Lectures on the structure and physiology of the male urinary and genital organs of the human body : and on the nature and treatment of their diseases : delivered before the Royal College of Surgeons in London, in the summer of the year 1821 / by James Wilson.

3

LECTURES

ON THE

STRUCTURE AND PHYSIOLOGY

OF THE

MALE

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OF THE

HUMAN BODY,

AND ON THE

NATURE AND TREATMENT

OF THEIR

DISEASES;

DELIVERED BEFORE THE

ROYAL COLLEGE OF SURGEONS IN LONDON,

IN THE SUMMER OF THE YEAR 1821.

BY JAMES WILSON, F.R.S.

PROFESSOR OF ANATOMY AND SURGERY TO THE COLLEGE;
LECTURER ON ANATOMY AND SURGERY AT THE HUNTERIAN SCHOOL
IN GREAT WINDMILL STREET;
AND ONE OF THE VICE-PRESIDENTS OF THE MEDICO-CHIRURGICAL
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TO

HENRY CLINE, ESQ.

F. R. S.

WHOSE great experience and extensive knowledge add lustre to the profession of Surgery, and whose liberality of sentiment and integrity of principle are not less distinguished than his scientific acquirements, I take the liberty of dedicating this Volume of Lectures; assuring him that I shall ever remain, with the highest respect and esteem,

His sincerely attached Friend,

And obliged obedient Servant,

JAMES WILSON.

Tenterden Street, Hanover Square,
August 24, 1821.

TO THE READER.

The numerous publications which have appeared, professing to treat on the Urinary and Genital Organs, made me hesitate in selecting the Structure and Diseases of these important parts of the human fabric, as the subjects for my Lectures in the Royal College of Surgeons. But when I considered how essential it was to the true happiness and real interests of mankind, that the diseases affecting such structures should be repeatedly investigated, and, so far as is possible, divested of all that mystery with which ignorance and quackery have in many instances endeavoured to envelope them, my choice was soon determined.

Similar motives to those which occasioned the publication of the two former

Series of Lectures, have induced me to commit the third Series to the press: and I have done this the more willingly, as I conceive the subjects discussed in the present volume, have a greater probability of receiving the due and serious consideration which their importance demands, when studied at leisure in the closet, than when orally delivered in a public theatre. It may be permitted me here to observe, that whatever motives may have determined the choice of the anatomical and surgical subjects for the Lectures given in the Theatre of the College of Surgeons, the Public must feel assured that the audience there assembled will protect them from the influence of opinions founded in ignorance, and from the pernicious effects resulting from empirical practice, however artfully and speciously disguised.

In those Schools, where the first principles of Anatomy and Surgery are taught, the side view of the pelvis and its contents

affords the Lecturer great facilities in explaining the diseases affecting these parts, and also the operations which are necessary for their cure. In the Theatre of the College of Surgeons, such recent dissection could not be introduced; I therefore occasionally referred to an accurate drawing made from one of my former dissections by Mr. Clift, our ingenious Conservator, an engraving of which accompanies the present work: and to render the volume more generally useful, two explanatory plates have been added, in the expectation that they may prove acceptable to those readers who have not had the opportunity of seeing such preparations as were produced at the time when the Lectures were delivered.

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CONTENTS.

DEDICATION.

TO THE READER.

LECTURE I.—Page 1.

Introductory Observations. On the Properties of healthy Urine. On the Alterations of Urine in certain Diseases, and general Remarks on the Glands secreting that Fluid.

Reasons for choosing the Structure and Diseases of the urinary and genital Organs — Page 3
Healthy Urine — — — 5
Its chemical Properties — — 6
Lithic Acid — — — 8
Urea — — — — 9
Other Substances found in healthy Urine — 11
Urine in Inflammatory Fever — 14
—— in Intermittent Fever — — 15
—— in Typhus Fever — — 16
—— in Gout — — — ib.
—— in Hysteria — — — ib.
—— in Jaundice — — — ib.
—— in Ascites — — — ib.
—— in Rickets — — — 18

Urine in Diabetes — — — Page 18
—— in Catarrhus Vesicæ — — ib.
On the Kidney generally — — 19
Variety in the Shape of Kidneys in different Animals ib.
Form of the human Kidney — — 20
Situation of Ditto — — — 21
The Fat surrounding the Kidney — 22
Arteries of the Kidney — — 23
Veins of Ditto — — — 24
Nerves of Ditto — — — 25
Absorbents of Ditto — — 26
Substance of the Kidney — — 27
Variety in the Substance of the Kidney in different Animals — — — 28
Simple and compound Kidneys — ib.
Kidnules — — — 30

LECTURE II.—Page 31.

On the internal Structure of the Kidneys. On the Capsulæ renales. On the Ureters, and Bladder of Urine.

Course and Distribution of the Arteries of the Kidney 31
Cryptæ — — — 32
Tubuli uriniferi — — — 33
Mammillæ — — — ib.
Infundibula — — — 34
Pelvis of the Kidney — — ib.
On the renal Capsulæ — — 37
Structure of Ditto — — — 39
Mr. Hewson's Opinion — — 40

On the Ureters — — — Page 41
On the Bladder of Urine — — 43
Situation of Ditto — — — 44
Shape of Ditto — — — 45
Size of Ditto — — — 46
Shape in the brute Animals — — 47
Attachment of the Bladder — — 49
Coats of the Bladder — — 51
On the Properties of Mucus — — 59
Arteries of the Bladder — — 60
Veins and Absorbents of Ditto — — 61
Nerves of the Bladder — — 62
Action of the Bladder — — 63

LECTURE III.—Page 65.

Preliminary Observations on the genital Organs. On the Semen. On the Scrotum, spermatic Chord, and Testicles.

On Generation — — — 65
On the human Semen — — 72
Chemical Composition of Ditto — 74
Animalcula — — — ib.
On the Scrotum — — — 75
Dartos Muscle — — — 78
Cremaster Muscle — — 80
Tunica vaginalis Testis — — 81
Shape of the Testicle — — 82
Spermatic Chord — — — 84
Blood-vessels, Absorbents, and Nerves of Ditto ib.
Vas deferens — — — 88

LECTURE IV.—Page 90.

On Secretion generally. On the Structure of the Testicle. On the first Formation of the Testicle, and on its Descent to the Scrotum.

On Secretion — — — Page 90
On the Structure of the Testicle — 93
Tunica albuginea — — ib.
Corpus Highmorii — — 94
Tubuli Testis — — — 95
Vascula recta — — — 96
Rete Testis — — — ib.
Vasa efferentia — — — ib.
Epididymis — — — 97
Descent of the Testicle — — 99
Gubernaculum Testis, &c. — — 101
Poupart's Ligament — — 107
Ring, internal and external — — 108
Cause of the Descent of the Testicles — 113

LECTURE V.—Page 115.

On the Vesiculæ seminales. On the prostate Gland, and on Cowper's Glands.

Vesiculæ seminales wanting in some Animals 116
Shape of the Vesiculæ seminales — 117
Structure of Ditto — — 118
Contents of Ditto — — 121
John Hunter's Opinion of their Use, and his Experiments — — — 122

The Author's Opinion — — Page 130
Case of Extirpation of the Testicles — 132
Prostate Gland — — — 134
Its Size, Shape, and Connexion — 135
Structure of the Gland — — 137
Glandulæ antiprostatæ, or Cowper's Glands 140

LECTURE VI.—Page 141.

On the Penis. On the membranous Portion of the Urethra. On the Cavity of the Urethra. On the Corpus spongiosum, and Corpora cavernosa Penis.

On the Form of the Urethra, &c. — 142
Caput Gallinaginis — — 146
Lacunæ of the Urethra — — 147
Inner vascular Membrane of Ditto — 148
Muscularity of Ditto — — 149
Vascular Plexus of the membranous Portion 152
Compressores Urethræ Muscles — 154
Action of Ditto — — — 157
Corpora cavernosa Penis — — 158
Corpus spongiosum—Glans Penis — 159
Structure of Ditto — — 160
Erection of the Penis — — 167
Arteries, Veins, Absorbents, and Nerves of the Penis 171

LECTURE VII.—Page 175.

General Remarks on calculous Concretions. On the different Species of Calculi, and on their Composition.

Situation of urinary Calculi — — 177
Size, Shape, &c. of Ditto — — 178

Consistence of urinary Calculi — — Page 180
Nuclei of Calculi — — — 181
Cases of attempted Deception — — 183
On Sediments deposited in Urine — 185
On the Formation of urinary Calculi — 188
Lithic acid Calculus — — 131
Oxalate of Lime, or Mulberry Calculus — 193
Cystic Oxide Calculus — — 195
Phosphate of Lime Calculus — — 196
The triple Calculus, or ammoniaco-magnesian Phosphate — — — 197
Fusible Calculus — — — 199
Alternating Calculus — — 201

LECTURE VIII.—Page 204.

Continuation of the Composition of Calculi. On the Symptoms produced by Calculi in the Kidneys and in the Bladder.

Classification of Calculi — — 204
Compound Calculus — — 205
Prostatic Calculus — — ib.
Composition of urinary Calculi — 206
Structure of Calculi — — 208
Causes of Calculi — — — 210
Symptoms of renal Calculi — — 213
Treatment of renal Calculi — — 224
Symptoms of vesical Calculi — — 225

LECTURE IX.—Page 230.

Symptoms of Calculi continued. On the Effects of Acids and Alkalies on urinary Concretions, and on the Treatment of the Cases of Stone previous to the Operation of Lithotomy.

Symptoms of vesical Calculi continued — Page 230
Case of Calculus in a Cyst — — 231
Case of M. P. A. Esq. — — 233
Case of Mulberry Calculus — — 234
Case of A. Y. Esq. (as related by Dr. Paris) 236
Treatment of vesical Calculi.—Principle on which Acids act, and in what Cases they should be administered—Doses, &c. — 245
Ditto of Alkalies—Doses, &c. — 250
When Lithotomy should be performed — 258

LECTURE X.—Page 261.

On Excess of Albumen and Urea in Urine. On Diabetes. On Hydatids of the Kidneys. On Inflammation and Suppuration of the Kidneys. And on scrofulous and scirrhous Affections of these Organs.

Albuminous Urine — — 263
Excess of Urea in Urine — — 265
Diabetes — — — — 268
Hydatids of the Kidneys — — 271
Case — — — — 277
Abscess of the Kidney — — 281
Case — — — — 283

Scirrhus of the Kidney — — Page 284
Peculiar morbid Appearance of the Kidneys 286
Suppression of Urine — — 287
Fatal Case of Ditto — — 288
Palsy of the Kidneys — — 291
Obstructions in the Ureters — — ib.

LECTURE XI.—Page 293.

On Suppression and Retention of Urine.

Ischuria renalis — — — 293
Retention of Urine from Inflammation of the Bladder 295
Treatment of Ditto — — 298
Effects of Retention — — 301
Bursting of the Urethra — — 305
Introduction of the Catheter — — 306
Constitutional Treatment of Retention of Urine 313
Retention from Paralysis — — 315

LECTURE XII.—Page 316.

On Diseases of the Bladder and prostate Gland.

Ulceration of the Bladder — — 317
Abscesses of the Bladder — — 319
Case of Ditto — — — ib.
Cysts of the Bladder — — 321
Herniæ of the Bladder — — 322
Fungous Excrescences of Ditto — 323
Case of Ditto — — — ib.
Scirrhus of the Bladder — — 325

Diseases of the prostate Gland — Page 326
Inflammation of the prostate Gland — 327
Suppuration of Ditto — — 328
Inflammation of the Gland from Scrofula — 330
Scirrhus of the prostate Gland — 331
Causes of Ditto — — — ib.
Appearances of Ditto on Dissection — 332
Lateral Enlargement of Ditto — 334
Enlargement of the third Lobe — 336
Symptoms of scirrhous prostate Gland — 338
Ditto when accompanied by Calculi in the Bladder 343
Treatment of scirrhous prostate Gland — 444

LECTURE XIII.—Page 346.

Continuation of the Diseases of the prostate Gland, and on Strictures of the Urethra.

Treatment of scirrhous prostate Gland, continued 346
Use of the Catheter in Ditto — — 347
Case of Mr. J. K. — — 349
Case of a Nobleman — — 350
Composition of prostatic Calculi — 352
Symptoms of Ditto — — 355
Treatment of Ditto — — 356
Irritation of the Caput Gallinaginis — ib.
Cases of Ditto — — — 358
Treatment of Ditto — — 360
Strictures of the Urethra — — 361
Spasmodic Stricture — — 363
Permanent Stricture — — 365
Situation of Strictures — — 366
Causes of Ditto — — — 369

LECTURE XIV.—Page 372.

Continuation of Strictures of the Urethra. On Fistula in Perinæo. And on puncturing the Bladder.

Symptoms of Stricture — — Page 372
Caruncles of the Urethra — — 375
Consequences of Stricture — — 376
Treatment of Stricture — — 377
Bougies — — — — 378
Use of Ditto — — — — 379
Metallic Bougies — — — — 383
On the Treatment of Strictures by Caustic — 384
Cases of Ditto — — — — 386
The Treatment by Incision — — 390
Effects of Stricture — — ib.
Fistula in Perinæo — — 391
Treatment of Ditto — — 393
Calculi in the Urethra — — 396
Case of Ditto attended with Stricture — 398
On puncturing the Bladder — — 400
Case of Ditto — — — — 401

LECTURE XV.—Page 404.

On the Diseases of the Testicle. On Impotence from bodily Defect, and also from Ideas of the Mind. Conclusion of the third annual Series of Lectures.

On the Testicle not descending to the Scrotum 404
Treatment of such Cases — — 406
Hydrocele — — — — 409
Treatment of Ditto — — 411

Inflammation of the Testicle — — Page 412
Treatment of swelled Testicle — — 415
Scrofulous Testicle — — 418
Scirrhous Testicle — — 420
Fungus Hæmatodes of the Testicle — 420
Impotency from Malformation — 423
Diseases of the Vesiculæ seminales, and of Cowper's Glands — — — 425
Impotency from Ideas of the Mind — 426
Treatment of Impotency — — 429
Conclusion — — — 431

Explanation of Plate I. — — Page 435
——————— Plate II. — — 437
——————— Plate III. — — 438

ERRATA.

Page 37, line last but one, *for* amphibiæ, *read*, amphibia.
—— 116, —— 10, *for* it, *read*, in.
—— 150, —— 1, *for* articula, *read*, articulo.
—— 166, —— 18, *for* passion desire, *read*, passion of desire.
—— 170, —— 21, *for* vas, *read*, vasa.

LECTURE I.

INTRODUCTORY OBSERVATIONS.

ON THE PROPERTIES OF HEALTHY URINE. ON THE ALTERATIONS OF URINE IN CERTAIN DISEASES, AND GENERAL REMARKS ON THE GLANDS SECRETING IT.

MASTER AND GENTLEMEN,

WHEN our College received the Museum of John Hunter, the same ruling motives which had produced the formation, influenced the offer and acceptance of it as a gift; these motives were the improvement and general diffusion of Surgical knowledge, founded on the basis of Anatomy. To forward such views, it was proposed by the Government of the country, and most willingly acceded to by the College, that twenty-four lectures should be annually delivered on such subjects as could best be illustrated by the preparations which the Museum contained. For more than a century previous to this, the philanthropy of two very worthy members of the old Corporation of Surgeons, Edward

Arris and John Gale, had instituted a fund to defray the expenses that might attend the delivery of six public lectures on Human Anatomy.

The Curators of our Museum, blending these with the Hunterian Lectures, have ordained, that six lectures upon Human Anatomy, and nine lectures upon Surgery, should be delivered annually by one of the Professors of this College, and fifteen lectures upon Comparative Anatomy and Physiology by the other. The experience of some years has now confirmed the advantages expected from this arrangement; as, by the public reference to John Hunter's preparations, in these our annual meetings, they are used as beacons, by whose light the shades of prejudice and mystery may be removed, and which show that anatomy and well-founded physiology are the certain steps to the acquirement of true Surgical knowledge.

In the present advanced state of Surgical science, the discovery of new facts, likely to become sources of farther information, no individual can command; and were even new modes of reasoning on those already known, necessarily attached to the office of the Professor, I never should have assumed this gown. Every person holding this responsible situation will, undoubtedly, endeavour to execute its duties in that way which he feels his talents the best able to accomplish, and in which he can be the most generally useful. The great

advantages to be derived in following the arrangement of John Hunter, in employing his well-selected and numerous preparations, have hitherto guided, and still continue to guide, my choice of subjects for the lectures which I am appointed to deliver. That great Physiologist had treated fully on the blood and its containing vessels; he had done the same on the structure and diseases of bone; I therefore made these the subjects of my discourses during the two preceding seasons. It is well known to this audience, that the urinary and genital organs had also occupied much of his attention, and that his Museum contained many most valuable specimens illustrative of their natural structure, and alteration of that structure by accident or disease. This becomes a sufficient reason for my endeavouring, in the present course, to bring to your recollection those circumstances that relate to the structure and situation of the parts of our bodies which are immediately concerned in secreting, containing, or passing the urine and semen, and to extend my remarks occasionally to other structures situated in or upon the male pelvis, that from action or vicinity are the most connected with such parts. This will occupy the six Anatomical Lectures; and the diseases affecting these parts will, in all probability, require most of the nine Surgical Lectures.

In addition to the above-mentioned reason, I

may add, that the number and complexity of diseases affecting these organs in the different periods of life, the various and sometimes difficult operations requisite for their relief or cure, added to the natural anxiety which the patient must feel, when such parts are imperfect either in structure or action, present the strongest claims to every member of our profession that he should use every means, not inconsistent with true delicacy, first to acquire, and then to retain in his memory, all the information that he can collect concerning them. It is certain that on these subjects very many authors have written, and in some of their works much useful information may be found; but it is also certain that much has been published by men unacquainted with anatomy, and totally deficient in physiological knowledge, whose views have been only to procure themselves a mercenary practice, and in whose works we find exhibited the worst and most dangerous species of low empiricism; such as tends to injure, and sometimes to destroy, the body and mind of the unwary patient, for whom they were printed, and by whom alone they were intended to be read; but which, sometimes, falling into the hands of ignorant medical practitioners, mislead them, and produce an accumulation of misery and disease on their unfortunate patients.

In treating on these subjects, I feel much

real gratification in seeing before me many of those persons from whom, in conversation, as well as from their published works, I have received much useful information, and to whom I cannot pretend to communicate more than they already know; for, as the diffusion of the knowledge of principles, founded on the basis of truth, and the application of these to relieve the miseries of mankind, are the avowed objects of these Lectures, should any doctrine be unintentionally delivered in this Theatre that might tend to mislead from their proper pursuit, the observations of such an audience would soon correct the error.

Previous to the anatomical description of the parts of the human body which are concerned in the secretion of urine, I shall solicit your attention to some of the most marked properties of that excrementitious fluid, when secreted by persons not labouring under the influence of disease, and which has been called healthy urine.

For the knowledge of these properties we are indebted to the praiseworthy attention which has been bestowed on animal substances by many of the recent chemists, more particularly to the experiments of Doctor Wollaston, Doctor Bostock, Professor Brande, Doctor Marcet, and Doctor Prout, in our own country; and by Berzelius, of Stockholm, on the continent. I shall not scruple to make use of the labours of these authors; and

to the different works published by them, I refer you for a further detail of the experiments by which the composition of urine has been known.

The physical, as well as the chemical properties of healthy urine, are subject to much variation from many apparently trivial causes; and in some diseases these changes become so evident as entirely to alter the nature of the secretion. Urine is, in fact, a most heterogeneous fluid.

It is secreted by the kidneys, and formerly was divided by physicians into two kinds; one of which was called crude urine, and the other urine of concoction.

The first of these is emitted soon after fluids have been taken into the stomach, or received otherwise into the body; and is more watery, clearer, and possesses much less taste or smell. The other is secreted more slowly, after the process of digestion is nearly finished, and contains a much larger quantity of the excrementitious materials and other principles found in this fluid.

The following observations apply chiefly to the urine of human beings.

Healthy urine, when first voided, is a transparent fluid of a pale yellow colour, and having a slight aromatic odour which leaves it as it cools, being succeeded by another called the urinous smell, which it generally retains until putrefaction commences. In some instances, after a few days,

the urinous smell is succeeded by one of a sour nature; in time this gradually disappears, and the fetid alkaline odour finally takes place.

The specific gravity of urine was found, by some experiments made by Mr. Cruikshank of Woolwich, and Dr. Rollo, to vary from 1005 to 1033, that of distilled water being 1000.

It has been remarked by able chemists, that there is hardly any essential fluid in the body, which does not yield traces of more or less phosphate of lime. This substance exists in the blood in a considerable proportion; it may be detected in bile, in saliva, in milk, in the tears, and its presence is readily demonstrated in urine; for, if a solution of ammonia be poured into fresh urine, it becomes turbid, and phosphate of lime is gradually deposited. This salt, in itself very insoluble, appears to be held in solution in urine by an excess of phosphoric acid, since urine reddens litmus paper, and deposits a neutral phosphate of lime when lime-water is added.

An accurate examination of the precipitate formed by ammonia, will show that a small proportion of magnesia is mixed with the phosphate of lime.

Urine, when exposed in a vacuum, gives out a quantity of air; the greater part of which, Professor Brande asserts, is carbonic acid gas. This acid, he states, exists in the human urine; Berze-

lius has doubted this, but other chemists have agreed in opinion with Professor Brande.

After urine has remained in a vessel undisturbed for many hours, it deposits a sediment, which is generally in the form of minute crystals of a red colour. These crystals are lithic acid. Lithic acid is not found in the blood, but always forms a constituent part of healthy urine, existing in it in a state of solution at all ordinary temperatures.

Lithic acid is distinguished by the following properties:—1st, it is very sparingly soluble in water; 2d, it dissolves with facility in pure alkalies, and in all alkaline carbonates; 3d, it is again separated from these bodies, in the form of a white precipitate, by the addition of muriatic acid; 4th, if a little of the lithic acid be dissolved in nitric acid, and the solution evaporated to dryness, there remains a substance of a beautiful crimson colour. Dr. Prout, from experiments made by him, says that it is probable the lithic acid does not exist in healthy urine in a pure state, but is in a state of combination with ammonia, forming lithate of ammonia, and that, in reality, urine contains no uncombined acid at all.

If a solution of tannin is added to fresh urine, a copious insoluble precipitate is formed, which consists of the tannin in combination with gelatine.

The substances which have been just enumerated, may be detected in urine without the application of heat. The evaporation of urine affords several other ingredients. One of these is a very peculiar substance to which many of the principal properties of urine are owing. This substance has received the name of urea, and was first described by Rouelle junior, under the title of saponaceous extract of urine. It may be obtained by evaporating fresh urine by a very gentle heat, to a thick consistency; on cooling, a crystalline mass is obtained, to which about three times its weight of alkohol is to be added, and a gentle heat applied. By this means a portion will be dissolved. The solution is to be decanted off from the remaining sediment, and very gently evaporated to the consistence of syrup. A concrete matter is obtained on cooling, which is urea. (For the description of this process I have been indebted to Professor Brande.)

Urea has the form of crystalline plates, which are transparent and nearly colourless, inclining however to a very pale straw colour. It has a faint and somewhat fetid peculiar smell, but not urinous, and is of the consistency of wax. It is neither sensibly acid nor alkaline. When exposed to the air in damp weather it deliquesces; but does not seem to be decomposed. Exposed to a strong heat it melts, and is partly decomposed and partly

sublimed apparently unaltered. It is very soluble in water, producing a degree of cold during its solution. It is also soluble in alkohol.

If nitric acid be poured into a concentrated aqueous solution of urea, a number of white laminated crystals are deposited, which consist of urea in combination with nitric acid. It forms a similar compound with oxalic acid, and in neither of these compounds are the acids neutralized.

Urea is a substance peculiar to urine; it is met with in the urine of graminivorous as well as of carnivorous animals, and is formed by the action of the kidney from some part of the blood.

When alkohol is employed to take up the urea, a residuum consisting of certain saline substances is left behind. This residuary matter was formerly distinguished by the names of fusible salt of urine, and microcosmic salt. It is soluble in water, and if allowed to crystallize, will afford two distinct species of crystals; at the bottom of the basin there will be a layer of flattened rhomboidal crystals, while the uppermost are in the form of rectangular tables. The former or undermost layer consist almost entirely of the phosphate of ammonia, while the latter or uppermost are phosphate of soda. These two salts may be separated by exposing them to a dry atmosphere: the phosphate of soda effloresces, falling into a white powder; while the phosphate of ammonia remains unaltered.

By evaporating urine with considerable caution, crystals of muriate of soda and muriate of ammonia may be obtained.

Urine also contains a small portion of sulphur, which is detected by the black incrustation of sulphuret of silver, formed when urine is evaporated in a silver vessel.

Dr. Prout on this subject observes, that sulphur appears to exist in some peculiar state of combination in the urine, but by far the greater proportion of this principle exists in the urine as sulphuric acid, in combination of course with the alkaline matter present. He further observes, that the presence of sulphuric acid in urine may be known by its yielding a precipitate insoluble in nitric acid on the addition of the nitrate of barytes.

From the accurate examinations of Professor Brande, it appears that healthy urine always contains the following substances, viz.

1. Phosphoric acid.
2. Phosphate of lime.
3. Phosphate of magnesia.
4. Carbonic acid.
5. Lithic acid.
6. Gelatine.
7. Urea.
8. Phosphate of soda.
9. Phosphate of ammonia.

10. Muriate of soda.
11. Muriate of ammonia.
12. Sulphur.

All which substances are held in solution by a considerable portion of water. Urine is also sometimes, indeed generally, mixed with the mucus from the membrane lining its containing parts.

Berzelius has observed that all urine, when newly evacuated, contains a matter suspended in it which in some degree affects its perfect transparency, and that this matter is the mucus of the inner coat of the bladder. If the urine while yet warm be poured on a filter, it will pass perfectly clear, and the mucus will remain on the filter in the form of transparent and colourless flocculi. Mucus is heavier than the urine, and collects in the lower part of the reservoir: thus, when a person evacuates his urine in a standing or sitting posture, after having continued in that posture for a long time, and receives it successively in different vessels, the first portion will contain the largest quantity of mucus, the second less, and the succeeding portions none whatever; but if a person be obliged to remain long on his back, and to evacuate the urine in that position, the lowermost portion does not come away first, therefore that which is last evacuated will contain most mucus.

It must appear evident, that any attempt to

ascertain the precise relative proportions of these substances to each other would be fruitless; and even if it could be ascertained in one instance, it would be of no manner of use as a general conclusion; for, there is not only the greatest variety in the proportion of the solid part to the fluid part of urine voided by the same person during the twenty-four hours, but even the solid contents themselves are continually varying. In proof of this assertion it has been observed, that if urine be examined which is voided immediately after a full meal, it will be found to contain a very small quantity of urea, whereas this constitutes nineteen twentieths of the solid contents of urine which is voided the first thing in the morning. Urine is in fact the most variable of animal secretions. It varies as to its appearance, quantity, colour, smell, and acrimony, in the fœtus, youth, and aged; being higher coloured, more fetid and acrid in the latter. In a person who is warm, it is in lessened quantity, more highly coloured, and more acrid. In a person who is cold, it is in larger quantity, it is pale, and possessed of little acrimony.

It is well known that many substances absorbed from the different parts of our bodies, and conveyed to the blood, become capable of communicating certain peculiar properties to the urine. This has often been found in the fetid

smell which urine possesses after the persons voiding it have eaten asparagus; and in the smell of violets in the urine of those who have swallowed turpentine. Various kinds of food, particularly when taken into the stomach of persons whose digestive powers are weak, will affect the urine with their peculiar odours. The colour of urine is known also to be changed by many substances, such as rhubarb and madder.

I have hitherto mentioned only those ingredients which enter into the composition of healthy urine; but urine when secreted by persons labouring under the influence of different diseases, has been found to contain many other materials, such as the albumen, coagulable lymph, and red particles of the blood, nitric and many other acids, sugar, bile, and pus.

It may be permitted me here to state, very generally, some of the prominent characteristics of urine secreted in persons during the presence of a few of the more common diseases, and for which I am indebted chiefly to Professor Brande.

In inflammatory fever, the urine is of a very red colour, or deep brown, but is perfectly transparent until the disease tends to terminate. It then deposits a quantity of reddish matter, termed the lateritious sediment, which generally consists of animal matter, phosphate of lime, and lithic acid; sometimes of lithate of ammonia.

The red lateritious sediments vary in tint; but, according to Dr. Prout, they consist essentially of the lithate of ammonia, or the lithate of soda, tinged with a large proportion of the colouring principle of the urine, and more or less of the purpurates of ammonia and soda; sometimes they contain also a small proportion of the earthy phosphates. The presence of this kind of sediment is considered as a sure indication of feverish or inflammatory action. The urine which deposits such sediment is usually of a deep red or brown colour, and of high specific gravity: the deeper the colour of the sediment, and the more approaching to red, the more severe in general are the inflammatory symptoms.

In intermittent fevers, the urine varies in its appearance according to the stage of the disease; but when a paroxysm of ague is over, the urine which is then voided deposits a red powder, differing from the common lateritious sediment. It is a peculiar morbid appearance, and has been particularly examined by Proust, who has called it, from its colour, rosacic acid. It is distinguished from lithic acid by its solubility, and by its not becoming of a crimson colour on the addition of nitric acid.

In typhous fevers, the urine is loaded with gelatine and urea. In healthy urine the proportion of urea is such, that, on the addition of nitric

acid, no crystallization takes place till the urine is concentrated by evaporation; but in some cases of disease the urea is so increased in quantity, that crystallization is produced without any concentration.

In gouty disorders, a large quantity of lithic acid is often deposited in the form of red crystals as the urine cools.

In hysteria, the urine is of a very pale colour: it contains an abundance of saline matter, but is very deficient in urea and animal matter.

In jaundice, the urine is usually of a brown colour, which arises from an admixture of bile.

In ascites, the urine frequently exhibits a very peculiar appearance; it is of a yellowish green colour and extremely viscid. It deposits a copious sediment of rosacic acid mixed with lithic acid, phosphate of lime, and animal matter; and it is often loaded with albumen to such a degree as to deposit it when heated, or on the addition of concentrated sulphuric acid. These appearances, which, however, are not constant, would seem to arise from the presence of serum in the urine; for the liquor of dropsies does not materially differ from the serum of the blood, and therefore contains much albumen.

Dr. Prout states that there is a peculiar condition of urine, in which it is found to contain one or more principles, usually rather more resem-

bling those met with in the chyle than in the blood. When so, on being exposed to the action of heat, it becomes opaque, and deposits flakes of albuminous matter. That which is passed some time after meals is generally more loaded with albuminous matter, and is more prone to decomposition. In some instances, what is voided at this time, after standing for a period, throws off a sort of creamy matter upon its surface. He observes, that this affection of the urine exists in every possible degree, from barely perceptible traces of an albuminous principle to perfect chyle or blood; that in some cases the urine is constantly albuminous for years, and in others it becomes so only occasionally. This state of urine is common in dropsies.

When urine is rendered albuminous by blood, it is readily distinguished from the above-named affection by the presence of the red particles which subside to the bottom of the vessel in which the urine has been allowed to stand some time. Bloody urine is from the same cause more or less of a dark colour.

Dr. Prout further observes, that there is a species of mucus sometimes found in the urine, and derived, he believes, from the prostate gland when in a state of irritation or disease, which is capable of undergoing a sort of coagulation by heat, and which he supposes has sometimes been mis-

taken for albumen. This, however, may be readily distinguished from albumen by its being coagulated by dilute acetic acid, which albumen is not.

In some cases of rickets, the urine has been found saturated to a high degree with phosphate of lime.

In diabetes, a saccharine mucilage may be obtained from the urine by evaporating it to a thick consistence, and adding alkohol, which takes up the sugar and the urea; the greater part of the latter is deposited as the urine cools. In a case related by Mr. Cruikshank of Woolwich, the urine daily voided by a patient labouring under this disease afforded twenty-nine ounces of sugar.

Berzelius states, that the cloud which appears in urine during fever is in fact merely the mucus of the bladder, which, from the increase of the specific gravity of the urine, subsides more slowly, or sometimes remains suspended in the fluid.

In catarrhus vesicæ the same author observes, that the urine is loaded with an enormous quantity of mucous matter which is suspended in it. This matter is a true mucus, although, from diseased action in the organ producing it, its characters are different from those of healthy mucus secreted by the bladder, and approaching nearly to that secreted in the nose; the secretions of different mucous membranes, he observes, being in

some things chemically different, depending upon the uses to which their peculiar mucus is to be applied.

ON THE KIDNEY.

It is not necessary that a description of the particular shape and form of the glands secreting urine in the human body should be given in this Theatre. Their oval appearance, bent so as to present a concave edge where the principal vessels enter and pass out, is so generally known, that other substances, approaching near to them in shape, have been distinguished by a reference to their name, as kidney beans, and kidney potatoes. The kidney is, however, capable of variation in shape in different animals. It is generally oblong: in fish it is so, and is very narrow; but in some other animals it is almost globular, as in the leopard. In certain animals, in every period of life, the whole mass of kidney is lobulated; in others, the outward surface is always uniform and smooth.

In the alligator the surface of the kidney seems to be thrown into processes not dissimilar in appearance to the circumvolutions of the brain.

Kidneys are found in all quadrupeds, in most animals of cold blood, and in birds and fishes; but there are some animals in which they have not been found, such as worms and many insects.

It is probable that the intestines of such animals perform also the office of kidneys.

In all animals which possess kidneys, the number in each animal has never been found to exceed two. From the fish upwards they are in pairs; but below fish, as in the sepia, snail, &c. there appears to be only one kidney.

In the human body the lower extremities of each kidney are sometimes found to have incurvated inwards, to have passed before the aorta and vena cava, and to have become firmly united to each other. This deviation from the natural form has been called, from its shape, a horse-shoe kidney. In cases of this kind, a distinct pelvis is generally found on each side, from which the ureter descends and pursues its usual course. I have met with one instance only of a single kidney; and as it was taken from a child not exceeding two years of age, it still preserved the lobulated appearance of a kidney in early life, but was more than double the size of one of that age. There was no vestige of a kidney on the opposite side; the kidney alluded to had, therefore, to perform the office of two, which accounted for the enlargement. In structure it appeared to be healthy and natural.

The situation of the kidneys in the bodies of different animals is various; they are generally placed in the belly near the back; but, in the inferior orders of animals, they vary in situa-

tion as well as in number. In the cuttle-fish they are in the anterior part of the belly, and in the snail they are near the lungs.

In some orders of animals the kidneys are very circumscribed bodies, being inclosed in a proper membrane or capsula, as in the more perfect orders, and in some degree in the amphibia; but in the fowl they are more obscure, being placed in the hollows of the pelvis; and in fish they are still less detached, lying all along the sulcus made by the spine, and are closely attached to the parts behind, not having there any particular capsula.

The consistence of the kidney is less solid in the inferior classes of animals: in fish it is composed of a very tender substance, and still more so in the snail.

These glands are placed, in the human body, one on each side of the lumbar vertebræ, between the lower rib and spine of the ileum, behind the peritonæum which passes over their anterior surfaces, and is connected to their proper capsulæ by cellular and adipose membrane; and before the psoæ and quadrati lumborum muscles, to which they are also attached by adipose membrane and small blood-vessels.

The upper extremity of each kidney lies before, and is in contact with, a portion of the diaphragm which is attached to the lower rib; the pressure of which muscle produces the pain felt in respira-

tion when the kidney is highly inflamed. The kidney of the left side extends farther upwards than that of the right, and is therefore generally found to be the longest; for the lower extremity of each kidney is placed as nearly as possible on the same level, viz. that of the inside of the spine of the ileum. This difference in length may arise from the more constant pressure made on the right kidney by the liver, which is a viscus not subjected, while in a healthy state, to any great alteration in size; whereas the kidney of the left side has, above and before it, viscera less solid in structure, and whose size is subjected to constant changes, as the stomach, the spleen, though in a less degree, and the colon.

A large quantity of that hard kind of fat called suet surrounds each kidney; it appears to be harder, and accumulated in larger quantity, in graminivorous than in carnivorous animals. The deposition of fat around the kidney seems to be more regulated by the shape of the parts affording a convenient place for its accumulation, than for any influence it might have on the urinary secretion.

Each kidney is invested with a strong and dense membrane, which admits of being divided into two laminæ; the inner of which is very smooth and fine in texture; the outer, thicker and more coarse, and which is, by means of the

cellular membrane adhering to its surface, connected to all the immediate surrounding parts. In very thin people I have seen this membrane, on the anterior part of the kidney, connected to the peritonæum by cellular substance, without having any fat deposited between them. This membrane, at the concave edge of the kidney, attaches itself to the vessels belonging to that organ, and even seems to accompany them some way into its substance.

The arteries of the kidney, from the fish upwards, arise from the aorta, as that artery passes along the back bones. In fish, the aorta gives off branches to the kidneys throughout their whole length, therefore we find many arteries going to these bodies. In amphibia and fowls, the kidneys are more collected in a mass, and of course the arteries immediately from the aorta are less numerous and larger in proportion; and in still more perfect animals there is in common but one artery to each kidney.

The vessels belonging to the human kidney enter at the concavity on its inner and anterior edge. The renal or emulgent arteries arise from the sides of the aorta, a short distance below the origin of the superior mesenteric artery: the right emulgent is frequently rather the lowest of the two; it is also the longest, as it has to cross behind the vena cava inferior to reach its destina-

tion. Each artery divides into several branches, which enter the kidney separately, and without previously anastomosing with each other. Sometimes two, three, or more arteries, shall come off separately from the aorta at first, and proceed directly to enter the kidney: I have in one instance seen six enter the same gland. The arteries which convey blood to the kidney have their coats thicker and stronger, in proportion to the extent of their cavities, than any other arteries in the body.

Branches from the lumbar arteries are sometimes found to enter the kidneys from behind; and I have also traced branches from the renal arteries passing out from the substance of the kidneys, and forming communications with the vessels of the neighbouring parts.

The trunks of the renal veins are not subject to this variety; it very rarely happens that more than one trunk enters the vena cava: I have more than once seen two enter, but never three. The left renal vein is the longest, having to cross before the aorta to reach its proper kidney.

In the lion, cat, hyena, &c. the veins of the kidneys accompany the arteries in the interior of those organs; but they have also a peculiar and rather beautiful distribution on the external surfaces.

The kidneys, like other abdominal viscera,

receive their nerves chiefly from plexuses formed by the intercostal of each side and the par vagum. Branches of nerves are sent off from the semilunar ganglion, and form the plexus renalis of each side; these communicate by distinct filaments with the plexus hepaticus on the right side, and with the plexus splenicus and stomachicus on the left: they likewise communicate with the mesenteric plexuses; filaments from the intercostal trunks join them, and also small filaments from the upper lumbar nerves. Nervous branches also pass off from them, which joining others from the inferior mesenteric plexus, proceed to supply the testicles and ovaria. These communications will in some degree account for those sympathies which are known to exist between the intestines, testicles, thighs, and the kidneys, when these last are affected by any acute disease. It is well known, that the secretion of the kidney is much affected from, and varied by, the passions of the mind; but it appears to be less sensible to pain felt in its substance when highly diseased, and even ulcerated, than other viscera, under similar affections.

The absorbent vessels of the kidneys are more numerous than might be expected in a gland whose principal use is to separate superabundant fluid, or accidental morbid or excrementitious matter, from the blood. I have repeatedly seen

from fifteen to five-and-twenty absorbent vessels passing from the substance of the kidney along with the blood-vessels, sometimes filled with air, when the kidney began to putrefy, but more frequently filled with a serous fluid when the kidney has been kneaded gently for some time in warm water, after a ligature had been made on the trunks of its vessels. I have occasionally filled many of these with quicksilver, and traced them into absorbent glands in the loins lying in the neighbourhood of the origin of the renal arteries and veins, the vasa efferentia of which entered the thoracic duct immediately below the entrance of the trunk of the lacteals; but I also have seen them enter above this vessel. The absorbents of the kidneys are usually small in size; a few are found to ramify on the surface, but these have no regular course; they join the others at the concave edge of the kidney, and enter the same glands. I have seen absorbent vessels coming from the interior of the kidney accompany the ureter downwards for some way, and then enter the lower lumbar glands.

A membranous cavity, called the pelvis of the kidney, passes out from its substance behind the blood-vessels, where it contracts itself into a long tube, which passes down behind the peritonæum to the bladder; this conveys the urine to the bladder, and is the ureter above alluded to. I

have frequently seen two ureters belonging to the same kidney continued on to the bladder, but they sometimes unite before they reach that viscus.

The use of the kidney is immediately to carry out of the circulation such parts as are useless and obnoxious, becoming, as John Hunter has emphatically expressed it, the common sewer of the constitution; but these parts must be carried off by a change performed on them, and constituting a secretion: the kidney, therefore, like all other glands, is composed of two parts; the one very vascular and fitted for secretion, and the other consisting chiefly of ducts to carry off the matter secreted. In all glands, some contrivance is generally found to lessen the force of the blood's circulation; from which it would appear, that slowness in the blood's motion is essential to secretion, or to that action by which substances are to be formed from it.

The secreting part in the kidney of some animals, consists chiefly of the ramifications of minute arteries, continued, by the smallest canals, into the veins, to return the blood, as in other parts of the body; and into the excretory vessels, without any intermediate substance between, which receive what is separated from the blood. In other animals, those globular bodies called cryptæ are found, into which ar-

terial branches enter, and from which excretory ducts arise. Some animals appear to possess both of these structures.

The first of these structures is found in those animals where the motion of the blood is generally languid, as is the case in fish, amphibia, and fowls; and to add to the slowness of the blood's circulation in their kidneys, the arteries pass to these organs in numerous small branches, especially in fish. In such kidneys there is no necessity for much unusual ramification of the arteries; for, being originally small when they enter, they soon come to their ultimate branches without forming any particular structure. But in the more perfect animals, viz. quadrupeds, as the blood is conveyed by one or two large trunks to the kidneys, there must be some contrivance to lessen the blood's motion; the arteries therefore ramify very quickly; they have a serpentine course, and also enter the bodies termed cryptæ.

