the undisputed stimulating action of phosphorus upon the sexual organs. It is more probable that this action is due to its general tonic and stimulating effect upon the nervous system. The preparations commonly employed are phosphorus itself in doses of 0.003 [$\frac{1}{20}$ gr.] a day, zinc phosphide in doses of 0.02 [$\frac{1}{3}$ gr.] a day, and dilute hypophosphoric acid in the dose of twenty drops in water three times daily. The dilute phosphoric acid has less the action of phosphorus and therefore is not to be recommended. Hammond combined strychnine with phosphorus.

He prescribed 100 pills made of

Zinc phosphide,	**0.6.** [gr. i]
Ext. of nux vomica,	**2.0.** [gr. xxx]

of which one is taken three times a day; or he ordered

Strychnini sulph.,	**0.2.** [gr. $\frac{1}{3}$]
Acid hypophosphor. dil.,	**120.0.** [f℥jv]

Of this mixture ten drops are taken in water three times a day and the dose gradually increased to twenty-five drops.

Atropine has the same action as these drugs. It causes dilatation of the blood-vessels of the genital organs, and, according to Gross, relaxation of the musculature in the trabeculæ of the corpora cavernosa, as the result of which more blood flows into the penis. Gross also saw good results produced by this drug in cases complicated by pollutions and prostatorrhœa, the losses diminishing in frequency or entirely ceasing. I have never observed this action; on the contrary I must confess that I believe atropine exerts a stimulating action on the genitals, which expresses itself as erections of increased frequency and duration. I order pills of atropine sulphate containing $\frac{1}{4}$ to $\frac{1}{2}$ milligramme each [approximately $\frac{1}{250}$ to $\frac{1}{120}$ of a grain], of which two or three a day are taken. If troublesome disturbances of vision are produced the drug must be stopped. More experience is necessary before judgment can be pronounced upon the recently introduced and highly recommended drug johimbine.

What now are the indications for the employment of these several drugs? To prescribe them indiscriminately in any and every case of impotence would not be rational therapy. In certain stages of most cases they are even contraindicated.

In organic impotence no one would think of using them; in irritative nervous impotence it is the task of the physician to reduce the irritability of the nervous system and especially that of the genital organs; in

paralytic impotence the first requisite for improvement is a long period of rest, so that the organs can regain vigor; in psychical impotence, too, there is often a temporary weakness, so that it is well first to give the sexual organs rest and opportunity to recover force. During this time a course of general tonic treatment may be advantageously employed. This comprises the hygienic-dietetic regimen already described, to which may be added such internal roborants as iron and quinine. After the general health has been improved and the tone of the nervous system heightened, then phosphorus, atropine, and perhaps cantharides as well, may be used as auxiliary remedies.

Inhalations of oxygen, which have been used by Gyurkovechky, may be considered to act in the same way. He has the patient inhale ten liters of oxygen at each sitting. Without presuming to explain the action of these inhalations, he recommends them most highly and attributes to them a distinct aphrodisiac effect; the latter is permanent, and as increase in bodily strength and general well-being also takes place almost without exception, it is probable that the favorable influence exerted upon the sexual power depends upon the general improvement which is produced. As yet I have not used this treatment, but as it is recommended by such a careful observer I believe it to be worthy of mention.

I must refrain from criticizing the treatment recently introduced by Zabludowsky, consisting of **methodical massage of the genital organs,** as I have not had any experience with it. The procedure would seem to be unpleasant for both patient and physician. I will confine myself to mentioning his method of producing vascular engorgement of the male genitals. A tube is put around the scrotum and root of the penis and drawn tight, and the tube is then flattened with a clamp. The scrotum and penis become engorged. The engorgement may be kept up for five to fifteen minutes. The effect of this procedure has yet to be determined.

STERILITY IN THE MALE.

Ultzmann has pointed out the difference between *impotentia cœundi* and *impotentia generandi.* When the first exists the latter is also found to be present, but the reverse is not always the case. It is well-known, however, that the power of fecundation is not rarely absent when the power of copulation is preserved. Before passing to the consideration of sterility in the male I shall briefly describe the pathology of the semen.

The composition and properties of normal semen have already been described.

The semen may vary in quantity. In healthy men its quantity varies under normal conditions from five to twenty grammes. This quantity may be diminished or increased. When the former condition obtains it is known as **oligospermia,** while the latter is called **polyspermia.**

The former is much more common than the latter. The quantity of semen is at times so small that only a few drops are ejaculated. This condition is physiological in old age and also occurs in young persons as the result of various diseases of the seminal passages. It is due to the absence of one or the other glandular secretions which are normally added to the testicular secretion. This absence may be caused by alterations in a certain organ, by failure of the organ to secrete, or by hindrance to the outflow of the secretion.