In the kidneys of quadrupeds, the secreting part forms a portion distinct from another part composed chiefly of the urinary tubuli; but in some of the less perfect animals, the structure appears uniformly the same throughout, the secreting and excreting portions being so intermingled as to produce no distinction of parts.

There is much difference in the outward appearance of a fœtal and of an adult human kidney;

but the internal structure is similar in both. The surface of the first is lobulated, the number of lobules varying from twelve to twenty, or even more; while the surface of the last is regularly convex, and nearly uniform. A longitudinal section of the adult kidney, from the convex to the concave edge, shows that it is made up of several portions, or kidnules, united under one capsule, each of these having a similar structure for secreting the urine, and conveying it to the cavity called the pelvis. The projection which these kidnules have on the surface of the fœtal kidney, is lost in the adult, perhaps from the long and constant pressure made on it by the surrounding parts.

Some animals have only a single or simple kidney on each side, and this consists of a vascular and more granulated part immediately under the capsule, called the cortical portion, in which the secreting power is placed, and which nearly surrounds a smoother conical-shaped portion, called the tubular, the vessels of which pass in a converging manner from its circumference towards a part which projects, forming a ridge, into the cavity called the pelvis, and terminate by open mouths on the surface of the projection. We have instances of this structure in the kidney of the lion, the dog, the cat, and many other carnivorous animals. The cortical part has its distinguish-

ing features, from its vessels running in all directions, so as not to appear to possess any particular regular arrangement either of vessels or fibres, and also, in most quadrupeds, from having the cryptæ dispersed every where throughout its substance. The tubular substance is placed towards the centre of the kidney; when cut in one direction, it appears to be made up of parts or fibres passing towards the centre; and when torn in that direction, it splits into numberless fibrous parts. Some animals have many kidnules of this structure, each of a small size, and covered with its own particular capsule, the whole hanging to the trunks of their different vessels, like grapes upon a stalk, examples of which are met with in the bear, porpoise, and some other animals.

Another set of animals have many kidnules under the same capsule, which do not lose the projections on the surface as the animal becomes adult, but these continue, forming as markedly distinct kidnules in the aged animal as in the young. The mode of the tubuli uriniferi opening into the pelvis of the kidney admits of some variety: in the horse and ass they open into the cavity of the pelvis upon a concave surface; in other animals they form either a projecting ridge or mammillæ.

LECTURE II.

ON THE INTERNAL STRUCTURE OF THE KIDNEYS. ON THE CAPSULÆ RENALES. ON THE URETERS, AND BLADDER OF URINE.

Much variety of opinion has prevailed at different times respecting the minute internal arrangement of the vessels of the human kidney; indeed, its secreting structure is still involved in almost as much mystery as that of other glands, although the vessels are large enough to admit injections of coloured materials to pass through their whole circulation, and which, from not shrinking in becoming cold and solid, can in that state have the microscope applied to them. I shall now relate the appearances which may be observed when injected kidneys are viewed with magnifying glasses, and in the microscope.

The several arterial branches which go to the kidney, pass to the cortical substances that nearly surround each tubular part; and entering these near the pelvis, they divide and form arches of communication with each other in the same lobule, and sometimes with those of a neighbouring

lobule. From these arches very small arteries arise, which form every where minute meshes like network, by anastomosing with each other: they run very serpentine while doing this, and send off branches, which seem to be continued partly into veins, and partly into vessels called tubuli uriniferi. These last pass towards the circumference of the tubular portion, and enter it; but no artery can be distinctly traced to its termination in a tubulus, although the particles of vermilion seem to pass readily from the arteries into the tubuli by a continuity of canal, no other structure appearing between them. It is supposed that this communication of vessels will allow the crude or very watery urine to pass from the blood, the action to perform this being merely that of separation, which perhaps does not require a more complicated structure: but every where, between the meshes formed by these serpentine vessels, are to be found a number of small bodies, generally of a round, but sometimes of an oval form, and varying a little in size, called cryptæ. I have seen four or five minute arterial branches enter one of these at different parts of its surface; these convolute and detach smaller vessels, which, as far as they can be traced, also run into numerous convolutions connected by cellular membrane, and form the bulk of the ball. I could never trace a communication with any tubulus; but I have

seen one or more tubuli, injected with materials which passed into them from the artery, proceed from the crypta, and direct their course to the circumference of the tubular portion. These cryptæ, being more complicated in structure, have been considered as the glands, in which many of those materials which are found in the urine are separated or formed from the blood; and it has been supposed, that the urine of concoction, as it was called, was principally secreted by them: this, although not proved, appears to be a reasonable conjecture. The discoverers of the cryptæ conceived them to be cavities, into which the urine was poured when first formed; but the microscope has shown them to consist only of vessels.

From every part of the cortical substance, the tubuli uriniferi, whether they are continued directly from the arteries, or pass out from the cryptæ, run towards the tubular portion of the kidnule, and, having entered its substance, they proceed, in nearly straight lines, from the circumference of it which is surrounded by the cortical substance, to the mammilla: the mammilla projects into a membranous cavity called an infundibulum; and the infundibulum soon communicates with the general cavity or pelvis. In taking this course, many of the tubuli unite ultimately in one vessel, which terminates by an open mouth on the projecting surface of the mammilla. These vessels

appear therefore, when injected, like rays, passing in straight lines from the surrounding surface, and converging to the nipple-like projection. Very many of these vessels open upon the surface of the mammilla, and often by such large pores, that fine injection, thrown by the ureter into the pelvis of the kidney, will enter these pores, and pass on by the tubuli uriniferi contrary to the course of the urine, so as to reach the cortical secreting portion. This is easily shown in the kidneys of the horse and the ass. It is probable that the termination of the tubuli uriniferi in these animals on a concave surface, instead of a mammilla or of a projecting ridge, allows the injection, thrown by the ureter into the pelvis, more easily to enter the cavities.

The arteries which pass into the tubular portion, lose their serpentine course, and run nearly in the direction of the tubuli uriniferi; but send off lateral branches, which anastomose with each other round the urinary vessels. The veins of the tubular portion ramify nearly in the same manner; but the proportion of vascularity in this substance from arteries and veins is much less than in the cortical part, the tubuli uriniferi occupying most of its substance.

The infundibula, into which the mammillæ project, have on their inner surfaces a constant secretion of mucus, which not being soluble in water,

defends the surfaces on which it is formed from the irritation which the acrimony of the urine would otherwise excite. The infundibula vary in length, and are not so numerous as the mammillæ; for two, or even three mammillæ, will not unfrequently be found to enter the same infundibulum. The infundibula generally collect themselves into three or four divisions, which communicate directly with the pelvis. The pelvis thus formed is usually of a conical shape, it leaves the substance of the kidney at the concave edge, passing out behind the blood-vessels, and terminates in the ureter. Its structure is similar to that of the infundibula: it possesses two coats, an outer one which is fibrous and more coarse in its texture, and an inner coat which is finer, more vascular, and which secretes the mucus. The fibres of the outer coat, at least some of them, have been supposed to be muscular; but they cannot, from appearance or any known properties, be demonstrated to be so, for they are not to be excited to contraction in living animals, nor have I ever seen the cavity of the pelvis diminished to the lessened quantity of its contents, as the bladder of urine and gall-bladder are always found to be when in a healthy state. These two coats are so intimately attached, as not to allow of distinct separation.

The arterial branches which separate from the renal trunk before they enter the kidney, do

not anastomose with each other in its substance; for, if one of these is tied up, or the injecting pipe placed beyond it, although the parts supplied by the other vessels will be highly injected, the part which was supplied with blood by the one which was tied up will remain without any injection having reached its cortical portion. It is only those vessels that branch off from the trunks which enter the kidney singly, which form arches of communication with each other.

The quantity of urine, and the celerity with which it is passed, after certain fluids have been taken into the stomach, have induced in some persons a belief that vessels existed, but which have not yet been discovered, that formed an immediate communication between the stomach and the bladder unconnected with the kidneys. But the quickness with which fluids can be absorbed and conveyed to the thoracic duct, the velocity of the circulation, and the great quantity of blood carried by the renal artery to the kidneys, will account for the celerity with which urine is separated, without recourse being had to the supposition of unknown channels. From the extensive communication which the nerves of the kidneys have with those of the alimentary canal, it is not improbable that the secretion of urine from the blood may commence before the absorbents have time to carry any quantity of water, received into the stomach, into the blood-vessels; nature being aware that these

vessels would be too much filled, did not a separation of some of the watery fluid already in them immediately begin.

That the secretion of the kidney is much influenced by passions and ideas of the mind, we need only instance in proof, the effect of fear on quadrupeds, on infants, and even on adult men, in suddenly increasing the quantity of urine, and producing an insurmountable desire to void it. In patients labouring under some difficulty, from stricture, in passing urine, the mind referring to the complaint will often greatly increase the secretion of that fluid, and multiply the calls to pass it from the body.

ON THE RENAL CAPSULÆ.

Although the renal capsulæ are not known to be in any way subservient to the secretion either of urine or semen, and nothing certain is known as to their real functions; yet, as they are placed so constantly in the vicinity of the kidneys, it may be expected that I should here state generally what has been discovered of their structure, and what is their appearance when minutely injected.

These bodies are found in quadrupeds, amphibiæ, and birds; they are wanting in fish. In the human subject they are placed imme-

diately above the kidneys, and are by their lower surfaces, which are concave, adapted to the convex surfaces of the upper extremities of the kidneys, rather nearer, however, to the inner than to the outer edges. They are often imbedded in the hard fat surrounding the kidneys; but, excepting from vicinity, they do not seem to have any particular connexion either with the substance, or office of those organs. They appear of a reddish yellow colour, and are of an irregular crescent-like shape. Their size, as to the kidneys, varies in different periods of life. Early in the formation of the fœtus, they are not so large in proportion to their respective kidneys, as they are immediately before, or immediately after birth. This is, however, not always so; for I have seen them in a fœtus of six months half as large as the kidneys. At birth, each renal capsula is generally about one third of the size of the kidney of the same side. I have seen them fully one half as large; but I have also at this period met with them not one tenth part of the size of the kidney. They usually are something of a triangular shape, their anterior and posterior surfaces being flattened, and their upper edges forming arches more bent at the very superior parts. After birth they do not increase either in breadth or thickness; on the contrary, they decrease in both but generally become rather longer.

In the adult they are much less in size, and appear to have degenerated in the distinctness of their structure. In aged persons, they scarcely can be distinguished from adipose and cellular membrane.

The arterial branches which supply the renal capsulæ with blood are numerous; the principal branch generally comes from the renal artery, but they receive ramifications sometimes immediately from the aorta, from the cœliac, from the frenic, and occasionally from the upper lumbar arteries.

A large vein is always found on the external surface of each renal capsula, and is usually imbedded in a deep sulcus which often appears to divide the capsula into two lobes. This venous trunk enters the renal vein on the left side, and the vena cava inferior on the right. The nerves of these bodies are supplied from the semilunar ganglion, by the plexus renalis. Each renal capsula is covered by a thin membrane, which, when the whole is injected, allows a structure apparently glandular to be seen through it, the surface appearing highly vascular, with spots on it resembling something the penicilli of the liver.

When a renal capsula is carefully opened by a longitudinal incision from one extremity to the other, a cavity will be found in its substance, corresponding in shape to the external appearance

of the gland, if it may be permitted to call a part glandular to which no excretory duct has been discovered. This cavity generally contains a fluid of a dark saffron colour, but varying in degree of tint as well as in quantity. Some anatomists have denied the existence of this cavity; but the preparations I now produce will show it to be distinct and perfect, of an oblong shape, and possessed of a vascular and apparently secreting surface. In one preparation which I have preserved in the Museum formed by me in Windmill Street, the membrane lining the cavity is vascular; and on the surface of the cavity as well as on the external surface of the capsula, there are appearances in some places resembling cryptæ, and in others penicilli; but no general excretory duct has been found, nor has any communication with other vessels been traced from this cavity.

Mr. Hewson had remarked, that the renal capsulæ were very small or entirely wanting, in those monstrous fœtuses which were born with a deficiency of, or without brain. I have in one instance, in my dissections of such fœtuses, seen this confirmed; but in several others, I have found the renal capsulæ as large as in children of the same age, and which were naturally formed.

To mention the conjectures which have been entertained respecting the uses of the renal capsulæ would be wasting the time of this audience;

as nothing approaching to certainty, and very little to probability, is yet known. It appears, however, from their size and distinctness of structure, that they are more necessary to the fœtal than to the adult animal.

ON THE URETER.

The pelvis of the kidney has been traced to its termination in the ureter. This tube extends downwards between the peritonæum and the psoas muscle, then crosses the iliac artery and vein, and, descending obliquely in the pelvis, passes behind the vas deferens in the male, reaches the posterior surface of the bladder, and by inclining inwards as well as downwards approaches the ureter of the opposite side; it then gradually insinuates itself between the coats of the bladder, near the broadest or lower portion of the oval which that viscus forms, and terminates by an opening of a considerable size in its cavity. This length and obliquity of course, between the coats of the bladder, produces the effect of a valve preventing any return of urine from the bladder to the ureter.

Like the pelvis of the kidney, the ureter seems to be made up of two coats; but these are so intimately connected with each other, as to admit of no very distinct separation in the human sub-

ject, although in the horse and ox the difference between them is very apparent. Some anatomists, fond of multiplying coats, have divided the outer coat into two, viz. into a cellular, and into what they have called a muscular coat; but in reality there is no such distinction. This coat, or tunic, is composed of cellular membrane more loose towards the outside, and towards the inside more dense and fibrous in its structure; but these fibres have no regular direction or arrangement, nor is there any positive proof of their being muscular in the human subject. I have in no dissection found the ureter in a state of contraction similar to that produced by muscularity; nor do I know a well-authenticated instance of the urine being stopped, by any morbid spasmodic contraction in this canal, from passing on to the bladder during life. The diameter of the canal always appears the same; and the urine in all probability constantly passing into it from the pelvis, finds its way to the bladder partly from what is behind pressing on it; partly, in certain positions of the body, from gravity; and is assisted partly by the pulsation of the neighbouring large arteries, and the occasional action of the muscles in its immediate vicinity. In the larger quadrupeds, the fibres of this coat however appear to be muscular; and are therefore probably so, but in a less marked degree, in the human subject.

The internal tunic is more vascular, and has a pulpy appearance on its surface, similar to all the other surfaces which contain urine, or those over which that fluid passes: and it is lined with a mucus secreted by its arteries.

The swellings which have taken place above ligatures made on the ureters of brute animals, and the instances of calculi being detained in these tubes and obstructing the passage of urine to the bladder, by retaining this fluid above them, in the human subject, sufficiently prove the usual descent of the urine from the kidney by the ureters to the bladder. When the bladder has been completely distended with urine, and can hold no more, and some obstruction in the urethra prevents its evacuation, the ureters, the pelvis, and the infundibula of the kidney, will sometimes enlarge to an immense size.

ON THE BLADDER.

The bladder of urine is well known to be the temporary receptacle of the secreted matter which is formed from the blood in the kidneys, and conveyed thither by the two ureters.

As much blood is at all times sent to those glands, the action of secretion is constantly going on in them, but varies from circumstances in

quantity and quality of the secreted materials. To prevent the obvious inconveniences which would have arisen from fluids, often containing much acrid matter, being conveyed immediately to the surface of the body, the urine passes as it is secreted to the bladder, and remains there until a sensation of fulness, or a convenient opportunity, call for its evacuation.

The bladder is liable to be affected by many distressing and dangerous diseases, some of which will admit of cure, and others of relief by manual operations: a thorough acquaintance with the structure of this organ, and its connexion with, and relative situation as to the surrounding parts in the alteration of its size from fulness to emptiness, become therefore indispensable to every surgeon: for without such knowledge no person could ascertain by examination the nature of the disease affecting it, or use with safety the only modes of cure when the disease had been ascertained.

The bladder, when not containing much urine, is situated in the anterior and lower part of the cavity of the pelvis. To this part the portion of it termed the cervix is always confined; but the bladder being subjected to great variation in size, part of it sometimes fills up a large proportion of the cavity of the pelvis, while the rest ascends some way above the pubes in the anterior part of

the abdomen; it is therefore, excepting at the above-mentioned part, very loosely connected by cellular membrane to all those structures which surround it.

Immediately upon the expulsion of the urine, the bladder, then being contracted, occupies a space behind the junction of the ossa pubis, extending from near the cartilaginous arch more than half way towards the upper extremity of the symphisis; the peritonæum, descending from lining the anterior parietes of the abdomen, then passes from the upper and back part of the ossa pubis over a large extent of its upper and posterior surface or that surface which projects towards the cavity of the abdomen.

It is of the utmost consequence to the operating surgeon, in every natural situation and form of the bladder, to know the extent and position of that part of the organ which is covered by peritonæum; as a wound of such part, allowing the urine to escape into the general cavity of the belly, would in all probability prove fatal.

The bladder is of an oval shape, its position being regulated by the obliquity of the cavity of the pelvis; one extremity of the oval, viz. the fundus, is turned upwards and forwards, and the other extremity, or that near the cervix, is placed downwards and backwards. The anterior and lower part which faces towards the pubes, and also

that part of the lower and posterior surface which is placed before the rectum, have no peritonæal coat; but both are connected to the surrounding surfaces by cellular and adipose membrane. A tendon, which is generally double, passing from the cervix of the bladder to the symphisis of the pubes, gives to it the only fixed and permanent connexion; and as the size of the bladder varies from its contracting on the last drop of urine, and on some occasions enlarging, so as to contain more than a quart of that fluid, much difference will be found in the space occupied by its upper and posterior surface; but the cervix, from the connexion it has to the pubes, will always remain in the same part of the pelvis.

When the bladder contains urine, it rises in proportion to the quantity of its contents, and also in proportion to the full or empty state of the rectum; for, if the rectum is empty, the bladder will occupy part of the space which the rectum would if full, and consequently will then be situated lower down and more backwards. A finger introduced into the rectum will then readily feel the distended bladder through the coats of the gut. In rising from the pelvis, the bladder forms a tumour which may be felt above the pubes; and carrying the peritonæum which covers its fundus upwards with it, a space is left between the part where that membrane is reflected

from the abdominal muscles, and the pubes, of three inches or more in the fully distended state, where the bladder may be cut into without the wound communicating with the cavity of the belly.

The size of the human bladder is larger in proportion to the whole body than it is in brute animals: this may arise from the urine being suffered to accumulate in it, either from want of opportunity, or from a disinclination to void it often. In women the bladder is generally larger than in men: in addition to the above reasons, the greater capacity of the female pelvis may contribute to this.

In the brute animal the shape of the bladder is pyramidal, the fundus being much broader than the cervix, the bladder gradually tapering to the part where the urethra comes out; a larger proportion of its circumference is also covered with the peritonæum. In the human body it is more of an oviform shape, but flattened before and behind; the fundus is the narrowest part, the broadest extremity of the oval being placed lowest and most backward. This shape, however, is not met with in the fœtal bladder; for, before and some time after birth, the capacity of the pelvis being small, both the bladder and the principal part of the rectum are situated in the abdomen; the shape of the bladder is then more cylindrical, and the fundus is the most capacious extremity.

The urine passes into the urethra from the most depending part of the bladder when we stand erect; but this part is not at the extremity of the oval, it is before and below it, and a little behind and above the cartilaginous arch of the pubes; this must be so from the obliquity of the bladder's position. The entrances of the two ureters point downwards, inwards, and forwards to this part. In the erect position, a calculus contained in the bladder will naturally gravitate to this part, and will sometimes cover and completely obstruct the passage into the urethra; and the effort which is made by muscular contraction to expel the urine will only increase the obstruction; but by placing the patient on his back in the horizontal posture, the calculus will leave the urethra and gravitate towards the part where the ureters enter, which now becomes the lower portion of the bladder, and the opening into the urethra being left free, muscular contraction will force the urine into and through it.

The termination of the human bladder in the urethra is not, as in the quadruped, by a gradual narrowing forming a distinct neck, but is abrupt; taking place at once where it is connected to the upper and anterior surface of the prostate gland, the beginning of the urethra passing through and being surrounded by the substance of that gland. The term cervix of the bladder is notwithstand-

ing applied to this termination. The cervix is placed behind and a little above the cartilaginous arch of the pubes and before the rectum. The muscular coat of the bladder surrounding the beginning of the urethra is firmly connected with the substance of the prostate gland, the surface of adhesion between them extending two thirds of the space on the upper and anterior surface of the gland from its base towards the apex, at which part the urethra comes out.

The ligamentum inferius vesicæ, as it has been termed, extends from this part to be inserted into the symphisis of the pubes, its fibres collecting themselves from the sides of the bladder, and also from part of the surface of the prostate gland near to the base, and passing forwards for that purpose. This attaching substance, however, can be proved to be the tendon belonging to the muscular fibres of the bladder, and will be noticed afterwards as such.

A ligamentous chord extends upwards from the fundus of the bladder, and passes on the outside of the peritonæum in a direct line to the navel, and is there lost: the name of ligamentum superius vesicæ has been given to it. By some authors this chord has been called the urachus, from its resemblance to the tube so named, which, in the fœtus of a quadruped, passes from the fundus of the bladder to the cavity of the allantois mem-

brane, and conveys the urine from the bladder to that cavity. In the human fœtus, no such tube or membrane is found. I have, however, traced the ligament forming a pervious canal to the navel; and in fœtuses which have still remained attached to the placenta, I have traced a white chord extending from the bladder through the navel along the whole funis to the placenta. In the funis, this chord is as fine as a small thread.

The ligamentum superius vesicæ being firmly attached to the outside of the peritonæum, draws that membrane downwards, when the bladder in contracting descends from the abdomen to the pelvis, so that it should line the lower part of the recti muscles, and pass from them to the upper and back part of the pubes. It also keeps the fundus of the bladder in contact with the inner surface of the abdominal parietes, when the bladder ascends above the pubes.

Two other impervious chords are found to run obliquely upwards, one coming from each side of the bladder; they gradually approach each other, and join the ligamentum superius vesicæ at the navel: these are also attached to the outside of the peritonæum, and were, before birth, the great umbilical arteries.

The bladder must necessarily consist of three coats, although five have been given to it by some anatomists, amongst whom is Baron Haller. The

peritonæum covers a part of its surface, viz. that nearest the cavity of the abdomen. This membrane is reflected from the pubes, or, in the distended state, from the abdominal parietes, over the fundus of the bladder, so as to pass along the upper and posterior surface, extending to within the distance of an inch, more or less according to the size of the adult and state of the bladder as to emptiness or extension, from the base of the prostate gland; it is then reflected backwards to the rectum in the male, and to the uterus in the female; of course a great part of the anterior and the whole of the under surface of the bladder have no peritonæal covering. This partial coat is loosely connected by cellular and adipose membrane to the muscular coat of the bladder, and being elastic, presents a smooth surface towards the cavity of the belly in all states of that viscus, from its utmost contraction to its greatest degree of distention.

The peritonæal coat requires no farther description, as it differs in no essential quality from that which covers the other viscera. But before I leave this subject, I trust I may be permitted to impress, as strongly as I can, and which I now endeavour to do, the necessity of every surgeon having clear ideas of how much of the bladder is covered by peritonæum, and of those situations where it passes to the bladder from the pubes, and from the bladder to the rectum in the male, or

uterus in the female. I have dissected the side view of the pelvis for the lectures of Mr. Cruikshank, for those of Dr. Baillie, and always for my own lectures; but I never have done this without deriving some advantage from my labour. I therefore earnestly entreat the student of anatomy to lose no opportunity which offers of performing this dissection of the side view of the pelvis, and carefully to attend to it when made by the dissection of others.

The parts of the external surface of the bladder not covered by the peritonæum have much cellular membrane adhering to them; this has been termed the first cellular coat; but as a proper coat it cannot be considered, cellular membrane being the universal connecting medium of the body.

Under this cellular membrane, and partially covered by the peritonæum, is to be found a structure consisting of contractile fibres divided into packets having an almost endless variety of directions, but extending round the bladder so as to form a complete muscular coat. These packets of fibres in the natural healthy state of the bladder are pale in colour; and when they are elongated, in the distended state of that organ, spaces are left between them, through which the internal membrane may be seen, in cases submitted to dissection. The coats of the bladder, when distended, are thin; but, from the contraction of

these fibres, when the urine has been expelled, the spaces between the packets are filled up, and the coats in this state form a thicker and more opaque mass. The muscular fibres of the bladder of a person who has long laboured under some obstruction to the flow of urine, from stricture or other causes narrowing the passage of the urethra, are generally found, on dissection, to have increased in proportion to the exertions they have been compelled to make: in this they resemble those of other muscles, which become stronger and thicker from use. The fibres, in some instances, have assumed the red colour of other muscles, and formed a coat exceeding, even when not in a fully contracted state, an inch in thickness. This thickening of the muscular coat is so general, that I have rarely seen an instance where mechanical obstruction had taken place to the flow of urine for any great length of time before death, without its occurrence in a greater or less degree.

Some anatomists have applied the term detrusor urinæ to the muscular coat of the bladder, and have arranged the fibres into longitudinal, oblique, and circular; but there is great variety and uncertainty in the direction of the packets, particularly in those nearest to the internal membrane; they are also so connected to each other as to be incapable of being divided into distinct layers. Their

general arrangement appears to be this.—Packets of fibres seem to meet at the fundus of the bladder where the ligamentum superius vesicæ is attached; from this part they divide and spread upon the circumference of the bladder, taking, however, a direction towards the lower or broadest extremity of the oval which it forms. The packets become more distinctly arranged as they approach the prostate gland, and sweeping round from the entrance of the ureters, they pass forwards above the gland (a few spreading on its substance), along the sides of the cervix of the bladder. Many of these packets terminate in tendinous fibres, which unite and form a tendon on each side: these tendons, leaving the bladder immediately above the prostate gland, and then contracting their breadth, but increasing in thickness, become firmly attached to the inside of the symphisis of the pubes, about half an inch higher than the cartilaginous arch. The number and appearances of these tendons are, however, subject to some variety: I have often seen two or even three tendons connected by condensed cellular membrane, pass from each side; and sometimes I have found the fibres of both sides uniting to form a single tendon. In many people much fat surrounds the tendons, and passes between the packets which form them. Muscular fibres, which proceed from the surface of the prostate gland, are also connected to these tendons;

and fibres of a ligamentous nature, passing from the pubes to the prostate gland and cervix of the bladder, are often blended with them; but these will, in general, admit of a distinct separation. It is obvious that the contraction of fibres having such direction and attachment, must draw the fundus and sides of the bladder towards the cervix; and of course, if the urethra is open, force the urine into that passage. This arrangement is very distinctly seen in the bladder I now produce: the person to whom it belonged having for several years been affected with a stricture; for many days after the bladder had been macerated and placed in spirits, the red colour of the muscular fibres was very apparent.

Within the longitudinal fibres, the packets have an irregular oblique direction; those which approach nearest to the inner membrane are, on the whole, more circular; but few or none are completely circular. The oblique packets cross each other in every direction, and are occasionally crossed by the longitudinal packets. The packets do not extend very far without joining others, to the sides of which they are connected by very thin white lines resembling tendons. The projections which these fasciculi of fibres make are very distinctly seen on the inner surface of a contracted bladder, the inner membrane often passing between them, and forming pouches.

From the termination of each of the ureters a band of muscular fibres, blended however with some fibres composed of elastic materials, descends obliquely towards the base of the prostate gland. These bands join each other before they reach the gland, and are lost at the back part of the beginning of the urethra, where that passage is firmly connected with the third lobe of the prostate: some of these fibres seem to be attached to that part of the gland. From the entrance of the ureters fibres of a similar nature stretch over from one ureter to the other, and form an arch bent in the middle towards the urethra; the bands passing from the ureters to the urethra form the two other sides of a surface of a triangular shape; which, from this increased thickness of the coats of the bladder, produces a slight projection into its cavity: the two ureters open at the upper and posterior angles of this surface, and the urethra passes off from the lower and anterior angle. This projecting surface has been called by some French authors the *trigone vésicale*. The above-mentioned fibres assist in the expulsion of the urine by contracting the bladder; and by drawing the ureters downwards at the same time, they preserve the proper obliquity of the course of these vessels through the coats of the bladder, thus continuing the valvelike effect of such course, in preventing the urine from returning into the ureters after

it has been deposited in the cavity of the bladder.

Where the bladder terminates in the urethra we might expect to find a very distinct arrangement of fibres forming a sphincter muscle; but we do not meet with this arrangement in the unequivocal form we find it at the beginning and termination of the primæ viæ; still, from the distribution of some fibres at the beginning of the urethra, and which appear to pass round it in semicircular packets from the fore part, and which meet with the fibres descending from the ureters behind, the contraction of such fibres, assisted by those of the parts of the urethra nearer to the penis, may be considered as sufficient to prevent the urine passing into the urethra. These fibres must necessarily relax, when those which form the muscular coat and join the tendon of the bladder, are employed in pressing the urine out of the cavity of that viscus.

When the muscular fibres of the bladder have been kept long in a state of distention, they very frequently lose the power of contracting on the urine so as to expel it from the cavity. It thus often happens, after the catheter has been successfully used in cases of retention of urine, and when the cause which first produced the retention has been removed, that this instrument must be introduced two or three times daily until the tone of these fibres is restored.

Within the muscular coat of the bladder Haller places his second cellular coat; and within that his nervous coat; but these two last are, in reality, not proper coats: there is nothing here but cellular membrane connecting the inner coat rather loosely to the muscular, and having a few ramifications of nerves and vessels taking place in it as it surrounds the branches passing from the one coat to the other.

The internal coat of the bladder is similar to the other mucous membranes, but is less vascular than most of them on its surface: it has a smooth and somewhat pulpy appearance and feel; it is vascular in a greater degree towards the cervix of the bladder than elsewhere; and is very markedly so where it covers the triangular surface between the entrances of the ureters and urethra: this part appears also to possess more nervous sensibility. In the distended state of the bladder the surface of the inner coat is even, but in the contracted state it is, like that of the stomach, thrown into folds. It sometimes passes between fasciculi of muscular fibres, and then appears to form small cysts. In the healthy state it is sheathed with mucus secreted by the vessels ramifying on its inner surface. Towards the neck of the bladder there is sometimes the appearance of small glands, but these are not often distinct, and are always too small to allow of any examination of the peculiar

properties of the fluids they secrete. The mucus defends the surface from the acrimony of the urine.

I have on a former occasion stated that Berzelius has observed, although the secretions of the different mucous membranes possess the same external characters which constitute mucus, yet that the mucus belonging to different organs, varies considerably in chemical properties according to the use it was intended for, as a defence to their surfaces from the contact of foreign matter. Thus the mucus of the nostrils and trachea, which is intended as a protection against air, differs from the mucus of the urinary bladder, which is to preserve that organ from the contact of an acrid and acid liquor, or from the mucus of the gall-bladder, the contents of which viscus are alkaline.

The animal matter peculiar to mucus is the same in all cases: it possesses the following properties: it is insoluble in water, but may imbibe so much of this fluid as to become more or less transparent, semi-liquid, or what is termed glairy; but in filtration, by means of blotting-paper, the moisture will soak from it. Mucus is not coagulable by boiling; it becomes transparent when dry, and generally resumes its mucous character on the addition of fresh water; but there is a great difference in this property.

The mucus of the urinary passages accom-

panies the urine, in which it is partly dissolved, and partly suspended mechanically. It is easily soluble in alkalies, and is not separated from this solution by acids. Tannin separates it into white flocculi.

The secretion of this mucus seems to be the greatest near the cervix of the bladder, particularly on the triangular projection. This may be supposed to arise from the greater degree of vascularity at that part; but more mucus may also lodge there from its depending situation. It is a part which seems to require more defence than any other, as acrid matter may be more constantly applied to it, or extraneous substances, such as calculi, irritate it more constantly, by gravitating to it. It is evidently the most sensible part to any irritation, particularly to those irritations which excite the muscular fibres of the bladder into action. We have instances of this in the sensation a bougie produces the moment it touches this part; the patient often feels then an almost irresistible desire to void his urine, although none may be contained in the bladder; and also in the irritation which a stone lodging on this part occasions.

The arteries which supply the bladder are chiefly branches of the internal iliac artery, but one or two small branches may be traced from the epigastric artery to the fore part of the prostate gland. and of the bladder where these or-

gans are connected with each other. The arteriæ vesicales sometimes have been found to pass immediately from the internal iliac trunk, but more frequently from the branches termed the glutea, and the sciatica; branches also pass to the side of the cervix from the pudica. The umbilical artery passes from the internal iliac, it reaches the side of the bladder about half way, in the middle state of that viscus between distention and contraction; it then passes to the navel, sending off a few branches to the bladder; it often remains open to the bladder even in the adult; but soon after birth it becomes impervious from the bladder to the navel.

The veins belonging to the bladder follow nearly the course of the arteries, and open into the internal iliac vein after forming a considerable plexus, before they do this, on the side of the bladder, immediately above the prostate gland, and extending as far as the part where the peritonæum is reflected to the bladder. One or two large veins on each side leaving the bladder more forwards, run between the levator ani and compressor urethræ muscles, and then enter the vena dorsalis penis, immediately before that vessel divides into the branches going to the internal iliac veins of each side.

The absorbent vessels of the bladder accompany the course of the principal veins, and enter glands,

some of which are situated on the side of the cervix of the bladder; but most of these vessels pass into the glands which are found surrounding the course of the internal iliac artery and vein on each side of the pelvis.

The nerves which supply the bladder enter its substance with the blood-vessels near to the cervix. The inferior mesenteric plexus sends off branches which descend into the pelvis and form communications with the sacral nerves; from these the nerves of the bladder proceed. Branches from the third and sometimes from the fourth sacral nerves are easily to be traced to the bladder; the nerves of each side meet and form communications immediately between the entrances of the two ureters and the beginning of the urethra; and branches pass from this part to the different coats of the bladder, but more particularly to the muscular coat.

The contraction of the muscular fibres of the bladder when the urine is not to be expelled, being no more than what arises from their tone, the urine in descending from the kidneys very readily overcomes it, and finds an easy passage by the ureter into the cavity, the muscular fibres continuing to yield as the urine accumulates, and the obliquity and length of course of the ureters through the coats of the bladder preventing its return into these vessels, as their entrance must be closed when pressure is made on their passage from the inside of

the viscus. There being no valvular apparatus at the beginning of the urethra to prevent the fluid escaping by the membranous part of that tube, it is probable that the muscular fibres which immediately surround the cervix of the bladder remain contracted while the urine accumulates, having the properties of other sphincter muscles, but not the regular arrangement of the fibres which most of the sphincters possess. When the bladder is distended to a certain degree, or stimuli are applied to the part where the nerves enter, and from which they are distributed to the whole of its muscular structure, this structure (with the exception of the fibres at the origin of the urethra, which must relax as other sphincters do) is excited to immediate contraction; the diaphragm and abdominal muscles pressing the column of viscera at the same time downwards, the muscles of the urethra also relaxing, the urine is forced into that passage and expelled from the body. A combination and successive action of many other muscles are required for the proper passage of the urine and semen through the penis, to which I shall advert when the structure of that organ has been described.

In the common act of voiding the urine, the abdominal muscles and diaphragm have but little, if any thing, to do with that action; a proof of which is, that as these muscles contract in respiration the jet of urine is not increased: if any pressure is used

by them, it is alternately and almost imperceptibly; but when a difficulty occurs, or the person's mind is led to make an effort to throw out the urine with force, then both the diaphragm and abdominal muscles act together, and great straining is produced.

LECTURE III.

PRELIMINARY OBSERVATIONS ON THE GENITAL ORGANS. ON THE SEMEN. ON THE SCROTUM, SPERMATIC CHORD, AND TESTICLES.

HAVING traced the urine from its formation in the kidneys to its lodgment in the bladder, and having brought to your recollection the structure of the parts employed in its secretion, in giving passage to, or containing it; I now propose to proceed in a similar manner with the semen, and to trace that fluid from the organs in which it is formed until it is deposited in the urethra.

The urethra will afterwards be noticed as the common outlet to both fluids on their ejectment from the body.

The production of the embryo and the formation of the fœtus have always been regarded as the most astonishing facts both in the animal and vegetable world, and in every age have been the subjects of much philosophical research. Some light has been thrown on these important actions by the experiments of recent physiologists, particularly by those of Haller, Bonnet, and Spallanzani; but

much still remains hidden from mortal observation.

It has been known from the beginning of the world, that in the more perfect classes of animals the co-operation of two of the same species becomes necessary for the production of others of their own kind. It has been more lately ascertained, that the semen found in the testicles of the male of the more perfect classes of animals, must be conveyed to those bodies called ova, which are formed in the ovaria of the female, and contain the rudiments of the future animal, there to excite the embryo to evolution, and to impart to it the principle of vital action. This constitutes generation: an action which, although not necessary for preserving the lives of the individuals who perform it, becomes one of much more real importance, as it implicates the future existence of the whole species: for, if the species was intended to be continued, unless a power was given to animals to produce others, the same animals must have lived to all eternity, or an entire new creation must have occasionally taken place.

In the male animal the testicles, which secrete the semen, are the primary organs of generation; the penis belongs to the secondary class, its use being to convey the semen where it may come in contact with the ova of the female so as to impregnate them. The ovaria in females are the pri-

mary organs, the uterus not forming but containing the ova until the fœtus arrives at maturity.

The testicles and ovaria remain from birth until near the period of puberty without undergoing much change in size; but at that period, when the secretion of semen begins in the testicles, and the formation of ova takes place in the ovaria, much change is produced in the human body. In the male, the growth of hair on the chin and pubes, and alteration of voice, mark this period; as do the enlargement of the breasts in the female: the passions, also, now become very different from what they were early in life. These changes, it is clear, are not produced merely by age, for they do not take place in the male if the testicles are extirpated; nor would they occur in the female, if we may be permitted to judge from analogy, if the ovaria were destroyed, or in too diseased a state to form ova. When the ovaria have been extirpated from quadrupeds, the passion of desire, which ensures generation, is always lost.

The action of generation is in all animals insured by very powerful passions; and the organs by which it is performed constitute the most marked and essential difference between the two sexes.

In those animals which are not endowed with reason to guide their actions, Nature has ordained that this passion should not exist constantly; it takes place in them periodically; for,

were this not so, from its excess and indulgence all the other habits of the animals might be lost, and even the necessity of procuring the present and future means of their existence might be forgotten; and in those classes of animals who have many young at a birth, and whose period of utero-gestation is short, there soon would have been an overstocking. As a lesser consideration, it may also be observed, that did the passion exist constantly in both sexes of domestic animals, they would have proved less serviceable to man; for we find them of very little use during its presence. It exists at different seasons and various temperatures in different classes of animals; but the coldest period of the natural resident climate is rarely the one it is found in, although to this there are exceptions, in the frog, wolf, and fox; for these animals generally copulate in cold weather.

In most of those animals which are exposed to the full severity of winter, their genial warmth during the continuance of that season seems to be overcome by the prevailing cold; and in other animals, in climates where the summer is very hot, the tone of the genital organs becomes so relaxed as to render them unfit for the perfect performance of the necessary act.

In some animals the testicles increase in size until the season of procreation is over, and then decrease, and continue small, until the commencement of the next season. John Hunter has left

us examples of this in the testicles of cock sparrows, which show these organs progressively increasing in size from January until the end of April, when the love season of these birds usually closes. His observations on this subject are to be met with in his paper on the glands called vesiculæ seminales, accompanied by an illustrating engraving. He there observes, that this increase and diminution of the testicles are not peculiar to birds, but, so far as he knows, are common to all animals which have their fixed seasons of copulation. He mentions having found this diminution of the size of the testicles in the buck, and in a still more remarkable degree in the land-mouse and in the mole.

Among the human race there is no country or season in which the passion which insures generation may not exist; artificial means having been at all times employed by mankind to render their bodies less exposed to the debilitating influence of too much heat, or the benumbing effect of excessive cold; extremes of either of these are, therefore, rarely felt for any long continuance: and the human testicles not being affected by them, remain nearly of the same size after puberty at all periods of the year. Even in animals which domesticate with man we find, that the passion is less periodical than in the wild animals. From domestic animals not being affected by the change of temper-

ature in so great a degree, the secretion of semen not restricted by continued cold, the testicles do not shrink as they do in wild animals which are exposed to its influence; but continue in every season capable of their proper actions.

The passion of desire commences in men at puberty, and seems to depend on the secretion of semen; for it does not exist before the testicles begin to enlarge and secrete, and it leaves the male whose testicles have been extirpated; in eunuchs we have examples of this. It is also more languid in advanced age, when the semen is more sparingly secreted; and it is also languid in people whose testicles are of a very small size, and sometimes in such persons does not exist at all.

In women it seems to depend on the healthy state of the ovaria; it begins at puberty when these bodies enlarge and ova are formed in them; but it does not occur in the female of quadrupeds where the ovaria have been destroyed, and is much lessened in advanced life when the ova cease to be formed, and when the ovaria begin to shrink.

In the important process of generation, nature however indulges in great variety, both in the formation of the organs, and in their time and mode of being used; indeed, so much is this the case, that the species of hydatid which is considered as the most simple of animals, produces others without having any distinct organs of generation, or any which denote a difference of sex.

Some animals are truly hermaphrodite, and can impregnate themselves, as polypi, oysters, and some classes of vermes. In the vegetable world there are many instances of male and female organs being placed on the same stalk, and mostly on the same flower, as in the monoïc plants. The snail is a peculiar kind of hermaphrodite; for, although it possesses in its own body the organs of the two sexes, it requires to be joined to another of its own species, so as mutually to impregnate and be impregnated; but it cannot impregnate itself.

In some species of animals impregnation of ova takes place without the male and female having been at any time in contact: as in certain fish; for, when the female has deposited her ova, the male discovers them apparently by the accuracy of the organs of smell; he then sheds over them that fluid which is to give them evolution and life; and unless the male semen comes in contact with them, they soon putrefy.

It is well ascertained that pullets which have never received the cock, will lay eggs containing the rudiments of the chick, but these eggs can never be hatched; on the contrary, they putrefy when placed for incubation under a hen. We are indebted to Baron Haller for this discovery.

If the ova of frogs are prevented from receiving the male semen during the time of spawning, they soon become putrid; but if the male frog

has moistened them with his semen they will not putrefy, and the tadpoles will be soon evolved. Spallanzani has proved by repeated experiments, that the male semen of frogs, collected and poured on the ova, prevents them from putrefying, and excites the tadpoles to vital action.

In the seeds of plants, the image of the young plantule is found before impregnation.

It is not my intention here to infringe on the province of my respected colleague by introducing more of comparative anatomy than may be necessary to illustrate by analogy, the functions of the organs of generation in men. The subject of generation affords a large scope for the labour of the comparative anatomist, and will, on some occasion, without doubt, be commented on in the lectures delivered in this theatre by the Professor of that science; but it is right that I here should adduce the proofs of the male semen being necessary to impregnate the ova, to show the importance of that fluid.

The semen, or fluid secreted by the testicles, is always, when evacuated, mixed with the secretions of other structures, such as those of the vesiculæ seminales, prostate gland, and the mucous glands of the urethra. To examine semen in a pure state, it must be taken from the vasa deferentia of an animal recently dead, and whose death has been produced from intention or accident, but not from disease. It has, upon examination, been found to

possess many of the properties of other animal mucilages. It is of a bluish-white colour, and nearly of the consistence of cream, but more unequal. That which is first discharged by living animals has nearly the properties of what is found in the vasa deferentia and other vessels of the testicles; it is whiter and more opaque, while that which follows is more resembling the common mucus of the nose, but is less viscid. It has, when first voided, a peculiar heavy smell, which has been compared to that of the farina of the Spanish chestnut. John Hunter states that its taste is at first insipid, yet there is some pungency in it, which after a little time stimulates and excites a degree of warmth in the mouth. Vauquelin describes semen as having a sharp and slightly astringent taste. Its specific gravity is greater than that of any other fluid in the body; it sinks in water; it is coagulable by alcohol; it is soluble in nitrous and sulphuric acids; it is softened by vegetable acids; it evaporates by fire; its viscidity is taken away by lime-water, and is increased by potash and soda; and it is thickened by ammonia. When exposed to air, it soon liquefies, and becomes then specifically lighter than before, but always remains heavier than water. When it does liquefy, it will combine with water in any temperature, but will not do so at the time of ejection; nor will water at any temperature,

from zero to the boiling point, dissolve it, if it has not been previously liquefied.

According to the detailed experiments of Vauquelin, which were published in the Annales de Chemie (1791), and have been quoted by Fourcroy, Richerand, and others, human semen appears to be composed of ninety parts water, six of common animal mucilage, three of phosphate of lime, and one of soda. It exhibits a very marked alkaline character, changing the syrup of violets green; this is owing to the soda contained in it. The animal mucilage is not pure albumen; but Richerand observes it should rather be considered as a gelatinous mucus, on which its indissolubility in water, its odour, and spontaneous liquefaction, seem to depend.

The application of the microscope to semen has discovered that very minute bodies swim in it, which move with rapidity, and from their various motions, avoiding obstacles, retrogression, and change of velocity, have been considered as animalcula. They are formed like a tadpole, with a round head or body, and a narrow tail. Ludovic Haume is said to have been the discoverer of these animalcula, and to have shown them to Lewenhoeck in 1677. Lewenhoeck has claimed the discovery as his own.

These animalcula, it is asserted by some physiologists, are not found in the fluid contained in the seminal organs until the period of puberty; and

they are stated to be wanting in that of mules. Some experimentalists have even gone so far as to assert that they are wanting in the semen of persons who are suffering from, or have been very much debilitated by, continued disease; and various have been the theories formed respecting their nature and uses. But it is not my intention to trouble you with the different opinions that have been entertained by fanciful individuals: I shall only observe, that similar appearances have been found in other animal humours, in the juices of plants, and even in vinegar.

The testicles, which secrete this most important fluid, are contained in a bag situated at the root of the penis, and between the groins, called the scrotum; but they were originally formed and for some time situated, in the fœtus, at the posterior part of the cavity of the abdomen, on the psoæ muscles immediately below the kidneys; from this they gradually descended through the ring to the situation above mentioned, their vessels and nerves continuing to pass through this opening from the same large trunks which supply the abdominal viscera.

Very early in the fœtus the skin at the part where the scrotum is found after birth, forms a loose and corrugated projection, but is not distended into a bag until the testicles reach it. The scrotum is continued from the surrounding common integuments, and is rather thinner and somewhat

browner than the contiguous skin; its surface is also more uneven, as, when not relaxed, it is thrown into very numerous small rugæ: it possesses also a number of sebaceous glands, and others which secrete what is necessary for the nourishment of the hairs which are, at puberty, spread over its surface, but in general rather thinly.

A line slightly projecting appears to pass from the anus along the middle of the perinæum to the upper and back part of the scrotum; it then crosses along the middle of the scrotum to the lower part of the root of the penis, dividing the scrotum into two equal lateral parts: this line is called the raphe. We do not find on dissection, that this line is so distinctly marked on the inside of the skin as it is on the outer surface.

Much cellular membrane, of a loose and ductile nature, adheres to the whole of the inner surface of the cutis of the scrotum; but from the inner surface of the raphe to the penis, a septum is formed dividing the scrotum into two cavities: this septum consists merely of the cellular membrane becoming firmer and more condensed. The septum scroti thus formed, by extending from the inside of the raphe to the under part of the corpus spongiosum urethræ, separates the testicles, so that they never can come in immediate contact. From the rest of the inner surface of the skin, and from the sides of this septum, much very loose cellular

membrane passes to the tunics immediately inclosing the testicles; by so doing it gives these organs proper support, at the same time enabling them to escape from the pressure to which, from their particular situation, they must be occasionally exposed.

Fat is not found in the cellular membrane of the scrotum, excepting where it is in immediate contact with the adipose membrane belonging to the lower part of the trunk of the body; and even there it seldom occurs; and when it does, it is in very small quantity; but watery fluid, in dropsical people, from the depending situation and ready communication of the cells, often accumulates in very large quantities. This deposition of watery fluid, when long continued, will often produce much thickening of the cellular membrane containing it.

The skin and cellular membrane of the scrotum possess much elasticity; but a peculiar kind of spiral motion is found in the skin, which cannot arise from that quality: the skin is also at times very much corrugated, and keeps the testicles pressed up towards the rings; at other times it is so much relaxed, as to allow of the testicles being suspended by their chords. This evidently arises from the action of muscular fibres; and these fibres have been called by some anatomists the dartos muscle. Other anatomists have denied that such muscle can be found. Both Haller and

Dr. Hunter doubted its existence. Winslow, usually very accurate, has given a minute description of its attachments. He states it to be a true cutaneous muscle, the fibres of which are for the most part strongly connected with the skin, but that some of them pass on each side of the septum scroti, so as to nearly surround each testicle; that they therefore assist in forming the division between the testicles; that below the groins the anterior and lateral portions have a strict connexion with the internal cellular membrane, by a kind of tendinous or ligamentary expansion, and that this expansion is fixed in the ramus of the os pubis, between the triceps muscle and crus of the penis on each side: also, that the internal portions which run on the side of the septum are fixed to the under part of the urethra. I have often, when dissecting these parts, looked for this distribution of muscular fibres, but never could make it out to my entire satisfaction, so far as regarded the attachments Winslow has described; I have very often, however, seen fibres attached to the inner surface of the skin, which had every appearance of being muscular. In a dissection made by the late Mr. Henry Horne of Newcastle, in Windmill Street, at the time when he was my house-pupil, I saw many red and fleshy fibres attached by tendinous expansions to the part of the perinæum where the acceleratores urinæ, transversi perinæi,

and sphincter ani muscles are connected with each other; these fibres, from this attachment, divided into three portions, which expanded themselves on the inner surface of the skin of the scrotum, two running laterally towards the groins, and one taking a middle direction near the raphe. Mr. Daw, then house surgeon to St. George's Hospital, made an accurate drawing of the appearances, that which I now have the satisfaction of producing; since then I have repeatedly traced, but not with the same distinctness as to colour or thickness of the packets, a similar muscular distribution and tendinous attachments. These fibres sufficiently account for the oblique motion which takes place in the skin of the scrotum, and for the corrugations of that bag in healthy people, where muscular action is strong, or where cold is applied to the surface.

On laying open the scrotum from the ring downwards, the testicle of each side is found to be covered by its proper coats, and having the substance termed the spermatic chord, which consists of muscular fibres, membranes, vessels, and nerves, extending from it upwards into and through the abdominal ring. It has been already stated that these parts have a loose connexion by cellular membrane to those which surround them, and therefore have no external smooth surface.

The membrane which envelopes the testicle and which is called the tunica vaginalis, is found to

have packets of muscular fibres attached to its outer surface; these can be traced upwards along the chord through the ring, where they are found to arise and be detached from the lower edge of the internal oblique muscle of the abdomen as it descends from the forepart of the spine of the ileum to the pubes; some of these fibres are attached to the back part of Poupart's ligament, and some can be traced as coming off from the under edge of the transversalis muscle. These fibres form the cremaster muscle; by descending from the above-named attachments through the ring, and adhering to the outer surface of the tunica vaginalis, they assist in supporting the weight of the testicle, and often, as in the coitus, draw it upwards to the ring. It is supposed by some physiologists that their contraction may afford some assistance to the secretion of semen in the body of the testicle, and in its passage upwards by the vas deferens to the ring. When the testicle has enlarged from disease, in cases of hydrocele, and in those of herniæ, these, like other muscular fibres, when they have more weight to support, increase in the number and distinctness of packets in proportion to the additional exertion they are called upon to use. This should be remembered in cases of operation, in which parts connected with the testicle, either naturally or from disease, are to be divided, as in the opening of the tunica vaginalis, in some cases of hydrocele, as in

the congenital hernia, or in the opening of any hernial sac found in these parts.

The tunica vaginalis covers the testicle in the same manner as the pleura covers the lungs, the pericardium the heart, or the peritonæum the viscera of the abdomen: it is, in fact, the remains of the peritonæum which descended with the testicle from the abdomen previous to birth, and it retains all the properties of that membrane. It forms a loose bag which envelopes the testicle; and it is then reflected over the outer surface of, and intimately connected with, the tunica albuginea, or membrane immediately inclosing the secreting structure of that gland.

On making a small puncture and inflating the cavity of the tunica vaginalis, it appears to be nearly double and sometimes more than double the size of the testicle, and of a pyramidal shape, terminating in a point, a little way above the testicle, on the chord. If the cavity is laid open, the testicle is seen to project into it from behind: from that part the tunica vaginalis is reflected on the surface of the testicle, becoming much thinner, and very firmly adhering to the tunica albuginea, from which it cannot be separated unless the parts have been long macerated in water. The inner surface of the tunica vaginalis is perfectly smooth, no vessels containing red blood appear on it, and a fluid similar to that found in other circumscribed cavities is se-

creted on it. The membrane thus gives to the bag containing the testicle, and to the testicle itself, a smooth and polished surface, moistened with a lubricating fluid, which, with the loose connexion its outer surface has to the scrotum by cellular membrane, allows the gland readily to slip from, and thus to elude, any pressure from common causes, to which, from its external situation, it might be exposed. When the secretion of this lubricating fluid is too great, or the absorption of it not in proportion to the secretion, I need hardly say to this audience, that the accumulation of it in the cavity forms the disease called hydrocele; and when this disease has been of long standing, the tunica vaginalis is increased in thickness, chiefly by a condensation of cellular membrane on the outside; and I have already stated that the fibres of the cremaster muscle are, under such circumstances, also increased. The testicle, excepting at the back part, where the membrane is reflected over it, is loose, in the cavity of the bag.

The oval shape, with the sides a little flattened, and the size of the testicles, are so well known, that I shall only observe, the flatness appears to be greater in the dead body, than in the living; for, when the testicles are healthy and secreting semen, they are then more rounded and full. Their precise situation must constantly be varying, from many causes. When allowed to be suspended by the

chord, the broadest extremity of the oval is placed upwards and forwards; the narrowest extremity is turned backwards and downwards; one edge, of course, faces backwards and upwards, and the other downwards and forwards: but this position will be continually altering, from the situation of the body, from external pressure, or from the action of the scrotum on the testicles from its natural property of contraction.

In the cavity of the tunica vaginalis, besides the body of the testicle, the appendage to it called the epididymis appears, and is placed on the outside of its upper and posterior edge. The shape of the epididymis is long and rather flat; it is broader, rounder, and more intimately attached to the testicle at its anterior extremity, the vessels from the testicle entering at that part. As it descends, it becomes narrower and more loosely attached, a kind of pouch forming between it and the body of the testicle; towards the lower extremity it becomes a little broader, and is again more firmly attached, but only by condensed cellular membrane, no vessels at this place passing from the testicle to join it. The epididymis has a smooth covering from the tunica vaginalis.

The vessels and nerves belonging to the testicle enter and pass out from its substance along the upper and posterior edge; and the termination of the chord which contains them is on the inner side of

the epididymis, or that farthest from the thigh. In their passage from the ring they are inclosed in a sheath formed partly of the remains of the peritonæum, after the cavity from the abdomen to the tunica vaginalis has been obliterated; and partly of condensed cellular membrane, covered by the fibres of the cremaster muscle.

The chord contains the following vessels, viz. the spermatic arteries and veins, the absorbents and the excretory duct, named the vas deferens. It also contains the nerves of the testicle. The spermatic arteries usually come off in pairs from the fore part of the aorta, a little lower down than the renal arteries. The artery on the right side is more subject to deviate from this origin than the one on the left; but both are subject to occasional variety. The left frequently comes off higher than the right, and sometimes, but not often, it arises from the renal artery. It is small at its origin; and in its descent behind the peritonæum to the testicle, it gives off small branches to that membrane, and to the cellular texture surrounding it. These branches have their corresponding veins; notwithstanding which, the artery rather increases than decreases in size before it sends off the vessels which enter the testicle. One effect of this distribution must be a diminished velocity in the current of blood the artery conveys to the gland. This is perhaps necessary for the secretion of semen;

for, in the bull, the spermatic artery is found not only to increase in capacity, but also to form numerous convolutions, before it enters the testicle, so as greatly to increase the length of its course between the aorta and the testicle. The spermatic artery passes downwards behind the peritonæum, and is soon joined by the vein; these vessels cross before the ureter, and reach the inside of the ring, where the nerves, absorbents, and vas deferens, meet them, to form the chord. Soon after the artery has passed through the ring and descended some way on the fore part of the vessels forming the chord, it divides into branches, varying in number from six to nine or ten; these separate at acute angles from each other, and enter the upper edge of the testicle singly: from the form of these ramifications, they have been named vasa pyramidalia testis.

The testicle receives another vessel of a smaller size, generally from one of the branches of the internal iliac artery, but sometimes from the inguinal, which runs downward on the back part of the chord, in contact with, or very near the vas deferens: this is called the posterior spermatic artery: it is sometimes distributed to the epididymis and coats of the testicle, but vessels from it often enter the substance of the gland.

The veins which pass from the upper edge of the testicle are very numerous; as they ascend in the chord they form extensive communica-

tions with each other; which, towards the testicle, often enlarge and become varicose: these communications continue until they pass through the ring, and have had the name of vasa pampiniformia given to them. One trunk is then formed, which usually enters the vena cava inferior on the right side, and the renal vein on the left; but this is subject to some variety. The spermatic veins in the abdomen occasionally communicate with the lumbar and mesenteric veins. A vein from the testicle, which accompanies the posterior spermatic artery, generally passes into the internal iliac trunk, but sometimes into the inguinal vein.

The absorbent vessels of the testicle are very numerous, and arise from every part of its surface and substance: they have been divided by Mr. Cruikshank into four sets, viz. those of the tunica vaginalis, those from the deeper seated parts of the testicle, those of the rete testis, and those of the epididymis. There is not, however, any good reason for this division, arising from any difference in the appearance of the vessels or in their mode of action; for they all join in the formation of four or five trunks, which ascend along the chord, and pass through the ring, without forming any communication with the glands in the groin, but pass upwards on the anterior surface of the psoas muscle, behind the peritonæum, and terminate in the lumbar glands. I have never seen fewer than four trunks

running upwards in the chord, but I have frequently seen double that number. These absorbents have often been injected from the attempt to fill the seminal vessels in the testicle with quicksilver from the vas deferens; but when so, it has never been by a continuity of canal; in every instance where I have seen them thus injected, there has been extravasation of the quicksilver into cellular membrane.

The absorbent vessels are so numerous on the surface of the testicles of dogs, that a puncture having been made, not sufficiently deep to pass through the peritonæal coat, and air inflated, it will in general fill as many vessels as will completely cover the whole surface, and distend also several trunks running along the chord.

The great number of these absorbents prevents the necessity of any particular vessels being formed for returning the semen into the blood when the vessels of the testicle have been distended by it, without its having been evacuated by the excretory duct; and the whole of these passing into glands situated in the abdomen furnish a sufficient reason, why in the beginning of scirrhous affections of the testicles, the glands in the groin do not enlarge, as the matter absorbed cannot reach them; but when the scrotum partakes of the disease, the absorbent glands of the groin immediately enlarge, as the absorbents of that part pass directly to them.

The testicle, although an organ not necessary to the life of the individual, is one absolutely necessary to the existence of the species; it is therefore considered by nature as a most important viscus, and as such receives its nerves from the same source which supplies the vital viscera. The nerves are sent to it chiefly from the inferior mesenteric plexus, which is formed by branches descending from the semilunar ganglion, but filaments from the intercostal trunk in the abdomen also join them; these accompany the blood-vessels through the ring, and account for the sympathy between the stomach and intestines and this organ, and the general derangement of the constitution, when any violent disease affects the testicle. I have traced branches from the superior mesenteric plexus, and also from the renal plexus, passing to join the nerves going to the testicle. Some branches of the lumbar nerves coming from the second, third, and fourth pair, are also found on the chord, which are distributed partly to the cremaster muscle, and partly to the coats of the testicle, and do not enter into its snbstance: but these last will account for the testicle being drawn up close to the ring in tumefactions of the kidneys and other parts which press on the trunks of the lumbar nerves.

The vas deferens, or excretory duct of the testicle, is also found in the chord, and is readily distinguished from the other vessels by its cartilaginous

feel; it is continued from the under part of the epididymis, and immediately ascends on the back part of the chord, and passes with the rest of the vessels and nerves through the ring; it then leaves the spermatic rope, and descends into the pelvis, passing backwards in the form of an arch on the outside of the peritonæum, to which it adheres; it then reaches the side of the bladder, to which it is connected by cellular membrane, and continues its course towards the cervix of that viscus, gradually inclining inwards during its descent, and coming at last in contact above the base of the prostate gland with the vas deferens of the opposite side, with which, however, it forms no other communication: in this course it passes behind, and crosses, the umbilical artery; it crosses also, but passes before, the ureter; adheres then to the inner edge of the vesicula seminalis, with which, immediately above and behind the prostate gland, it communicates, so that the fluids from each pass by a common duct which perforates part of the prostate gland, into the lower part of the urethra by the side of the caput gallinaginis.

LECTURE IV.

ON SECRETION GENERALLY. ON THE STRUCTURE OF THE TESTICLE. ON THE FIRST FORMATION OF THE TESTICLE, AND ON ITS DESCENT TO THE SCROTUM.

When I last had the honour of addressing this audience, the properties of semen were mentioned, and some observations made on the situation, form, and vessels of the glands which secrete this fluid.

Secretion is that action in an animal body, by which fluids are separated from the blood, that were mechanically mixed with it, or new fluids formed, whose elements, although not combined, were contained in the blood-vessels.

To accomplish the first of these processes, it does not appear that any peculiar structure, forming a gland, is necessary; for those minute arterial branches which open upon every internal surface of the body, seem capable of themselves to separate a fluid from the blood of a serous nature, or only differing from serum in the proportions of the various substances which that fluid contains.

This action is not unlike filtration, and requires no intermediate structure between the arteries and the parts where the fluid is to be deposited; there is, therefore, no excretory duct.

Next to the serous fluids, the secretion of the mucous fluids requires the least complicated structure. The mucous fluids are formed by the minute branches of arteries on surfaces, the vessels of which contain red blood; and, when secreted, they are deposited on these surfaces, to which they adhere, affording to them protection and defence: they are also secreted by small follicular glands, and, in some instances, on the vascular inner surface of small cavities, called lacunæ, the orifices of which allow the mucus to escape and spread over the surface of the membrane on which they open.

But those fluids which are essentially different from the blood, require a more complicated structure, and have accordingly masses of vascular flesh called glands, appropriated for their formation: the minute structure of each, as well as the secreted fluids themselves, varies, each different fluid requiring a particular structure for its secretion. Neither bile, milk, nor semen exist in healthy blood as such; they cannot, by any known chemical process, be formed from the blood, nor can they be formed in any other structures in an animal body, excepting in the liver, the breasts, or

the testicles; but the liver cannot form milk or semen, the breasts cannot form semen or bile, nor the testicles form bile or milk.

Many theories have been entertained on secretion, founded on the peculiar structure of the different glands; some of these have been ingenious, and others very evidently absurd. At this moment it is not known how secretion is actually performed in any one gland.

With the exception of the liver, in which secretion takes place from venous blood, all the other glands are supplied with arterial blood for that purpose: such blood cannot differ much in its properties in any of the branches of the aorta; but as the blood is conveyed to some glands by the shortest possible course, and by one artery; and to others by a long contorted route, or by many branches from neighbouring arterial trunks, it does seem probable, that different velocities of its current, different junctions, size, and angles of its vessels, may dispose this fluid to different arrangements, so as to produce peculiar secretions; still the secretions must be formed by the immediate action in the vessels of the glands, disposing and exciting the blood to different combinations, actually to produce them. It is probable that we shall never know more of secretion than what amounts only to conjecture; but, notwithstanding, it is very necessary to inform ourselves of the minute

structure of glands, as far as it can be unravelled; for, without such knowledge, no physiological reasoning can be well founded.

ON THE STRUCTURE OF THE TESTICLE.

The secreting structure of the testicle is inclosed in a membrane termed the tunica albuginea, a name given to it from the whiteness of its colour, this arising from no vessels containing red blood ramifying on its outer surface. On this membrane, the tunica vaginalis is reflected, and adheres so firmly to it, that with great difficulty the two membranes can be separated. The reflected part of the tunica vaginalis is very thin.

The tunica albuginea is a firm and dense membrane; it is fibrous, but not muscular; the fibres run in a variety of directions. It possesses some elasticity, so that it yields a little when the vessels of the testicle are full, and contracts, after they have been evacuated, to its former state. From its density, it often presents much resistance to the sudden enlargement of the testicle, and thus contributes to the great degree of pain which always attends an active inflammation of that organ.

To the inside of the tunica albuginea, where it lines the upper and posterior edge of the testicle, a particular set of vessels is firmly attached,

and at this part the other vessels and nerves of the gland enter. A white prominent substance extends along this part, from the one extremity of the testicle to the other, which has been named the corpus Highmorii; it has also been called the nucleus of the testicle.

A number of narrow white slender bands pass from this part to different portions of the inside of the tunica albuginea, forming small septa, the spaces between which become wider as they recede from this body. The use of these septa appears chiefly to be, the support of the packets of the tubuli testis. I have generally found the large veins of the testicle clinging to these septa; and indeed some of these septa, on injection, have proved to be merely veins, which collecting branches as they ascend, leave the substance of the testicle by perforating the tunica albuginea, and then mount upwards with the chord. The larger arterial branches are generally in the vicinity of these membranous bands.

Between these bands there is a lightish brown substance, from which the tunica albuginea can readily be detached, excepting where the corpus Highmorii is placed. This substance appears to consist of very minute and highly twisted vessels formed into packets, connected to each other by very fine and loose cellular membrane, and which ascend, and appear to be attached firmly

at the inside of the upper edge of the tunica albuginea. There are from thirty to forty of these packets, and the vessels forming each packet are very numerous. These vessels, when drawn out and untwisted, appear to be of considerable length, and very small in their circumference. A celebrated anatomist has reckoned the diameter of a single tube to be the three hundredth part of an inch, and asserted that the length of the whole when unravelled, in an adult testicle, proved to be 5208 feet. These vessels have been called the tubuli testis, and they form the largest proportion—indeed, nearly the whole—of the bulk of the testicle. The semen is first found in these tubuli. They are supposed to proceed from the most minute arterial branches by a continuity of canal, as no intermediate substance has been discovered between them in the most highly injected testicles. They may be filled with quicksilver from the vas deferens, contrary to the course of the semen. I now produce many preparations, showing the appearance of the packets of tubuli when thus injected*.

Each packet of tubuli surrounds a short and straight vessel, placed at its upper extremity, into the bottom and sides of which the tubuli enter and deposit the semen, first found in their cavities. This common recipient of the fluid from the tubuli

* Several very beautiful preparations of injected testicles were shown, and particularly described, at this part of the Lecture.

of each packet has been called a vasculum rectum: I have sometimes seen two or more vascula recta belonging to the same packet of tubuli. The length and circumference of these vascula recta are subject to some variety; the vessels seldom, however, exceed one tenth of an inch in length, and are usually about one third of their length in diameter.

The vascula recta pour their contents into a set of vessels of a cylindrical shape, which have been named the rete testis. These are firmly attached to the tunica albuginea, running parallel to each other in the direction of the corpus Highmorii: they are generally about thirty in number, and form immediate communications with each other, either by lateral openings or by very short branches, so that the fluid poured into one will readily pass to the others. The vascula recta are inserted into the rete testis nearly at right angles.

At their upper and anterior extremities each of the vessels forming the rete testis sends off a tube, which leaves the body of the testicle and enters the epididymis singly, where it forms numerous convolutions, which assume a conical shape; these tubes are named the vasa efferentia testis, and vary in number from thirty to forty. At the upper and anterior part of the epididymis they unite in succession with each other, so as ultimately to form one vessel, which, being thrown into numerous convolutions, constitutes the epididymis. It has

been calculated that, were these convolutions to be unravelled, the length of the vessel forming the epididymis would exceed thirty-one feet, and that it makes, while forming the epididymis, 11,100 flexions. The knowledge of the exact number of flexions can be of no consequence, but their extent proves that slowness of motion is necessary to perfect the semen.

The tube increases in capacity as it approaches the lower extremity of the epididymis, and from this circumstance also, the motion of the semen in that part must be slower; it then suddenly bends inwards, the convolutions cease, and the vas deferens is formed, which, ascending at the back part of the chord, takes the course I have formerly mentioned.

In injecting the seminal tubes of the testicle, by throwing in quicksilver by the vas deferens, it is not unusual to find a vessel filled from the epididymis, which, leaving that body, mounts upwards on the chord. It has been supposed that such vessel was intended to convey any semen which might be secreted but not used in generation, from the testicle back to the blood; from which supposition the name of "vas semen sanguini reddens" has been applied to it. It has been already shown that the absorbent vessels of the testicle were sufficiently numerous to effect the above purpose; but no dissection has found that

this supernumerary tube has ever extended beyond the brim of the pelvis, and many dissections have proved that it seldom has reached so high as that part. In some instances, when a vessel of this description has run upwards in a straight direction, it has been mistaken for a second vas deferens; but, when traced on, it generally has been found to terminate in an imperforated extremity, or cul de sac, and therefore has been not unlike to the diverticulum ilei.

A straggling portion of the epididymis has sometimes been found to leave that body and mount upwards on the chord, and, after having formed several convolutions, to have returned back, so as to convey the semen to the vas deferens. Preparations of these varieties are before us. The term vasculum aberrans is now commonly used to express such wandering vessel.

The coats of the seminal tubes, in the body of the testicle and upper part of the epididymis, are much too thin and minute to have their structure clearly made out; but, at the lower part of the epididymis, where the vas deferens is formed, and in the vas deferens, two coats can be demonstrated. The external coat is white and thick; it has a cartilaginous feel and consistence; it has also fibres, which, although they are not very distinct, and are irregularly disposed, in all probability have muscular properties, and are employed in forcing on the semen through so many and such different

convolutions; for the general compression of the testicle from the cremaster and dartos muscles would have very little effect in doing this if unassisted; and the vis à tergo from the arteries scarcely seems sufficient for such purpose. Some anatomists have, however, supposed that the power communicated from the arteries is sufficient to press on the semen, without any muscular contraction in the epididymis or vas deferens; indeed, that the cartilaginous consistence of the vas deferens was given to it for the purpose of the canal being always kept open, so as to afford no resistance to the vis à tergo from the arteries. The internal coat of the vas deferens is connected by firm cellular membrane to the external coat; it is vascular, and appears to be formed into small cells on its interior surface; these cells are very apparent where its cavity enlarges previous to joining the vesicula seminalis, and give to it a honeycombed appearance, similar to that which is found in the vesicula itself. Such is the structure of the testicle, so far as it can be ascertained by injections.

DESCENT OF THE TESTICLE.

The knowledge of the descent of the testicle through the ring to its permanent situation in the scrotum, has thrown much light on many circumstances connected with the structure and forma-

tion of its coats, and also on the nature of some important diseases which frequently occur in them, or are much connected with them and the surrounding parts, such as hydrocele and hernia.

This discovery arose from Dr. William Hunter and Mr. Sharp, in consequence of the latter having stated that he had seen the intestine in contact with the testicle in herniæ, examining together a subject which was brought into Dr. Hunter's dissecting-room ruptured on both sides, the size and shape of the swelling being almost exactly the same in each. On one side, on laying open the hernial sac, the testicle immediately appeared in contact with the protruded parts at the bottom of the cavity; on the other side, the tunica vaginalis and the lower part of the hernial sac were between them: these gentlemen then concluded that, in the first instance, a laceration had been produced in both of these membranes. Some time after this, Dr. Hunter discovered, in examining the contents of the abdomen in a still-born child, of seven or eight months, both the testicles lying in that cavity. This he mentioned to his brother with some degree of surprise, and requested him to take every opportunity of learning exactly the state of the testicle before and after birth, and how the intestine was situated in regard to it in ruptures of children. The result of these inquiries was mentioned by Dr. Hunter to his pupils in the year 1756, and was afterwards pub-

lished in his Medical Commentaries, and since republished by John Hunter, in his Observations on certain Parts of the Animal Economy. John Hunter's investigations soon made out that the testicles are formed in the cavity of the abdomen, and therefore, until the approach of birth, they may be considered as parts of the abdominal viscera.

From their first formation until the sixth month, they are situated immediately below the kidneys, on the fore part of the psoæ muscles, and on each side of the rectum, the greater part of which, in the fœtus, lies before the lumbar vertebræ, the cavity of the pelvis being very small when compared with its relative capacity in the adult. At these periods the shape and appearance of the testicles are nearly the same as we find them afterwards when in the scrotum; but the connexion of each testicle being by a loose fold of peritonæum to the loins, between which its vessels and nerves pass, the precise position will readily be altered by any pressure from the surrounding viscera. The peritonæum covers the testicle in the same manner as it does the other abdominal viscera, passing to the testicle from behind, so as to reach its posterior and part of its upper edge, and then being reflected over its body, as also over the epididymis.

The testicle, in the fœtus, is also connected to the parietes of the abdomen, and to the scrotum,

by a pyramidal-shaped substance, to which the name of gubernaculum testis has been given. The basis or broadest part of this substance is thick and bulbous, and is attached to the lower extremity of the body of the testicle and of the epididymis, from which it descends, on the fore part of the psoas muscle, to the inner orifice of the ring; its slender extremity then passing through the ring is lost in the cellular membrane immediately below the outer opening. While in the abdomen the gubernaculum forms a projecting mass, and, excepting at its posterior surface, where it is attached by cellular membrane to the psoas muscle, it is covered by the peritonæum: it is vascular and fibrous, the fibres running chiefly in the direction of its length, and, very probably, being possessed of muscular properties. In some animals, in which the testicles continue to be lodged in the cavity of the abdomen during life, they are found to have a ligament similar to the gubernaculum, extending from each of them to the groins. The fibres of the cremaster muscle run upwards immediately under the peritonæum, on the surface of the gubernaculum. In the human fœtus the fibres are very thin and pale, but may be traced from their leaving the internal oblique muscle to the testicle in the loins; and I have traced them thus far distinctly in more than one instance, although John Hunter has observed that the cremaster at this period forms so slender a muscle, that he could not

trace it to his own satisfaction either turning up towards the testicle, or running downwards towards the scrotum. In those animals where the testicles, either intentionally or accidentally, remain in the cavity of the abdomen, the fibres of the cremaster muscles are found running towards them.

The peritonæum is loose on the surface of the psoas and iliacus internus muscles, but it is closely applied to, and gives a firm covering both to the testicle and its gubernaculum. At the ring a portion of it passes outwards with the slender extremity of the gubernaculum, making, of course, a slight depression or pouch opening from the abdomen. The peritonæum which does this is thin, but all around this descending part, on the inside of the ring, the peritonæum is firmer and less loosely attached. The loose part of the peritonæum covering the narrow part of the gubernaculum, by drawing the testicle upwards, may be made tight, and then no cavity appears leading towards the ring. But when the scrotum and gubernaculum are drawn downwards, an aperture is seen from the cavity of the abdomen all around the fore part of the ligament, and which seems ready to receive the testicle.

Between the fifth and sixth months, sometimes later, the testicle begins to move towards the ring; about the seventh month it has usually reached the inner orifice of the ring; and during or before

the ninth, it passes through the ring: so that before birth it is generally found in the upper part of the scrotum; from this it descends until it reaches its ultimate situation. During the whole of its course the descent is not sudden, but very gradual.

The gubernaculum testis passes through the ring first; and as, from its pyramidal shape, the size increases, it may, on the principle of a wedge, contribute to the enlargement of the opening—thus both directing the descent of the testicle which is to follow it, and making room for its passage.

In passing through the ring, the gubernaculum carries along with it the peritonæal coat which covered it in the abdomen; so that, as it descends, the appearance of a bag (continued from the cavity of the abdomen through the ring, ready to receive the testicle when that body has reached its inner orifice) is very distinctly marked. The testicle, both during its passage to the ring and through it, carries along with it its original peritonæal coat, adhering by the reflexion of such coat during the whole of its descent to the parts behind, in the same manner it did at its first formation. The testicle, therefore, does not pass abruptly forward, and fall into the pouch ready to receive it, and remain in its descent, suspended by its vessels attached only above, but it slides gradually into the passage, continuing still to be attached to the parts behind by the peritonæum, between the folds

of which the vessels and nerves reach its substance. When the testicle has passed through the ring, it therefore remains covered by the peritonæum, in a similar manner as when in the cavity of the abdomen, the portion of peritonæum which descended with the gubernaculum investing it loosely, as the peritonæum did which lined the abdominal parietes, and being continued into that portion of the same membrane which covered and was intimately attached to its surface, and descended with it from the abdomen, a bag is thus formed, into which the testicle projects; and this bag, having a smooth internal surface, and being composed of the peritonæum, continues to possess all the other properties of that membrane, secreting a lubricating fluid, which allows the testicle to slip from any external pressure from common causes. As the inner surfaces of different parts of the peritonæum do not unite when placed in contact, unless some inflammation arises, it is evident that, on the first descent of the testicle through the ring, a communication must be open from the abdomen to the bag in which it is placed, so that fluid in the living, or a probe in the dead body, would pass from one to the other. A portion of intestine or omentum also might insinuate itself into the opening, and would then be in contact with the surface of the testicle. This actually does happen in hernia congenita; and accounts for the appearance met with by Mr. Sharp, and com-

municated by him to Dr. Hunter, and which, the descent of the testicle at that time being unknown, had been accounted for by the laceration of the hernial sac, and of the tunica vaginalis testis.

The aperture from the abdomen puts on the usual appearance of that of a hernial sac, with a small mouth or entrance; and if the passage be laid open by an incision on the fore part, the communication with the abdomen and lower part of the bag into which the testicle, with its epididymis, projects from behind, will be very apparent, and the whole bag will then be seen to be a continuation of the peritonæum, the posterior outer surface of which covers the vessels of the chord from the groin to the testicle.

In the descent of the testicle, the apex of the gubernaculum never leaves the neighbourhood of the ring, and remaining there after the testicle has reached the scrotum, during the descent it must have been inverted; the base which was in the abdomen, now being in the scrotum, and the surface which was anterior, now having become the posterior surface. It can be traced adhering to the testicle for some time after its descent, but it afterwards becomes obliterated and lost. The fibres of the cremaster muscle spreading on the gubernaculum, suffer the same inversion, but they remain adhering to the chord and to the membrane enveloping the testicle. The part of the passage which affords the most resistance to the descent of the

testicle, is the opening in the tendon of the external oblique muscle, for tendon being an unyielding material, is dilated with difficulty; sometimes, indeed, it prevents the testicle from reaching the scrotum, and keeps it confined above that part of the ring.

The passage of the testicle and of the spermatic chord through the parietes of the abdomen, is not the shortest and most direct, but is of some length, and very oblique; this is necessary to prevent the viscera of the abdomen from protruding through it; to which, from the constant and occasionally increased pressure made on them by the abdominal muscles and position of the body, they are always much inclined; but, notwithstanding this structure and form of the passage, herniæ very frequently take place through it; every surgeon should therefore be well acquainted with its nature, situation, and course.

There are few surgeons who can now be ignorant, that Poupart's, or Fallopius's ligament, extends from the superior anterior spinous process of the ileum, and is inserted into the tuberous angle of the pubes; that the lower edge of the external oblique muscle of the abdomen is attached to its upper surface; also that many fleshy fibres of the internal oblique and transverse muscles, arise from its inner or posterior surface; and that with these parts the passage of the spermatic vessels is much connected, as is also that of inguinal hernia, for

the protruded viscera must follow the same course with the chord.

This passage, which some surgeons have lately called the inguinal canal, begins very nearly about half way between the two attachments of Poupart's ligament, and the two extremes of it have been called the internal and external rings; but the term, abdominal ring, has been by some anatomical authors applied to the whole passage.

The spermatic vessels and nerves reach the superior and internal orifice of this canal, passing to it behind the peritonæum.

This first orifice, or inner ring, is formed by an aperture in a thin expansion of fascia which proceeds from the posterior margin of Poupart's ligament, and whose fibres, running upwards between the back part of the transversalis muscle and the peritonæum, adhere to both, and become gradually lost. The fibres of this fascia divide to give passage to the spermatic chord, and by again uniting form a circular boundary to the canal of some firmness; but occasionally the fibres are so thin, and so indistinctly marked, as to give the fascia little more than the appearance of condensed cellular membrane.

The spermatic vessels pass through this aperture covered by their investing membrane, which was formerly peritonæum; they then extend downwards, and incline inwards and forwards towards the pubes, passing under the lower

margin of the transversalis and internal oblique muscles, but without perforating any part of their substance. The spermatic rope is here bounded on the posterior part by the fascia already described arising from the inner surface of Poupart's ligament, and on the anterior part by the tendon of the external oblique muscle before it forms the outer ring, of course above its insertion into Poupart's ligament. The chord is here connected to the inner circumference of the passage by cellular membrane, more or less condensed, and receives on its outer surface those fleshy fibres detached from the transversalis and internal oblique muscles, which accompanying it through the ring, form the cremaster muscle. In this manner the chord descends until it reaches the opening in the tendon of the external oblique muscle, and in doing this it crosses before the epigastric artery and its corresponding vein.

The external or outer ring is not round, but is formed by a slit, or rather something of a triangular-shaped opening in the tendon of the external oblique muscle. This opening is broadest below, near to the pubes. The fibres of the tendon, which descend obliquely from the part of the muscle above the ileum, separate into two columns, one of which is attached to Poupart's ligament, and, passing below and behind the perforating chord, is inserted into the pubes at the root of and before the tuberous angle, immediately above the lower

extremity of the ligament. The other column passes above or before the chord, and is inserted into the upper part of the body of the pubes from the root of the tuber to near the symphisis. The chord, therefore, actually passes through a distinct opening in the tendon, and not, as some writers have described, through an opening formed above by the tendon, and below by the ligament.

Several packets of fibres proceeding from the fore part of Poupart's ligament, are found on the outer surface of the tendon, which cross the oblique descending fibres before they separate to form the outer ring; of course these strengthen the tendon, and resist farther dilatation of the opening.

In females the vessels of the round ligament of the uterus pass through this opening, and are lost on the labia pudendi. Winslow describes the external ring to be situated lower down in this sex than in males; but in saying this, he could only mean that it does not extend so far upwards in the direction of the anterior superior process of the ileum; for, near the pubes it is equally low down in both sexes, and could not be lower unless it had perforated the bone. It is certainly smaller in the female than in the male, for in the female it never was dilated to allow a large body, such as the testicle, to pass through it, or to give passage to so many and such large vessels as belong to that organ.

In inguinal hernia, the sac and protruded vis-

cera take the same oblique course in their descent; it is, therefore, obvious, that when the protruded parts have been returned, to prevent a second protrusion, the pad of the truss should not be applied immediately to the external ring, for, if so applied, it would obstruct the circulation of the blood in the testicle by compressing the vessels of the chord against the bone, while it left the upper part of the passage open to receive any viscus that might be forced into it, and which might be strangulated as soon as it had entered; the pad should therefore be applied above the external ring, and between the two extremities of the inguinal canal.

But to return to the descent of the testicle. In quadrupeds the passage between the cavity of the abdomen, and that in which the testicle is lodged, remains open during life; but in the human body, had it remained open, its depending position would have encouraged the falling of the intestines or omentum into it, and hernia would have been the certain consequence. The opening, therefore, begins to be closed immediately after the testicle has passed through it. The obliteration is effected by the whole of the internal surface of the peritonæum at, and immediately below, the ring adhering. This obliteration is generally begun before the birth of the child; and proceeding downwards from the groin, until it nearly reaches the testicle, it there ceases, leaving at the lower part a bag loosely

inclosing the testicle, into which that organ projects from behind. It thus is clearly ascertained, that the tunica vaginalis was formerly peritonæum, that which loosely envelopes the testicle having descended with the gubernaculum, and that which is closely applied to the tunica albuginea, so as to be nearly inseparable from it, having been the peritonæal covering it had in the abdomen, and which descended with it. The obliteration of the passage appears to take place from an established law of the constitution, and, as John Hunter has expressed it, seems to be a peculiar operation of nature, depending upon steady and uniform principles, and not the consequence of inflammation or of any thing that is accidental.