By **hydrospermia** is understood an abnormal dilution of the semen. If fresh semen is put into a conical glass it separates into two layers, the lower of which is the thicker and the heavier of the two and usually constitutes from one-third to one-half the total quantity. If the semen is very thin, this layer, which is composed of cellular elements, is less than the upper layer, which is made up of the intercellular fluid. Hydrospermia, then, occurs especially when few or no spermatozoa are present. It is often associated with oligospermia and azoöspermia. In such cases the sperm-crystals form very quickly, often within half an hour, whereas in normal semen it takes two or three days for them to develop.

The color of normal semen is grayish white, similar to that of boiled starch. It shows best on linen, making a grayish white stain having yellow borders and producing moderate stiffness of the fabric. If the stain is yellow there is an admixture of pus with the semen, a condition known as **pyospermia.** If the stain is of a homogeneous yellowish-green color the pus is intimately mixed with the semen; this occurs only in spermatocystitis. Differing from this condition is **pyospermia spuria,** in which the seminal stain is grayish-white with here and there a streak or spot. This condition is due to a coexistent inflammation of the seminal or urinary passages. Pus becomes mixed with the semen as the latter is expelled. The condition occurs in gonorrhœa, cystitis colli and prostatitis. Under the microscope the semen of pyospermia spuria shows pus cells, molecular débris, epithelium and living sperm-

atozoa; in true pyospermia the number of spermatozoa are small and they are lifeless or malformed.

Red or brownish-yellow semen bespeaks the presence of blood (**hæmospermia**). Like pyospermia this may also be true or spurious. In the first instance the seminal stain is of a red to a chocolate-brown color and is homogeneous, in the second isolated blood spots are discernible upon the brownish-yellow base. Under the microscope bloody semen shows blood-corpuscles, which are more or less altered, epithelium, pigment, granules and flakes, molecular detritus, leucocytes, and spermatozoa. In true hæmospermia, which is caused by severe inflammation of the seminal vesicles, spermatozoa are absent, dead, or malformed; in the spurious form, which is almost always due to a violent posterior urethritis, they are present, and are usually motile.

Wine-colored, violet and blue semen, which is mentioned by Ultzmann, is probably due to the presence of indigo, and is of no pathologic significance. Crystalline blue indigo is found upon microscopic examination.

Three forms of male sterility are recognized: 1. Those cases in which physiological semen is secreted, but owing to malformation of the genitals cannot be discharged into the vagina. 2. Those cases in which coitus, though possible, does not end with an ejaculation. 3. Those in which the semen, though ejaculated, has no power of fecundation. This may be due to death of the spermatozoa, or what is more frequent, to their absence. The first form is called *sterilitas e defectu seu deformatione*, the second *sterilitas ex aspermatia*, or for short aspermatism, the third *azoöspermia* (absence of spermatozoa).

1. STERILITAS E DEFECTU SEU DEFORMATIONE.

In this rather rare form, as a result of malformation of the penis, the semen is not ejaculated into the vagina, but escapes above or below. The most frequent causes of this condition are severe hypospadias and epispadias, and urethral fistulæ. It is only when the opening through which the semen escapes is far back on the penis that the power of fecundation is lost; even under these conditions the semen may occasionally gain access to the vagina, the walls of the latter organ filling in the defect in the penis.

Congenital or acquired shortness of the frænum may produce such a deviation of the penis that the semen is ejaculated in a direction which prevents its ingress into the vagina.

In such cases treatment is entirely operative. The prognosis is better when the trouble is due to shortening of the frænum than when it is caused by hypospadias, epispadias, or urethral fistula.

2. ASPERMATISM.

In this condition, as has already been stated, the semen is formed, but is not carried out of the body through the genital and urinary passages. We distinguish an absolute or permanent and a relative or temporary aspermatism.

Absolute aspermatism may be congenital or acquired. In the former case ejaculation has never occurred, in the latter it has ceased to take place. The cause in these cases is always an organic lesion, which may be located anywhere from the seminal vesicles to the external urethral orifice. According as the lesion can or cannot be removed the aspermatism is permanent or temporary.

Temporary or relative aspermatism is characterized by the fact that ejaculation occurs only occasionally or under certain conditions, failing to take place at other times or under other circumstances.

This form of sterility may depend upon lesions of the urinary and seminal passages, non-irritability of the ejaculatory center, anæsthesia of the peripheral genital nerves, or inhibitory action of the brain upon the ejaculatory center. The forms of relative aspermatism accordingly are one due to insufficiency of the genital organs, an atonic, an anæsthetic, and a psychical.