This obliteration does not, however, always take place immediately after the descent of the testicle, for I have known a hernia occur in a person twenty-eight years of age, who, according to the account of his parents, had at no period before in life been affected with this disease, and which proved fatal in eleven hours. I was desired to open the body, and in so doing found the intestine strangulated and in contact with the testicle; I produce the preparation for your inspection. It seems probable, from the numerous cases of congenital herniæ which have occurred, that if nature is prevented, by the slipping into the passage of a portion of intestine or omentum, from effecting the oblitera-

tion at first, she finds much difficulty in completing it afterwards.

The immediate cause of the descent of the testicle has never been satisfactorily accounted for. The cremaster muscle, which has been supposed by some physiologists to effect the descent, could only, by the utmost extent of its contraction, draw the testicle into the opening of the internal ring; it would then rather tend to keep the testicle in the passage, than to assist the passage of that body through the opening in the tendon of the external oblique muscle. And that this muscle does not produce the descent, we may infer from those animals whose testicles are intended by nature to remain in the abdomen during life, having the cremaster muscle running upwards to join them. The gubernaculum does not seem to possess more power in assisting the descent than what arises from its wedge-like shape; its apex never leaves the ring, and it becomes inverted as the testicle passes through the external opening. Those who have attributed the descent of the testicle to pressure by respiration, have forgotten that the testicle is found to be on the outside of the ring previous to the child's birth, therefore before this supposed cause could exist. It cannot be doubted that the erect position of the human body, the constant and alternate pressure of the abdominal muscles and diaphragm in respiration, and their

conjoint action in expelling the urine and fæces, might contribute mechanically to the descent of the testicle if this process took place after birth; for we find these causes often producing protrusions of the viscera through the ring, not only before the passage from the abdomen to the testicle is closed, as in congenital hernia; but long after the obliteration has taken place, as in the usual inguinal herniæ, when a process of peritonæum is forced out, so as to form the sac; but the natural descent being before birth, no advantage can be gained from such mechanical assistance. I may here be permitted to observe, that at the period of birth, in cases of breech presentation, from the position of the child and the greater degree of pressure it suffers, congenital herniæ are found more frequently to take place than when the infant comes into the world in the usual way.

If I have dwelt too long on the descent of the testicle, my doing so has arisen from the anxious wish that this process should be perfectly understood, as the description which I have now given must be referred to, should I ever have the honour of submitting the nature of herniæ, hydrocele, or other important diseases of those parts which require operations, to this audience.

LECTURE V.

ON THE VESICULÆ SEMINALES. ON THE PROSTATE GLAND, AND ON COWPER'S GLANDS.

The vas deferens, having received the semen from the lower part of the epididymes of the testicle, conveys it through the ring, and from thence, by the course already described, to the space beyond the part where the peritonæum is reflected from the bladder to the rectum. It then passes between the two viscera, adhering to the outer surfaces of both, and to the vesicula seminalis of its own side by cellular membrane. In this situation its breadth and capacity become much increased, so that, in appearance and in the structure of its coats, it is not dissimilar to the vesicula, along whose inner side it passes to the base of the prostate gland. In approaching this gland it gradually becomes smaller, and joins at a very acute angle the lower extremity or cervix of the vesicula of the same side, but has no communication with the vas deferens, or with the vesicula of the other. The common duct, formed by this junction, enters the substance of the prostate gland at the notch on the

middle of its base, and passing on towards the under part of the urethra, which the gland here surrounds, it gradually contracts its cavity, and, having formed a tube varying it extent from half to three quarters of an inch, it enters the urethra by a small opening on the side of the caput gallinaginis.

The vesiculæ seminales cannot, like the testicles, be considered as organs essential to generation, for some of the more perfect quadrupeds do not possess them; they are wanting in many of the fiercer animals, but not in all: thus, although the lion, panther, cat, and dog, are without them, they are very large, thick, and capacious in the rat and in the hedgehog. They are found in many animals which are not naturally carnivorous, as in the elephant, camel, horse, bull, and sheep; but in these animals they have either no communication, or, if any, one which is very imperfect, with the vas deferens. This communication takes place distinctly only in man, and in those animals which most resemble him in form, as in the whole tribe of simiæ. Vesiculæ seminales are not to be found in birds, amphibious animals, nor in fish which have testicles.

John Hunter, who does not consider these bags as reservoirs for semen, but as glands secreting their own peculiar fluid, observes, that if they were reservoirs of semen, they would be more necessary

in birds than in other animals, as birds have the power of repeating the act of copulation much more frequently than quadrupeds; and he says, that in birds there are other reservoirs, which will account for this power: the vasa deferentia being enlarged just before they enter the rectum, probably to answer that intention. In birds some reservoir is absolutely necessary, for they have no urethra, but simply a groove, as in the drake and gander, and many are even without the groove, as in the common fowl.

It is well known that animals possessing a penis, but destitute of vesiculæ seminales, remain for a long time in sexual contact, for the fluid necessary for fecundation, from the long course it has to take, during copulation, only flows into the urethra drop by drop.

In men, the vesiculæ seminales form two oblong bags, situated behind and below the bladder, between that viscus and the rectum, in the space to which the peritonæal covering of these two viscera does not extend. They are surrounded by cellular membrane, and more intimately connected by that substance to the bladder, than to any other part. Like to the terminations of the vasa deferentia, to whose external lateral edge they adhere, their anterior surfaces are concave, adapted to the bladder, and their posterior convex, adapted to the hollow sweep on the fore part of the rectum.

Their position is oblique, for their lower extremities are separated only by the vasa deferentia, while their upper extremities are placed at a considerable distance from each other on the sides of the bladder. They are rounder and broader at their upper extremities than at their lower; their breadth at the widest part is generally three or four times less than their length; and their thickness is about one third of their breadth, but they gradually become less broad as they approach the cervix of the bladder. The size of the vesiculæ varies in different men; but this variation does not seem to depend upon bodily height; for, in some men of short stature, they are in every respect larger than in others who are tall.

The external surface of the vesiculæ seminales is unequal, giving to them the appearance of being formed of the convolutions of vessels whose diameters repeatedly vary; and when long macerated and carefully dissected, the contortions may be unfolded, so that they will appear as long vessels with openings on the sides, which in the original form were so applied as to correspond with each other, and to permit the contents of the vesiculæ to pass through them from one part of the tube to another. When distended they appear to consist of large irregular cells; this is more distinctly seen when they have been inflated, dried, and then slit open.

The vesiculæ seminales have two distinct coats, the external of which is soft, thick, and pulpy to the feel, and not unlike the lower end of the vas deferens, to which it is joined. It is fibrous, and these fibres appear to be muscular, but cannot be traced into any regular arrangement in their direction. In some quadrupeds, as in the horse and ass, the vesiculæ seminales form large bags, and the muscular structure of their outer coat is very evident to the sight, and is divisible into two distinct layers. The inner coat is very different from the outer; it is much more vascular, and is every where on its surface formed into small cells of a honeycombed appearance, from which short villi project: these cells are irregular, however, both in size and shape, and are not dissimilar to those on the inner surface of the gall-bladder and biliary ducts; the inner coat has thus every appearance of being, and no doubt is, a secreting membrane.

The vesiculæ seminales are abundantly supplied with arteries from the same trunks which supply the bladder; they have also numerous veins and absorbents, which communicate with those belonging to the bladder. Some filaments of nerves arising from plexuses of the intercostal, and joining small branches from the fourth and fifth sacral nerves, may be traced into their coats.

Each vesicula near the base of the prostate

gland ceases to be cellular, its inner surface becomes smoother, and it forms a duct of a conical shape, by gradually contracting its circumference; this duct closely unites itself at a very acute angle to the lower part of the vas deferens, which at last opens into its cavity. The surfaces of these vessels, which are in contact previous to this opening, unite and form a kind of septum, which projects some way between their cavities, and terminates by a semicircular edge; and, as the canal leading from the vesicula is larger than that leading from the vas deferens, this septum allows of fluid passing more easily from the vas deferens into the canal of the vesicula, than from the canal of the vesicula into the vas deferens. The common duct, thus formed, as I have before stated, is from half an inch to three quarters in extent; it continues to grow narrower as it passes behind the third lobe of the prostate gland; it perforates that body, and, running some way along the under surface of the urethra, it enters obliquely the cavity of that canal by a small opening on the side of the caput gallinaginis. The junction of the two vessels which form this common duct, is such, notwithstanding the acuteness of the angle, that air, gently thrown into the vas deferens by a blowpipe, will inflate the vesicula before it enters the urethra; but, if thrown in with violence, it will immediately inflate both the urethra and the vesicula.

When the fluid contained in the vesiculæ seminales is examined, it appears of a brownish colour, and much thinner than the fluid found in the vasa deferentia, and it varies both in consistence and colour in different parts of the bag. In smell, it does not resemble the semen; nor does it, like the semen, become more fluid by being exposed to air. In bodies which have been dead some time, the fluid is of a darker brown colour; this might be supposed to arise from the contents in the vesicula having undergone a change in their sensible properties from putrefaction; but when the contents of the vesicula and vas deferens of the same side have been compared, they have been dissimilar in appearance and in other properties.

John Hunter, to be still more certain of the nature of the contents of the vesiculæ than was possible from the examination of bodies which had been dead some hours, took an opportunity of opening a man, immediately after his death, who had been killed by a cannon-ball; he observed that, in this body, the fluid in the vesiculæ was of a lighter colour than in men who have been dead some time; but was not by any means like the semen either in colour or in smell. In another person, who died instantaneously in consequence of a fall from a great height, and whom he inspected soon after the accident, he found the contents of the vesiculæ of a lightish whey colour,

and in so fluid a state as to run out on the vessels being cut into, but having nothing of the smell of semen. From these and many other circumstances he had observed, as to the absence of these glandular bags in some animals, their peculiar formation in others, and their contents almost constantly differing from the semen of the same animal, he was induced to conclude that they do not serve the purpose of reservoirs to the semen until it should be wanted for the act of copulation; which use had hitherto been ascribed to them by all physiologists; but that they secreted a peculiar mucus of their own: and although their particular use had not been ascertained, it was reasonable on the whole to conclude, that they were, together with other parts, subservient to the purposes of generation.

In this theatre, where the labours of John Hunter are so often produced, and doctrines founded on them so often adverted to, I think I may be justified in repeating the grounds, although they may have been published by himself, on which he formed any new opinion. On the propriety of these grounds the members who compose this audience must determine for themselves.

John Hunter has stated, that on examining a mucus, which some men throw out when straining hard at stool, or after expelling the last drops of urine, an action which requires a considerable

exertion of the parts, such mucus resembled the contents of the vesiculæ in the dead body, but was not quite of so deep a colour. This discharge is generally called a seminal weakness; and, if the vesiculæ contain semen, must be so, as it proceeds from these bags; but the power of emitting semen, or fluid similar to that in the vasa deferentia, continuing in the same quantity as usual immediately after the former fluid has been discharged, is, John Hunter asserts, a further proof that the former fluid was not semen.

The examination of the bodies of those men who have lost one testicle, he conceives, will throw more light on this subject than the examination of eunuchs, or those who have been deprived of both testicles; for it is to be presumed that such men have afterwards had connexion with women, and consequently had the act of emission, which must have emptied the vesiculæ of the castrated side if these had contained semen; and, as they could not be replenished, they should have been found empty after death. We can also, in such cases, make comparative observations between the vesiculæ of the perfect and those of the imperfect side. John Hunter then relates the inspection of the body of a man who was received into St. George's Hospital for a venereal complaint, and died there, in whom it was discovered that he had lost the right testicle some consider-

able time before his death, as the cicatrix was hardly observable, and the complaint for which he was received into the hospital was a proof that he had connexion with women after that period. The vas deferens of the right side was smaller and firmer in its texture than the other, and the vessels which ramified upon the right vesicula were not so full of blood. But, on opening the vesiculæ, both appeared to be filled with a kind of mucus similar to that which is found in other dead bodies, and the vesicula of the right side was rather larger than that of the left. This he gives as a proof that the vesiculæ in the human subject do not contain semen.

In a man who died in St. George's Hospital with a very large bubonocele, the testicle of the affected side was discovered to have almost lost its natural texture from the pressure of the hernial sac; and upon examining the testicle there was no appearance of vas deferens until near the bladder, where it was almost as large as usual. The vesicula of that side was found to be as full as the other, and to contain the same kind of mucus.

A married man died about a year after one of his testicles had been extirpated, on account of its being diseased; on examining the body the vesiculæ were both found nearly full, more especially that on the same side the diseased testicle had belonged to. But on examining the vas deferens of

that side where it lies in contact with the vesiculæ, and where it has nearly a similar structure with the vesicula, it was found to be filled with the same kind of mucus.

A young man who had a disease in his left testicle, had the testicle removed at St. George's Hospital, in August, and in February he returned to the hospital on account of uncommon pains all over him, for which he requested to be put in the warm bath; but before he could be placed in it he dropped down, and died almost immediately. On an examination of the vesiculæ, the bag of the left side was as full as that on the right, and the contents in both were exactly similar.

In dissecting a subject for the side view of the pelvis, John Hunter found a bag on the left side above the angle of reflection of the peritonæum, below which the bladder and the rectum come into contact. The left vas deferens passed on to this bag; the vas deferens from the right side crossed the bladder to join it. The left vas deferens was traced down to the testicle, but was found to have no connexion with it, as there was a deficiency of nearly an inch of the lower portion of the epididymis. The right vas deferens was traced from the bag through the ring, about an inch below which it terminated in a blunt point, that was impervious. Below this there was no vas deferens, and the epididymis of the testicle was deficient in

half of its usual length, and its canal terminated in an impervious blunt point. The bag found in the pelvis proved to be the two vesiculæ; for, by blowing into one vas deferens, one half of it was inflated, and from the other vas deferens the other half. No ducts led from this bag towards the prostate gland or to the urethra, and no vascula aberrantia led from the testicles, or their imperfect epididymes, upwards on the chord.

In this subject it was evident that there was no communication between either vas deferens and the epididymis, nor between the bag and the urethra. The testicles were round, and their vasa efferentia leading to the epididymes were filled with semen. The vesiculæ contained the mucus commonly found in these bags. This dissection affords a proof that semen can be absorbed from the testicle and epididymis; and also that the vesiculæ secrete a mucus which they are capable of absorbing when it cannot be made use of. From these cases John Hunter infers that the semen is not retained in reservoirs after it is secreted, and kept there until it is used; but that it is secreted at the time, in consequence of certain affections of the mind stimulating the testicles to this action. When semen, in consequence of such affections of the mind, is secreted and not used, it distends the vessels of the testicle which contain it, and produces a swelling of that organ attended with great ten-

sion and pain, which will often continue until the paroxysm is brought on and the evacuation of the semen through the penis takes place; but during this no sensation of pain or even of fulness is felt in the vesiculæ seminales.

The vesiculæ are found to be as full of mucus in bodies much emaciated, and where persons have died of a lingering disease, as in strong robust bodies, where death has happened from acute disease or from violence, and they are nearly as full in the old bodies as in the young.

Such are the facts which John Hunter has given, taken from the human subject, and which he thinks are sufficient to establish the opinion he has himself adopted; but he has also added facts and observations on them, drawn from his pursuits in comparative anatomy, some of which I think it my duty here to name.

These vesiculæ, he observes, are not similar in shape or contents in any two genera of animals which he has dissected, and they differ more in size, according to the bulk of the animal, than any other parts whose uses in different animals are the same, while the semen in most of those which he has examined may be said to be similar.

In the horse, the vesiculæ are two bags like small urinary bladders, having two layers of muscular fibres and a partial coat from the peritonæum; they are thicker in their coats at the fun-

dus, and appear there to be glandular. Where they enter into the urethra, which they do by one large opening on each side along with the vasa deferentia, the common passage is so short as not to admit of regurgitation from the vasa deferentia into these bags, the septum between them being continued nearly to the urethra. They are not of the same size in the gelding and in the stallion, being largest in the last. Their contents in both are exactly similar, and nearly equal in quantity; but in no way resembling the semen emitted by the stallion in the coitus, or what is found in the vas deferens of that animal after death.

As castration is performed early in the animal's life, before the vesiculæ can be supposed, even did their ducts communicate with the vasa deferentia, to have received semen from these vessels, we have a proof in their fulness of fluid similar to that found in the vesiculæ of the stallion, that they secrete their own mucus. They are connected with generation, although not as receptacles of semen; and if the constitution is deprived of that power by the early removal of the testicles, these vessels do not grow to their full size.

In the boar these vesiculæ, or rather bags, are very large, and divided into cells of a considerable size, having a large duct common to the whole: the ducts contain a whitish fluid, very unlike what is found in the vasa deferentia of the same animal, with which they have no communication.

In the rat the bags are large and flat, with serrated edges, and contain a thick ash-coloured mucus, nearly of the consistence of soft cheese, very unlike the semen of the same animal; and they have no communication with the vasa deferentia.

In the beaver they are convoluted; their ducts have no communication with the vasa deferentia, but both the one and the other open on the caput gallinaginis.

In the guinea-pig they are composed of long cylindrical tubes, and lie in the cavity of the belly; they do not communicate with the vasa deferentia. They contain a thick bluish transparent substance, which is softest near the fundus, and becomes firmer towards the openings into the urethra, where it is as solid as common cheese.

John Hunter found this substance in the vesiculæ of a guinea-pig, immediately after copulation with the female, and six months after he had extracted one of its testicles: had the bags contained semen, he observes, it should have been thrown out in the previous connexion with the female. He then killed a female guinea-pig as soon as the male had left her, and examined with attention what was contained in the vagina and uterus: in neither could he find any of the mucus of the vesiculæ, which, from its firmness, must have easily been detected.

Such are the facts from human and comparative anatomy given by John Hunter, in support of his opinion, that the bags called vesiculæ seminales do not receive semen from the vasa deferentia.

The facts adduced by that great physiologist, and his strong reasoning on these facts, do not, however, afford a demonstrative and conclusive proof, that *in the human subject* the semen may not pass into the vesiculæ from the vasa deferentia. There exists no anatomical or mechanical structure calculated to prevent such occurrence; for, notwithstanding the acuteness of the angle between the two vessels at their junction, from the length of the common tube, the wideness of that part of it formed by the vesicula where the two vessels meet, and the very small aperture by which it opens into the urethra, the fluid (which, from the length and contortion of the seminal tubes, must pass very slowly from the testicle) will insinuate itself much more readily through the large communication with the vesicula than through the very small one with the urethra, unless it is prevented from so doing by the vesicula attempting to throw its contents into the urethra at the same time. In the coitus this attempt is made, and both fluids pass at once into the urethra, where the fluid secreted by the vesiculæ being added to that coming from the testicles by the vasa defe-

rentia, between them a proper quantity is produced to distend sufficiently the sinus of the urethra, that the muscles of ejection may act on its contents with more power.

The same effect may be produced, whether the vasa deferentia and the vesiculæ seminales communicate or not, provided that they both open near each other into the urethra, and both convey their contents to it at the same time.

In the dead body, I have invariably found that air or any fluid, when not thrown into the vas deferens with much force, will fill the vesicula before it enters the canal of the urethra: and, in examining the contents of the vesiculæ, although the fluid contained near the fundus differs in colour, consistence, and smell, from the semen, yet that found towards the cervix is often very similar to semen, or to the fluid contained in the enlarged extremities of the vasa deferentia.

From the frequent excitement of the passions and the gratification of them denied in the civilized state of human society, fluid must often be secreted in the testicles at times when it cannot be naturally evacuated; and, although the accumulation of it in this organ sometimes produces tension and pain, the fulness of the vessels often subsides without these unpleasant symptoms having taken place. Thus, when the secretion ceases, and the vis à tergo no longer drives the semen

slowly on, the muscular properties of the vas deferens may assist in conveying that fluid on towards the vesiculæ, which may receive it until the time of ejectment arrives. They may thus, under particular circumstances more likely to occur in the human species than in brutes, be employed as reservoirs, although their ordinary use may be to secrete a fluid which, mixing with the semen in the coitus, may render the act more perfect, and more likely, therefore, to produce fecundation.

Although I cannot draw exactly the same conclusions with the founder of our Museum, as to the impossibility of the vesiculæ receiving semen in the human body, a fact having come within my immediate knowledge which makes in favour of his opinion so far as regards their secreting their own mucus, I think it my duty to mention it here. Several years ago I was consulted by a respectable tradesman, who had been married only a few months, and whose testicles were much diseased. Mr. Cline met me in consultation on his case; as both of the testicles and greater part of the scrotum were in a state of cancerous ulceration and the chord much thickened, we could not propose the operation of extirpating the diseased parts; soothing means and a palliative treatment were therefore recommended. The patient, however, from the excessive pain which he suffered, was most importunate to have the testicles re-

moved. Having explained to him and to his relatives the small chances there were of the wounds healing, I at last complied with his most urgent request, and ventured to extirpate the diseased parts. I was much surprised to find that the wounds cicatrized in little more than a month, and that no recurrence of the disease, in the space of the two years that he survived the operation, took place. His health for some time rapidly amended, but his peculiar situation as a married man preyed on his mind, and, to smother the feelings it excited, he took to drinking spirits, became dropsical, and died. I was not permitted to open his body; but having tapped him two or three times, I felt, on the evacuation of the fluid, a mass of hard substance in the loins, which I considered as indurated absorbent glands. I was assured by this person, that, after the removal of the testicles, he had occasional erections, not unaccompanied with desire, and which when, as a married man, he indulged, were attended with the usual paroxysm and emission of some fluid; and which, from his description of its colour, consistence, and other properties, I could not doubt came from the vesiculæ seminales. We have in this case a proof of fluid in the absence of the testicles, having been secreted, evacuated, and *repeatedly* renewed, in and by the vesiculæ seminales. That they secrete their own fluid, does not admit of a doubt;

but in the human subject there exists no structure to prevent the semen from entering their cavities.

ON THE PROSTATE GLAND.

The prostate gland forms another structure, which secretes and conveys a fluid into the urethra, and which likewise seems in the human body to be connected with the process of generation.

The fluid of the prostate gland is of a white, or rather of a cream colour; in the dead body it is rather darker than the colour of cream, which may arise from some globules of the blood by transudation mixing with it, or from incipient putrefaction. It is viscid, and has a slightly salt taste. When the passage of the urethra through the gland is slit open from before, and the substance of the gland is squeezed, this fluid may be seen to issue from several pores on the under surface of the canal, by the side of the caput gallinaginis. This secretion seems to be used in lubricating the surface of the urethra, along which the semen is to pass. It is thrown out in considerable quantity when the parts are in a state fit for immediate copulation; much of it then unites to the seminal fluid, and is discharged with that fluid when the paroxysm of emission takes place. Haller observes, that in the discharged semen the white colour and viscidity of the

fluid of the prostate gland are predominant; but I know of no chemist who has particularly analyzed it. The fluid of the prostate gland, like that of the vesiculæ seminales, is not essentially necessary to generation in all animals who possess testicles; for, although the gland is found in men, the tribes of simiæ, the lion, dog, &c. it is wanting in the bull, the buck, the ram, the goat, and most probably in all ruminating animals. In this last class, the coats of the vesiculæ seminales are thicker and more glandular than in those which have prostate glands. John Hunter supposes, therefore, that the vesiculæ answer nearly the same purpose as the prostate gland. Both the gland and the vesiculæ are wanting in birds, in the amphibious animals, and in fish which have testicles, as all the ray kind. The gland is said to be double in the elephant, camel, horse, and some other animals.

The prostate gland, in shape and size, something resembles a chestnut; it has been compared in shape to the ace of hearts, as represented upon playing cards. Like the rest of the viscera of the pelvis, the prostate gland is placed obliquely in respect to the trunk of the body. The sacrum is hollowed out on the anterior and lower surface, and both the rectum and bladder have a sweep which is regulated by the concavity of that bone. The gland is situated between the bladder and rec-

tum, below and behind the bladder, and above and before the intestine, between the angle of reflection of the peritonæum and the lower extremity of the gut. The base of the gland is placed so as to incline upwards and backwards; the apex points downwards and forwards. A depression in the middle of the base divides the gland into two lateral lobes; immediately above this notch are placed the lowermost portions of the vasa deferentia, and the vesiculæ seminales, the ducts of which begin to perforate the gland in the middle of the notch, and then pass into the under part of the urethra where it is surrounded by the substance of the gland. The surface of the gland from this notch to the apex is, on the lower and back part, in contact with the rectum, to which it is connected by cellular membrane; a depressed line, continued from the notch to the apex, along this surface, points out the division between the lateral lobes; this line, however, is not always very distinct. The general appearance of the surface turned towards the rectum is convex. The bladder is intimately attached to the anterior and upper portion of the gland from the base, nearly two thirds of the extent of this surface, towards the apex: in the middle of this attached portion, the urethra is continued from the cervix of the bladder, and passes, surrounded by the substance of the gland, to its apex; the urethra there comes

out, and forming the membranous part, proceeds to the penis. The apex of the gland is placed behind, and a little above, the cartilaginous arch of the pubes.

The surface of the gland to which the bladder is affixed, is slightly concave; the remaining part of the anterior surface is convex, but not in so great a degree as the surface which is connected to the rectum. A strong fascia connects this anterior part of the gland to the symphisis pubis, and to the descending rami of each of the bones forming it. As this fascia approaches the gland, it sends off on each side two thin planes of fleshy fibres, which spread out and are connected to the lateral external surface of the gland, forming what Winslow has called the prostatici superiores and inferiores muscles. These fibres, with their tendinous fascia, serve to sustain the gland; and pressing on its substance in their contraction, will aid in passing the secreted fluid from it into the urethra.

The substance of the prostate gland is firm and compact, and when cut into gives the sensation to the operator of dividing soft cartilage; its substance is whiter than that of any other gland.

Behind the beginning of the urethra, between the passage of the ducts from the vasa deferentia and vesiculæ seminales, a portion of the prostate gland is found connected to both of the lateral

lobes, but belonging exclusively to neither. In the natural state of the gland, this portion makes no prominent appearance; but when enlargement of the gland from disease takes place, it presses upwards towards the cavity of the bladder, immediately behind the commencement of the urethra, and occasionally bends over that opening. When the bladder begins to contract in expelling the urine, this projection is forced downwards, and then, acting as a valve, it closes the passage, so that no urine can pass; and, from its situation, it is clear, that the more the patient strains, the more the difficulty of expelling the urine will be increased. This structure should be well known to every surgeon, and will be referred to in a future part of these Lectures, when the diseases of the gland are before us. Many authors have noticed the diseased appearance produced by the enlargement of this part of the gland, and the valuable specimen of it I now place before you, has been used by me to demonstrate it since I first delivered Surgical Lectures in 1793. Sir Everard Home published an account of the natural appearance of this middle portion of the gland, in 1806; and has so drawn the attention of surgeons towards it, that it is not likely in future to be overlooked. He has named it the third lobe of the prostate gland, by which designation it is now generally known.

In examining the internal structure of the prostate gland, it is found to be supplied with fewer minute arterial branches than most other glands, and from this arises its whiter appearance. The arteries which supply it with blood are branches of the pudicæ internæ; most of these enter on its sides near the base. The veins are numerous, so are the absorbents; they both join vessels of their respective sets coming from the bladder. The nerves belonging to it come from branches continued downwards from the intercostal plexuses, which are joined to filaments passing from the fourth and fifth sacral nerves.

The secreting structure approaches to that of the conglomerated glands, and consists of minute cells, from which small ducts arise and unite with each other, so as to form several vessels, which terminate by separate orifices. I have seen twenty or thirty of these orifices in one urethra, by the side of the caput gallinaginis. When mercury is thrown by an injecting tube into one or two of these orifices, it will, by passing contrary to the course of the natural fluid, inject a portion of the gland; but not the whole.

The urethra passes through it, not actually from the base to the apex, but it begins to enter about one fourth part of the length of the anterior surface of the gland below and before the base; it also passes by at least one third of the

thickness of the gland nearer the anterior surface than the posterior one. The gland can readily be felt by a finger introduced in the rectum, so that its healthy or diseased state can be ascertained from the cavity of that gut.

The glandulæ antiprostatæ, or Cowper's glands, are placed between the bulb of the urethra and the membranous part of that canal. They vary much in size and in consistence, and sometimes they cannot be found. Their usual healthy size is that of a small garden pea. They are not so firm as the prostate gland; they also consist of very minute cells, the excretory vessels of which unite with each other, and form ultimately two ducts, which run forwards on the urethra for about an inch and a half, and then open by large lacunæ on its inner surface. The exact nature of the secretion of Cowper's glands is not known, but it appears to be a viscid mucus, intended to lubricate the inside of the urethra.

LECTURE VI.

ON THE PENIS. ON THE MEMBRANOUS PORTION OF THE URETHRA. ON THE CAVITY OF THE URETHRA. ON THE CORPUS SPONGIOSUM, AND CORPORA CAVERNOSA PENIS.

The fluids which pass through the penis are very different in their quantities, as well as in their qualities and uses.

The urine being a truly excrementitious fluid, is secreted in large quantities, and requires to be frequently evacuated: it flows, during its evacuation, in a continued stream, until the whole of the contents of the bladder are expelled: the canal is then wide and the penis in a flaccid state; at least, it is so generally, and is not required to be otherwise while the urine is flowing through it.

The semen is only occasionally passed, and then comparatively in very small quantities; but it is thrown out by a spasmodic contraction of certain muscles, and at once; and, as it is to be used for the important purpose of impregnation, the canal through which it flows must have its shape adapted to convey it to the uterus, and also

to allow of proper direction and force to be applied to it in the act of ejectment. The penis is therefore enlarged, and rendered firm and turgid. This is produced by a flow of blood into the two bodies which constitute the greater proportion of its bulk, viz. the two corpora cavernosa, and to a third portion surrounding the urethra, and forming the glans penis, called the corpus spongiosum. The internal membrane of the urethra is likewise concerned in these alterations of the form and actions of the parts.

The urethra is at first completely surrounded by the prostate gland; it enters that body from the cervix of the bladder, on the upper and anterior surface, a little more forwards than the notch at the base, and proceeds through the gland, in a slightly incurvated direction, to the apex. In its course, it passes before the third lobe of the prostate gland: it has a larger proportion of the substance of that body in thickness on each side and behind, than on the anterior surface; and, from the concavity of the curve being forwards, a longer extent of the surface on the back part is covered by the gland than on the fore part.

The urethra is wide where it first leaves the bladder; but this part being acted on by the fibres of the cervix vesicæ is rather narrower than the canal is as soon as it is completely surrounded

by the prostate gland; for it forms then a bulbous swelling, and, gradually decreasing until it leaves the apex of that body, the passage through its substance assumes something of a conical shape.

The urethra quits the gland behind and above the cartilaginous arch of the pubes, and passes onwards in nearly the same incurvated direction until it reaches below that arch; it there enters, and is for its whole remaining course surrounded by the corpus spongiosum urethræ. The urethra from the gland to the penis has, from its circumference being less than any other part of the canal, been named the membranous portion. In an adult of the usual size, the length of this part is about an inch when the penis is fully distended; when not so, it is something less. It is generally described as cylindrical for its whole extent; but, like the passage through the prostate, its cavity is narrow at first, it then enlarges a little, but soon contracts, so that in rather more than one half of the length it is cylindrical. Soon after the membranous portion of the urethra leaves the prostate gland, it meets with that part of the corpus spongiosum which is called the pendulous part of the bulb, and extends its course along the anterior and upper surface, but does not enter the substance of the bulb until it reaches the arch of the pubes. Certain muscular fibres are interposed between the membranous portion and this surface of the

bulb of the urethra, which, having surrounded, attach the membranous portion to the symphisis of the pubes. The glandulæ antiprostatæ also are so placed partly behind the bulb, and on the posterior and lateral surfaces of the membranous portion, as to form a small groove between them, along which this part of the urethra passes. When a staff is introduced into the bladder, it may be felt through the pendulous part of the bulb. A finger introduced into the rectum, and carried forwards, can readily distinguish this part, and, from our knowledge of the course of the canal, will enable us often to give a proper direction to the point of the instrument, when a difficulty occurs in passing the staff or catheter into the bladder.

As soon as the urethra enters the bulb, the canal enlarges; but the enlargement is chiefly on the under part of its circumference, so as to form a sinus there, which becomes a kind of reservoir for the semen until a sufficient quantity be collected to be acted on and expelled by the muscles which nearly surround this part. The canal here bends forwards, being now surrounded by the corpus spongiosum, and continuing to be so to its termination. The last drops of urine are accumulated in the enlarged part of the canal in the bulb, and are expelled by the contraction of the acceleratores urinæ muscles after

the urine has ceased to flow in a continued stream from the bladder.

This part should be carefully examined so as to be fully understood, and the dissection of the side view of the pelvis may be made most useful to the surgeon in showing the necessity of elevating the point of the catheter when it reaches the bend, so that it should take the natural sweep into the bladder; whereas, if this is not done, the instrument passing along the under surface of the urethra, will not reach the entrance of the membranous portion, and by pressing on the back part of this wider and bulbous cavity, it may force itself under the true passage, and, perhaps, by rupturing the membrane, pass into the substance of the corpus spongiosum, and if much violence is used, even into the rectum. The urethra beyond this part contracts its diameter, and the size of the passage varies but little until near its termination, where in general it becomes somewhat wider, but contracts again before it leaves the glans penis.

A cast of the urethra is now before us, which shows most distinctly the variations in the different parts of the canal; it was made by Sir Everard Home, who has published the result of his admeasurement of the various inequalities not arising from disease in his valuable work on strictures of the urethra*.

* Vide Plate II. fig. 1.

On the under part of the internal surface of the urethra where it passes through the prostate gland, about half way between its entrance and exit, a prominent oblong body is found, projecting more and being wider behind; but having a narrow ridge continued on the forepart which passes along the whole of the lower part of the membranous portion to the bulb, where it terminates. This has been called the caput gallinaginis, also the verumontanum, sometimes the caruncula. On the sides of the widest part of this projection, the common duct of each vesicula seminalis and vas deferens enter the urethra. There is often a cavity on the most projecting part of the caput gallinaginis between the entrances of the seminal vessels, into which the point of a small bougie might pass and become entangled, but which, leading to no other structure, has been called the foramen cæcum, it has also been called the sinus pocularis, being compared to a drinking cup. It seems to be formed in a projecting part of the internal membrane; and its orifice being directed forwards, the urine, while flowing, presses its margin downwards, so that its edges being loose, afford some protection to the seminal ducts in preventing that fluid from entering their orifices. But, if formed for that express purpose, we should expect the ducts to open within its margin, which although they sometimes do, yet much more generally they open on its sides. This sinus is

occasionally wanting, and has been found so in people who, during life, had not complained of any thing wrong or deficient in the action of these parts; it is to be considered, therefore, merely as a large lacuna formed to increase the surface for secretion.

On each side of the caput gallinaginis on a depressed flat and oblong surface of the urethra several ducts from the prostate gland open into its cavity. The semen here meets with the secretion of the prostate gland, and then passes on each side of the ridge or narrow part of the caput gallinaginis, which seems to direct and conduct it to the enlargement of the cavity of the urethra situated in the bulb. Every surgeon will remember the importance of the ducts which here open into the cavity of the urethra, and will, of course, avoid offering any irritation which can be prevented to such part. It has been formerly stated, that the fluid secreted by the glandulæ antiprostatæ, or Cowper's glands, passes into the urethra, by two distinct openings on its under surface, about an inch and a half more forward than the situation of the glands themselves. These ducts, of course, enter obliquely.

The whole of the internal surface of the urethra is abundantly supplied with mucus to defend it from the acrimony of the fluid which flows over it. This mucus is secreted partly by vessels

which form small projecting papillæ on the inner surface of the canal, and partly by glandular structures, situated at the bottom and sides of very numerous lacunæ dispersed over every part of the internal membrane, and whose openings are directed towards the termination of the urethra, so that the mucus is pressed out of their cavities by the urine as it flows from the bladder. These lacunæ are of different sizes; the largest are interspersed with the others, but are found in greater numbers on or nearest to the upper surface.

The point of a very small bougie is apt, if not properly directed by the person who passes it, to become intangled in some of these openings; an occurrence of this kind has often been mistaken for stricture, and, by improper interference, a false passage has been formed. There is a large lacuna which opens within an inch of the orifice of the urethra, into which the point of a small bougie will often enter; this should be recollected in using those instruments, as from the lacunæ not admitting middle or larger sized bougies, such often pass on to the bladder much more readily than those of a smaller size.

The constant secretion which takes place on the inner surface of the urethra requires that the membrane should be very vascular; its colour being red like the inside of the lips, so far as we can see it, in opening the orifice of the urethra of

a living person proves that it is so; and injections of coloured materials demonstrate in the dead body that it is crowded with vessels.

In common, with many other parts of the body, it possesses some elasticity, although not enough to prevent being thrown into folds when the urine or semen is not passing; for at all other times but those, the inner surface of the urethra is in contact, and an open canal cannot be said to exist. If this membrane is carefully dissected from the surrounding structures, it appears to be very thin, and when uninjected, almost transparent, and without fibres, so that in itself it does not inherit the power of muscular contraction and relaxation. But adhering to its outer surface between it and the structure of the corpus spongiosum, I have repeatedly seen packets of longitudinal fibres connected to each other laterally in such manner, and putting on so marked an appearance, that I could entertain no doubt of their being muscular, and for several years have shown the preparation I now produce in confirmation of their being so; for I know of no structure but a muscular one that would put on an appearance similar to what is seen in this urethra. It is the penis of a healthy young man who was executed for murder, and in whom I found the bladder contracted*. In such deaths, the expulsion of the urine often takes

* Vide Plate III.

place in articula mortis; the muscular fibres of the urethra seem to have contracted at this time, and to have remained in that state. The property of elasticity, and the vascular structure of the corpus spongiosum, cannot account for the alteration which the penis, and the canal through it, must undergo when the urine is to be expelled in large quantities in the flaccid and shortened state of the penis; and when the semen is to be ejected, in small quantities, in the turgid and lengthened state of that organ. It is true, that, beyond the membranous part of the urethra, viz. that portion between it and the glans penis, no fibres are to be seen arranged in regular circular packets; but the same effect would be produced by others similar to those now shown, which, although their general direction is longitudinal, are formed into short fasciculi, connected by their origins and insertions with each other, and are much interwoven together. I have been much gratified by the description which Sir Everard Home has given of the arrangement of fibres, as made out by himself, and Mr. Bauer, in viewing the parts which surround the urethra in a microscope. The engravings which he has published of their appearance, correspond exactly with what the preparation I have alluded to exhibits to the naked eye. I shall quote nearly the words used by Sir Everard Home in describing this muscular structure, after having given up the idea of

circular fibres, which were supposed by their contraction to form the spasmodic stricture: he says, "We now find that the lining of the urethra is never met with in a contracted state; but is thrown into folds by the action of the elastic ligamentous covering of the corpus spongiosum, and the swell of the longitudinal muscular fibres within it; and when these fibres have, by acting through their whole length, reduced the urethra to its shortest state, the pressure upon the internal membrane is so great that there is not room for the urine to pass till these fibres are relaxed by elongating the whole canal."

"A spasmodic stricture," he observes, "is, in reality, a contraction of a small portion of the longitudinal muscular fibres, while the rest are relaxed; and as this may take place, either all round, or upon any one side, it explains what is met with in practice, and which could not before be satisfactorily accounted for, viz. the mark or impression of a stricture, sometimes forming a circular depression upon the bougie, at others only on one side."

In introducing a bougie, a resistance is sometimes made to its progress when not inserted an inch into the urethra; a sudden determination of blood to the penis could not have produced this, for, if so, the resistance should last; but it goes off, and then a large bougie will immediately

enter. I have at this moment a patient of high naval rank, where this resistance not only takes place in the urethra to the passing of a bougie, but sometimes, when one has easily passed, the attempt to draw it out is baffled by the strong grasp which the urethra, within two inches of the orifice, has on it: on waiting a short time, although more blood, from the irritation that has been produced, seems to be sent to the penis, the bougie will come out with the greatest ease; indeed, I have seen it frequently expelled by the action of the urethra itself. This gentleman possesses great muscular powers, and I often have met with similar occurrences in men equally muscular. The patient alluded to has told me frequently that he has felt the contraction of the passage coming on and taking place at one part, as distinctly as he could feel his hand close, or any voluntary muscle act. This subject may possibly be again brought before us, when stricture of the urethra is considered, and, from the preparation produced, I think I am warranted in saying, that so far as appearances can determine the structure of parts which have muscular action, a proof has not been withheld, of the urethra being possessed of muscular fibres attached to the outer surface of its vascular inner membrane.

I have for more than twenty years, in demonstrating the male organs of generation, described

a congeries of veins which surround the internal lining of the membranous portion of the urethra, the cavities of which, like other parts of the penis, are distended with blood when erection takes place. Most of these veins have a longitudinal direction; but they form numerous lateral communications with each other. They are placed between the internal membrane and the external ligamentous covering, on which the fibres of the compressor urethræ muscle are spread. When I first injected this structure, I conceived, from the appearance, that I had filled some absorbents, but I soon detected its true nature. Mr. Shaw has repeatedly injected this plexus of vessels; he has found that it extends on the outside of the inner membrane of the urethra to the orifice of the penis; but, from forming communications with the vessels of the corpus spongiosum, it is less distinct on the body of the penis than on the membranous part of the urethra; he has also observed, that the peculiar character of this vascular structure is lost where the urethra is surrounded by the prostate gland above the caput gallinaginis, although it is found in the substance of the caput itself, but above it the veins run into and become blended with the common veins of the bladder. These veins are rather more capacious, and therefore rather more prominent when filled with blood on the lateral parts of the under surface of the urethra, than on

the middle; a depressed part, forming a kind of groove, therefore appears on each side of the projecting ridge, which is continued from the caput gallinaginis to the cavity in the bulb; this depressed part is wider near the caput, where the ducts from the prostate enter the urethra, and gradually becomes smaller as it approaches the bulb; this structure gives facility to the passage of the semen and other fluids to the bulb. These veins are covered externally by, and enclosed in a tunic which resembles cellular membrane when condensed, and is also very elastic.