That semen has never entered the urethra nor escaped therefrom during coitus, is a condition which may be due to various causes, the recognition of which is of diagnostic and particularly prognostic value.

The cases in which there is congenital occlusion or absence of the ejaculatory ducts or deviation in their opening into the urethra are very rare. Cases of this kind have been reported by Munroe, Rindfleisch and Klebs.

Acquired obstruction and deviation of the ejaculatory ducts are more common.

Demeaux reports the case of a healthy man aged twenty-two years, who as the result of a fall upon his perineum developed an abscess which necessitated incision. A few months afterwards the patient noticed that coitus no longer ended with a discharge of seminal fluid.

Although there was no stricture of the urethra, urine voided after connection was heavily loaded with spermatozoa. Upon rectal palpation it was found that the perineum was contracted and the prostate drawn down, which led Demeaux to conclude that the orifices of the ejaculatory ducts had become displaced backwards as the result of the injury.

Gonorrhœa may also cause aspermatism, not only by leading to the formation of urethral stricture, which will be discussed later, but also by advancing into the ejaculatory duct and producing thickening and contraction of its walls, and by producing alterations in the surrounding tissues which lead to obliteration of the ducts.

Hypertrophy of the prostate, prostatic calculi, fibrous degeneration, tuberculous ulcerations, stones and concretions in the ejaculatory ducts, trauma, or injury inflicted during an operation, may likewise lead to occlusion or narrowing of the ducts.

In regard to concretions they may develop as the result of inflammation, the pus becoming thick and cretaceous, or they may be formed out of dead spermatozoa, mucus and epithelium, with a deposit of inorganic elements.

Examples of injury to the ejaculatory duct inflicted in lateral or bilateral lithotomy which have resulted in aspermatism have been cited by Gross and Teevan.

The formation of a fistula between the seminal vesicles and rectum which led to aspermatism has followed a recto-vesical lithotomy. In Sabatier's case ejaculation took place into the rectum.

Covillard's case is even more remarkable; vesical calculi passed through fistulæ in the perineum and down the inner side of the thigh, and the semen also followed this course.

All the cases thus far mentioned which depended upon organic lesions were alike in that the semen did not enter the urethra, or at least did not reach that portion of it situated anteriorly to the prostatic part.

We now come to that form of aspermatism in which the semen enters the urethra but does not flow out of it. Here there is a congenital or acquired narrowing of the urethra. A further point of differentiation between this class of cases and those previously described is afforded by the fact that the obstruction can be overcome, the aspermatism consequently being curable.

Gonorrhœa is recognized as the most frequent cause of acquired urethral stricture. Doubtless the number of strictures causing reten-

tion of the semen is few, although I have seen several myself and others have been reported.

As strictures nearly always are permeable to the urine—cases of complete retention are not considered as they have no bearing upon aspermatism—it may be assumed that they will also permit the passage of the seminal fluid. This assumption, however, is not correct. The stricture may allow urine to pass through and yet be impermeable for the semen. The conditions for ejaculation are different than those for micturition.

Semen is thicker than urine and the pressure which it exerts is less than that of the stream of urine; it is also conceivable that the stricture may be more yielding when the penis is flaccid than when it is erect. The scar-tissue may be deposited in such a manner that the shape of the stricture is changed when erection occurs, with the result that it becomes less permeable.

By analogy the occurrence of spasm of the urethral musculature may be assumed in explanation of the condition. It is known that many strictures are permeable one day and impermeable the next. In such cases it is not that the lumen of the urethra has become so much smaller over night, but that muscular spasm, a spastic stricture so to speak, has been superimposed upon the organic lesion. This is an occurrence which every surgeon has often observed, and from which it follows that the stricture may be permeable again for days at a time. In like manner retention of semen may often be due to spasm superimposed upon stricture.

Those cases in which the semen fails to be ejaculated, although the caliber of the urethra is comparatively large, are to be conceived as due to this cause.

To these are added those cases of phimosis which lead to retention of semen.

Concerning the treatment of these cases there is nothing to be said except about those depending upon stricture of the urethra and phimosis. The appropriate operative procedures are self-evident. Circumcision, dilatation of strictures, and reduction of urethral hypersensibility in cases where spasm superimposed upon stricture causes retention of semen will almost always effect a cure. The dulling of hyperæsthetic portions of the urethra may be secured by the repeated introduction of large metal sounds or by instillations of mild astringents or weak caustics.

ATONIC ASPERMATISM.