Dr. Baillie, when describing the structure of the membranous part of the urethra, used to observe, that it appeared to him to be surrounded by a very vascular flesh, like muscle, having its fibres arranged transversely, or circularly, but that, at the lower part, they were divided by a fine line of tendon.

In dissecting the side view of the pelvis, about twenty-five years ago, when, wishing to make out clearly the appearance and connexion of these circular fibres, I found that they were continued from two tendons, which had distinct attachments to the pubes immediately behind the cartilaginous arch, and were very different from those belonging to any of those muscles which Winslow and some other anatomists had described as passing to the prostate gland. Since that period, as I have shewn

the compressores urethræ muscles in every course of my anatomical Lectures, I must have dissected them at least fifty times; and in these numerous dissections I have not found them to vary either in situation, form, or attachment, more than any other muscles of a similar size. As no difficulty attends the dissection, I have been rather surprised to hear that their existence as distinct muscles has been doubted. Having given an account of their particular situation and attachment in the first volume of the Medico-chirurgical Transactions, accompanied by an engraving of the side view of the pelvis, drawn by our worthy conservator, Mr. Clift, I do not think it necessary to enlarge on those subjects here; I shall therefore only say, that the compressor urethræ muscle of each side arises by a tendon from the inside of the symphysis of the pubes about one eighth of an inch above the lower edge of the cartilaginous arch, and at nearly the same distance from the attachment of the ligamentum inferius vesicæ, or tendon of the bladder; to which, and to the tendon of the corresponding muscle, it is connected by very loose cellular membrane. The tendon is at first round, but it flattens as it descends. It is first in contact with and parallel to the one of the opposite side: it sends off fleshy fibres, which increase in breadth; and approaching to the upper surface of the membranous part of the urethra, they separate from those

of the corresponding muscle, and pass from the anterior and upper surface over the sides of the whole of the membranous portion, and folding themselves underneath it, again approach the other muscle, and unite with it in forming a narrow tendinous line, which, at its anterior and lower extremity, is, by a detachment of its fibres, joined to that common centre in the perinæum where the tendons of the muscles of the perinæum, of the penis, and sphincter ani, are blended with each other. Although some fibres, from the lower part of this muscle, seem occasionally to be connected with those of the levator ani, they may, in general, be very easily separated by dividing only cellular membrane. At the upper part some veins, passing from the sides of the cervix of the bladder to join those which come from the dorsum of the penis, and which pass from the internal iliac trunk, take their course between the compressor urethræ muscle and levator ani, and therefore make so marked distinction between them, that any person, attending to this single circumstance, may very easily trace the whole extent of these muscles of the urethra*.

From the attachment and course of these muscles, it is clear, that in contracting they will draw the membranous part of the urethra towards, and compress it against the cartilaginous arch of the

* Vide Plate I.

pubes. They will also contract the circle formed by them, so as to close the canal when neither urine or semen are to pass through it; and as their anterior edge surrounds the narrowest part of the urethra, where that canal enters the bulb, and immediately enlarges, their contraction may form a very powerful impediment to the passage of any instrument to the bladder, although no alteration of structure exists. When the perinæum is made a fixed point, so as to prevent the muscles drawing the membranous part of the urethra nearer to the symphysis of the pubis; it will account for the flatness sometimes observed on the sides of bougies which have been inserted through the part of the canal which these muscles surround. The knowledge of these circumstances, and of the enlargement of the urethra into a bag below the surface where the canal from the membranous part enters, will induce every surgeon to be cautious of the force he uses in introducing any instrument to the bladder, when it meets with some opposition at this part.

The penis belongs to the secondary class of the male organs of generation. Although it gives passage to the urine, it is not a structure necessary to the evacuation of that fluid, for in the female no such structure exists; its form and shape, therefore, have no reference to that action, but are adapted solely to the conveyance of semen to the

womb of the female, for the important purpose of impregnation.

It would be idle here to talk of its external appearance. It is formed chiefly by three hollow bodies of particular structure. The two corpora cavernosa giving it size and firmness; and the corpus spungiosum, covered by the glans, assisting in doing this; and the whole adapting the form of the organ to the uses it is to be employed in. These bodies are covered by the common integuments loosely attached by cellular membrane to their surfaces, so as to allow of the necessary variations in the size of the penis: no fat is mixed with this cellular membrane.

The corpora cavernosa are formed by two bodies called the crura of the penis, which are placed between and firmly attached to the ascending rami of the ischia, and which continue to be attached to the descending rami of the pubes, gradually getting before them in their ascent towards the cartilaginous arch. Before and below this arch they unite, and are continued in the form of two cylindrical-shaped bodies, to near their termination, where they are covered by the glans penis; here each of them forms a conical-shaped extremity. In the groove above their junction, a large vein, two arteries with some nerves and absorbents are placed; and in the groove below, the corpus spongiosum is situated. As the urethra passes

through the corpus spongiosum, I shall make what relates to its structure the first subject of our present inquiry.

The corpus spongiosum begins by an oblong swelling of a pyriform shape, placed between the crura of the penis; this part, I have before observed, is called the bulb of the urethra, and, at its broadest extremity, it often projects into two round tumours, having a slight depression between them. The bulb is placed between the arches of the pubes and the rectum, above the skin of the perinæum, and below and behind the membranous part of the urethra. Cowper's glands are placed partly above and behind it, on each side of the urinary canal. At first this part, named the bulb, descends; it is very convex behind, but less so before, and is incurvated forwards, gradually becoming narrower, until it reaches the groove on the under part of the corpora cavernosa; it fills up this groove, strongly adhering to the ligamentous covering of these cellular bodies: it continues now of a cylindrical and equal shape, until it reaches the extremities of the corpora cavernosa, when it projects in every direction but the lower, forming the glans penis, which covers these extremities, and gives to the end of the penis its proper conical form.

The external coat of the corpus spongiosum is thin and elastic, but does not appear to be very

vascular: between it and the inner membrane of the urethra is a congeries of vessels, which are sometimes more, sometimes less, distended with blood.

Three or four branches from the trunk of the pudic artery, as it ascends within the ischium, pass across and enter the sides of the bulb of the urethra; other branches from the two arteries continued from the pudic, and which run on the dorsum of the penis, enter the sides of the corpus spongiosum, and also the glans penis at the part called the corona glandis. All these soon terminate in a set of vessels which possess most ready communications with each other, and form by much the largest proportion of the whole substance of the corpus spongiosum. John Hunter asserts that this substance is not cellular or spungy, but made up of a plexus of veins, having most frequent and ready communications with each other, and producing the same effect in the erection of the penis as if the blood were thrown into communicating cells. I have often injected this substance, with fine and coarse injections, and with quicksilver, and have always considered it as an assemblage of veins; indeed, on the surface of the glans penis, which is a continuation of the same substance, when it has been injected with quicksilver, the venous appearance is most manifest. If injection is thrown into these

parts either by the arteries, or by a puncture made into these vessels, the whole of the corpus spongiosum from the bulb to the glans penis, including both of these extremities, will become filled from the ready communication of vessels; but, as these interior vessels communicate immediately with the external veins, by branches leading from the corona glandis and sides of the corpus spongiosum, the same degree of firmness and rigidity cannot take place in these parts, in erection of the penis, as in the corpora cavernosa, where the blood is detained, and prevented from passing into the veins.

Sir Everard Home, in his late publication, has stated, that, from the examination of these parts in the microscope by Mr. Bauer and himself, it is apparent that the internal structure of the corpus spongiosum consists of cells formed and divided by a trellis work from each other, similar to what is found in the corpora cavernosa, but on a less scale, and more regular throughout, without, however, having any muscular fibres mixed with the trellis work, these being confined to the outer surface of the inner membrane of the urethra. He has given the engraving of several drawings illustrative of this structure when the parts have been viewed in the microscope. These vessels or cells have blood poured into their cavities when particular ideas or passions of the mind take place.

The bulbous part of the corpus spongiosum,

excepting on the surface where the membranous portion of the urethra is placed, and where it enters, is surrounded by the fibres of the accelletores urinæ muscles, which passing from the ligamentous covering of the corpora cavernosa nearly two inches more forward than the arch of the pubes, and then from the descending rami of those bones, incline backwards, forming two oblique planes of fleshy fibres, which meet at an acute angle on the under surface of the bulb, and are joined there by a common middle tendon, which passing the whole length of the bulb, is connected, in the perinæum, with the tendons of the transversales perinæi, the compressores urethræ and sphincter ani muscles.

In the coitus, the corpus spongiosum and glans penis are rendered turgid by the blood filling their vascular structure, and the whole canal of the urethra is lengthened, but made more narrow and straight. The semen is gradually deposited in the sinus of the bulb; the glans penis being placed at the other extremity of the corpus spongiosum, and endowed with a peculiar sensibility, when a sufficient quantity of semen is collected, excites the muscles covering the bulb into action; and the contraction of their fibres taking place, from their attachment in the perinæum now being rendered fixed by the other muscles, in quick succession from behind for-

wards, the semen is propelled rapidly along the canal; the blood in the bulb is at the same time pressed forwards, but requiring a greater impulse, it forms an undulatory wave behind the semen, narrowing the urethra, and urging on the semen with increased force. John Hunter has therefore, with great propriety, termed these muscles expulsores seminis. The compressores urethræ muscles having allowed the semen to pass into the bulb, then close the urethra, so that the semen cannot be pressed back to the canal in the membranous part; this use, which cannot be doubted, in addition to those formerly mentioned, has been ascribed to these muscles by Sir Everard Home in his late publication.

The convex conical surface of the glans is covered by a fine villous membrane, in colour resembling the red part of the lips. At its basis, or corona, there are rows of projecting papillæ which secrete a sebaceous matter having a peculiar smell. The glans, possessing exquisite sensibility, is protected by the loose covering named the prepuce, which is tied to the penis immediately below the orifice of the urethra, by the band called the frænum; this limits the motion of the prepuce, and tends to keep it in its proper place. The prepuce is known to be composed of the common integuments, viz. cuticle, rete, mucosum, and cutis, continued loosely beyond the glans,

and being then reflected back to the cervix surrounding the corona glandis, are afterwards continued over that body, forming its immediate covering, but becoming, when doing this, much thinner, finer, and more vascular. The natural aperture of the prepuce is often so small as not to admit of the glans penis passing through it. The secretion about the corona, in people who do not use frequent washing, is apt to become acrid, so as to inflame, and even ulcerate, the parts on which it is placed. Much inconvenience must have happened from this in warm countries where water was not plentiful, and which, in all probability, induced the eastern legislators to make circumcision and frequent ablution part of their religious rites.

The covering of the corpora cavernosa and crura of the penis is of an elastic ligamentous nature; it is white in colour, of some thickness, and not very vascular. It consists of longitudinal fibres on the outside, and within of circular or transverse fibres; but these are interwoven together so that the two do not form distinct layers. A perforated septum passes between the grooves in the under and upper surface, where the corpora cavernosa are in contact, dividing them from each other, but allowing the blood contained in their cellular structure to pass readily through the openings from the one to the other. From the shape of the perfo-

rations, this division has been called the septum pectiniforme.

Within the ligamentous covering of the corpora cavernosa, a structure is found consisting of numerous cells of very irregular size and shape, bounded by a reticular membranous substance which allows of a most ready communication of their cavities with each other; this membranous substance has more vessels, in proportion to its extent and thickness, ramifying upon its surface, than the ligamentous covering enclosing it. Some muscular fibres seem to be mixed with this structure. John Hunter has observed that the cells of the corpora cavernosa are muscular, although the fibres are not distinct in men; for the penis in erection is not equally distended at all times; which probably, he states, arises from a kind of spasm, that could not act upon it were it not muscular. He also says, that in the horse, the parts composing the cells of the penis appear evidently muscular to the eye; and in a horse just killed they contract upon being stimulated. From Mr. Bauer's examination in the microscope, Sir Everard Home has described this cellular structure, as made up of an infinite number of thin membranous plates, exceedingly elastic, so connected together as to form a trellis work, the edge of which is firmly attached to the strong elastic ligamentous substance which surrounds the

whole, and also forms the septum pectiniforme. This substance, he observes, has an intermixture of muscular fibres. The cells are generally larger, or rather the trellis work is more loose in the middle portion of each corpus cavernosum. In the dead body most of these cells are found empty, but occasionally blood is contained in them.

A considerable branch from the pudic artery, accompanied by veins and some nerves, perforates the ligamentous covering of the crus, and having entered the cavernous structure, sends off a vessel which runs to the root of the crus; it is itself then continued in the middle of the cavernous structure to the farther extremity of the corpus. Ramifications pass off from these vessels which are supported by the reticular structure, and are distributed every where throughout the cavernous part. When the passion desire does not exist, the blood is not poured into the cells, but returns by the veins as usual, and the penis remains flaccid; but when a person is under the influence of particular impressions which excite the nerves of these parts, the minute arterial branches, which before had their orifices closed, now have their action suddenly increased, and pour from their open mouths the blood into these cells, so as to distend them, of course overcoming the elastic power that under ordinary circumstances keeps them collapsed. In thi way

the penis is rendered fit to convey the semen to the womb of the future mother.

The crura of the penis, excepting at the surfaces by which they are attached to the pubes and ischia, are covered by the erectores penis muscles, which arise from these bones immediately on the edges of the crura, and have a tendinous insertion into the ligamentous covering of the corpora cavernosa, at some considerable distance from the arch of the pubes. These muscles being only in the state which all healthy muscles, when not acting, are in from tone, do not oppose the entrance of blood into the cells which they cover, when the erection of the penis is to take place; but when their further contraction is required, they will force the blood on to the cells in the bodies and anterior extremities of the corpora cavernosa, the communication of the cells readily allowing of this. When the semen is to be expelled, these muscles contract at the same instant with the expulsores seminis, and thus forcing the blood suddenly from the crura into the body of the penis, increase the undulatory wave which follows the semen in the corpus spongiosum, and thus assist in driving that fluid on.

When the penis is erected, these muscles will become directors, drawing that organ downwards and forwards, so that it shall make a right angle with the trunk of the body. In quadrupeds,

this last action may be more necessary (for obvious reasons) than in men.

During the state of erection, the circulation, in the integuments and other coverings of the penis, by the veins goes on as usual; but that in the veins of the cellular structure is probably not more than is necessary to preserve the blood in a healthy state; and when the passion which excited the erection ceases, the veins then absorb the blood from the cavities of the cells: this is an action dependent upon life, and is probably the only instance of venous absorption in the body; for in the dead body no mechanical force, when the cells are injected with fluid from the arteries, or when the fluid is thrown immediately into the cellular structure, can, without the rupture of some of the vessels or cells, drive such fluid on to the veins: this proves that the blood from the cells is not during life forced into the veins by the vis à tergo from the arteries.

It has been alleged by some authors, that erection of the penis is produced by the mechanical action of some parts of the penis when distended, producing compression on the trunk of the veins against the pelvis, and thus preventing the blood from leaving the cells. But if so, the cause should continue to act, and the penis, when once erected, should remain in that state.

Boerhaave and Haller have been of opinion

that the erection is produced by compression of the veins, but have differed in their ideas of the manner how this compression is made. Boerhaave thinks that the blood is stopped by the action of the erectores penis muscles compressing the vena magna dorsalis penis and other veins against the pubes; but these muscles are so attached, that it is quite impossible for any action of theirs to compress the veins on the body of the penis; the only muscles which could have any effect in doing this would be the compressores urethræ and levatores ani; but in attempting this, they would be counteracted instead of assisted by the erectores penis, these last muscles drawing the penis downwards. Haller seems aware of this objection, and has imagined that the veins are compressed by the nerves which surround them; but of this imaginary structure of the nerves we know nothing.

It is well known, that the taste, or even the sight or remembrance of food which had proved grateful to the palate, will produce a sudden and uncommon flow of saliva into the mouth; thus the passions of the mind excited by the present, the recalled, or imagined ideas of certain objects, stimulate, through the medium of the nerves, certain branches of the arteries of the penis to that increased action, which produces the flow of blood in much greater quantities to the cells of the corpora cavernosa, than can be immediately re-

moved by the absorbing powers which the veins of these parts possess, and continuing to do this, the penis remains erected; but when the exciting causes cease to act, no more blood is conveyed to the cells by the arteries, the veins then quickly remove that which distended them, and the elastic property of their boundaries and coverings soon return the penis to its usual state.

In erection, the urethra, by the elongation of the penis, becomes straight, its curvatures at least are much lessened: the excitement in the coitus is conveyed from the glans to the internal parts, so that the testicles, vesiculæ seminales, and prostate gland, assume more active secretions; the cremaster and dartos muscles press gently on the testicles, and draw them upwards towards the ring, assisting probably by that action the passage of the semen in the vasa deferentia; the levatores ani draw the parts to which they are attached below forcibly against the vesiculæ seminales, the terminations of the vas deferentia and prostate gland, and thus assist their muscular structure in forcing their fluids towards the penis. When the semen has reached the cavity in the bulb of the urethra, and is accumulated there in sufficient quantity, the fibres at the neck of the bladder and the compressores urethræ close the passage by which the semen had passed to the bulb, and prevent also the urine from escap-

ing; the sphincter ani closes the rectum, and with the transversalis perinæi renders the point in the perinæum fixed to allow the acceletores urini muscles an advantageous fulcrum to act from; and these muscles being thrown into convulsive action along with the erectores penis, eject the semen in the manner before described, and with sufficient force to reach its proper destination.

Having thus traced the action of generation so far as the male organs are concerned, it is not my intention at present to proceed further; for, although conception, the nourishment of the fœtus while in utero, and its passage into the world, afford most interesting and curious subjects of research, they do not tend to the explanation of the diseases of the male urinary and genital organs which are intended to be considered in the nine following lectures.

It only remains that I should name the course and distribution of the vessels and nerves which supply the penis: this I shall do very concisely, as these cannot fail to be known by the majority of the audience.

The pudic artery having sent off the branches named hæmorrhoidales externæ, which supply the sphincter muscle and skin of the anus, detach some branches to the prostate gland and to the membranous part of the urethra, and also send off those which enter the side of the bulb of the

corpus spongiosum. Before the artery enters the crus penis or ramifies in the corpus cavernosum, it sends off a branch which passes between the arch of the pubes and the penis, and then pursues its course on the dorsum of that body by the side of the large middle vein; it supplies part of the integuments, also part of the corpus spongiosum, its branches entering at the side of that body, and the glans penis. Other small branches from the inguinal, the femoral, the obturatrix, and the epigastrica arteries of each side, assist in supplying the integuments of the penis near its root.

The smaller veins follow the course of the arteries; but the larger branches from the glans, sides of the corpus spongiosum, and integuments of the penis, unite in forming a trunk, which passes from the corona of the glans along the dorsum of the penis to the arch of the pubes, and is called the vena magna dorsalis penis: at the root of the penis it divides into two vessels, which passing under the arch of the pubes, receive branches from the bladder and prostate gland, and convey the blood into the internal iliac vein.

The absorbent vessels of the penis are numerous; they form trunks which run on the dorsum towards the root of that body, but there is great variety in their course towards the glands: in general, they pass into the glands of the groin on the same side on which they are situated in the

penis; but a vessel will often be found to divide into two branches, which will pass to different groins. I have frequently seen the vessels from the right side of the penis cross to the left groin, and those from the left side of the penis pass to the right groin. From this variety it cannot be certain on which side a buboe will form when a chancre takes place on one side of the penis; most probably it will form on the same side, but it may form on the other, or on both. Generally the absorbents enter the gland nearest to the root of the penis, but they will often pass the nearest gland and enter others further removed, occasionally passing to one of the lowest of those in the groins. The vasa efferentia of these glands then extend under Poupart's ligament, and enter other glands situated in the course of the external iliac artery and vein, from which the substances absorbed are conveyed to the thoracic duct.

Branches from the lumbar and sacral nerves communicate with others sent off from the trunk of the intercostal after it has entered the pelvis, and also with filaments detached from the inferior mesenteric plexus; a nerve is formed from these, which enters the corpus cavernosum, and ramifies with the arteries; other branches enter the corpus spongiosum at the sides of the bulb, previously supplying the muscles which cover it. Another nervous rope is formed from the same plexuses which

passes under the arch of the pubes, and takes its course on the side of the artery furthest from the great middle vein; filaments from this nerve supply the remaining part of the corpus spongiosum, the internal membrane of the urethra, the glans, and the integuments of the penis.

LECTURE VII.

GENERAL REMARKS ON CALCULOUS CONCRETIONS. ON THE DIFFERENT SPECIES OF CALCULI, AND ON THEIR COMPOSITION.

In the six preceeding Lectures upon human anatomy I have endeavoured to bring to the recollection of this audience, the structure and functions of those parts of our bodies which are concerned in the secretion and ejection of the urine and of the semen. It is now proposed to employ the nine Museum Lectures, in inquiring into the nature of those alterations in structure and in actions, which constitute the diseases of these very important parts of the human frame; particularly such which it is in the province of the surgeon to amend or remove.

In prosecuting this inquiry, it is not my intention to give a regularly detailed history of these diseases, nor do I mean to enumerate all the various modes of treatment that may have been recommended for their cure; but I shall endeavour to direct your attention chiefly to those points of their history and treatment, which can be best

illustrated by the materials which our Museum affords, and confirmed by the best authenticated facts which my own experience and inquiries will allow me to produce: I therefore wish it to be understood, that I mean not to combat theoretical opinions held by particular individuals in any other manner than what will arise generally from the statement of such facts, and what shall appear to me the most rational inductions from them. In this theatre, where each of those persons who compose the audience has studied, and many have had years of experience in treating the diseases of the urinary and genital organs, any other mode of proceeding would excite but little interest, and that little would soon give place to weariness and inattention.

In pursuing my proposed object, I must necessarily bring before you many facts and opinions which have already been published, and more particularly those which have been recently ascertained, relating to the composition of urinary calculi. In doing this, should I not attach to each individual the credit due to his particular discoveries, the omission will not proceed from any intention of depriving him of his just claims to public estimation, but from the nature of these discourses not allowing of those particular references which in elementary lectures or regular essays would be required and should be given.

The formation of urinary concretions is a disease which varies in the composition and form of the deposited matter, either from some constitutional cause, or from the parts in which such matter is lodged, in consequence of natural shape or morbid alteration affording more convenience for the separation from the urine of certain materials, and for their subsequent concretion than others.

Urinary calculi may be found in the kidney, the ureter, the bladder, and the urethra, and in each situation may be composed of the same general ingredients, although in some of these situations, certain combinations of them may be more usual than in others. I have in the first lecture of this season, taken notice of the ingredients which are met with in the natural state of the urine, and of their depositions in diseases where hardened concretions are not formed. The torments suffered by those people in whom such concretions take place, and the pain and danger which must necessarily attend the operations for their removal, present most powerful claims upon the medical profession to call in the aid of any science, which might afford even a distant chance of removing the deposited masses, or at least of blunting their effects without having recurrence to the operation of lithotomy.

As these concretions take place independently of any vital action, chemistry has appeared to be the

science most likely to afford the means both of preventing their deposition and of their removal when formed; and several of the most eminent of its professors on the continent, and in this country, have contributed their efforts towards these most beneficial purposes, and have in many cases succeeded in ameliorating the sufferings of the unfortunate patients; but enough has not yet been effected to render the manual operation of the surgeon unnecessary; lithotomy, therefore, still continues among the most useful, although it is one of the most painful acts of those whose profession often obliges them to appear "cruel only to be kind."

The size of urinary concretions varies from those minute angular crystals which form what is called gravel, and which being mechanically diffused through the urine subside immediately to the bottom of the vessel which receives that fluid, to that of a calculus filling up the natural cavity of the bladder. Of this last we have a remarkable specimen now before us in a calculus which was formed in the bladder of Sir David Ogilvie, and which was presented to our college by the late Sir James Earle. The weight of this enormous concretion was forty-four ounces, and the form being elliptical, the circumference on the longer axis measured sixteen inches, and on the shorter fourteen. An account of the case with the symptoms produced, accompanied by an engraving of the calculus, has

been published in the Philosophical Transactions of 1809. Calculi may vary in the number found in the same patient, from a single concretion to some hundred; the greatest variation is in those formed in the kidneys and in the bladder.

Their particular shape is also subject to great variety; this arises from their situation, from their number, from parts of their surface being more exposed to the contact of urine flowing over them than others and from other more accidental causes.

In the kidney, a single concreted mass is sometimes formed, nearly filling up the cavity of its pelvis, and having processes corresponding to the infundibula, with enlargements at their extremities answering to the bottom of these cavities; sometimes many different concretions are found in separate cavities of the same kidney, and occasionally several pressed together in one cavity. These gradually enlarging from the constant deposition of fresh matter, the urine is detained behind them, and produces from its pressure an absorption of the substance of the kidney, sometimes to that extent that the gland is reduced to a mere shell.

When calculi are retained in the ureter, the shape of each is generally oval, but with one extremity less than the other.

When calculi are found in the bladder, their form is usually spheroidal when single and loose,

but when two or more are found, the shape will be altered by the surfaces pressing against each other; they will therefore sometimes be oblong, sometimes flattened on the sides, and often angular. When many are contained in the same bladder, they are generally angular, but not always so; I have taken seven or eight from one bladder, the shape of each of which has been nearly oval. The variety of calculi at present on the table, will however give more information to the audience from being seen, than could be conveyed by the fullest and most accurate description.

Urinary calculi differ much in their consistence as to hardness and softness; some are loose and are easily broken into pieces; others are very firm and nearly as hard as marble. The colour of urinary concretions will vary much, so will their surface in regard to smoothness or roughness: in the first the variation may be from a chalky white to a deep mulberry brown, and in the second from a uniform and smooth surface to one which is rough and more tuberculated than a mulberry. These two properties of deepness of colour, and tuberculated inequality, generally indicate the chemical properties of the calculus, but not in every instance, as the colour may depend on bloody mucus, or some vitiated secretion being blended with the concretion. Their internal structure, as seen by a section of the whole calculus, generally exhibits

different laminæ formed in concentric circles, which often vary in colour and in chemical properties. These concentric laminæ are sometimes formed round nuclei consisting of extraneous matter, but often consisting of similar materials to those of which the rest of the calculus is composed. A calculus, when cut through, in some instances shall exhibit concentric circles forming on two or more nuclei, at first separately, but afterwards the two sets shall become consolidated together by concentric laminæ surrounding the whole, as in the specimens now produced.

The nuclei of some calculi are formed of coagulated blood, of others of extraneous substances which have been introduced and left in the cavity of the bladder; for any extraneous body being introduced and allowed to remain in parts which contain urine, or through which urine flows, will have the matter which urinary concretions are found to consist of deposited upon its surface.

Formerly when leaden bougies were used, pieces have been broken off and left in the bladder, and formed of course the nuclei of calculi. I have seen instances of this in the collection of Dr. William Hunter now in Glasgow, and also in other collections. In this collection there are several instances of calculous matter formed on common bougies. Sir William Blizard, to whom we are indebted for many valuable additions to our

museum, has presented us with a calculus, which he removed from the bladder of a patient, that had formed on a common bougie which had slipped into the bladder about a year before the operation was performed. This patient had been in the habit of wearing bougies during the whole night; one morning he missed the bougie, but made no inquiries as to what had become of it, nor was he aware that it had entered the bladder, until Sir William Blizard had found it in the concretion. Leaden bullets have found their way into the bladder, and have formed nuclei; so have nails, bodkins, pieces of slate, peas, and various other substances, which, from accident or intention, have been introduced into the cavity of that organ: specimens of these are now before us. From the shortness of the female urethra, extraneous bodies are more likely to enter the bladders of that sex than of males. I have in my hand a calculus where the nucleus is a hazel nut. I took this calculus from the bladder of an elderly woman; and when it was sawn through, the kernel of the nut was in good preservation, although the nut must have remained enclosed in the calculus a long period before it was discovered, for it would require at the least several months before so large and firm concretion as this now produced could be formed.

Here I cannot refrain from observing, how

much it behoves the surgeon to be constantly on his guard against deceptions which are sometimes attempted to be practised on his credulity, and that of the public, by people interested in propagating the belief, that they, or some part of their family, are afflicted with a dangerous and painful disease; for it is almost beyond credibility, how much trouble will be taken, and how much real pain will be endured by some impostors, to gain credence for their assertions on points of this kind. Gravel and stone are diseases not unusually fixed on for such deception, and previous to the chemical properties of urine being known, such attempts were likely to succeed, by substances (now easily detected as having none of the properties of urinary calculi) being produced, and affirmed by the pretended patients to have passed from the urethra. A few years ago, a young lady of rank, without any discoverable motives, insisted that she daily passed a large quantity of gravel from the bladder; I saw as much of this as nearly filled half of a pint bottle, and which she strongly asserted had been evacuated with the urine on the preceding night. It was sent to Professor Brande, who immediately detected the imposition, and found the pretended gravel to be common sand, such as is strewed on the floors of kitchens and servants' rooms; but, notwithstanding the detection of this palpable fraud, the young lady long and obsti-

nately persisted in her absurd attempt to deceive. Many years ago, when I resided in the house of Mr. Cruikshank, a person brought his son to that gentleman for surgical advice and assistance, asserting that the boy had long been cruelly afflicted with stone; in proof of which he produced several pieces of hard slaty substances, which he stated he had assisted the child in removing from the urethra. Upon my expressing an opinion that these were not urinary concretions, he pretended to be angry, and indignantly left the house, declaring that he would seek for a surgeon to perform the operation for the removal of the stone, whose humanity would not let him doubt the assertion of a father, who, though in poverty, would sacrifice his own existence gladly to save that of his son. A few days after this he brought back the boy with a large piece of slate sticking in the urethra, which had torn the inner membrane, and from the swelling it had produced, was, with much difficulty, removed. Wishing to detect the imposture, I persuaded him to leave the boy in Mr. Cruikshank's house, under the pretence that the operation of lithotomy should be performed, if necessary; and it was only after the forms of binding the boy and bandaging his eyes were gone through, that he could be prevailed upon to confess his father had taught him to introduce these substances, which he procured from coals, for the

purpose of exciting commiseration for his pretended sufferings, and obtaining money from the charitably disposed; and perhaps, in this instance, to have extorted money from the surgeon to conceal his ignorance, had he seriously attempted to perform any operation.

Let me not be accused of trifling with your time, by introducing these two anecdotes; if they should put any of my auditors properly on their guard against such attempts at imposition, the purpose of their introduction is fully answered.

ON SEDIMENTS DEPOSITED IN URINE.

The sediments, which are deposited in the form of a fine powder after the urine begins to cool, exist in a state of solution in the urine before it is discharged, and when deposited, the particles do not appear to be crystalline. Their colour and composition are various: the first is generally red, diluted with more or less of brown or yellow; the second may contain, at different times, principles capable of becoming solid themselves, or forming a solid compound with any other principles found in the urine. Some of their properties have been mentioned in the First Lecture. Dr. Prout says, "that generally speaking they may be stated to consist of two species of neutral saline compounds

viz. the lithates of ammonia, soda, and lime, tinged more or less with the colouring principle of the urine, and with the purpurates of the same basis, and constituting what are usually called the pink and lateritious sediments; and, secondly, the earthy phosphates, namely, the phosphate of lime, and the triple phosphate of magnesia and ammonia, constituting for the most parts sediments nearly white. These two species of sediments very frequently occur mixed together, though the lithates generally prevail. The salts of such sediments have little tendency to assume the crystalline form."

The sediment usually called gravel is discharged in a solid form, when the urine is evacuated, and immediately falls to the bottom of the vessel where it instantly may be detected. It is not unusually discharged by patients predisposed to the formation of urinary calculi, or labouring under calculi already formed. It is voided in the form of minute angular crystals, some of which are mechanically mixed with the urine, and voided with it; and others are deposited upon the sides of the vessel in which it has stood some hours.

When the crystals are small, of a roundish form, and of a brick-red colour, they are composed of lithic acid. When they are irregular, brittle, and white, they are of the fusible kind, or they are composed of the triple phosphate of magnesia and

ammonia; and when of a dark brown, or blackish green colour, they most usually consist of the oxalate of lime: these last are the most rare.

In the treatment of such depositions, when the lithic acid predominates, the alkalies seem to be the proper medicines to be used; for these, if added to recent urine, will precipitate a sediment consisting of phosphate of lime, with some ammoniaco-magnesian phosphate. Ammonia, or the liquor potassæ, may be used for this. Lime-water will produce a precipitate of a similar kind, but more copious.

When the deposition consists of the triple phosphate of magnesia and ammonia, acids should be given, particularly the muriatic; for if this is added to recent healthy urine, in a short time small reddish crystalline particles of lithic acid will be gradually deposited. Phosphoric acid, or even common vinegar, will also produce this effect.

When oxalate of lime is deposited, Dr. Marcet observes, "that alkalies may be used with advantage in this as in other species of calculous deposition, to allay irritation; and that probably they also may be beneficial, by combining with the oxalic acid in the primæ viæ, and presenting those displays of affinities which causes it to unite with the lime. But still more beneficial effect," he observes, "is likely to be obtained from the mineral

acids, which have the power of dissolving the oxalate of lime in its nascent state, and may, therefore, if they do not prevent its formation, at least serve to assist its passage, and ultimate expulsion from the system in a state of solution."

URINARY CALCULI.

Until Scheele's discovery of the lithic acid in 1776, nothing certain was known of the composition of urinary calculi; since that period, to the labours of Dr. Wollaston, we are indebted for the knowledge of the following materials contained in these concretions, viz. phosphate of lime, ammoniaco-magnesian phosphate, oxalate of lime, and cystic oxyd. Dr. Wollaston also ascertained the composition of the calculi from the prostate gland.

It seldom happens that the above named substances exist singly in a state of purity in urinary concretions, although some of them generally prevail, in a sufficient degree, to impart to the calculi a peculiar character: sometimes, however, the mixture is such as to preclude the appearance of any characteristic form.

Besides the above-named ingredients, Dr. Prout has analysed some small urinary calculi composed almost entirely of thecarbonate of lime.

Dr. Marcet has analysed one small urinary

calculus, to which, from the yellowness of colour it exhibits when acted on by nitric acid, he has given the name of xanthic oxyde calculus. The same respectable physician has also analysed three others which were passed by the urethra, each of the size of a large garden pea, and found them to possess all the characters of the fibrin of the blood: he has called this species fibrinous calculus. These have not been analysed by any other chemist, indeed they have not been met with in any other instances.

To Dr. Prout we are greatly indebted, not only for much useful information on the subject of urinary calculi, founded on his own laborious investigation of their properties, but also for his attention and accuracy in collecting and arranging the valuable materials dispersed in the works of others. Wishing to ascertain the comparative prevalency of the different forms of urinary deposite, and the order of their succession, he has collected data for that purpose from the examinations, made by Professor Brande, of the concretions contained in this the Hunterian collection; by Dr. Marcet, of those in the Norwich collection, and in that of Guy's Hospital; by Dr. Henry, of those in the collections at Manchester; and by Mr. Smith, of those preserved in the collection of the Bristol Infirmary; and having divided the concretions into six classes, marking their general character, the following is the result:

The number of calculi examined on the whole was 823; of these 294 were classed under the name of lithic acid, 98 of these were nearly pure; 151 were mixed with a little of the oxalate of lime; and 45 mixed with a little of the phosphates.

113, consisting of the oxalate of lime, were classed under the name of mulberry calculi.

3 were classed under that of the cystic oxide.

202 were classed under the name of phosphates; of these last, 16 were nearly pure; 84 mixed with a small proportion of lithic acid; 8 consisted of phosphate of lime nearly pure; 3 of triple phosphate nearly pure; and 91 of the fusible, or mixed calculi.

186 were classed under the name of the alternating calculi, or those whose laminæ varied, but consisted of lithic acid, oxalate of lime, and phosphates; of these 15 consisted of lithic acid and oxalate of lime, the first being in the greatest proportion; 40 of the oxalate of lime, in the greatest proportion, and lithic acid in the least; 51 of lithic acid, and the phosphates; 49 of the oxalate of lime, or the mulberry and the phosphates; 12 of the oxalate of lime, the lithic acid, and the phosphates; 1 of fusible and lithic; 2 of fusible and mulberry; and 16 the composition of which was not mentioned.

Of compound calculi, whose composition was not mentioned, there were 25.

It will be proper here to mention concisely the difference in the composition of the above-named six classes. The lithic acid calculus is hard, inodorous, and generally of a reddish brown or fawn colour, and of a flat oval shape. Its surface is sometimes smooth; but sometimes studded with fine, but smooth tubercles. Its specific gravity generally exceeds 1,500. When cut into, it consists of concentric laminæ; when broken, the fractured surface generally exhibits an imperfectly crystallized texture. It is one of the most common species of calculi, and was first particularly described by Scheele. It is completely soluble in caustic potash, and precipitable again in the form of a fine granular powder by any acid.

This species of calculus can generally be identified, by being submitted to the flame of the blowpipe. A portion of calculus, not larger than a pin's head, held by the extremity of a slender pair of platina forceps, and thus exposed to the action of flame, if composed of lithic acid, will blacken, emit a smoke having a strong and characteristic odour, and will be gradually consumed, leaving a minute quantity of white ash, which is generally alkaline. Another test is the application of a drop of nitric acid to a small particle of lithic calculus, and then heat applied to both; the lithic acid is dissolved, and if the solution be evaporated to

dryness, the residue assumes a beautiful pink, or carmine colour.

A concretion has been described by Dr. Prout, under the name of lithate of ammonia calculus. It is generally of a small size, and is rather uncommon. It is usually of a clay colour; its surface is sometimes smooth, and sometimes tuberculated; it is composed of concentric laminæ, and its fracture much resembles that of compact limestone. It is much more soluble in water than the lithic acid calculus, and always gives off a strong smell of ammonia, on being heated with caustic potash. Before the blow-pipe it usually decrepitates strongly.

It is the opinion of Dr. Prout, that at least two thirds of the whole number of calculi originate from lithic acid; for as the lithic acid forms by far the most common nucleus round which other calculous matter is subsequently deposited, if such nuclei had not been formed and detained, two persons at least out of three who suffer from stone, would never have been troubled with that affection.

It is here to be remarked, that although the general appearances of lithic calculi have been mentioned, much difference exits in their sensible properties: viz. in their colour from deep fawn to clay; also in the distinctness of their laminæ, and their crystallized texture. The depth of fawn colour, and the more of crystallized texture, denotes

that the calculus in its composition approaches nearer to pure lithic acid. The lighter the colour, the greater in general is the proportion of lithate of ammonia and the phosphates.

The properties of the oxalate of lime calculus were discovered by Dr. Wollaston. This calculus, from its colour and shape resembling very much a mulberry, has usually gone by the name of mulberry calculus. It is generally of a dark brown colour. Its specific gravity is from 1.428 to 1.976. Its surface is very rough and tuberculated. Its substance is usually very hard; and when cut through, it appears to be of an imperfectly laminated texture. But sometimes a calculus, of which the oxalate of lime shall be the chief component part, shall be remarkably smooth, and of a pale and somewhat bluish colour; and when small, resembling hemp-seed. A calculus which I now produce, of so large a size as to fill up and greatly distend the pelvis of the kidney, is nearly white, although, from Professor Brande's analysis, it is composed of the oxalate of lime. It has therefore been conjectured, that the mulberry colour of the tuberculated calculi may arise from a mixture of blood thrown out from the vessels of their containing parts, in consequence of the roughness of their surface. The hemp-seed calculus is supposed to be of renal origin; and Professor Brande has remarked, that persons who

have voided this species of concretion, are less liable to a return of the complaint than those subject to lithic calculus. The observation of Dr. Marcet coincides with this interesting remark; and so far as my own experience goes, I am convinced of its justness, and I think it will apply to all calculi voided which are formed of oxalate of lime. The mulberry calculus seldom exceeds the middle size and is rather common.

In the calculation recently alluded to, from the examination of urinary concretions preserved in different collections, the mulberry calculi were found to constitute rather less than $\frac{1}{7}$ of the whole number. It will be proper, however, to state that the proportion differs exceedingly from this calculation, and also differs from one another in the different collections. Thus, in the Museum of this College, out of 150 calculi, examined by Professor Brande, only six were composed of the oxalate of lime, or $\frac{1}{25}$ of the whole. He states, that the mulberry calculus he has rarely met with; and in those preserved in the Hunterian collection, there is a large proportion of phosphate of lime and of lithic acid. The purest which he examined, afforded of oxalate of lime, 65 grains; lithic acid, 16 grains; phosphate of lime, 15 grains; and loss in animal matter, 4 grains; it therefore contained 35 per cent. of other matter.

In the Norwich collection, the mulberry calculi amount to nearly $\frac{1}{4}$; and in the collection of

Guy's Hospital, even somewhat more than this. In the Manchester collections, only $\frac{1}{17}$ consist of the oxalate of lime, nearly pure; but Dr. Prout observes, if we take into account all those that contain this substance, the proportion will be found to constitute about $\frac{1}{4}$ of the whole collections. In the Bristol collection, rather less than $\frac{1}{6}$ of the whole consists of the oxalate of lime, nearly pure; but if all be included containing this substance, $\frac{5}{12}$, or nearly one half of the whole, will belong to this class; this far exceeds the relative proportions as found in other parts of the kingdom. Since Professor Brande's analysis, several calculi from the British Museum and elsewhere, containing oxalate of lime, have been added to the specimens in this college.