In contradistinction to the forms of aspermatism previously described, the causes of which depend upon defects in, or impermeability of, the seminal passages, the form now to be discussed is due to non-irritability of the ejaculatory center situated in the spinal cord. This non-irritability prevents coitus from being completed in the normal manner, although the patients are generally potent, erection being good and of sufficient duration, sexual impulse normal, and intercourse pleasurable. It is remarkable that men thus affected often have nocturnal pollutions which occur both with and without voluptuous sensation.

This occurrence is due to the fact that when the seminal vesicles become distended with a certain amount of semen, they contract as the result of the mechanical irritation thus produced irrespective of any irritation in the central nervous system.

This atonic aspermatism may be congenital or acquired; the latter is much more common. In the congenital cases the ejaculatory center in the cord is non-irritable *ab origine;* in the acquired cases its irritability has been lost in consequence of certain causative conditions, with the cessation of which the tonicity of the center is restored.

Accordingly the acquired cases are often curable if the causative factors can be removed.

Chief among these causes are excesses in venery. As in psychical impotence, so likewise here, masturbation has a more injurious effect than immoderate sexual intercourse. The reasons for this, as already stated, are that masturbation can be practised more frequently than even the most wanton excess and that the nervous excitement occurring in masturbation is greater than that incident to copulation. This is also shown by the fact that the general relaxation of the body is greater after masturbation than after coitus. It may also be assumed that the central nerve-cells, however well they may be regenerated, may in time become so weakened as the result of abuse that the usual stimuli no longer suffices to arouse them.

The congenital cases are not amenable to treatment; in the acquired cases we have seen that the cause is attributable to too great demands upon the ejaculatory center. The most effective remedy is rest; accordingly a long period of abstinence from sexual intercourse must be enjoined upon patients of this class, and a generous diet, together with a hygienic regimen, prescribed in order to build up the general health.

Patients suffering from general neurasthenia require the usual

nervines and suggestive treatment described in the article on the treatment of impotence; if there is hyperæsthesia of the urethra, local measures, such as the injection of slightly cauterant drugs and the introduction of metal sounds, are indicated.

ANÆSTHETIC ASPERMATISM.

A few rare cases of aspermatism may be referred to sensory disturbances in the skin of the penis, as the result of which the reflex action of the peripheral nerves upon the ejaculatory center is rendered impossible. It has been attempted to demur to this theory by attributing the nocturnal pollutions to purely psychical irritation of the nervous center occurring independently of peripheral irritation. Nocturnal emissions have been known to occur in anæsthesia of the penis, but they are doubtless due to purely mechanical irritation caused by distention of the seminal vesicles.

Ulceration and scar-formation on the penis may lead to the same result. Absence of sensibility of the penis may also be congenital.

When the condition is acquired an attempt may be made to restore the lost sensibility by means of the faradic current.

PSYCHICAL ASPERMATISM.

If psychical aspermatism is spoken of, it must be granted that the mind can influence ejaculation as well as erection. This influence is revealed by the fact that many men are able to retard ejaculation at will. It was this method which the adherents of Malthus practised in coitus interruptus, and one which is also made use of by sensualists for the purpose of prolonging the pleasure of intercourse.

It is also known that ejaculation may occur only during intercourse with certain women, just as in psychical (relative) impotence coitus can be practised only with certain women; as in the latter so in the former, aversion, suspicion of infidelity, in short, psychical influences, are the causes which prevent the occurrence of emission.

Reasoning still further by analogy it may be assumed that the inhibitory center in the brain is so stimulated by mental impressions that it sends forth an impulse suppressing the activity of the ejaculatory center.

The removal of this condition lies without the realm of medical practice.

The diagnosis of aspermatism is self-evident. From what has already been said it is also evident that the differentiation between the various forms, which is important from the standpoint of prognosis and treatment, is not at all difficult.

AZOÖSPERMIA.

In azoöspermia, as in aspermatism, the power of copulation is usually not weakened, although in contradistinction to the latter coitus ends with an ejaculation. Notwithstanding this, however, the subjects of azoöspermia are sterile for the reason that their semen has lost its power of fecundation.

Generally speaking the criterion of fecundity consists in the presence or absence of spermatozoa in the semen; furthermore, it is to be observed whether they are inactive or dead or whether they soon die.

The following conditions are recognized as the principal causes of azoöspermia: the organs which produce the spermatozoa are absent or their function is destroyed; the semen may be rendered unfruitful by disease of the seminal passages; the semen, though normally produced, may be prevented from passing out of the body by anomalies of the genital passages; finally severe constitutional disease may undermine the strength of the generative organs.