This species of calculus, although in general abundantly distinguishable by its external appearance, is not always so. Before the blow-pipe, it expands into a kind of white efflorescence, which, when moistened and brought into contact with paper stained with the juice of violets, turns it green; or with turmeric paper, changes it to red.

The cystic oxide calculus is of a yellowish white colour, and semi-transparent; commonly it is smooth, but is not always so. Its external appearance resembles more nearly the triple phosphate of magnesia calculus than any other; but is more compact.

The rarity of this calculus is such, that only

three in 294 appear from the data before alluded to, to be of this description: and three out of the five collections which were examined, contain no specimen of it. There are none in this collection. When broken, its structure does not consist of distinct laminæ, but presents a waxy, confusedly crystalized mass throughout, having a peculiar glistening lustre. It was first discovered and described by Dr. Wollaston, in the Philosophical Transactions for 1810. It yields a peculiar smell when heated, and is very readily soluble in acids and alkalies.

The phosphate of lime, or bone earth calculus, is generally of a pale brown colour on its surface, which is also so smooth as to appear polished; when sawn through, it is found very generally laminated, and the laminæ commonly adhere so slightly to each other as to separate with ease into concentric crusts. This is nearly the description which Dr. Wollaston has given of it; for he first discovered the existence of urinary concretions consisting entirely of the phosphate of lime; although both Bergman and Dr. Pearson had distinctly ascertained the frequent occurrence of *some* of this substance in urinary calculi. Dr. Wollaston says in a specimen, with which he was favoured by Dr. Baillie, each lamina was striated in a direction perpendicular to the surface. A section of the specimen which Dr. Wollaston alludes to, is that

which I now have the honour of producing; two separate nuclei are seen in it, each first surrounded with concentric laminæ belonging to itself, and then larger concentric laminæ surround the whole. This calculus does not fuse when the usual flame of the blow-pipe is applied to it; it first blackens and afterwards becomes perfectly white. It is readily soluble in muriatic acid; and if the excess of acid be not very considerable, the lime may be precipated in the form of an insoluble compound, by oxalate of ammonia.

The triple calculus, or ammoniaco-magnesian phosphate, is always nearly white; its surface is commonly uneven and covered with minute shining crystals, and these appear also internally between masses of other calculous matter. Dr. Wollaston, to whom we are first indebted for any accurate knowledge of this calculus, describes the form of the crystals to be a short trilateral prism, having one angle a right angle, and the other two equal, terminated by a pyramid of three or six sides; these calculi are whiter but less compact than those of the phosphate of lime. The texture of this calculus is not laminated, and it is easily broken and reduced to powder; in some rare instances, however, it is hard and compact. It is scarcely ever found without an admixture of some other substance, but is often discernible by its whiteness and crystalline sparkling appearance.

Before the heat of the blow-pipe, this calculus gives off the odour of ammonia; it then becomes opaque, and is capable of undergoing an imperfect fusion. It is readily soluble in dilute acids, much more so, indeed, than the phosphate of lime; and if these solutions have abundance of ammonia added to them, the triple crystals re-appear.

This calculus often attains a very large size. Dr. Paris has very kindly permitted me to show the specimen of triple phosphate crystallized on a decayed beam which was taken from the privy of a public house, and to which he alludes in a note in his Pharmacologia. The triple salt is here seen in large and well-defined octohedrons. Dr. Paris considers this as a very valuable specimen, illustrating a fact of important practical application, viz. that urine, in a state of incipient putrefaction, by yielding ammonia precipitates the triple phosphate.

This may account for such species of calculi being so frequently found in old people, whose prostate gland is diseased. The fusible calculus occurs more frequently than any other urinary concretion, excepting that of lithic acid. The late Mr. Tennant found that, when urged by a blow-pipe instead of being nearly consumed, a large proportion of it melted into a white vitreous globule. Dr. Wollaston first ascertained its true

nature. It is composed of a mixture of the phosphate of lime, and triple phosphate of magnesia and ammonia. It is commonly whiter and more friable than any other species of calculi, so that it sometimes resembles a mass of chalk, leaving a white dust on the fingers. The colour is a less brilliant white than the triple and inclining to grey. In general, the laminated structure is not obvious; but it sometimes separates into layers, the intestices of which are often studded with sparkling crystals of the triple phosphate. The variety of this species, which is not laminated, often acquires a very large size, and assumes the form of a spongy, friable, whitish mass, evidently moulded to the contracted cavity of the bladder in which it has been formed. The calculus presented by Sir James Earle was of this kind. The fusible calculus may be readily distinguished by the ease with which it melts before the blowpipe. It is readily dissolved by acids, and in particular by the dilute muriatic acid; and if to this solution oxalate of ammonia be added, the lime is precipitated alone, and the magnesia may be afterwards separated by the addition of pure ammonia. As the proportions of the two phosphates in this calculus are liable to indefinite variations, so its degree of fusibility is also different. The proportion of lithic acid may be ascertained by a solu-

tion of caustic potash, which dissolves the lithic matter, and expels the ammonia, but has no effect on the other ingredients of the calculus.

In most instances, when concretions take place round any extraneous substance introduced into the bladder, they are found to consist of the mixed phosphates or fusible calculus.

It would appear from general result of the examination of the collections, which Dr. Prout has so carefully drawn, that about one fourth of the whole number of calculi consist of the phosphates; and that half of this proportion, or about one eighth, consists of the mixed phosphates; but that gentleman remarks, that whoever has paid much attention to the subject of urinary calculi, will perceive that these estimates are very incorrect, especially as far as regards the proportion of the calculi composed of the mixed to those composed of the pure phosphates. He also farther observes, that calculi have frequently the appearance, externally, of being composed of the phosphates, while they contain a nucleus of a very different substance: except, therefore, calculi are sawn through the centre, it is impossible to ascertain their composition where the phosphates are concerned. He supposes, from this method not being pursued, in examining some of those at Warwick, sufficiently accurate data are not given to enable us to draw

any inference with respect to the point in question. And from some other reasons, which he also gives, he thinks we are entitled to conclude, that the proportion of calculi, composed essentially of the phosphates, is much less than what it appears to be from the data above given, taken collectively; and that those composed *entirely* of the phosphates bear even a very small proportion to those composed principally of them. Dr. Henry has stated, at Manchester, where these points were attended to, that in four instances only, out of 187, the calculus has been composed throughout of the earthy phosphates.

The alternating calculus, or compound calculus, in distinct layers, may consist of different laminæ of any of the preceding species; hence its appearance may be much varied. Most commonly it is composed of a lithic acid, or of a mulberry nucleus, and an external crust of the fusible calculus. In some rare instances, three, or even four, species of calculi occur in the same concretion disposed in distinct concentric laminæ. A calculus is before us in which lithic acid may be seen in the centre, pure phosphate of lime next to this, then oxalate of lime, and ultimately the fusible crust enveloping the whole.

Dr. Marcet, when describing this calculus, observes, "this alternation of different species of

calculi may, at first sight, appear to throw great difficulties in our attempt to cure this disorder upon chemical principles. But, on the other hand, it is somewhat encouraging to observe, that, since the occasional variations in the state of the body can produce a total change in the nature of the urinary secretion, medicines may, in all probability, affect similar changes; and that, therefore, it is not unreasonable to hope that we may, at some future period, acquire a considerable control over those morbid secretions." The chemical character of these calculi must, of course, vary in the different layers. The nature of the different laminæ can therefore only be ascertained by examining them separately, and submitting them to the tests already mentioned.

From the preceding data, taken collectively, it appears that between $\frac{1}{4}$ and $\frac{1}{3}$ of the whole number belong to the class of alternating calculi; but this Dr. Prout considers to be an erroneous calculation: for there appears to be only five calculi in our collection which, according to Mr. Brande's table, belong to this class out of 150. In the portion examined by Dr. Marcet, at Norwich, about $\frac{1}{5}$ of the whole, and in Guy's Hospital, $\frac{1}{14}$ of the whole; while, in the Liverpool collection, according to Dr. Henry, there are no less than 73 out of 187; and in the Bristol, according to Mr. Smith, 83 out

of 218. These differences, in all probability, have rather arisen from some arrangement by the respective authors than from actual examination. In every collection which Dr. Prout has seen, the proportion of alternating calculi has been strikingly great.

LECTURE VIII.

CONTINUATION OF THE COMPOSITION OF CALCULI. ON THE SYMPTOMS PRODUCED BY CALCULI IN THE KIDNEYS AND IN THE BLADDER.

When I last had the honour of addressing this audience, I stated the plan I meant to adopt in bringing before them certain observations on the diseases of the urinary and genital organs. I gave my reasons for beginning with urinary concretions, as a disease of the urine, but varying in the composition of the deposited materials from several causes. I then proceeded to point out general circumstances, respecting the size, number, form, outward appearance, and most usual seats of urinary calculi.

Their classification into six species was then mentioned, viz.

1. Those composed of lithic acid.
2. Those of oxalate of lime or mulberry.
3. Those of the cystic oxide.
4. Those of the phosphates, with their varieties.
5. Those called alternating.
6. Those called the mixed or compound.

I then proceeded to state their comparative frequency, their difference of appearance, their chemical composition, and the tests by which they could be distinguished and ascertained. The last subject which I mentioned was the appearance, composition, and test, of the alternating calculus.

The compound calculi, or those with their ingredients intimately blended together, have been called mixed calculi; such concretions may consist of an intimate mixture of any two or more of the preceding species; but consist generally of a mixture of ammonia and the phosphates. Their colour of course varies with their composition, their figure is less regular, they are for the most part not laminated, and possess considerable hardness. They are seldom of a large size and are very rare. The chemical characters of such calculi will depend upon their composition, the nature of the different principles entering into which may be ascertained from what has been already stated.

The prostate calculus, although not of urinary origin, when discharged from the urethra is very apt from its appearance to be mistaken for a lithic concretion. It is to Dr. Wollaston that we are indebted for distinct information as to the composition of such calculi. They vary in size from a pin's head to a hazel nut: their form is more or

less spheroidal, and their colour is yellowish brown. They consist of neutral phosphate of lime not distinctly stratified, and are tinged by the secretion of the prostate gland. By these properties they can readily be distinguished from calculi derived from the urine.

It is evident, that although these species of calculi are so different in their composition and appearance, they may, in fact, be considered as made up of only four elementary substances, viz. 1st, the lithic acid and its compounds; 2d, the oxalate of lime; 3d, the cystic oxide; and 4th, the earthy phosphates; two or more of which principles are seldom or never found in excess in the urine at the same time.

From Dr. Prout's observations it appears, that the phosphates, when found, always follow and never precede any of the other species of urinous concretions.

The layers or successive depositions of urinary calculi are cemented together by some animal matter, which, however, appears to be of a compound nature, and to vary in the different species of calculi. The mucus, which is at all times secreted by the inner coat of the bladder, and which becomes remarkably ropy and glutinous when that membrane is inflamed, is one of the constant ingredients in the cement. Dr. Henry conceives, that the animal matter is chiefly composed of albu-

men; urea probably enters also into its composition, as Professor Brande, and other chemists, have detected considerable quantities of that material in urinary calculi.

The nuclei of urinary calculi have been divided into two kinds, viz. the primary or renal, and the secondary or vesical. The primary nuclei have been found to consist, for the most part, of lithic acid; occasionally of the oxalate of lime; sometimes, but very rarely, of cystic oxide; and still more rarely of the phosphates. In some calculi from the kidneys also, coagulated blood, or hardened mucus, have appeared to constitute the primary nucleus.

The secondary or vesical nuclei are almost always constituted of small renal calculi, which have desended from the kidney to the bladder; or of foreign substances introduced into that organ. What should produce the first deposition of lithic acid, cystic oxide, or the phosphates in the kidney, so as to form the nuclei, is at present impossible to be satisfactorily accounted for; but in such calculi, nuclei of coagulated blood, or other animal matter, may arise from local injury, or morbid action in the secreting organs in consequence of such.

When a nucleus is once formed, an accumulation of calculous matter soon takes place round it, and thus it increases in size. This accretion arises

from the gradual precipitation of that excess of certain principles of the urine, which cannot be retained in solution in that fluid. Every saline solution, which precipitates a salt without any change of temperature, obviously contains more of that salt than is necessary to saturate it. Such solution is then said to be supersaturated; hence in any supersaturated solution, the excess is always deposited until the solution arises at the point of saturation. It is a remark of Dr. Prout's, that a calculus in the bladder may be considered as a substance placed in a solution of various principles in a certain quantity of water. If any of the more insoluble of these principles exist in this solution in a state of supersaturation, the calculus will afford a nucleus, round which the excess will be deposited. But if none exist in a state of excess, none can be deposited, and the calculus will not increase in bulk.

The general structure of most calculi is laminated, which shows that their formation has been interrupted, or has taken place at different intervals: for if a calculus was constantly increasing after its first formation, its texture should not be laminated, but homogeneous. An interval therefore takes place, during which the excess of no material is deposited; during this interval also the surface of the calculus may become smoother, and less fitted for future accretion. Thus when a tendency to deposition returns (which deposition may

be either the excess of lithic acid, the oxalate of lime, or the phosphates), it has to commence on the worn or new surface of a foreign body; the consequence will be, that the colour of the laminæ will be different, according to the materials then deposited, and the adhesion between the old and new laminæ will be less firm than in the intermediate parts; a calculus will therefore be sometimes disposed, when broken, to separate into concentric laminæ. In this manner upon chemical principles the increase of many calculi can be accounted for, and their structure warrants the inferences drawn. But we know that the arteries have a power from natural action, also occasionally in diseased action, and those which are the consequence of disease, of separating various substances from the blood, and where no supersaturation of such substances can be supposed to exist: this we find in the formation of bone, and in the salivary concretions. The vessels of the kidney may therefore, from some alteration of natural action, have the power of immediately separating or forming the lithic acid, which constitutes the nuclei of most urinary calculi, and this power may either continue, the calculus increasing with the same materials, or the oxalate of lime, or the phosphates may be deposited and concrete on its surface. This power of separating the lithic acid, seems to be proved by the numerous deposi-

tions of calculous matter, which on some occasions have been found in various parts of both of the kidneys of the same patient. A local injury throwing out any substances that would form accidental nuclei would not produce such numerous concretions in such various parts.

In the writings of Dr. Marcet, Mr. Smith, and Mr. Copland Hutchison, much interesting and important information is to be found, respecting the periods of life, the mode of living, the sex, and climate which are the most favourable to the production of calculous disorders. From the data which their praiseworthy researches have afforded us, it appears that nearly one half of the stone cases occur before the age of puberty, and that there is an evident increase in the number of cases about the age of forty years.

I removed a calculus, the one I now produce, from the bladder of a girl under two years of age, which, from the symptoms her mother described as having taken place, must have began to form immediately after birth. She had been exposed to no known cause likely to produce calculous concretions. She is now a young woman, and the mother of two children; nor has any disposition to the formation of calculi appeared in her since the operation. In the dead body of an infant, under seven months, I have found a calculus, of the size of a garden pea, loose in the bladder:

this child could not retain urine from his birth; it was constantly dribbling away, and never flowed like other children's in a stream.

In regard to the mode of living, it does not appear that any thing certain is made out as to the original causes of the formation of calculi. The disease has been found to take place in infants, as in the above recited instances, in young people, and in adults of very temperate, even of abstemious lives, as well as in others of different ages, and whose habits of living have been the reverse; but upon the whole, people of studious and sedentary habits appear more disposed to the formation of these concretions, than those whose lives are more actively employed. Mr. Copland Hutchison, in some papers which have been published in the Medico-chirurgical Transactions, and which do much credit to the industry and good sense of the author, has shown how seldom urinary concretions occur in that valuable class of men the British seamen. From several circumstances which he has fully detailed, he infers that animal food, combined with a certain portion of the muriate of soda, in conjunction with farinaceous aliment, on which seamen principally subsist, are favourable to the prevention of calculous aggregation. He supposes that there may be something also in the occupation, drink, and general habits of seaman as to exercise and frequently emptying the blad-

der, which render them more peculiarly exempt from this disease than other classes of labouring men.

We have also the testimony of Dr. Scott, whose long residence and extensive practice in India render him a competent judge, that the formation of stone in the urinary bladder is nearly unknown between the tropics.

It appears from his testimony and that of others, that although the disease may be found to exist in warm climates, it is not common; and when it does occur, it is usually imported. We have also evidence that some districts in our own country are more favourable to its production than others, and that its frequent occurrence does not arise from the temperature of the district, but from some other causes which have not yet been thoroughly ascertained. The materials used in food, it has been supposed, might be one of the causes, but the proof is deficient.

Having made these general observations on calculi formed in the urinary organs, which from the number of specimens preserved in the Museum, as well as the general interest of the subject, I have thought it my duty to make; I shall now endeavour, as we proceed, to state the symptoms produced by them, and to show their effects on the different parts of the body where they may happen to be deposited, and the prin-

ciples on which medicine has been given for their cure.

Urinary concretions are found in different parts of the kidney, and vary of course in their size and shape; the first depending on their duration, and the second on the form of the cavity in which they are detained. In the kidney, as elsewhere, they vary in colour and in the roughness or smoothness of their surface: their difference in colour depending much upon the materials which enter into their composition; and the roughness or smoothness on the mode in which the deposited matter concretes, also on hard or soft parts surrounding them; for if two or more calculi play upon each other, parts of their external surfaces must be worn smooth.

Small depositions of calculous matter are sometimes found in the tubular portions of the kidney, having formed there small cavities for themselves; I have even seen small granules of lithic acid in the cortical portion, but it is uncommon to find them in that part. The most usual situations of renal concretions are, either the infundibula, or pelvis of the kidney, where they often increase to a very large size, filling up these cavities, excepting a small space by which the urine still continues to pass to the ureter. In some instances one large mass shall be formed; in others, detached concretions in various parts of the kidney; and in

some of the cavities several of these shall be seen compressed together.

When a calculus is once formed in the infundibula or pelvis, and is of a size too large to enter the ureter, its growth will gradually increase from the constant contact of urine, and it will take the shape of the cavity in which it is contained.

What produces the original deposition it is impossible to ascertain, but, when a calculus is once deposited in the cavities alluded to, it is placed in the most favourable situation for its increase in size, as the urine must constantly be flowing over its surface; and by its increase it materially alters the substance of the organ in which it is formed; for the urine being detained behind it, by the pressure produces first an enlargement of the infundibula, and, by the continued and increased pressure as it accumulates, the absorption of the substance of the gland: thus each calculus has a cavity round it, containing urine on the side nearest the secreting structure of the gland. I have seen, from these causes, the pelvis and infundibula increased to a very great extent, and the kidney reduced in its substance to a mere shell, which still, however, continued to secrete urine. During this morbid alteration of structure, the kidney shall generally increase in size, so that as many cryptæ as possible shall be crowded into the thin capsule, into which the cortical portion of the kidney is re-

duced. From the altered state of the diseased kidney, it might naturally be expected that the secretion of urine would be carried on by the sound kidney enlarging for that purpose; but this, although it sometimes happens, is far from being generally the case. I have seen the kidneys on each side reduced to a substance little thicker than a common wafer, in cases where no diminution of the natural quantity of urine had taken place before death; from which it would appear, that a very small portion of the natural structure of the kidney is capable of secreting very nearly the ordinary quantity of urine.

I have seen instances of this morbid alteration of the kidney, without any appearance of ulceration, and without the formation of pus; but it often happens, that the irritation of these calculi, particularly if they lie rather loose, shall excite inflammation, suppuration, and ulceration, so that large abscesses shall be formed in the kidney, and the pus shall descend with the urine into the bladder. I have met with instances where the urine was completely obstructed in its passage to the ureter, where its accumulation was attended with abscesses in the kidneys, and where both urine and pus were evacuated by the tumour bursting in the loins. I also have known similar abscesses burst into the great intestine. There are many most excellent preparations in the Museum,

showing the renal calculi and their effect on the kidney; these would require too much time to describe them particularly here, but they are well worth the attentive consideration of those who view the Museum of our College. It is not in every instance that the kidney is enlarged when containing calculi. I have seen it, under such circumstances, much reduced in size.

Mr. Henry Earle has published some cases in the 11th volume of the Medico-chirurgical Transactions, in which he thinks he has traced the formation of calculi in the kidney to some local injury. He supposes, that where blood is not thrown out so as to become the nuclei of calculi, in consequence the injury, some local morbid action takes place, and causes a secretion of the lithic acid, which becomes a centre of attraction for the salts of the urine, in the same manner as a clot of blood or a portion of bougie left in the bladder. I can have no doubt but that calculous concretions often arise from local injury of the kidneys, as I have seen coagulated blood form the nucleus of a renal calculus, in a case where no symptoms of disease had existed in the kidney previous to the person having received, by a fall from a window, a severe injury in the loins. I have frequently been consulted by a stout and otherwise healthy man, for the excruciating pains he has often felt, when calculi were descending from the right kidney; and which ge-

nerally happened when his business obliged him to be long on horseback. He could, from the pain, trace the descent of the calculus to the bladder, and when the calculus entered that viscus the pain ceased, and much blood has usually, at these periods, come away with the urine. In three or four days after this, he generally has passed the calculus through the urethra, and this with but little pain. He has carefully preserved several fragments thus passed. On one of these being detained longer than usual, it began to produce symptoms of stone in the bladder; on sounding him, I distinctly felt a calculus there; it, however, passed next day, almost without his knowing that it had entered his urethra; I have sounded him since, and can find no stone, nor has he any symptoms of one lodged in the bladder, but every symptom remains which denotes concretions to be present in the kidneys. This person can trace the formation of the renal calculi to a fall from a hay-cart when he was a youth; after which fall he for a long time voided blood with his urine. He is now sixty years of age, and the father of a numerous family. I have met Mr. Mayd, of Epsom, in consultation on a case neary similar to the above, the patient now being the active steward to a gentleman who has a large estate in that neighbourhood.

Although coagulated blood is sometimes the nucleus of renal calculi, the more usual nucleus

is formed of lithic acid; and this generally is so when the formation of calculi in the kidney cannot be traced to any local injury. Lithic acid appears to be more frequently deposited from the urine than any other of the substances which form calculi; but why that substance should be first deposited in the kidney, and retained there when of a small size, we do not know. Some other circumstances than the mere separation and deposition of the lithic acid, are also necessary to change it into the hardened form it afterwards assumes; these may sometimes be accidental, but it is more probable that they are generally the result of disease.

Dr. Prout attempts very ingeniously to account for the formation of lithic acid nuclei. He supposes, that as the structure and action of the different kidnules in secreting the urine, are independent of each other, one or more of these may be deranged in disease to a greater degree than the rest, so as to secrete very little water, but a large proportion of lithic acid. In such a case, he observes, the lithic acid must be obviously supposed to exist in that peculiar semi-fluid condition, or state of hydrate, which it is well known to be readily capable of assuming. In this state it is bulky, and may occupy the whole of the infundibulum in which it has been deposited. After remaining in this state for a greater or less time,

crystallization may be supposed to take place; the semi-fluid is now much diminished in bulk, and perhaps reduced to the form of a congeries of crystals easily separable from one another, and thus passes off in the form of gravel; or what may easily be supposed to take place (especially when the lithic acid is very impure and combined with a larger proportion of other matters than usual), it may assume the form of an imperfectly crystallized mass, and thus constitute a nucleus possessing these characters. Whatever may form the nucleus when detained in the pelvis, or infundibula, the concretion often enlarges to a considerable size. When there is a great disposition to the formation of lithic acid, the calculus consists wholly of that substance and animal matter, and will increase in bulk, so as frequently to form a complete cast of the pelvis of the kidney. When there is less disposition to form lithic acid, the external laminæ of the calculus are composed of the ammoniaco-magnesian phosphate and phosphate of lime. Renal calculi composed of the phosphates are however very rare.

Calculi of the cystic oxide are extremely rare, and when found, there is reason to conclude that they generally originate in the kidneys.

Calculi, composed entirely of oxalate of lime, are not very often formed in the kidney; they are more frequently formed in this viscus on pri-

mary nuclei of lithic acid. Professor Brande found only three calculi preserved in the collection of this college, composed of the oxalate of lime, which were voided from the kidney: two of these are very small and hard, having an appearance of being made up of several smaller calculi, of a dark brown colour; the third is of the size of a small pea, or hemp seed, its surface smooth, it is of a grey colour, and not very hard.—The same gentleman has stated, that in one instance a small lithic calculus had been deposited in the kidney, in such a situation that its upper surface was exposed to a continual stream of urine, and upon that surface beautiful crystals of the triple phosphate had been deposited. It would therefore seem, the Professsor observes, that under common circumstances a stream of urine, passing over a calculus of uric (or lithic) acid, has a tendency to deposite the phosphates upon it.

In looking over the collection of calculi belonging to our Museum, for specimens to produce in this theatre, I found the very large renal concretion, formerly mentioned, which had been examined by Professor Brande, and found to be oxalate of lime, although of a bluish white colour; and attached to it was a paper, in the hand-writing of John Hunter, which I have transcribed, and shall repeat to you in his own words:—"A calculus, taken from the pelvis

of the right kidney of Mrs.——, a natural daughter of Sir Richard Steel. She was never known to have a nephritic symptom till just before her death, when she was taken with a violent pain in the right side near to the back, the seat of the right kidney, which appeared to have thrown her into a fever, of which she died: upon opening the body was found this stone, and the substance of the kidney itself was become so thin, as only to appear a coat or membrane covering the stone, and which gave the idea to the surgeon, that the substance of the kidney was grown into a stone. It at present weighs seven ounces and a half."

Calculi, even of a larger size than the above, have been discovered, after death, in the kidneys of people who during life had no symptom characteristic of such disease; it therefore is possible that they may be formed in the kidney and remain there for life without producing much irritation. When known to exist, the symptoms, when they produce irritation, are very similar to those which attend inflammation of this organ. The kidney, although possessed of numerous nerves, does not seem to be a part very susceptible of pain; I have seen its substance nearly destroyed, without much pain having been referred to its situation during the life of the patient. When, however, the calculus, from size or weight, produces suppuration and ulceration of the kidney in which it is im-

bedded, the disease is accompanied by a constant sense of weight in the region of the kidney, with a heavy pain, occasionally rendered more acute by any sudden and jolting motion of the body, particularly by riding on horseback, or over the stones in a rough carriage, such motion often being accompanied with a copious discharge of bloody urine. When pus is formed, quantities of it are voided with the urine, and shiverings generally precede its formation. The urine is moreover generally loaded with a brick-coloured sediment, which it soon deposits when received into a vessel; it is sometimes pale, but is usually of a deep red colour, and is voided frequently and in small quantity at a time. There is often a sense of numbness in the thigh, and in the male there is often a retraction of the testicle, and some pain felt in it; these symptoms are confined to the side of the affected kidney. These are the most usual symptoms which attend the retention of a calculus in the kidney, and which often terminate only with the life of the patient; but, although they proceed from a disease which we have no certain powers of curing, the patient may exist under them for many years without suffering excruciating pain, and may at last die from other causes.

But calculi formed in the kidneys more frequently find their way by the ureters into the bladder than remain where first formed. When

of a moderate size, they will pass from the pelvis of the kidney into the ureter, and they have sometimes passed on to the bladder without pain; but more generally, unless very small, their entrance into the ureter is accompanied by an accession of very acute pain in the region of the kidney, and which shoots downwards to the groin, and to the inner part of the thigh of the affected side; the urine is high-coloured, in small quantities, and generally mixed with blood; the testicle is sometimes drawn violently upwards to the external ring; the stomach usually in these cases sympathizes, so that violent sickness occurs, and vomiting often takes place. On some occasions I have known the bowels also affected, and a diarrhœa come on.

After some time, the length of which is uncertain, the pain having gradually descended to the pelvis, suddenly ceases, and the other attending symptoms disappear; this indicates the entrance of the calculus into the bladder, from which it sometimes passes into the urethra, and is voided without pain or difficulty; but it often is retained in the bladder, increases in size, and produces most distressing symptoms, which will presently be mentioned. A calculus has been retained in the ureter, and has completely blocked up its cavity, so that no urine could pass; this has produced a great enlargement of the ureter above

the calculus, also of the pelvis of the kidney, and of the infundibula, a diseased state of the kidney itself, and finally the death of the patient.

When there is reason to suppose that a calculus has recently formed in the kidney, although we have no symptoms that can positively ascertain this, we should have recourse to that mode of treatment which is the most likely to expel it immediately, without waiting for the imaginary effect of solvents. Should any symptoms of inflammation be present, we should of course endeavour to remove them. Blood taken from the arm, in strong constitutions, may be had recourse to; and bleeding from the loins, by cupping or leeches, even in weakly constitutions, may be tried, and will often, so far as lessening irritation goes, have a good effect. Hot fomentations applied to the loins; the use of the warm-bath, with purges of calomel, are likely to assist in the expulsion of the concretion, if recently formed and small; these purges may be immediately followed by full doses of some narcotic substance, such as opium, hyosciamus, or extractum conii, so as to insure their antispasmodic effects on the system. Neutral salts, particularly the tartarized soda, acting as diuretics as well as purgatives, may be used so as to keep up the purgative effects of the calomel. The extent of the use of these means must depend on the symptoms of irritation present, and the state

of the patient's constitution. In cases where the irritation has been very great, some good effect has, in a few instances, been felt from the introduction of setons into the loins, but in other instances no benefit has been derived from this practice.

When the calculus has entered the bladder, it becomes an object of the greatest consequence to expedite its removal from the cavity, and this is best done by following up the plan already recommended to procure the removal of it from the kidney and ureter, as it is obvious that what has so lately passed the ureter, is equally likely to pass along the urethra. The inflammation and irritation, therefore, of the ureter and bladder should be allayed by antiphlogistic and antispasmodic medicines, and the diuretic purgatives should be persevered in. When the inflammatory symptoms have abated, the more copious we can make the flow of urine, the sooner is the offending body likely to be expelled; diluting fluids should therefore be used. In the female, calculi are generally expelled from the bladder almost as soon as they enter it, and usually with little pain. Should a calculus remain in the bladder, a train of most distressing symptoms begins to take place, and these can only be removed by an operation which, although it has been successfully performed in a large majority of cases, never can be attempted

without some risk, and always must be attended with much personal suffering.

At first, the patient, on changing his position, or on making any hasty bodily exertion, feels a peculiar sensation at the end of the penis, as if suddenly called upon to evacuate the urine, although the bladder may have been emptied immediately before; this sensation occasions the sufferer often to apply his hand to the part where it is felt: in children when afflicted with stone, such action is constantly occurring. The sensation gradually changes to absolute pain, becoming progressively more constant and more severe. The desire to pass urine becomes more and more frequent, and as the irritability of the bladder increases, so does the frequency and urgency of this desire; the urine, therefore, is discharged in very small quantities at a time, sometimes only drop by drop; occasionally a little blood accompanies the efforts to discharge it; and these efforts often bring on a painful tenesmus, and an irresistible desire to expel the contents of the rectum. In other instances, the patient is for a time free from pain, and a tolerably large quantity of urine is allowed to collect in the cavity of the bladder, which on evacuation will flow at first in a full stream and without pain, when suddenly the stream shall at once stop, although much urine remains in the bladder, and the desire of passing it still continues urgent; this desire is con-

sequently increased by the stoppage, and becomes most distressingly painful; and in proportion to the efforts made to pass the urine by pressure, the difficulty is increased and the pain is aggravated. On these occasions, the change of position will do more than muscular efforts; for the stoppage being occasioned by the calculus gravitating to the orifice of the urethra as the most depending part in the erect position, when the patient changes that position for the horizontal, and lies on his back, it then leaves the urethra open by falling to the part now become the most depending, viz. between the ureters. So long as the urine continues to flow in a copious stream, usually little or no pain is felt, the urine defending the neck of the bladder from the stone; but when only a few drops of urine remain, the concreted mass and irritable membrane then coming in contact, much pain is excited. The urine deposits a large proportion of a mucous sediment, which is produced by the vessels and glands near the cervix of the bladder being, by the presence of the calculus, excited to an increased secretion. Small portions of calculous matter occasionally come away with the urine, which on these occasions is generally, although not always, mixed with a ropy fluid tinged with blood; but some calculi are so firm and hard, that this last symptom does not take place.

When the calculus obtains a large size, a dull

but constant pain is felt at the neck of the bladder, and numbness is sometimes perceived in the inner and upper part of the thigh; a painful sensation of weariness is also felt in the back, which is increased on exercise being used. These symptoms seem to be aggravated when the stone presses upon the surface between the urethra and the ureters, and while in that situation, very violent fits of pain occur, which are only relieved by the removal of the stone from the part; various positions of the body are tried by the patient, to effect this removal, even those where the fundus of the bladder is made the most dependent part. In the case of the enormous calculus, which has been published by Sir James Earle, the patient, to evacuate his urine, was obliged to place his head where the feet usually are, and his body at the same time nearly in a vertical position, and to repeat this sometimes every ten minutes.

Dr. Prout has mentioned a symptom, which I have also observed occasionally in persons afflicted with stone. He says, that in every severe case of the stone, and particularly when the calculus is composed of the phosphates, which have hitherto fallen under his observation, the patients have constantly experienced some peculiar sensation, and referred it to the hollow part of the bottom of the foot; sometimes such sensation being only that of slight numbness; in other cases producing trouble-

some and almost constant itching, and in some instances it has amounted to pain as severe and harassing as that which was felt in the bladder.

I have known similar sensations take place from tumours of the prostate gland, and from excrescences of the inner coat of the bladder, where there has been no stone; but more frequently, when there has been one, and the coats of the bladder much diseased in consequence. In a gentleman who died in the beginning of last winter, in whose bladder several small calculi were found, and in whom the prostate gland was also diseased, the pain in the hollow of the foot became most distressing: but as it went off in a fortnight, it was attributed to gout.

LECTURE IX.

SYMPTOMS OF CALCULI CONTINUED. ON THE EFFECTS OF ACIDS AND ALKALIES ON URINARY CONCRETIONS, AND ON THE TREATMENT OF CASES OF STONE PREVIOUS TO THE OPERATION OF LITHOTOMY.

Instances have been met with, where the usual symptoms of stone in the bladder have occurred, where fragments of stone have been passed, even where the stone itself has been found in the bladder by the introduction of the sound, notwithstanding which all the characteristic symptoms of its existence have disappeared, and the patient has experienced comparative comfort for the rest of his life. Such cases have been given in proof of the efficacy of certain lithontriptic medicines, and until the death of the patients have been received as such. But on the examination after death, calculi have been found imbedded in cysts formed in the coats of the bladder, which contracting round them, and preventing them from gravitating to the neck of that viscus,

produced those favourable alterations of the symptoms, which were attributed to the dissolving powers of the medicine employed. Preparations showing such cysts are now before us.

One of these shows a large calculus imbedded near the fundus of the bladder, which viscus does otherwise not appear to be diseased, although the packets of its muscular fibres, as is usually the case when the bladder has additional action, have become somewhat increased in thickness. Had the stone been felt by the sound, and the operation of removing it been attempted, it is doubtful whether it could have been grasped by the forceps, so as to have been extracted without tearing through the coats of the bladder.

A gentleman who was nearly eighty years of age, had long been affected with symptoms, which although not of an aggravated nature, were supposed to proceed from stone; he had often been sounded by various surgeons, but no stone had been felt. I was requested to draw off his urine, and to ascertain, if possible, at the time, whether a stone was actually in the bladder. Upon the first introduction, the point of the catheter immediately came in contact with the calculus, so that the stone was most distinctly felt, and the sound on touching heard by me, and also by his nephew, who was himself a surgeon of the highest eminence as an oculist. The patient's age prevented any operation from be-

ing proposed. Soon after this he died; and on the body being inspected, a large opening appeared to pass from the bladder into a cavity bounded on one side by the peritonæum, which was a little thickened, and on the other by the muscles of the abdomen: this cavity contained a calculus which weighed four ounces; the edge of the opening seemed in a state of ulceration, and the size was sufficiently large to let the stone pass readily through into the cavity of the bladder. The symptoms of calculi in this gentleman, until within a few months of his death, were never violent, but had existed in some degree for more than twenty-five years.

The reason of the stone not having been felt by the former introductions of the sound, had been attributed to some enlargement of the prostate gland preventing the calculus from coming in contact with that instrument; the prostate gland, however, in this case, was not sufficiently enlarged to produce such effect, and only the inspection of the body made the true cause evident.

Several years ago I was consulted by a gentleman who had some symptoms of stone, but none which were of a very distressing kind. Upon my introducing a catheter into the bladder, I distinctly felt a stone; but as the patient did not then suffer much pain he objected to any operation, and for many months, indeed years, made trial of the liquor potassæ. Soon after he had commenced

the trial of this alkaline medicine, he passed by the urethra several calculi of various sizes, but all rather small, the composition of which appeared to be lithic acid; he was then about fifty-five years of age. After this, his prostate gland became enlarged, and I was in the habit, for nearly twenty years, of occasionally introducing the elastic gum catheter, he himself introducing it every night and morning, but no calculus was felt, nor were any particularly searched for. About a twelvemonth before his death, which happened about six years and a half ago, the symptoms of calculi returned; I now sometimes thought the catheter touched a hard body, but the sensation was not exactly that which a stone would be supposed to produce. Laterally, I distinctly felt a stone, and several fragments of calculous matter, apparently composed of the phosphates, occasionally were passed through the canula of the instrument. For the last three years of his life, he had changed the liquor potassæ for the muriatic acid, of which he was in the habit of taking 25 drops three times in the day in spring water, and when he omitted to do this for a few days he found his symptoms became more distressing. He continued, however, to enjoy the society of his friends, and to attend his duty in Parliament, until within a very few days of his death, which happened in his seventy-third year. Two cal-

culi, something of an angular shape, and rather of a large size, were found imbedded in cysts in the coats of the bladder, one of which had become rather loose; each calculus had a part of the surface not enclosed in the cyst of a dark brown colour, very shining and smooth, apparently polished by having rubbed against the other. This smooth portion I suspect from its appearance to be composed of oxalate of lime: every other part was covered by calculous matter, softer in its texture, and of a white colour, which appeared to consist of the triple phosphates. How far the medicines which he had been in the habit of taking could influence these appearances I know not. Both of his kidneys were diseased, and in one several small abscesses were found; both contained calculi, the appearance of which, but they were not analyzed, seemed to be that of lithic acid. The calculi found in the bladder are those which I now exhibit, and in future they will be deposited in the Museum of our College.

Several years ago I examined, along with Mr. Cruikshank, the body of a gentleman who died of a dysentery at the advanced age of eighty-one. For some years before his death he was a constant attendant on the lectures delivered by Dr. Baillie and Mr. Cruikshank in Windmill Street when I was the demonstrator of anatomy in that school. I frequently, at that time, dissected bodies for him; and, before his death, received a paper from

him with a detailed account of all the symptoms of disease which he could remember as having occurred to him during the last forty years of his life, with a view of having the parts affected by them examined by Mr. Cruikshank and myself after his death, he having inserted a clause in his will to that purport. I mention this, particularly as among the various parts of the body he had named, neither the kidneys nor bladder were alluded to; and as he had long been professionally attended by Mr. Cruikshank and myself, had any difficulty of passing his urine occurred, it would not have been concealed from us. Notwithstanding this, a very dark coloured oxalate of lime or mulberry calculus was found in his bladder, the bladder itself exhibiting no particular diseased appearances. The projections from this calculus were rather long spicula with blunted points than tubercles; and probably from their shape, preventing at any time the whole surface of the calculus from touching the sides of the bladder, allowed the urine to pass into the urethra, so that no obstruction to its flow ever took place. What could have prevented such calculus from irritating and bringing on the other symptoms of stone I know not; but I have met with other instances where the oxalate of lime calculus has produced but little comparative irritation, although, I believe, it is a generally received opinion that it produces the

greatest. A recent instance of this having occurred in the person of a gentleman well known in the philosophical world, and long one of the most useful members of the Agricultural Society, I shall relate his case in the words of Dr. Paris, who had with Mr. Chilver attended him during life, and inspected his body after death, on which last occasion he took a calculus from the bladder, of the mulberry kind, which weighed 631 grains; its specific gravity was found to be 1775.

Dr. Paris says, "The existence of a calculus was never suspected until about a week previous to the patient's death. On the 6th of April 1820, he walked in St. James's Park, and feeling fatigued, sat down on one of the benches, which, from its unexpected lowness (he being blind), gave him a considerable shock, which, I imagine, dislodged the calculus from the sac in which it had reposed; he immediately expressed a most urgent desire to pass his urine, which increased so painfully, that it was with difficulty he could reach his house in Sackville Street: this distress became more violent, and he could only discharge his urine drop by drop. In this state of suffering, Mr. Chilver, who had been sent for, suggested the propriety of an examination, and Mr. Wilson accordingly passed the catheter, and detected the existence of a stone in the bladder. I was then," continues Dr. Paris, "requested to see

him professionally, and I concurred with Mr. Chilver in recommending a continuance of the draughts which he had been taking, composed of carbonate of soda and opium; I also recommended the trial of an opiate glyster and the warm bath. These measures relieved his agony, and he passed his urine in the bath, and occasionally in larger quantities in the day; but he sunk rapidly, and on the 12th of April he expired, being in his eightieth year.

"It deserves notice, that in the year 1810 he was attacked with what appeared at the time to be a violent rheumatic complaint, affecting the muscles of the back and thighs, but it was not attended with difficult micturition, and was ultimately cured by a perpetual blister. I remember his consulting me at this period for a most distressing cardialgia, for which he daily took, for several months, a large quantity of the carbonate of soda. For the last five years he has occasionally complained of strangury, but the inconvenience was transient, and he continued to travel from his seat at Bradfield to his official duties in London without interruption. He was in the habit of taking a small portion of nitre, and occasionally some demulcent draughts recommended by Mr. Chilver, and he told me they always afforded him relief. Upon examination of the bladder, its interior surface was found to be

much inflamed, and the sac was discovered in which the stone had lodged."

I have mentioned these cases to prove that stone may exist in the bladder for years without producing always those distressing symptoms which render life a burden, and which so frequently occur in this disease. The only certain indications of a stone actually being there are fragments of formed calculi passing, or the calculus being felt by an instrument introduced to the bladder; an irritable neck of the bladder, or a diseased prostate gland, may produce almost all the other symptoms which attend this disease.