Absence of both testicles, **anorchism,** of course precludes the possibility of fecundation.

If the absence of the testicles is not congenital, being acquired during adult life, the individual may retain the power of copulation for a time, although the power of procreation is extinguished when the testicles are lost.

Bilateral absence of the testicles affects the entire organism. The individuals are different in appearance, character and habit; they have no sexual desire and no voluptuous feeling, being similar to eunuchs who were mutilated in the early years of life.

Unilateral anorchism does not destroy the power of fecundation, provided the second testicle is healthy and no other anomalies are present to alter the fertility of the semen.

Cryptorchidism, a condition in which one or both testicles do not lie in the scrotum, but are abnormally situated, although more common than anorchism is nevertheless comparatively rare.

It is not always easy to decide whether the testicles are absent or abnormally placed. As a rule, they can be felt in the inguinal canal,

iliac fossa, or crural canal, but if they are within the abdomen the appearance and habits of the patients must be taken into consideration in making a differential diagnosis.

Unilateral cryptorchidism never causes sterility unless some other anomalies are also present. Opinions differ in regard to the effect of bilateral exstrophy of the testicles.

The literature on the subject shows that cryptorchidism does not always result in sterility. This, however, does not mean that cryptorchids are not often sterile, a fact which evidently depends upon the pathic changes which have occurred in the testicles as the result of their malposition. They are usually small, undeveloped, atrophied and affected with fatty or fibrous degeneration. The fecundating power of the semen depends upon the degree of degeneration present. Definitive information can be secured only by microscopic examination of the semen.

Certain **diseases of the testicles** may also result in diminution or destruction of the fecundating power of the semen. If both testicles are destroyed by disease, permanent azoöspermia is the result; in cases in which the disease can be cured the azoöspermia is only temporary; in others the function of the testicles is not entirely destroyed but is weakened. The result is that only a few spermatozoa are produced. This condition is called oligospermia (Ultzmann).

The most common cause of lessened functional capacity of the testicle is atrophy. It may depend upon a variety of causes.

In the first place there are testes which may be designated as undeveloped. Here we have to do with malformations due to arrest of development, which are of rare occurrence, although they occasionally affect the testicles the same as other organs. The entire sexual apparatus usually shares in the non-development; the external organs are of the appearance and size of those of a child.

Of greater importance are the atrophies which are due to demonstrable causes. As such are recognized lesions of the central nervous system and inflammation or continued compression of the testicles.

Exceedingly rare are degenerations due to disease of the nerve-tracts. Such disease may affect the spinal cord, particularly the lumbar region, where the centers of erection and ejaculation are situated, and also the brain. In addition to clinical observations, experiments prove that atrophy of the testicles may follow injury to certain portions of the brain and cord.

Inflammation of the substance of the testicle, no matter what variety it be, may also be followed by atrophy. Although gonorrhœa usually attacks the epididymis, it has been known to invade the testicle. Trauma is one of the most frequent causes. Simple catheterization may give rise to orchitis; metastatic orchitis accompanying parotitis is very frequent, and it is important to remember that there are cases of parotitis without orchitis, and vice versa.

In the majority of cases the function of the testicle is restored after the inflammatory process subsides. Occasionally, however, the inflammation is followed by fibrous degeneration of the parenchyma of the gland, which, according to whether one or both testicles are involved, and also to the degree of inflammation, leads to oligospermia or azoöspermia, and consequently to complete sterility.

Finally, as concerns atrophy of the testicles due to compression, it is necessary for the pressure to be of considerable intensity and of long duration. Such pressure may be produced by large hydroceles, scrotal herniæ and varicoceles.

Among other diseases of the testicles which may result in sterility are syphilis, carcinoma and tuberculosis.

The most favorable prognosis is afforded by syphilis. Both testicles are usually affected, but unless the gummatous degeneration be too far advanced antisyphilitic treatment will restore their function.

Carcinoma more often results in oligospermia, for, as a rule, it is circumscribed and, moreover, generally affects only one testicle, so that sufficient healthy parenchyma remains. The same is true of tuberculosis.

In the cases due to **absence or occlusion** of the epididymis and vas deferens the testicles are healthy, but owing to the former condition the semen cannot be carried to the seminal vesicles.

If there is congenital absence of epididymis and vas deferens on both sides, the fluid ejaculated during coitus naturally cannot contain spermatozoa.

The same effect is produced by acquired occlusion of the spermatic ducts. If the epididymes are attacked by inflammation complete obliteration of the ducts not uncommonly results. It is immaterial from what cause the inflammation develops; the result is the same. All depends upon the degree and the extent of the inflammation.