A disposition to form urinary concretions is generally attended with some deranged state of the alimentary canal: thus acidity and flatulence, with much irritation of the stomach and imperfect digestion, often accompany its beginning and progress.

The constant irritation of the coats of the bladder produces a considerable thickening in their substance, but principally in the muscular coat, the packets of its fibres becoming very large, and incapable of that dilatation which they formerly possessed; their irritability however increases, so that they are excited to contract upon a few drops of urine; and thus, by pressing the stone against a part already too sensible to pain, an almost constant state of suffering is kept up. The

bladder in time becomes more diseased, the inner coat more constantly inflamed and sometimes ulcerated, all the unfavourable constitutional symptoms increase; and unless an operation is performed which removes the stone, the patient's sufferings are only ended by death. The inspection of the bladders on the table which contain stones, affords us the fullest and most instructive proofs of the alteration of structure they undergo by the continuance of this disease. The degree of morbid alteration of the inner membrane much varies, but the muscular coat is always thickened. In two preparations of bladders from young people, who had been long affected with, and operated on, for the stone, the only morbid alterations consist in the thickening of the muscular coats.

The lithic acid calculi have been supposed to produce symptoms of a milder nature than those brought on by any other. This is so in most instances, but not in all. I have already mentioned cases where the mulberry calculus produced no aggravated symptoms. When the calculus is composed of lithic acid, the urine is nearly of the natural colour, but more or less deep; Dr. Prout observes its specific gravity is higher than that of health; and it almost always deposits crystallized sediments, on cooling, which are much increased in quantity at those periods when the pain and irritation are worse than common. At these

times also, the crystallized sediments are not unfrequently accompanied by amorphous sediments and much mucus. The mucus, however, is by no means ordinarily so abundant in this species of calculus as in some others; and the urine, which is usually a little turbid at first, commonly becomes, after standing some time, perfectly transparent.

In many instances the symptoms attending the mulberry calculus have been found severe, but so far as I can form an opinion from what I have observed of the patient's sufferings, they are not so distressing as they have been imagined to be; and perhaps the supposed greater severity may have arisen in some degree from the weight, hardness, and tuberculated shape of the concretion.

When a stone has been felt in the bladder, it may be conjectured to be of this species, or of the cystic oxide, if the urine be clear and deposits neither lithic acid nor the phosphates. If no small calculi have been voided, it is probable that the calculus is then composed of the oxalate of lime; for, when composed of the cystic oxide, small fragments of that substance are frequently passed.

When the calculus in the bladder is composed of the phosphates, it is sure to produce the most painful symptoms which attend this disease. All the local symptoms are severe, the constitu-

tional symptoms occur in the most aggravated degree, and the patient's countenance denotes that his sufferings are extreme. The urine is generally voided in considerable quantity, and is of a pale whey colour, and slightly opaque; its specific gravity is low, usually varying between 1.006, and 1.012;—it commonly deposits the phosphates in abundance, mixed with a large quantity of mucus; it soon becomes putrid, and emits a most offensive smell: the smell indeed is generally very offensive when the urine is first passed from the bladder. Dr. Paris has accounted for the triple phosphates being precipitated, by the urine in a state of putrefaction yielding ammonia, which substance produces the precipitation; and this explains why the triple phosphates are so often formed in elderly people, who from some disease in the prostate gland, or other causes, cannot wholly evacuate the urine; so that some always remains, and becoming putrid, yields much ammonia. On this subject, Mr. Brande also has observed, that if from any cause the urine becomes in the slightest degree putrid, ammonia is evolved, and the deposition of the phosphates much accelerated and increased.

When a patient is labouring under what has been termed a phosphatic diathesis, the system is rendered very irritable, and much derangement of the organs of digestion usually attends that state.

There is much flatulence and also nausea, sometimes obstinate costiveness, sometimes a peculiar debilitating diarrhœa, and these will be found frequently alternating. The fæces are extremely unnatural, being sometimes black, sometimes clay-coloured, and frequently like yeast.

Dr. Prout has observed, that the greater proportion of phosphatic cases, which have come under his own observation, has been distinctly traced to some injury of the back; but frequently to one of that nature that has been quite forgotten, until the patient's attention has been called to the subject.

So much useful information is to be obtained in the works of Dr. Marcet and of Dr. Prout, and in an excellent essay published by Professor Brande, in the Journal of Science and the Arts, explaining the principles of the medico-chemical treatment of calculous disorders, that it becomes perhaps a work of supererogation to introduce this subject in the present course of Lectures; I conceive it right, however, to give a summary account of what will be found more amply detailed in their respective works.

It is not to be expected, that a large calculus already formed can be chemically acted on, so as to be dissolved by substances taken into the bladder, which would not at the same time greatly injure the coats of that viscus. Dr. Marcet judiciously observes, " the only benefit which we can

expect from medicine in this disease, is either to prevent the increase of calculi already formed; or, what is still more important, to guard the constitution of those who are subject to the disorder against the prevalence of the particular diathesis from which it arises. There are cases in which some impression may be made upon small calculi or gravel, so as to blunt their sharp edges, and enable them to be discharged from the urethra with less difficulty and inconvenience. At all events, as unorganized bodies are to be acted on which do not obey the laws of the living principle, although contained in living parts, unless surgical aid be resorted to, it is in a great measure from chemical principles that our views of treatment must be derived. It is therefore of the utmost importance that the early symptoms of gravel should be attended to; it is in this stage of the disease only that we can have any dependence on solvent medicines; and that it is in our power to prevent that concretion of substances which ends in that painful disease the stone."

It has been already stated that alkalies precipitate the earthy phosphates, and that acids precipitate lithic acid: and on the knowledge of these two facts the principles of chemical treatment ultimately depend. So that when the deposition of lithic acid prevails, alkalies are considered the appropriate remedies; and acids, particularly the mu-

riatic, are to be had recourse to when the earthy phosphates form the predominant deposit.

When the phosphate of lime, or the phosphate of ammonia and magnesia, are deposited from the urine, they form a sand of a white colour; when the lithic acid is deposited, the sediment is more or less red. The deposition of white sand very frequently takes place when the organs of digestion are disordered. It is often produced by the free use of farinaceous diet; it may always be abundantly formed by alkaline medicines; and persons who habitually drink soda water, or take magnesia, are frequently voiding it. Mr. Brande remarks, that its appearance in the latter case has often led into serious errors, so that the white sand which came from a patient, to whom soda water was administered for a stone in his bladder, was considered by the patient and his medical attendant as being part of the stone acted on by the solvent power of the medicine; whereas the soda water was in reality doing much mischief, by giving the urine more than its usual tendency to deposit the phosphates, and consequently was augmenting the size of the calculus: the urine has a natural tendency to deposit the above-mentioned phosphates upon any extraneous body in the urinary passages, and often upon the inner coat of the bladder itself, if it be at all diseased. I have seen several instances of the last in opening diseased bladders. In one of the

preparations which I now present to the audience, very many points appear on different parts of the surface of the inner coat of the bladder, where calculous matter has been deposited, and which adheres firmly to it. In another preparation, ulceration appears to have taken place over an extensive surface of the inner membrane, and the whole of the ragged surface appears to be covered with urinary concretions.

The use of magnesia will also occasion the deposit of the phosphates by the urine; which has caused the white sand to be described as magnesia passing off by the urine. Where such deposition is only occasional, or follows indigestion brought on by some accidental excess, it is not perhaps of any great importance; but when it invariably follows meals, and is observed in the urine, not merely as a deposit on cooling, but at the time the last drops are voided, it should then be seriously attended to; for it may create much irritation, and collect and concrete so as to form a stone, more especially in those cases where the complete evacuation of the bladder does not take place. It has been sometimes considered as the effect of an irritable bladder, when in reality it has been the cause.

As acid medicines are here the most useful, Professor Brande has published the result of his observations on those which are the most success-

ful in removing the disposition, and also on those which are injurious in certain cases of calculous concretions. Each of the mineral acids has been employed; all of them are found to be improper in cases where there is much irritation of the urinary passages, and they are apt to produce this irritation. Thus, although they are effectual in checking the formation of white sand, they require to be cautiously exhibited, and their effects watched over. These acids may be taken three times in the day, diluted with water until they become palatable: the nitric acid, from five to twenty drops; the dilute sulphuric acid, from ten to thirty drops; and the muriatic acid, from five to twenty drops.

Of these acids, the nitric is the most apt to disagree, and to occasion those symptoms of indigestion which are announced by flatulency and eructations.

The sulphuric acid generally admits of being longer persevered in than either of the others; it seldom gripes or nauseates, and it may most properly be termed a tonic, as it almost always promotes the functions of the stomach, where they are sluggish or irregular.

The muriatic acid agrees in most cases with the stomach, but not so with the bowels, which always become more relaxed during its use than when the other acids are employed: this circumstance, however, often recommends it; for constipation

very frequently attends the state of body which favours the formation of white sand; and hence aperient medicines are alone adequate, in some cases, to suspend or prevent the disorder.

Where the mineral acids agree, they are usually very effective, and in a few days they diminish or prevent the formation of the sandy deposit; but where they disagree, they rather increase its quantity, or they tend to the production of a mucous secretion, which envelops and is voided with the sand. This mucus, by increasing the materials of agglutination, adds to the risk of the formation of a concretion in the bladder.

When the mineral acids disagree with the patient, recourse may be had to the vegetable acids. The tartaric acid, or as it exists in cream of tartar, may be used in liberal doses, the former from five to twenty grains, and of the latter from twenty to sixty grains. The cream of tartar is more apt to relax the bowels than the tartaric acid; a circumstance which in this disease tends to its beneficial efficacy.

The citric acid is, on the whole, preferable to the tartaric; it may be given in doses from five grains to half a drachm; it rarely proves inconveniently purgative; and is very effectual in modifying the secretion of urine. Professor Brande recommends to patients depositing sediments of the above description, not to employ medicine so much

as diet; to adopt a general acid system; to abstain from soda water and all alkalies; to refrain from malt liquor; to take weak lemonade or cyder as ordinary drink at meals; if accustomed to wine, to prefer Champagne or Claret to Madeira or Port; to use Epsom salts dissolved much diluted with lukewarm water to prevent costiveness; or what is more pleasant, to stir a tea-spoonful of magnesia into an occasional glass of sour lemonade; to eat salads and acid fruits, more particularly oranges. He further states, that the carbonic acid, in cases where the other acids disagree, has sometimes been attended with beneficial results. After all, Professor Brande believes it frequently happens, that much of the benefit of mineral acids may be referred to their tonic effect; to mending the digestion, and thus improving the general state of health. He considers that air and exercise, bark, bitters, and mineral tonics, are often successfully resorted to in urinary complaints when white sand is deposited.

When patients are suffering from a calculus composed of the phosphates, opium will be found useful in diminishing the unnatural irritability of the system, and should therefore be given in doses proportioned to the patient's age and the urgency of the symptoms, from one grain to three or four, twice or three times in the day; or what is better, when the rectum will retain it, should be thrown

into that gut in the form of a glyster. All remedies that act as diuretics should be carefully avoided, so should all that are of an alkaline nature; the patient should also be prohibited from taking much fluid into his stomach. In mild incipient cases, the greatest advantage is sometimes derived from the combined use of the muriatic acid, hyosciamus, and uva ursi, conjoined with the use of alterative purgatives. Dr. Prout advises the diet should be of the mildest and most nutritious kind, and taken in very moderate quantities at a time; and on the whole he is inclined to advise an animal diet in preference to an acescent vegetable diet. In this he differs from Professor Brande; he is decidely of opinion, that all watery diet, such as soups, &c. should be taken very moderately. Dr. Prout further observes, that it should be our object, in the phosphatic diathesis, as in all other cases of stone, to restore the urine as speedily as possible to its natural state; he is sorry, however, to be obliged to confess that he has never been able to accomplish this purpose in a single instance, even after the most fair and persevering trials of almost every remedy hitherto recommended, or that he could devise as likely to effect his purpose. The operation of lithotomy, therefore, seems to be the only alternative in this form of the disease.

When red sand or gravel is deposited, distinc-

tion must be made between those cases in which the sand is actually voided with the urine, and those in which it is deposited after some hours by the urine, which at first was clear. The appearance of red sand, in the former case, is an alarming indication of a tendency to form calculi; in the latter, it is often a temporary symptom of indigestion.

Caustic fixed alkalies have been used as solvents for the red sand, since it was known to consist of lithic acid more or less pure. It was soon, however, discovered, that the alkaline subcarbonates and carbonates were equally effectual in preventing the deposition, and less apt to disagree with the stomach than the pure alkalies; and as in them the lithic acid is not soluble, it became pretty evident, that the benefit of alkaline medicines was not rationally referable to their solvent powers; indeed, the caustic alkalies could never reach the urine in a caustic state, but would naturally combine with the carbonic or other acids of that secretion. Professor Brande next inquires into the kind of alkali to be preferred, and the state in which it should be exhibited. Soda, he observes, seems to be preferred to potash; he recommends it to be used in its highly carbonated state as it is sold under the name of soda water. He has, however, seen cases where soda water has been less effectual in removing the tendency to the

deposition of red gravel, than a similar solution of potash; and he further observes, that this fact has been adverted to by Sir Gilbert Blane, in his paper (published in the Transactions of a Society for improving Medical and Chirurgical Knowledge) on the Effects of large Doses of the vegetable Alkali in Gravel. Sir Gilbert has there dwelt on the advantages of combining opium with this remedy, in cases attended by irritation, or other symptoms calling for the use of sedatives.

Ammonia and subcarbonate of ammonia are of use in many cases of red gravel, and may be resorted to with advantage where symptoms of indigestion are brought on by the other alkalies, and appear to be of great service in that form of red gravel which is connected with gout.

Magnesia has also been employed as a preventive of lithic gravel. It is not proposed by Mr. Brande as excluding the alkalies; but where potash and soda have been so long used as to disagree with the stomach, to create nausea, flatulency, a sense of weight, pain, and other symptoms of indigestion, magnesia may be adopted with the greatest chance of success.

Caustic alkalies may be taken in any mucilaginous vegetable infusion, as barley-water, or water-gruel: for instance, from five to sixty drops of the liquor potassæ may be taken in one dose: the average dose may be from ten to twenty

drops thrice in the day. A drachm of the carbonate of potash, or of the carbonate of soda, may be dissolved in two ounces of water sweetened with honey, to which half an ounce of lemon-juice may be added, and taken during the effervescence three times in the twenty-four hours.

From half a drachm to two drachms of the solution of ammonia of the Pharmacopœia may be taken in a sufficient quantity of water; or from one to two grains of the subcarbonate may be given in the form of pills united with some bitter extract, two or three times in the day. Either calcined magnesia, or the subcarbonate or common magnesia, may be used; of the calcined magnesia from ten to thirty grains may be taken as a dose, and it is preferable where the stomach is distended with wind. In most other instances, the common magnesia is to be preferred, in doses from twenty to fifty grains. These two preparations of magnesia may be given with advantage where the long employment of the alkalies may have excited flatulency and indigestion, or where they may have disagreed with the bowels. It is here right to state, that as magnesia sometimes collects in large quantities in the bowels, some mild aperient should be used to carry it off. During my attendance on the late Lord Heathfield, some pounds of magnesia passed from his bowels, although he had taken none into his stomach, nor in

any other way for the preceding three months. That the alkalies do not act by any solvent power upon the gravel after it is formed, is rendered probable by the action of the carbonates and by that of magnesia, which, though incapable of dissolving lithic acid, are as effectual in checking its formation as caustic alkalies. "It would appear," says Mr. Brande, "that the benefit derived from these medicines must be principally ascribed to their action upon the digestive organs, where, by preventing the formation of, or neutralizing and combining with acid matter, it is probable they prevent its secretion in the kidneys."

Alkaline remedies should be discontinued, whenever a tendency to the production of the phosphates, or white sand, appears after the formation of the red sand has been checked.

The severity of the symptoms, when the patient labours under lithic acid diathesis, is generally in proportion as the urine is loaded with gravel or sabulous sediment; our first attempts should therefore be to restore the urine to its natural state. In addition to the means already mentioned, the local employment of anodynes in the form of glysters may be useful. At night a pill of hydrargyri submurias or Plummer's pill, may be taken; and in the morning after, a purgative draught, composed, for example, of a mixture of Rochelle salts and magnesia, or subcarbonate of soda, or any

other alkaline diuretic purgative. Dr. Prout recommends, that during the day a strong infusion of uva ursi, combined with hyosciamus, and the liquor potassæ may be taken. If these means are persisted in, we may expect that the lithic calculus will not increase in size; but this treatment cannot be expected to relieve the patient from those symptoms which a hard and perhaps rough extraneous substance in the bladder, by mechanical irritation, would create.

If from the symptoms and state of urine a calculus composed of lithate of ammonia is supposed to be formed in the bladder, recourse, Dr. Prout observes, must be had to the means recommended to be adopted in the phosphatic diathesis, and alkaline remedies must be carefully avoided; he doubts much, however, if any treatment will prevent, under these circumstances, the phosphatic diathesis from being sooner or later established. In cases of oxalate of lime and cystic oxyde calculi, the local and general use of anodynes, to relieve the immediate urgent symptoms, may be tried; but if the patient's state admits of it, the operation of lithotomy is the only certain mode of relief.

In the administering of remedies for these sabulous sediments, it therefore appears, that the first object should be to ascertain the nature of the matter voided; the next, to select the most appro-

priate acid or alkali; and in either case to watch carefully over their effects, since the acids, after having removed the superabundance of the phosphates, will sometimes induce the excess of lithic acid; and nothing is more common than the appearance of white sand during the use of alkaline medicines. In all cases of urinary sand and gravel, it is necessary to pay particular attention to the general state of the patient's health, and, along with the acid or alkaline medicines, to pursue a tonic and invigorating plan respecting the stomach.

When calculi are known to exist in the bladder, if medicines are given with any view to dissolve the stone, they should be regulated by the effect acids or alkalies are known to have on the sabulous deposits; but when either are employed, care must be taken not to carry their use too far, as a concretion of another kind to that which they were intended to dissolve may be the consequence.

Numerous cases describing stones as having been much acted on, if not entirely dissolved, have been given to the public; but many of these have been founded in error, others in imposition, and none are completely favourable in their result; for no well-authenticated case goes farther than to prove, that acid or alkaline medicines may occasionally correct some peculiar diathesis, which, from the symptoms or marks already given, may be known at the time to predominate.

Alkaline and acid solutions, appropriated to the particular composition of the contained calculus, have been injected by the urethra into the bladder, with the view of dissolving the stone, or reducing it into fragments which could be discharged by the natural passages: but the results, hitherto, have not been such as have afforded much encouragement either to the patient or medical attendant to persevere in this plan; but notwithstanding this, we are not as yet justified in entirely abandoning it; and we are surely entitled to hope that, from the judicious combination of local with general constitutional treatment being persevered in, and the means occasionally varied, much more may be done, than has as yet been effected, to relieve, without having in all cases recurrence to the operation of lithotomy, the miseries occasioned by one of the most painful diseases to which the human frame is liable.

As at present we have no certain means of relieving the patients, but by the performance of a surgical operation, I cannot avoid noticing the liberal, well-informed, and candid manner in which Dr. Prout treats this part of the subject of his laborious investigation. He first takes statements of the Bristol, the Leeds, and the Norwich Hospitals, as to the average number of deaths attending the operation; from which he estimates the mean ratio of mortality at very nearly 1 in $7\frac{3}{4}$. He finds

that the chance of success before puberty is greater than after that period. He then expresses it to be his opinion, that the operation of lithotomy should in general be performed either immediately or as soon as possible, in every case of calculus occurring before puberty, of whatever species it may be; and in all others, whenever the phosphatic diathesis is present, or even when the urine abounds with pale-coloured lithate of ammonia. But if the lithic diathesis be steadily present, if the state of the general health be good, and if the sufferings in consequence be moderate, the operation may be delayed towards the age of puberty, as, from the favourable changes which commonly take place at this period, there will be less risk of the disease returning; but if the patient's health is declining, delay will be exceedingly dangerous. In all those cases where the phosphatic diathesis is fairly established, he gives it as his decided opinion, that the operation is the only alternative, and the sooner it is performed the better.

He states, that only under the following circumstances he should feel great hesitation in recommending a person in the prime of life, with perhaps a family depending upon his exertions, to risk his existence by submitting to the operation of lithotomy; at least, until it had been ascertained that the means proper for rendering the urine natural had been resorted to, and failed. The circumstances

are these: when the calculus is small or of a moderate size, of the lithic acid species, the lithic acid diathesis being steadily present, the constitution sound, and the sufferings comparatively moderate; *provided always*, that the patient will conform to the necessary plan of regimen calculated to remove or diminish the diathesis, and thus to prevent the increase of the calculus.

After stating that he has the strongest reasons for believing that the mulberry calculus is subject nearly to the same laws as the lithic acid species; and that of the cystic oxide calculus, from want of experience he can say nothing; he observes in conclusion, that he wishes the above remarks to be understood in a general sense, and as totally independent of surgical reasons or difficulties, with which he has nothing to do, but which must likewise be obviously taken into account in all cases of calculus of the bladder.

No surgeon, I presume, will now venture to perform the operation of lithotomy before he is certain of the existence of a stone, by having introduced the sound into the bladder, and felt it in contact with that instrument; and without having ascertained, as far as circumstances will permit, whether the age and constitution of the patient, the state of the prostate gland, bladder, and kidneys, will justify the recommendation of an operation of such consequence; always remembering when any doubt occurs of the pro-

priety of an operation, and, in cases where *it is certain not to succeed*, acting on the remembrance that an operation performed under such circumstances, is cruel and unjustifiable, not only in regard to the patient, but in preventing others from submitting to an operation in cases where success would be certain.

It has often been a disputed point, whether opening into the bladder above the pubes, or from the perinæum, is to be preferred in extracting the stone: men of equal experience and celebrity have exclusively adopted each of these operations, but some have practised both; and each, under common circumstances taken on an average, appears to have been attended with nearly the same ratio of success. Cases, however, may and do occur, where the magnitude of the stone will call exclusively for the high operation, or that above the pubes.

The patient, when the operation is determined on, will do well to consider whether the intended operator not only has good eyes and steady hands, but also whether his head is furnished with that stock of anatomical knowledge and surgical experience, which will enable him to foresee the difficulties that possibly may occur during the operation, and, when they do occur, to meet them with the best and most immediate means of counteracting their dangerous effects. It is well known that females

are much less liable to the formation of calculous concretions than males: this may arise partly from their more regular habits, and partly from the shortness, straight course, and great dilatability of their urethræ, allowing any calculus that might descend from the kidney to the bladder to escape. The operation of cutting into their bladders is therefore seldom necessary.

It is not, however, to this audience that I shall describe what must be done in the performance and subsequent treatment of the different surgical operations which have been practised for the removal of urinary concretions, or give any account of the instruments used. Every member of this College must, or should, know whatever belongs to such operations. Many now present have frequently performed them, and every student must have attended to them in those places where they can best be studied and comprehended, viz. in the dissecting-room, the anatomical theatre, and the operating-room of his hospital. All must recollect, that the removal of the stone is only one point gained in the cure of the patient; that the treatment after the operation, until the wound heals, and that the plan on which the patient is to be placed, to prevent a return of so distressing and dangerous a disease, founded on our knowledge of the materials which form the stone, and the principles of their agglutination, demand an equal share of our unremitting attention.

LECTURE X.

ON EXCESS OF ALBUMEN AND UREA IN URINE. ON DIABETES. ON HYDATIDS OF THE KIDNEYS. ON INFLAMMATION AND SUPPURATION OF THE KIDNEYS, AND ON SCROFULOUS AND SCIRRHOUS AFFECTIONS OF THESE ORGANS.

In studying the nature of diseases, those arbitrary and artificial distinctions cannot be made between the professions of physic and surgery, which by common usage and mutual consent, in this and other large cities, have been adopted in their treatment; for many diseases occur which require the aid of both, and where it is impossible to separate the one from the other. The knowledge of the principles of both local and constitutional diseases should therefore be acquired by the members of each profession, although the application of the means of cure in particular diseases should be regulated by the honourable feeling of the physician and surgeon in regard to each other, and the established custom of the place where their professions are

exercised. In country practice, and in confined societies, such distinctions cannot be acted on.

I have been led to the above observations, from daily perceiving how impossible it would be to understand the true nature and principles of cure of many diseases, but more particularly of those affecting the urinary and genital organs, or even to distinguish between symptoms and the original disease, had not the morbid alterations of the internal as well as the external parts been known to the surgeon.

Impressed with this feeling, I consider myself justified, as your Professor of anatomy and surgery, in bringing to your recollection some morbid alterations of the properties of the urine, and of the structure and action of the kidneys; which, although they cannot strictly come under the designation of surgical diseases, and are usually placed under the physician's care, should have their symptoms well known to every surgeon, as they often lead to the formation of, or exist with, other diseases, which require surgical treatment, and even manual operations, for their cure.

I have, in the first Lecture of this Course, already taken notice of some of the alterations which urine undergoes in several diseases. The mere increase or diminution of the quantity of urine depends on the greater or less quantity of watery fluid separated by the kidneys; the other mate-

rials remaining the same, only being in the one instance more, and in the other less diluted with water. An increased flow of urine very frequently accompanies a peculiar state of nervous irritability: it is thus often produced by the state of the mind, as well as by great quantities of fluid taken into the stomach, and in these cases the urine is of a pale colour; but when an extensive local inflammation exists, or an inflammatory state of the system is present, the urine is always in diminished quantity, and is of a deep colour.

I have formerly stated, that the urine is sometimes found to coagulate into a jelly-like mass, from its containing much albumen. The disposition in the kidney to separate this principle from the blood often goes on for years, but sometimes it is only accidental and depending on temporary causes. When of long duration, it is usually accompanied by a desire to pass the urine frequently, and the quantity evacuated is much increased beyond that passed in a healthy state; it is also accompanied by great irritability and general uneasiness, but without any particular sensation being referred to the kidney; and where albumen is separated in a large quantity, it is also usually attended with an inordinate desire for food. The albumen sometimes coagulates in the bladder in such quantities, that much difficulty is found in passing the urine by the urethra. Albuminous urine,

when voided, appears to form a coagulated mass of a pale yellow or amber colour, and from this mass an apparently serous fluid may be pressed, or will drain out; the remaining coagulum has then the appearance and properties of the coagulated lymph of the blood, and is sometimes mixed with, and coloured by the red particles of that fluid.

The danger of this morbid secretion of albumen must depend on the degree to which the separation of it is carried, and the length of its duration. It sometimes, when moderate, has lasted for years, without producing any very injurious effects on the constitution; but when both permanent and excessive, it indicates some great derangement of the animal economy, and must prove injurious.

How the disposition to separate albumen from the blood, and to deposit it in the urine, is to be counteracted, we cannot know, unless the state of the kidney, as to the presence or absence of inflammatory action, could be ascertained. Such separation often occurs in dropsical patients; but whether it is to be considered as the cause or the effect of the dropsy, is not always very easy to be determined. Dr. Wells conceived that albuminous urine was connected with too great action in some part of the system; and Dr. Blackall is of opinion, that when the urine is albuminous in dropsy, the use

of blood-letting is in general indicated. We know that in local inflammations the coagulable lymph is separated from the blood, and it may be also separated in the kidneys, if their secreting action is too strongly excited, and then bleeding might do good; but before this plan is adopted, it should be ascertained whether the dropsy is the cause of the separation of albumen, or the effect; if it proves to be the cause, by bleeding we should increase the disease. I have seen instances, in which the muriated tincture of steel proved very useful in lessening, and I believe in removing, this complaint.

An excess of urea is sometimes met with, not only in regard to the proportion of water contained in the urine, but also to that of the other materials. It is not uncommon to find this excess in the urine of children, and in people depositing the phosphates. In these cases, the urine is usually pale, but occasionally it is high-coloured, like porter and water mixed: when first voided, it reddens litmus paper; in many other respects it is not dissimilar in appearance to healthy urine: it is for the most part entirely free from sediment; but on the addition of nitric acid, crystallization speedily takes place, and it is then found to contain an abundant quantity of urea. Such urine is very prone to decomposition, and soon becomes alkaline, especially in warm weather.

Dr. Prout observes, that those diseases in which an excess of urea may be considered as in some degree characteristic, do not appear to have been hitherto distinguished; but have been probably confounded with other diseases, and particularly with that form of diabetes which has been sometimes denominated diabetes insipidus; they differ, however, considerably from diabetes.

Where urea is in excess, there is usually a frequent and almost irresistible desire of voiding the urine: this does not arise from fulness of the bladder; for, in general, a small quantity is voided at any one time; but from the frequency, the total quantity voided in a given time is greater than natural. This quantity is augmented in cold weather, and is also increased by all causes producing mental agitation. There is often a sense of weight or dull pain in the back, and an occasional irritation about the neck of the bladder, which sometimes extends along the urethra. The pulse however is not affected, and the tongue is clean: there is no remarkable thirst, nor is there any craving for food, nor are the functions of the stomach and bowels much deranged.

This affection often occurs in persons of the middle age, of thin and spare habits, whose countenances in general denote anxiety, but who are free from gout and other constitutional disease, and who have no apparent defect in the urinary

organs. From Dr. Prout's observation it would however appear, that a majority of the cases which he had seen, were in persons who early in life had been addicted to habits, which, when carried to excess, must weaken the urinary as well as the genital organs; so that whatever debilitates the system, and particularly these organs, may give origin to this affection. He supposes that the train of symptoms which takes place, in cases where the urea is in constant excess, if permitted to proceed, will sometimes terminate in diabetes, or in a deposition of the phosphates. Stimulating remedies, such as the copaiba, have been found to increase the complaint; and sedative medicines, particularly opium and hyosiamus, joined to those which may be necessary to keep the stomach and bowels in healthy action, have been found the most efficient in suspending the disease, if not in removing it altogether. As this complaint often accompanies diseases which require surgical aid, I have mentioned the symptoms, that they might not be overlooked by the surgeon; but when they occur independent of other diseases, they are to be considered as belonging in their treatment to the province of the physician.

ON DIABETES.

Diabetes is a very peculiar disease, in which the urine is secreted more abundantly than in the natural quantity; and also contains much saccharine matter. In some instances from 16 to 20 pints of urine have been evacuated in twenty-four hours.

The urine in this disease is sometimes of a pale straw colour, and sometimes not unlike to whey: its smell is faint, and often resembles that of whey when fresh. It is always more or less sweet, sometimes as sweet as the most concentrated solution of sugar in water. Its specific gravity varies from 1.020 to 1.050: it is sometimes higher than this. The quantity of urea is very much diminished, and it contains for the most part little or no lithic acid. The usual saline matters existing in healthy urine are met with in diabetic urine in nearly the same relative proportions, but their absolute quantity is very much diminished. Diabetic urine sometimes contains a little blood, and not unfrequently albuminous matter similar to that of the chyle. In the case of a physician who was long affected with diabetes, half a pound of sugar has been frequently formed by the evaporation of the urine evacuated by him in twenty-four hours.

And in a former Lecture I have mentioned, on the authority of Mr. Cruikshank of Woolwich, that twenty-nine ounces of sugar were produced from the urine voided daily by a person labouring under diabetes. Vegetables, by a peculiar action of their vessels, can form sugar from water; and in this disease the vessels of the kidney appear to have the same power. Nothing however very peculiar appears on the inspection of the kidneys of those who die of this complaint, excepting a greater degree of vascularity, and sometimes a small quantity of a whitish fluid, in appearance between chyle and pus, contained in the tubuli uriniferi, infundibula, and pelvis. I have inspected three bodies, where diabetes had preceded death, and in neither were the kidneys enlarged. In two of these I found that vascular appearance which Dr. Baillie has described, where the superficial veins were much fuller than usual of blood, forming upon the surface of the kidney a most beautiful net-work of vessels. In one of these cases the renal capsula was enlarged, and contained a fluid in a circumscribed cavity, which in colour was like the bile when mixed with water; and in both cases the liver was sound. The spleen was sound in one of these, but tuberculated in the other. In the third case, the liver was tuberculated, and much shrunk in size; the lungs also were filled with scrofulous tubercles. All these patients were under forty years of age.

This disease is attended with a dry and parched mouth, a white and foul tongue, much thirst, a voracious appetite for food, but bad digestion of it; the skin is dry; there is much listlessness and aversion to exercise; the spirits become low and depressed; the pulse is variable, but is always somewhat accelerated; the patient becomes much debilitated and emaciated; pulmonic symptoms generally come on, accompanied by hectic fever, which sooner or later prove fatal. Occasionally diabetes terminates in an incurable dropsy.

As it is the province of the physician to treat this formidable disease, I shall only observe that some of the most experienced physicians have stated it to be very little under the control of medicine. In one case, where animal food was used solely, no sugar was formed, but the quantity of sugar was always found to be greater in proportion as the quantity of vegetable found was increased. Dr. Prout conceives that animal food, blood-letting, and opium, are the remedies which are entitled to the most attention. When it begins as an idiopathic disease, it is in general fatal; but in cases where it arises as connected with acute diseases, and with great violence, it is more probable that it would have a favourable termination.

ON HYDATIDS OF THE KIDNEYS.

It occasionally happens that hydatids of different sizes are voided with the urine; and when opportunities have occurred of tracing from whence they came, in almost every instance their nest has been found in one of the kidneys; for, with the exception of the liver, the kidney more frequently contains hydatids than any other structure in the human body.

There are two kinds of hydatids found in the kidney, very different in their nature, and something different in their appearance, but both kinds consisting of membranous bags or capsulæ filled with watery fluid. Those which are dispersed every where over the surface, and also imbedded in every part of the substance of the kidney, appear to be merely a diseased alteration of the structure of that organ, and have neither the properties nor the appearance of distinct though simple animals. Their coats are thin and nearly transparent; the fluid contained in them is very similar to water, but possessed of some coagulable matter. They are never loose, but remain firmly attached to the substance of the kidney, their outer circumference adhering to all the parts which surround it. Their size varies from that of a small pin's head, to one occupying by much the larger proportion of the kidney; and their number also varies from a single

hydatid to many hundreds. Each is a distinct bag, and does not contain others within it. The kidney so affected is generally enlarged, but not painful. As this state of the kidney cannot be ascertained during life, I can here do no more than exhibit several well-marked specimens, which will show the difference between it and the other species, which appears to consist of distinct and organized animals, but of the lowest or most simple order.

This last species, or true hydatid, is found in general in a distinct cyst, which is often of a large size, and composed of firm materials; so that in some glands, as in the liver, it frequently appears, and to the touch feels, like cartilage. In the kidney, the cyst containing the hydatids is generally thinner than in the liver; but the thickness is different in different parts of the same cyst, and when cut into, the cyst appears laminated; the laminæ are white, and on the inside they are lined by a pulpy substance like coagulable lymph. The cavity of the cyst is sometimes subdivided by a portion of this pulpy substance. Within this cyst there is sometimes one hydatid, but oftener a very considerable number; some of these are attached to the side of the cyst, others are loose in the cavity and swimming in a fluid. Each hydatid consists of a round bag, composed of a pulpy semi-opaque substance, generally of a whitish, though sometimes of a light amber colour, and containing a fluid capable of

coagulation, although in a less degree than serum. I have found the fluid coagulate by heat, and become very turbid by the addition of acids.

Dr. Marcet has analyzed the fluid which was taken from a hydatid attached to the kidney; but he has not informed us whether it was from the first species, which is merely a morbid alteration of structure, or from a hydatid which was floating in a cavity; from the expression of attached, I presume he meant the first. I mention this, because he says the fluid did not coagulate by adding dilute sulphuric or muriatic acid; although concentrated muriatic acid produced a milkiness; also that heat did not produce any coagulation, except after very considerable concentration. He says that the fluid appeared to resemble much in its chemical composition, that of hydrocephalus and spina bifida, only containing a larger proportion of animal matter, which appeared to be chiefly of the muco-extractive kind, since it did not either coagulate by heat, or gelatinize by cold and concentration.

The bag of the true hydatid consists of two laminæ, and possesses a good deal of contractile power. The thickness and opacity of the coat or bag vary in different hydatids, and are not always proportioned to the size. Even in the same hydatid, the coat will be thicker in one part than in another. Dr. Baillie has given so clear and just

an account of the nature of hydatids, from a case which he particularly examined after death, that I shall quote it here. "The right kidney, in a soldier," he says, "was converted into a bag capable of containing at least three pints of fluid, and only a very small part of the kidney at its lower end retained its natural structure. The bag was of considerable thickness, was obscurely laminated, and had a cartilaginous hardness upon its inner surface. It was full of hydatids, which differred very much from each other in size, some of them being as large as a small orange, and others not larger than the head of a pin. Some of the small hydatids were lodged in little cavities formed in the inner surface of the bags." After certain observations on their laminæ, he says, "some hydatids had, adhering to their inner surface, a cluster of small hydatids, which looked like small pearls; others had hydatids even of a considerable size floating loose in their cavity; and others contained only a fluid. The fluid in many was transparent, but in some hydatids it resembled whey. Some of the small hydatids had frequently been passed along with the urine, when the person was alive. It required an increased exertion of the muscular power to drive them through the urethra; and the bladder, by this exertion, had acquired a stronger muscular coat."

From the mode of generation, hydatids growing within each other, and from the analogy between the hydatids in the liver of sheep, and those found in the human subject, it is very probable that they form a species of imperfect animals. The hydatids taken from the liver of a sheep have been seen to move when placed in water heated to 100°; and they retain this motion long after the sheep has been killed. The hydatid from the liver of a sheep has, however, a neck and a kind of mouth appended to the bag; the hydatid belonging to the human subject has no mouth, being a simple uniform bag; but life may be attached to the most simple form of organization: in proof of which I have to state, that hydatids have been found in the brains of sheep, resembling almost exactly those found in the human liver, and which having been seen to move, are known to be animalcules. I have had some hydatids brought to me, which were taken out of the body of a woman, who, having died from a fall, was opened within four hours of her death: they had been placed immediately in tepid water, and when I saw them half an hour after their removal from the body, seemed to contract and expand themselves, and to move in the water. The hydatids from the brain of a sheep have a similar motion.

Dr. John Hunter has given an interesting ac-

count, which is published in the first volume of the Transactions of a Society for improving Medical and Surgical Knowledge, of the dissection of a man that died of a retention of urine, occasioned by a collection of hydatids between the neck of the bladder and rectum; with observations on the manner in which hydatids grow and multiply in the human body; in which, after having given an account of their structure nearly similar to the above, he says, when they were opened, their coats possessed a strong contractile force, so as to roll themselves up in part;—he also says, that some, when opened, had their inner surface covered with very small hydatids, and that many of these minute bags were found floating in the fluid contained in their cavities, of which the largest were visible to the naked eye, and, when examined in the microscope, were about $\frac{1}{200}$th part of an inch in diameter, and the smallest were less than a red globule of blood.

When the young hydatids growing in the coats of the larger were examined with the microscope, they were found not to be set in the coats like pearls, but to be covered by a thin transparent membrane, so as to lie between two layers. Dr. John Hunter then compares the hydatids found in the human subject with those found in quadrupeds, and observes, it is not altogether allowable to conclude, from the resemblance of human hydatids

to those of quadrupeds, that the first as well as the last form a part of the animal kingdom; yet they agree in so many circumstances, that such conclusion appears very probable.

Some years ago, in opening a body, in the theatre in Windmill Street, of an adult man, I found a cyst in the liver, containing an immense number of hydatids. A small part of the cyst reached the surface of the liver, on which something like a cicatrix appeared, as if the coat had formerly burst and afterwards united. Another cyst was found in the lower part of the pelvis of the same man, between the rectum and bladder. In the inside of this cyst a white earthy substance was found adhering to parts of it, and the whole was lined with a substance, which, though thicker and more opaque than hydatids even of the largest size usually are, seemed to be one. When opened, its coats were readily divisible into two laminæ, and a large quantity of a whitish substance, divided into lobes, was found adhering to an extensive portion of its inner surface, somewhat resembling a placenta of four or five months and its membranes: as I now produce the preparation, the audience may judge of the similarity. Many small and some very minute hydatids were and are still seen firmly attached to the inner surface of this larger one; hundreds of various sizes were loose in its cavity, some of which still remain there, and

the others I have preserved in a separate bottle. Many of these contained smaller hydatids within them. As none of the contents of the pelvis were diseased, it appeared to me that the cyst in the pelvis had been formed in consequence of some hydatid having, from a rupture of the original cyst in the liver, escaped at the part where the cicatrix appeared, and which had descended so as to reach the most depending part of the cavity formed by the peritonæum; being a living animal, it had there increased in size and produced others; and adhering to the parts in its immediate vicinity, it had stimulated the peritonæum to throw out that matter which had formed a cyst, and confined it between the rectum and bladder. This case, I conceive, adds a little to the probability of the hydatid being a living animal. Long after I had expressed this opinion in writing the catalogue of my preparations in the Museum of Windmill Street, I read, in Dr. John Hunter's paper, that he had the same idea of hydatids bursting from a too crowded sac, escaping and forming another sac, in which they propagated others of their own kind.

There are no peculiar symptoms which mark the first formation of hydatids in the kidneys; pain indeed, in cases where they afterwards were known to exist, has been felt in the loins; and there also have been nausea, vomiting, and symptomatic fever: but these symptoms belong likewise to other

diseases. The disease is first ascertained to exist by hydatids having descended by the ureter into the bladder, and from thence having passed along the urethra with the urine. When small, they have passed without much pain; but sometimes, from their size, they have lodged in the passage, and, by interrupting the course of urine, they have occasioned much suffering. When the presence of hydatids is suspected, it would prove of the most beneficial consequence, if an outlet for them could be immediately and conveniently procured; but when they are situated in viscera placed in the cavity of the abdomen, that outlet must be left entirely to nature, and the occasional symptoms produced by them in stopping the flow of urine prevented by the use of the bougie or catheter. In one case, when turpentine was given and persevered in, in full doses, the pain in the kidney ceased, so did the passing of hydatids; but as the person is at present alive and in tolerably good health, it may be many years before ocular demonstration will prove where the kidney had entirely recovered its healthy structure. In two other cases I have known the patients make long trial of the muriated tincture of steel, and at first with some appearance of advantage, but with no permanent good result.