As injury to the epididymis, syphilis, tuberculosis, carcinoma and sarcoma are rare, and their bilateral occurrence still rarer, they are not

of great importance, particularly in comparison with the **most frequent cause of sterility,** namely, **gonorrhœal epididymitis.**

Even though it be an exaggeration to state that "absolute impotence results when both epididymes are attacked by gonorrhœa" (Sanger), it is unfortunately true that this complication often leads to azoöspermia. Out of eighty-three men affected with bilateral epididymitis Liegeois found spermatozoa in the semen of only eight. I have very frequently observed sterility in men who have had double epididymitis.

Unilateral inflammation causes a decrease in the number of spermatozoa, an oligospermia.

This well shows what a serious disease epididymitis is. It makes it necessary for us to treat every case of epididymitis most carefully, and above all things to endeavor to limit its extension as much as possible.

If any portion of the seminal passage, by which term is meant the entire tract from the testicle to the external urethral orifice, becomes inflamed, the products of inflammation mingle with the semen. In epididymitis, inflammation of the vas deferens, spermatocystitis, prostatitis and gonorrhœa, the semen contains pus-cells and perhaps blood-corpuscles. As far as sterility is concerned it is only those processes in which the admixture diminishes or destroys the vitality of the spermatozoa which are of importance.

During the acute stage of the above named affections it is immaterial whether the spermatozoa are destroyed at the seat of the disease or not, although after the disease has lasted longer it is of interest in respect to the general condition.

A much discussed question now arises, namely, "what is the action of pus upon spermatozoa?" Many investigators state that the latter are killed by pus-cells or the microörganisms which are present with them.

On the other hand, it has often been observed that patients who have had unilateral or even bilateral epididymitis, chronic prostatitis, or gonorrhœa not only produce semen containing active spermatozoa, but that they actually beget children.

What is the meaning of this? How can these observations be harmonized?

The numerous cases of prostatitis and epididymitis in which admixture of pus and semen takes place and fecundation nevertheless occurs prove that pus is not always deleterious to the spermatozoa. At times, however, it may reduce or completely destroy their vitality. In many

cases this may be due to the thickness of the fluid produced by the admixture of pus. A case has been reported by Beigel in which the semen was extraordinarily thick and the spermatozoa motionless and close together; upon the addition of lukewarm water they became motile. Warm water was also injected into the vagina to dilute the semen, with the result that conception occurred. This case is an exception, for suppuration is rarely so profuse as to produce such a degree of thickening in the semen.

For this reason I maintain with Fürbringer that pus, although exerting an unfavorable influence upon the spermatozoa, does not destroy them nor render the semen unfertile.

Conditions are exactly the same in hæmospermia.

Blood itself does not destroy the spermatozoa. Robin has shown that they may live in it four or five hours. One often has occasion to examine bloody semen which is ejaculated during the course of posterior urethritis, cystitis colli or prostatitis. The number of spermatozoa is generally diminished; a few are lifeless or inactive, the majority, however, are apparently normal.

THE RELATION OF GENERAL DISEASES TO AZOÖSPERMIA.

Physiological Azoöspermia. That alterations in the general health may influence the secretory activity of the testicles is best shown by physiological or temporary azoöspermia. By this term is meant the secretion of a semen in which spermatozoa are absent at times and present at others.

It has long been known that the frequency of ejaculation has a great influence upon the composition of the semen. The oftener it is discharged within a given time the less its quantity and thinner its consistency, whereby the number of spermatozoa become less and less. Finally it consists of the secretion of the accessory genital glands.

Liegeois mentions the case of a medical student who had connection three or four times a day for ten days in succession, and whose semen upon repeated examination failed to show spermatozoa. After three weeks of abstinence from sexual intercourse they were found in abundance.

A similar case reported by Casper (the medico-legal expert) is that of a naturalist aged sixty, who examined his semen microscopically

with Casper for a long period of time. It was found that it became more fluid and poorer in spermatozoa the oftener coitus was indulged in. If he had connection on two successive days no spermatozoa were present; after abstaining for three days the ejaculate contained spermatozoa in abundance, although they were small; on the day after they were small and few in number. After five days of rest they appeared in abundance, and an interval of six days produced few though large spermatozoa.

Thus it may happen that a man who is fully potent and in possession of his fecundating power may become temporarily sterile. This is a matter of practical importance. It explains why many men whose *potentia cœundi et generandi* are absolutely normal fail to beget children. The reason is that they have connection too often. This physiological azoöspermia, therefore, is especially common among very sensual men.

It is interesting to note that experiments upon animals confirm these observations. Plönnies proved that frequent ejaculations produced in dogs by electrical stimulation of the spinal cord brought about diminution in both quantity and quality of the semen; the spermatozoa are often entirely absent.

Sexual Neurasthenia. These considerations lead us to that form of azoöspermia which develops in certain forms of neurasthenia, and which is to be regarded as an augmentation of the transitory physiological form just described. Masturbators and men who have indulged excessively in coitus constitute the chief contingent of sexual neurasthenics. One of the most constant symptoms of this disease is nocturnal pollutions, or even spermatorrhœa.

There are also various associated phenomena on the part of the nervous system and mind, as well as disturbances of nutrition.

If the semen of a man thus affected be examined, it will not uncommonly show signs of azoöspermia, oligospermia, or changes in the spermatozoa—conditions which indicate that there is impairment of the power of fecundation.

The principal alterations in the spermatozoa are impairment of motility and low vitality; they soon die. It has not been positively determined whether changes in their form, such as kinking and coiling of the tail, noticed by Ultzmann, and swelling of the head, observed by Neumann, are pathologic changes. It is certain, however, that impairment of nutrition and disturbances of the nervous system, and above all things undue demands upon the secreting organs, may

lead to grave disturbances in the nutrition and innervation of the testicles, and consequently to the production of a semen deficient as to quantity and quality.

Syphilis. A constitutional disease in which azoöspermia occasionally occurs is syphilis. It need scarcely be stated that syphilitic orchitis and gummata of the testicles are not referred to, because in these conditions the entire glandular substance is destroyed, so that no semen can be secreted, or else the lesion is circumscribed so that enough healthy tissue remains to secrete. It is only constitutional syphilis without localized lesions in the testicles which will be discussed.

This form of the disease produces azoöspermia in many cases, although in others living spermatozoa are found (Gross and Bryson). Demonstration of the latter fact is scarcely necessary, as the numerous children affected with hereditary syphilis who are born of healthy mothers prove that syphilitic men retain their power of procreation. Zeissl, however, states that he has known several men who had had syphilis, who although of strong constitution, were unable to beget children with perfectly sound women. As long ago as 1861, Lewin found that semen secreted by testicles presenting no abnormalities except signs of syphilis contained spermatozoa in only fifty per cent of cases.

A few years ago I had the opportunity of observing a case which well illustrates the effect of syphilis upon the generative organs. It was that of a man who had lived in childless marriage two years, although his wife was perfectly healthy. This man had had syphilis. There were no signs of disease upon his genital organs except an old unilateral epididymitis. The semen contained no spermatozoa. After a course of energetic antisyphilitic treatment a few spermatozoa appeared. After further iodine-medication more were found, and finally his wife bore a syphilitic child. Thus it was demonstrated that azoöspermia may be caused by constitutional syphilis without any signs of disease in the testicle being present, and that it may be cured by antisyphilitic treatment.

Morphinism. The excessive use of morphine occasionally produces azoöspermia. This is an occurrence to which Rosenthal has called attention. In the case which he described the patient had taken from 0.5 to 0.7 [$\frac{3}{4}$ to 1 gr.] of morphine subcutaneously every day for the relief of headache and insomnia. Paralysis of the bladder developed, and in the white fluid which escaped with the last drops of urine sper-

matic crystals, but no spermatozoa, were found. After a protracted course of treatment, of which the most important part consisted in the withdrawal of the morphine, the semen was found to contain living spermatozoa, although they were not so numerous nor so active as they normally are.

Azoöspermia resulting from morphinism, then, is merely transitory; as the system is freed from the poison the testicles produce a functionally potent secretion.

Many other cases in which men addicted to morphine have begotten

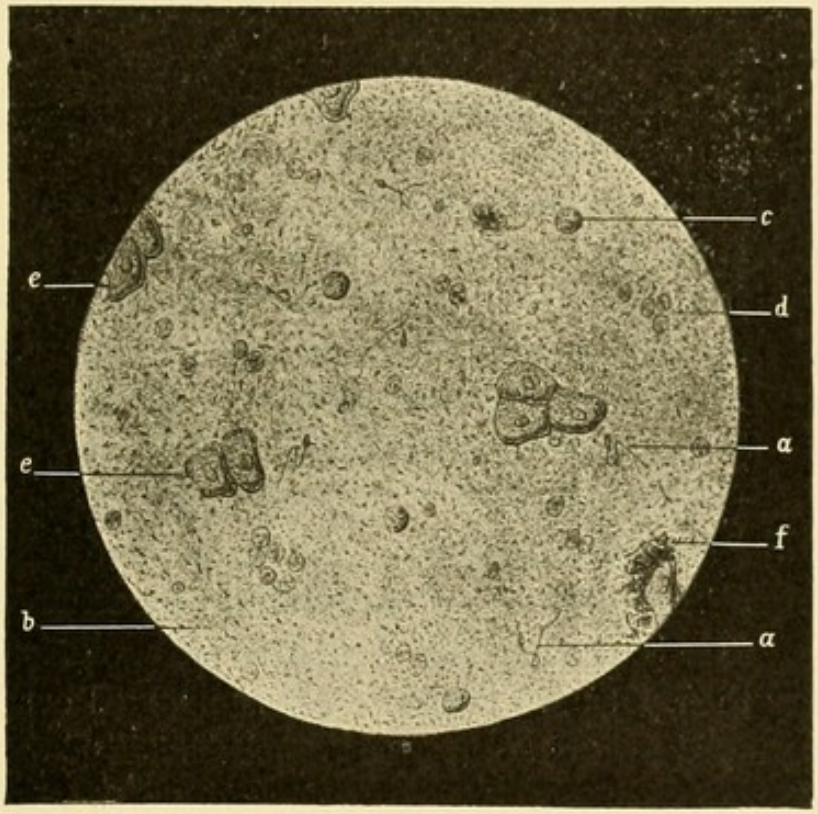


Fig. 230.—Azoöspermia. *a*. Dead spermatozoa, coiled and kinked. *b*. Molecular detritus. *c*. Spermatoblasts. *d*. Leucocytes. *e*. Epithelium. *f*. Flakes of pigment.

children also prove that the above named action is not constant, and that it develops only when a certain grade of poisoning is reached.

Tuberculosis. The widespread opinion that consumptives usually have numerous progeny is contradicted by observations which tend to show that tuberculosis exerts a deleterious effect upon the generative organs.

The result of many observations shows that the truth lies midway between these opposing theories. Tuberculosis may rarely give rise

to azoöspermia and oligospermia. In many cases, however, the semen is entirely normal.

The diagnosis of azoöspermia presents no difficulties. A drop of fresh semen is placed under the microscope; absence of spermatozoa, or non-activity of a few which may be present, and also formation of spermatic crystals, proves the existence of azoöspermia.

When due to sexual excesses and general neurasthenia the chances of recovery are good.

Treatment. The treatment of azoöspermia has narrow limits. If due to syphilis then antisyphilitic treatment is in place; in syphilitic epididymitis local inunctions of mercury, with long-continued internal administration of potassium iodide, are advantageous.

Neurasthenia and sexual excesses require above all things abstinence from sexual intercourse, together with the employment of the measures recommended for the treatment of impotence (*quod vide*).

In morphinism the first requisite is the withdrawal of the drug.

In cryptorchidism there is no treatment. If the patient is presented for treatment very early in life, the threatening arrest of development in the testicles may be prevented (see also under *Cryptorchidism*).

In gonorrhœal epididymitis an attempt must be made to prevent extension of the inflammation. If thickening and hardness remain, a suspensory bandage should be worn, so that the testicle may be elevated and fixed. The testicle is first enveloped in cotton wet with a solution of aluminum acetate; this is covered with rubber tissue and the suspensory then put on. The dressing is changed every day. It should be continued for months. The patient should also take potassium iodide for a long time.

In atrophy of the testicle little can be expected. Any treatment which may be employed in cases dependent upon a central lesion is naturally without result. In cases due to other causes electrization is worthy of trial. The current, which is passed from the positive pole placed on the spine to the negative laid upon the testicles, should be weak, and should be used for only a few minutes.

[Azoöspermia due to occlusion of the vas deferens resulting from gonorrhœal inflammation has been treated by anastomosing the vas with the head of the epididymis.

This procedure was first practised by Edward Martin, of Philadelphia. After experimenting upon dogs he performed the operation upon man with apparently successful results, inasmuch as the semen

discharged nineteen days after operation contained motile spermatozoa.

Posner and Cohen, of Berlin, have treated six cases by this method. They advise preliminary puncture of the testicle in order to determine whether spermatozoa are present.

A portion of the head of the epididymis is excised, the vas opened longitudinally for the distance of a quarter of an inch, and then implanted into the epididymis by means of four very small silver-wire sutures; the sutures are introduced from the outer surface of the vas into its lumen, thence into the incision in the epididymis and out through its fibrous tunic.

Further experience with this operation is necessary to determine its exact value. I consider it worthy of trial. The possibility of the anastomosis becoming closed by the products of inflammation must be taken into consideration.]

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