In examinations after death, many morbid appearances have been met with in the kidney, which

had been attended with no discriminating symptoms by which they could be known during life, and which, even if they had, were produced by diseases, the cure of which was beyond the reach of medical or surgical art; but several morbid appearances have also been met with, which, if their true nature had been known, might have had their urgent symptoms palliated, and some, perhaps, might have admitted of cure. It is obvious, that the first rational step towards the cure of any disease, is to know the nature of the morbid change produced in the parts affected by it; and as our Museum contains many very valuable specimens of morbid alterations of the kidney, I think it my duty not to pass them over entirely unnoticed; I therefore have placed some of the most remarkable before you, with the hope, that their nature being more generally known, may lead to the melioration of the symptoms produced by them, and advance us in the knowledge of the treatment likely to effect the cure of those capable of being removed. Had not the founder of our Museum been convinced that useful knowledge might be derived from contemplating these morbid changes, he would not have preserved specimens of them in his valuable collection.

I have already produced several preparations, showing the effect of ulceration and suppuration of the kidney, in cases where these actions have been attended with the deposition of calcareous matter.

Abscesses of the kidney will occasionally form without this deposition having preceded them, and without its taking place; but in by far the greater number of cases, calculi produce them. These abscesses have sometimes been occasioned by common phlegmonous inflammation terminating in suppuration, but they are more usually of a scrofulous nature. They then contain the curdly kind of pus peculiar to that specific disease, and their inner surfaces are lined with pulpy matter—on the table we meet with specimens where they are of a small size, and confined to one or two; and of others where the tubular, and also the cortical substance is destroyed, and the whole kidney converted into capsules, which surround one or a greater number of irregular cavities lined by a pulpy substance in many places strongly adhering to them. I have very rarely seen abscesses in the kidney unaccompanied by this pulpy matter. In one or two instances I have met with scrofulous tubercles in the kidney, not in a state of suppuration, but resembling those large scrofulous masses occasionally found in the liver; and which, in the instances I allude to, were also found in that viscus, and in the spleen.

In general, indeed I may say always, when the suppuration is of a scrofulous kind, the infundibula, pelvis, and ureter partake of the disease, and are lined by the same kind of pulpy matter.

When active inflammation is going on in the kidney, more or less pain, according to its extent and progress, is felt in the loins, and the pain occasionally shoots downwards in the direction of the ureters. It is generally attended with a sensation of numbness in the thigh of the affected side; the testicle of that side is also drawn towards the outer ring, and often becomes painful. In phlegmonous inflammation, these last symptoms more frequently occur than in scrofulous, and, when taken with the general habit of the patient, will aid us in discriminating between phlegmonous and scrofulous action. The urine also in the first is usually of a deep red colour; and in the last it is much paler. I have before stated, that there is much sympathy between the primæ viæ and the kidneys; so that when the last are inflamed, from the stomach sympathizing, sickness and vomiting are produced; and from the bowels also sympathizing, costiveness comes on, attended with frequent and often violent colicky pains. More or less symptomatic fever is present, depending on the extent of the disease and constitution of the patient. The pus which is formed generally comes away with the urine. These cases are most usually fatal in their termination, the patient being gradually worn out by the irritation and drain; but they are not always so. I have known an instance where there was every reason, from local symp-

toms, to suppose that scrofulous suppuration of the kidney had taken place, where the patient had scrofulous glands in almost every part of the body, and where pus was discharged with the urine for nearly three years: the patient, soon after the period of puberty, recovered, and is now alive and strong; he never passed any calculus, nor has he one symptom left of the kidney having been diseased. This patient was treated as those usually are where scrofula prevails; sarsaparilla, bark, and cicuta, were occasionally given, to which for nearly three months, liquor potassæ was added, in very moderate doses, and during its exhibition the patient began to recover.

I examined the body of a youth, who died at sixteen years of age, of a very scrofulous habit, and whose spine had become carious. This person had been confined to a horizontal posture for nearly three years, and had passed but little urine through the urethra for many months, and none for several weeks, preceding his death. Abscesses had formed in both kidneys; the ureters were completely closed by scrofulous matter; and sinuses from the kidney led to the lower part of the loins, and opened on the nates and outer part of the thigh: through these openings the urine, which was not deficient in quantity, was constantly discharged. By means of setons these openings were at last healed, and one was made at a more

convenient part in the loins, through which the urine of both kidneys continued to discharge until his death. The kidneys were nearly changed into capsules, surrounding cavities lined with the pulpy substance; but each had a small part left of the cortical portion near the upper extremity. The ureters were plugged up with scrofulous matter, and the bladder was contracted, but every where lined by a similar substance. The urethra was small, but in a perfectly natural state.

In an adult, where an abscess formed in the kidney, and opened in the loins, discharging there a renal calculus, and from which opening urine was passed for some weeks, I have known the sinus leading from the kidney healed by a seton and the proper application of pressure afterwards; but in this person the urine also passed from the first along the urethra.

It is very unusual for the kidney to become scirrhous, but I have more than once found it in that state. It is then converted into a firm substance nearly as solid, and, when cut into, feeling more like, softened cartilage, than any other substance to which I can compare it; so that the natural structure of the gland appears to be lost. In every case where I have found this appearance, the substance has been intersected by those white membranous lines, or septa, so constantly met with in scirrhus of other parts, and the kidney has been enlarged. The specimen now

before us shows the membranous septa, and the conversion of the kidney into a brownish uniform hard mass. It is marked in the catalogue as having been taken from a scrofulous subject, but I believe it to be truly scirrhous.—I have only met with one case where the scirrhous affection of the kidney had taken place, where I could become acquainted with the symptoms produced; and these were not discriminative of the disease as affecting the kidney only. The person was fifty years of age, a woman, and one who had an incipient cancerous affection of the uterus, and some scirrhous enlargement of the absorbent glands of the loins; a dull heavy pain was constantly felt in the back, sometimes shooting downwards from the kidney to the bladder, and occasionally from the bladder to the kidney: very little urine was passed from the bladder, but her perspiration in warm weather had a peculiar fetid and rather urinous smell: both kidneys, on her death, were found in this hardened state. I have no treatment to propose for this morbid alteration of the kidney, should it be known to exist, excepting the exhibition of such medicines as will tend to allay irritation and pain. Where it has been suspected, as in the last-mentioned case, I have seen two opposite medicines given, but without any good effect produced by either. The liquor potassæ was first used, in the hope that it might remove glandular obstruction; and the muriated

tincture of steel was afterwards given upon the supposition that it is sometimes useful in cancer. The patient seemed to derive more benefit from cicuta, hyosciamus, and opium, than from any other medicines. In the Musuem a kidney is preserved which seems to have gone into the disease termed fungus hæmatodes. This patient discharged bloody urine for years.

Dr. Baillie has described a very peculiar appearance, which he had met with in the kidney, and of which I have seen some instances since the publication of his work on morbid anatomy. The kidney was converted into a soft loose mass, almost resembling, he says, the appearance of common sponge. On the surface there were many round interstitial cavities scattered at irregular distances; and when the substance of the kidney was cut into, it exhibited the same spongy and cellular appearance. The blood-vessels of the kidney were seen ramifying very distinctly through the spongy mass. No pus was found in the kidney: the process which produced this appearance was of a peculiar kind, and seemed to act more on the cortical than tubular part of the kidney. When shaken in water, the parts all separated from each other, somewhat like the unravelling of the shaggy vessels of the placenta. I have produced here two kidneys, both of them very much enlarged, with their texture exceedingly soft. The parts seem as much dissolved, and many

of the vessels as much unravelled, as if they had been for a long time macerated in water. A number of small vesicles filled with a brownish fluid were dispersed throughout what remained of the substance of the kidneys, forming the species of hydatid arising from altered structure, but very dissimilar to the true or animal hydatid. In some of the larger cavities a quantity of imperfectly formed purulent matter was found. No account of the previous history of the case could be obtained; but in a case where I met with nearly similar appearances in the kidneys of a person who had long resided in the West Indies, whom I had cut for the stone, and who, after recovering from the operation, died of suppuration of the parotid glands, small shreds, apparently portions of blood-vessels, had been passed by the urethra both before and after the operation; and which, upon examination after death, I conceived might have come from the kidneys, having there been detached. This is one of those unfortunate cases over which, even when known to exist, our art can have no power.

There are two kidneys preserved in the collection, in which the secretion had stopped for three days previous to death, but there is no sensible alteration of their structure, to show why it necessarily did so. As suppression of urine, however, sometimes does happen, every surgeon should be able

to distinguish between it and the retention of urine in the bladder. The distinction is so easily made, that it appears almost impossible for the two cases ever to have been mistaken. In suppression no tumour will be felt above the pubes, and the bladder, when examined by the finger introduced into the rectum, will be found empty.

I have however known an instance where the mistake was made, and the patient's life lost, from the ignorance and improper practice of the surgeon. A person, who was a musician of some celebrity, and had been lately living rather an intemperate life, and particularly so by indulging in the use of spirits, not having passed any urine for some hours, became alarmed, and sent for his medical attendant, who was a surgeon and apothecary then in extensive practice, but who has been dead some years. After trying the usual means in cases of retention of urine, to procure the patient relief by medicine and the warm bath, without effect, this gentleman introduced a catheter, as he thought, into the bladder, and had, he told me, some difficulty in getting the instrument to enter; no urine, however, flowed through it; when he withdrew it, a quantity of feculent matter was adhering to it, and which had filled up the holes by which the urine should have entered. Immediately after this the abdomen swelled, and symptoms of peritonæal inflammation came on. Dr. Pearson was

then called in, who immediately desired a consultation with a surgeon, and I was sent for. I found the patient in articulo mortis, although still able to speak; there was no tumour above the pubes; and on introducing my finger into the rectum, it gave great pain; but the bladder was not distended. Being strongly urged by all present, and also by the patient, to introduce the catheter, I did so; it passed into the bladder without the smallest difficulty; but no urine passed through it, nor did any feculent matter adhere to it, or urine follow it, when it was withdrawn. On the patient's death, which happened before we left the house, the relations strongly requested that the bladder might be examined, which was done next day, Dr. Pearson and the gentleman who first attended the patient being present. A hole was found in the coats of the bladder, on the back part of its cavity, a little above and between the entrance of the ureters, corresponding exactly to the size of the catheter; the edges of the hole evidently were not ulcerated, but torn. This hole communicated with the cavity of the abdomen, as it was above the reflexion of the peritonæum from the rectum to the bladder: the peritonæum round it was much inflamed, and was partially adhering to the rectum. Another hole exactly corresponding to the first was found on the fore part of the rectum, and which entered the cavity of the gut: both holes seemed to

have been made by the same instrument. It appeared afterwards, that the surgeon, finding no urine passed through the catheter, conceived that the instrument had not entered the bladder, and to produce its entrance, had, to use his own expression, applied no more force than was necessary to pass a stricture. From the bladder not appearing to have been distended, and from no urine being found in the abdomen, I apprehend the case was in the first instance a suppression and not a retention of urine: being treated as the last, the above unhappy consequences arose. I have preserved the bladder, and now produce it, as affording one more of many numerous proofs, that it is not force alone, which will enable the surgeon to pass the catheter with safety.

No general indication of cure can be offered for suppression of urine; its treatment must be relative, and must depend on the cause which produced the disease, when that cause can be ascertained. In those cases of suppression which are sometimes attendant on inflammation of the kidney, bleeding from the arm and from the loins will frequently have the effect of restoring the proper secreting power to the kidney; and in these cases, aperient medicines will also be proper; so will the use of diluting fluids after the bleeding has lessened the inflammatory symptoms. All stimulating medicines should be avoided; but a seton inserted into the loins may prove useful.

Palsy of the kidney, producing suppression of the urine, is an uncommon occurrence; but when it does arise, no fever attends it, nor is there any particular pain in the lumbar region. Stimulating medicines may be tried, but no great hopes of their effecting a cure can be entertained. The tinctura lyttæ has been given, and in small doses been found useful. Tonic medicines should be administered, with warm diuretics. Electricity also should be tried.

The urine may be prevented from passing into the bladder, either by calculi filling up the cavity of the ureter, or morbid tumours formed in other parts pressing on it. In some cases of such mechanical obstruction, the urine, by being accumulated above the part, has distended and greatly enlarged the ureter, the pelvis, and the infundibula; and has also produced, as in the specimens before exhibited, much absorption of certain parts of the kidney, and enlargement of others.

There are, however, few or no cases before death, where we can positively ascertain the enlargement of the ureter; for, however much its capacity may have increased, from its situation no tumour can be apparent externally, nor could it be discovered by the feel, through the abdominal parietes. When this enlargement exists only on one side, the quantity of urine evacuated is not diminished, as the other kidney will secrete a double portion;

and when an enlargement takes place on each side, the case will be confounded with suppression of urine. We may, however, in some instances conjecture, that it has taken place, by attention to the nature and seat of the pain, tracing the last from the obstructed part up to the kidney, particularly in people who have before voided small stones with their urine, and who have a recurrence of similar symptoms to those which were felt on the descent of the former calculi. Fistulous sinuses have sometimes formed, and extended from the distended and ulcerated ureters, and have conveyed the urine to the surface of the body, by opening in the loins, or in the lower part of the anterior parietes of the abdomen near the groin. In cases where the obstruction of the ureter is supposed to proceed from a mechanical cause, emetics have been recommended to be administered occasionally, and also that the patient should use violent exercise, either on foot, or riding on horseback, so that the action of the abdominal muscles and diaphragm, and shaking of the body, if a calculus was lodged in the ureter, might assist in passing it on to the bladder. But these means are reprehensible, and never should be carried far, as we cannot, with sufficient certainty, ascertain either the cause of the stoppage or the state of the parts. The occasional use of opiates, of bleeding, and the warm bath, are the only remedies on which we can safely found any dependence for producing beneficial effects.

LECTURE XI.

ON SUPPRESSION AND RETENTION OF URINE.

The ischuria renalis, or complete suppression of urine by the kidneys, seldom takes place as an original disease; but towards the fatal termination of other diseases it does occasionally, and then generally precedes death about two or three days. It sometimes occurs in the commencement of an acute inflammatory fever, and in violent paroxysms of the gout; but this suppression, in general being purely symptomatic, ceases with the disease, and its degree is influenced by the force and duration of the original complaint.

In true suppression, the patients usually experience but little desire to void their urine, and when they attempt to do so, little or none is evacuated: pain is felt in the loins; a bad taste is perceived in the mouth; they often complain of the sensation of a urinous smell; indeed, all the excretions of the body exhale a urinous odour perceptible to other people: nausea, hiccupping, and vomiting take place; and if the secretion of urine in the kidney does not return, a difficulty

of respiration frequently comes on, and sometimes is succeeded by coma, convulsions, and delirium.

The prognostic, when suppression of urine arises as an original disease, should always be unfavourable; for, although the exertions of nature may carry off some parts of the urine by other emunctories, these prove but bad substitutes for the kidneys; and the suppression is sure to produce a number of symptoms, which, although slow in their progress, are not less formidable in their effects. Cases have indeed been related, where patients have not sunk under this disease for many months; but when it begins as an idiopathic disease, it generally terminates in three weeks or a month.

Sir Everard Home, in his treatise on the diseases of the prostate gland, has published some interesting cases, from which he concludes, that the suppression of the secretion of urine is one of the causes of death, when the retention of water in the bladder has been long continued; the pressure of the urine against the mammillæ stops, he supposes, the secretion in the secerning vessels; and when such an event takes place, death is the consequence.

ON RETENTION OF URINE.

A variety of causes may produce retention of the urine in the bladder. I shall now bring a few of them to the recollection of this audience. Retention of the urine may arise from inflammation of the bladder, although it does not follow that it should take place every time the bladder is inflamed; for, in certain states of that action, the bladder becomes so irritable and so disposed to contraction, that it will allow only a few drops of urine to accumulate before an attempt is made to expel it; but in other instances, the swelling round the cervix, and the extension of the inflammation to the muscular coat, prevent the fluid from being expelled, and retention is the consequence. Retention, from some obstruction of another nature, either mechanical or morbid, which prevents the fluid flowing through the urethra, and obliges it to accumulate in the bladder, may be the cause of that organ inflaming. Inflammation may therefore be either the cause or the effect of retention.

The symptoms of inflammation of the bladder will vary from the extent of the action, the part of the inner or outer surface of the bladder affected by it, and the number of coats which are inflamed.

Inflammation may arise from various causes, affecting the whole of the coats; or it may arise from a cause acting only on one, and may be confined to that single coat.

The peritonæal covering is sometimes inflamed, from that action spreading to it from another part of the membrane; and as it is loosely connected by cellular membrane to the muscular coat, the inflammation may not be communicated to the muscular. Indeed, the inflammation of the peritonæal covering is seldom confined to the bladder, but extends generally to the contiguous membrane. It rarely, if ever, proceeds to suppuration, but I have often seen coagulable lymph thrown out on the inflamed surface, which has formed adhesions with some part of the peritonæum, covering other viscera, or lining the cavity of the abdomen.

The internal coat of the bladder may inflame from some irritating substance lodged in the cavity of the bladder, acting immediately on it; or the inflammation may spread to it from the mucous membrane of the ureters or urethra. Inflammation of the inner membrane, although it may arise at any part, and extend over the whole cavity, most frequently begins near the cervix of the bladder, often on the triangular surface between the entrance of the ureters and the beginning of the urethra; but from this point it may spread in all directions. This part of the inner membrane

I have stated, in a former Lecture, is more vascular and more irritable than any other. It is also, from its vicinity to the passages leading into, and from the cavity of the bladder, more exposed than any other, to be acted on by acrid or extraneous substances introduced into the bladder or retained there; for these substances, in the erect position of the body, would naturally gravitate to that part.

The inner membrane of the bladder has not, in the natural state, many vessels large enough to contain red blood; but when inflamed, the trunks enlarge, and the minute vessels are then found to be sufficiently numerous to impart a florid red appearance to the whole surface. When the inflammation runs high, the muscular coat may be affected, and sometimes the peritonæal also; but as the inner membrane is loosely attached to the muscular, the inflammation is often prevented from extending from the one to the other.

Inflammation of the bladder may be brought on, not only by stone or gravel, but by drinking to excess of spirituous liquors, by the abuse of warm diuretics, by cantharides either taken into the stomach, or absorbed from the surface of the body, and by other more accidental causes.

In these cases a pain is felt in the perinæum and above the pubes, accompanied with fulness or swelling. When the muscular coat is inflamed,

a retention of urine takes place. At first the urine is evacuated in very small quantities, the attempts to evacuate it being frequent and productive of great increase of pain; at last none will pass, although the desire to void it remains as strong as before. The inflammation of the muscular fibres takes from them the power of contracting, or much weakens that power; so that the fibres of the bladder are nearly in the state of those of a voluntary muscle when inflamed in rheumatism; and if forced into action, their contractions are weak and enfeebled, from whence retention of the urine arises. The pain now begins to pass upwards in the direction of the ureters, and frequently also to descend along the urethra to the glans penis. The pulse becomes hard and frequent, and febrile symptoms come on. The urine, when any is discharged, is generally red, and often mixed with a bloody mucus. The stomach usually sympathizes, being affected with sickness and vomiting; and the rectum, from its connexion with the bladder, is excited to much straining, so that most distressing tenesmus often takes place.

It is obvious, that, in the treatment of this complaint, those means which are found useful in lessening inflammation should be had recourse to, and used with activity. Blood should be taken from the arm, and by cupping from the pubes and perinæum; the warm bath should be used, and emollient fomentations; the urine should

have its stimulating qualities lessened by a moderate use of mild diluting drinks, such as linseed-tea, barley-water with or without some gum acacia dissolved in it. Opium will sometimes be found useful, given in a full dose once in the twenty-four hours; so will the liquor potassæ to the extent of fifteen drops three or four times in the day. Emollient glysters may be thrown up the rectum; but as costiveness must be prevented, they should be succeeded in a few hours by glysters of a mild laxative character. Blisters applied to the perinæum, the loins, and above the pubes, will sometimes prove useful in lessening long-continued inflammation and irritation of the bladder; but if blisters are applied, they should be continued no longer than merely to raise the cuticle; they should then be removed, and the surface carefully washed, as the absorption, and deposition of the cantharides in the bladder would add to the inflammatory action. A counter-irritation, however, may be useful; and this may be made by the application of stimulating materials to the surface produced by the blister, as ointments composed of cummin-seed, red precipitate, tartarised antimony, and many other such ingredients.

The catheter should be carefully introduced, and the urine drawn off: the frequency of the introduction must depend on the quantity collected in a given time, twice or three times in the day.

The instrument is in general, in these cases, easily introduced by the surgeon; but exquisite pain is often felt by the patient immediately on its entering the bladder and touching the inflamed coats of that organ. Injections of mucilaginous materials dissolved in water, have in these cases been strongly recommended by the French surgeons to be thrown into the bladder after the urine has been evacuated by the catheter: this practice has been adopted also by several English surgeons. From the experience I have had of the effect of such injections, the benefit we might expect from them has not been realized so generally as at first seemed probable. I have seen them increase the irritation; but I also have seen them used in cases where they have not irritated, but rather lessened the irritation and pain by taking off the acrimony of the urine, and on the whole been serviceable. In one particular case I have known injecting tepid water into the cavity of the bladder productive of ease to a patient who had long been afflicted with stone, but who would not submit to the operation of lithotomy; for more than four years he was in the habit of occasionally throwing about three ounces of tepid water into the bladder through an elastic gum catheter, and frequently repeated this through the day, whenever the irritation from the stone was great, and always, he stated, with temporary relief. The patient was a medical

man; but dying in the country, the bladder was not inspected.

When, from the disease either not having been understood, or from other causes, the bladder has been kept long in a state of distention, the muscular fibres are very apt to lose their tone or natural disposition to contraction; so that, after the catheter has been used, the inability to pass the urine remains, and when a fresh secretion takes place, the bladder soon becomes distended as before: thus a secondary kind of retention occurs, and continues, although the cause which produced the original retention, whether arising from local or constitutional affection, has been completely removed. The bladder, after the first evacuation of the urine through the catheter, remains, until again distended, in the flaccid state we find it in the dead body when the urine which it contained has been discharged. In these cases the muscles, however, which surround the cervix of the bladder and membranous part of the urethra, not losing their tone, continue their contraction, and resist any pressure that may be made by the abdominal muscles and diaphragm, or the hands of the patient or surgeon applied to the surface of the abdominal parietes to force the urine into the urethra.

The surgeon should, therefore, recollect this, and inquire in proper time after the first evacua-

tion, in every case where the bladder has been long distended before the catheter was used, whether the patient has passed any urine by natural efforts; if he has not, he should, by introducing the catheter frequently, in proportion to the quantity of urine secreted, prevent the accumulation of such quantity as would again distend the bladder. At first the introduction every eight hours may be necessary, as the kidneys often secrete largely, when the obstruction to their being relieved from what they have secreted, is first removed. Twice in the twenty-four hours will be necessary in almost every case; and this should be continued until the bladder regains its tone. In cases where a difficulty occurs in introducing the catheter, and where, when one is introduced, it does not produce much irritation in the bladder, it may be retained there by a proper bandage, and the urine be evacuated at given times by withdrawing a cork or plug inserted into the instrument. If this is attended to, the tone in general will soon be recovered; but the time will depend on the degree and duration of the former distention, and on the age and constitution of the patient. An experienced surgeon will therefore not delay the passing of the catheter when a retention of urine capable of being relieved by that instrument exists, for by the delay most injurious consequences may arise. When all in-

flammatory action in the bladder is removed, tonic medicines may assist in the cure.

In cases where a difficulty from inflammation, or from some spasmodic contraction of muscular fibres, or from mechanical obstruction, prevents the immediate introduction of the catheter, we may try to facilitate its entrance by bleeding either from the arm, if the pulse is full and strong, and the patient's constitution good, or, where there is much temporary action, with but little strength, from the loins, by cupping, and from the perinæum by cupping or by leeches. Blood taken from the loins often produces an immediate good effect in facilitating the introducing of the catheter, when difficulty has arisen either from inflammation or spasmodic action. The use of the warm bath should be had recourse to; the hip bath will sometimes answer; but the full bath, on the whole, is to be preferred. Opium used in one full dose, once in twenty-four hours, will have a better effect in lessening spasm than a much larger quantity would, if administered repeatedly in smaller doses in the same time. Small doses, frequently repeated, I have often found to keep up both the inflammatory action and spasm. Glysters of tepid water and oil are useful in clearing the rectum; and afterwards tepid water thrown into the gut, by soothing the parts in the neighbourhood of the bladder, assists in lessening the diffi-

culty in introducing the instrument by which the urine is to be evacuated.

There is a state of the bladder which is apt to deceive the patient, and also the surgeon who contents himself with superficial observation, and which has sometimes occasioned a retention of urine to be mistaken for incontinence of it. After the symptoms of retention of urine have taken place and lasted some time, the patient is agreeably surprised by finding his linen wet from a quantity of urine dribbling from the penis, and from his being able, upon exertion, to expel a few drops. A considerable quantity in a given time is evacuated in this manner; so that he believes all obstruction is removed, and the bladder emptied: but his pleasure soon becomes lessened by discovering, that all this has afforded him no permanent relief. In fact, the bladder remains as much distended as before; but, from being able to hold no more, a certain quantity enters the penis, from the muscles which usually contract, to retain it in the bladder, having had their power of resistance overcome by the long and constant pressure which, from the fulness of the bladder, has been made on their fleshy fibres. The patient finds at last that he has only suffered a change of misery, and that the acute sensation which was brought on by the frequent and urgent desire to pass the urine, is now changed into one, perhaps still more distressing,

of general uneasiness. The muscles now, from having been overstretched, lose their power of contracting, and, as the distention continues, they become violently inflamed; the coats of the bladder either burst from the distention, or, what is more frequently the case, go into ulceration, or perhaps mortify. The urine then escapes, and if it passes into the cavity of the abdomen, life is inevitably lost; but if the part which gives way is below the portion of the bladder covered by the peritonæum, although, in all probability, the same event will take place, still there is a chance afforded, although a very distant one, of life being saved; but this chance, slight as it is, can only be made successful by cutting freely into the loose cellular membrane which receives the urine from the bladder, and procuring an unobstructed and dependent outlet for that which is extravasated, and by the constant use of the catheter, preventing any fresh quantity from accumulating in the bladder. In the cases which I have examined, I never have met with the appearance of an opening actually formed from the bladder bursting from distention: the appearances have either marked ulceration, or the death and consequent sloughing of the part through which the urine had escaped. A distended bladder may, however, be burst from a kick, a fall, or other accidental injury; and such cases have happened, where the opening has put

on the usual appearance of a part having given way; but occurrences of this kind are rare. A preparation has been presented to the College by Sir William Blizard, which enables us to show the difference of appearance between a bladder burst by external violence, and one that has given way from inward distention. The bladder in this case was burst by one person falling on another from the overturning of a coach. The effects of urine escaping into the cellular membrane, and producing fistulous openings, will be shown in a subsequent discourse.

The introduction of the catheter, although often in appearance a simple operation, is one on which the life of a human being so frequently depends, that it requires the most attentive consideration which the surgeon can bestow. In most cases it is performed with great ease; but in others it often requires the full share of the operator's anatomical and physiological knowledge. Rules for the introduction of this instrument are to be met with in several authors; but these alone are not sufficient to convey the necessary instruction, nor can they comprehend all the cases of difficulty that may occur; indeed, some of them seem to be founded on vague theories, and to be impracticable in the cases for which they have been recommended. Books, although useful for reference, are not the best channels through which the knowledge of introducing the catheter can be

obtained; they may give important practical hints, they may caution us to shun many difficulties, to obviate others, and to avoid incurring the certain danger of applying force in a wrong direction, even if force should ever be necessary; but to render the information which they convey practically useful, we must carefully and most attentively dissect and compare the parts through which the instrument is to pass; we must remember all their various enlargements and diminutions, the curves which they form, their natural structure, and, above all, their relative situation and connexion with the parts surrounding them: we must ascertain how and where they can be felt and examined, and then we must consider the alteration in length, incurvations, shape, and structure, that may arise from disease. This audience must feel that every opportunity should be taken to pass the catheter in the dead body before dissection; and after the parts are dissected and brought into view, that every difficulty which might arise should at those times be considered, and the means of obviating it, inquired into, and, if possible, ascertained. All present, I trust, have done, or endeavoured to do this. Should any student feel that he has been negligent in using these means, let him consider that the care of life is a heavy responsibility; let me entreat him, therefore, to lose no more time, let him immediately repair to

his dissecting-room, and, before he leaves London, feel confident that he has acquired the necessary and expected knowledge: when engaged in business, and in the country, he will find few opportunities of referring to the dead body; he may then deeply repent, but cannot repair his loss.

The elaborate descriptions given by some authors of the mode of passing the catheter, the allusions to the required delicacy of the hand, the great attention to the sweep of the passage, the tour de maitre, as it has been absurdly called, and the precise point where the handle of the catheter is to be depressed that the other extremity may be elevated, are certainly useful to the student who has previously dissected; but to those who have not dissected, or seen dissection, these particular directions avail but little; they may produce a feeling in the mind of the reader, of the superior talents of the author who can describe the mode of so easily shunning difficulties in introducing the catheter, but they will convey very little real practical information to those who have not attended to the dissection of the parts themselves. This attention alone will teach him how to introduce the catheter safely, and to shun any error arising from misconception, into which, reading without dissecting might possibly lead him.

What man should dare to call himself a surgeon who has not carefully attended to this sub-

ject? Let such person consider, should his patient, labouring under retention of urine, die, he not being able to pass the catheter, and ignorant of whence the difficulty arises, that such death must for ever lie heavy at his door; and that not only the death of the individual is produced by his ignorance, but also the miseries which may be entailed perhaps on a numerous family, left by such death in indigence; and by him, the person in whom their confidence was placed, but which he had abused by undertaking the case, although conscious that he was not equal to its proper management.

In every anatomical theatre in London, the teachers of anatomy zealously strive to convey information on these subjects; and the side view of the pelvis, when accurately dissected, affords them ample means of so doing. In every London hospital the surgeons most willingly and unreservedly show, by their practice, the mode of introducing the bougie, the catheter, and the sound, to the students; and although cases may occur where it is, perhaps, impossible for the best anatomist, or most experienced surgeon, to succeed in passing any of these instruments, such cases are rare, and justify the recurrence to other operations. But if this does sometimes happen to men who have taken every means of perfecting themselves in their profession, how much

more frequently must those persons fail, who have been negligent and inattentive, and who must of course want the consolation of having done their duty, to soften the feelings which must arise from their want of success! It might be considered almost insulting this audience, were I here to introduce those anatomical and practical directions which in another place I have thought it my duty to impress on the mind of the students attending their first course of anatomical lectures. Those who are in the daily practice of their profession cannot require such directions; and I must not suppose that any student who has attended a course of dissections, anatomical lectures, and hospital practice, can now be ignorant of this, so frequently required, and important operation; but if any one does find himself incapable of inroducing the catheter from want of knowledge of the parts through which it is to pass, or want of practice with the instrument, let me entreat him to apply to the means I have pointed out, and gain from the dead body the art of preserving the health and life of the living.

In the Practical Observations in Surgery, illustrated by cases, and written by a most experienced surgeon, the late Mr. Hey of Leeds, are to be found some useful remarks on the passing of the catheter, and on the comparative advantages, in particular cases, of those formed of silver and of the elas-

tic gum. Among other observations, he says, "Whatever method of performing this operation is pursued, the catheter should be introduced with the greatest gentleness. When any obstruction occurs, the design of the surgeon should be to evade rather than overcome it. Unsuccessful attempts may render a case extremely difficult, which was not so before. I wish to impress upon the mind of my reader, that a moderate force, improperly directed, is capable of injuring the urethra in such a manner as to render the operation almost (and without a just knowledge of the injury, altogether) impracticable." He concludes his remarks on the treatment of retention of urine, by urging the propriety of an early introduction of the catheter in this disease; he says, "Delay is not only fruitless in general, but also renders the operation more dangerous, as well as more difficult; and usually protracts the completion of the cure. Besides, the great degree of inflammation which the bladder suffers, when the extraction of the urine is long delayed, brings on a suppuration in the part. I have," says he, "seen many instances of this. The retention, indeed, has been cured; but a discharge of purulent matter has succeeded, and the patient has died tabid. If the circumstances of the case require bleeding, purging, the injection of a glyster, or the use of a warm bath, a delay for these purposes may be beneficial; but delay should

only be considered as preparatory to a more safe introduction of the catheter." My own experience fully confirms these practical observations of Mr. Hey.

In early cases of retention, it sometimes happens, that, to remove it, nothing more is necessary than to overcome the resistance made by the sphincter muscles of the urethra, and that may be done by a common bougie being carefully introduced; and which, when withdrawn, will be attended with the flowing of the urine. In slight cases a bougie may be tried first; but in the hands of a surgeon a catheter will pass, if there is no stricture, with as little difficulty to the operator, or pain to the patient, as a bougie. In such cases, when retention frequently occurs in the same patient, he can readily be instructed to pass a bougie himself, for it will be less dangerous in his hands than a silver catheter. I have often seen a very good sympathetic effect produced in bringing on the flow of urine when the bougie was withdrawn, by letting the patient hear the pouring out of water from a height, without telling him of the effect intended to be produced by the sound. In patients where the genital organs have been for a long continuance much relaxed by an inordinate indulgence, which has produced too frequent actions for their powers to support, the bladder has sometimes partaken of the general debility, and be-

come incapable of contracting with sufficient force to expel the urine, and a retention of that fluid has consequently taken place, at first unattended with inflammation, but which, if not removed, would soon produce it. Here, the elastic gum catheter, frequently introduced, or left in the bladder, and the cork occasionally removed, is likely to be productive of good effect. The weak and relaxed state of the system should be attended to, and tonic medicines given for its restoration to health; abstinence from the cause which produced the debility should be enjoined; the patient, whose mind is generally depressed, should be encouraged to hope for a cure; and, in addition to medicine, attention should be paid to the degree of exercise he uses, the food he eats, and the purity of the air he breathes. Many of these cases will, by a judicious management of the above means, completely recover.

Should the bladder have become so weakened by an immoderate use of diuretics, as to refuse to expel its contents, the cause having been removed, and the urine evacuated by the catheter, a similar treatment to that last mentioned should be had recourse to. The cold bath may be used; blisters applied to the pubes and loins will sometimes prove useful, but care should be taken not to keep the cantharides too long applied, as the absorption may change debility of the bladder to active inflammation of it. In some cases of debility from

the last cause, a few drops of the tinctura lyttæ have been attended with favourable effects in restoring the tone of the bladder.

Injuries done to the spinal marrow will sometimes produce retention of urine, by pressing on the nerves, and thus palsying the muscular fibres of the bladder. In these cases the whole of the lower extremities are in general included in the affection; sensibility in the parts being also destroyed, the patient is not aware of his situation, as he suffers no pain, and does not complain of any derangement in the urinary organs. In all cases of injury of the spine, the surgeon should ascertain whether the patient passes his urine, or whether it is retained in the cavity of the bladder. In occurrences of this kind the catheter should be passed, but this affords only temporary relief; the state of the spine must be attended to, and will require to be treated according to the nature of the injury and the patient's constitution. Blisters to the loins, cupping and scarifying, or the introduction of a seton, so as to afford a permanent drain in the loins, may, in some instances, do good, and therefore should be tried.

Tumours pressing upon the nerves of the bladder, by rendering the organ paralytic, may, like injuries of the spine, produce retention: all that can be done here, in regard to the retention, is to use the catheter until the cause and effect of the

paralysis are removed. The particular treatment, of course, must be dependent on the nature and situation of the tumour.

Those cases of retention of urine which arise from some mechanical obstruction to its flowing through the urethra will be mentioned with the diseases of the prostate gland and penis.

LECTURE XII.

ON DISEASES OF THE BLADDER AND PROSTATE GLAND.

It is not usual for mucous membranes, when in a state of inflammation, to throw out coagulable lymph on their inner surfaces; for the deposition of this substance on any surface, is the first step towards adhesion; and that action, by closing the canals, would in every instance be attended with great inconvenience and danger, and in most instances would destroy life; the inflammation of such membranes, therefore, for the most part terminates in the formation of pus.

I have, however, seen the bladder, in a person of a scrofulous habit, lined by a coating of coagulable lymph, which adhered firmly to its inner surface. The person to whom this bladder belonged was a very attentive medical student, who, when about twenty years of age, brought on a fever by great professional fatigue which destroyed him in three weeks. He did not complain of his bladder in the beginning of the fever, but towards

the latter part he did, and had some difficulty in voiding his urine, although the attempt was attended with but little pain, and a purulent discharge came away whenever the urine was passed. On the body being inspected, a substance, apparently something between coagulable lymph and curdly scrofulous matter, was found to line and strongly to adhere to the inner surface of the bladder.

Inflammation of the bladder occasionally proceeds to the formation of pus, ulcers are produced on its inner surface, and abscesses sometimes take place in its coats. The ulcers vary in appearance and magnitude, and occasionally form very complex diseases by communicating with several other parts; of course, when they communicate with the abdomen, life is soon destroyed by the extension of peritonæal inflammation. They sometimes, the surface of the bladder having been previously united to the intestines, open into that canal, and, in the female, into the vagina. I have seen repeated instances of communication with the intestines through which seeds and other substances, mixed with feculent matter, have passed from the intestine and were evacuated by the urethra. I have preserved the bladder and ileum of a person which had adhered fifteen years before the death of the patient; ulceration to a large extent had taken place through this connected part; so that, for the whole of the above period, the fæces readily passed

from the ileum into the bladder. The patient died when sixty-eight years of age; being a female, the shortness of the urethra allowed the substances which passed into the bladder a tolerably free escape, and no calculus formed; but on these ulcers, as surgery cannot reach them, I shall not occupy more of your valuable time.

Ulcerations of the inner membrane of the bladder are attended with constant pain and much irritation, producing repeated calls to void the urine, which fluid is never suffered to accumulate in any large quantity; much difficulty generally attends the passing of it, accompanied by an increase of pain and all the other symptoms of an irritable bladder. Shiverings usually take place when pus is formed, and purulent matter is discharged with the urine. When we suspect that ulceration of the inner coat exists, all we can do is, by opium and other narcotics administered internally, to endeavour to lessen irritation; the uva ursi is generally given; but why I know not; I have never seen it of the least use. Opium, the extract of poppy, and the extract of hemlock, together or separately, formed into a bolus, and introduced into the rectum, will sometimes allay irritation when medicines taken into the stomach have failed in procuring relief; but these, when used, should after a few hours be succeeded by a laxative glyster to prevent habitual costiveness. Diluting fluids should be taken into

the stomach, but not to that extent as to increase in any very considerable degree the secretion of urine.

When the inflammation of the bladder proceeds to the formation of abscesses in its coats, these usually begin in the part nearest to the prostate gland, but they occasionally extend over the whole bladder; they are sometimes occasioned by the violence used in introducing an instrument to the cavity of the bladder, but they also arise when no external violence has been applied: they generally produce a most formidable and fatal disease. The symptoms attending abscesses depend upon their size and situation.

The bladder I now produce affords a tremendous example of the effects of abscesses in the coats of that viscus. The patient was forty-one years of age and very corpulent. When I first saw this gentleman, he was labouring under the symptoms of a highly inflamed and irritable bladder; he had a gonorrhœa six weeks before, but of which he imagined himself cured. He had a retention of urine. I attempted to pass an elastic gum catheter of the full size; it passed without difficulty to the neck of the bladder, and there stopped without entering the cavity; but on my withdrawing it, a plentiful stream of urine followed. Next day he felt something give way near the neck of the bladder, and immediately a large quantity of very fetid purulent matter, unmixed

with urine, was evacuated by the penis. A catheter of the largest size now entered the bladder without difficulty. Three hours after this, not expecting to see me until the evening, he sent for the medical man who had constantly attended him, and persuaded that gentleman to introduce the catheter, who made the attempt, but after several trials failed of success. One of the most experienced anatomical surgeons in London met me at the patient's house in the evening, when we were informed of what had happened. Neither of us could introduce the elastic gum catheter, which in the morning had passed with the greatest ease. On my endeavouring to pass the silver catheter, I found it entered the cavity of an abscess, but I could not make it enter that of the bladder, and I gave up the attempt. After this another attempt was made for more than a quarter of an hour without success, when the catheter suddenly entered the bladder, and pus mixed with some urine flowed through it. Soon after this the febrile symptoms increased, excessive pain and great tension of the abdomen came on, and which continued but with little variation for ten days, when the patient died; much purulent matter for the whole of this period flowing through the penis.

On inspecting the body, the peritonæum near and on the bladder was highly inflamed, and several adhesions had formed. A whey-coloured

fluid, mixed with coagulable lymph, was found in the cavity of the abdomen. The bladder was much thickened; on opening into its cavity, the urethra, at its origin, and the cervix of the bladder, were not only inflamed but ulcerated, and the rest of the internal membrane was highly inflamed. An opening (that which has now a bougie inserted into it) was found near the entrance of the right ureter. This opening communicated with the bottom of a large abscess which had first formed in the prostate gland, the substance of which was nearly destroyed: an extensive suppuration in the coats of the bladder had taken place from this part to the fundus, the matter being lodged every where between the coats; and near the fundus several ulcerations had taken place through the internal membrane, by which the matter had passed into the cavity of the bladder.

Cysts are sometimes found communicating with the bladder; calculi are occasionally lodged in them, but I have met with them in bladders where no calculi had ever formed. These vary in number, from a single cyst to several; and in size, from a small pea to one nearly as large as the bladder itself. To me they have always appeared to be formed by the internal membrane protruding between the fasciculi of fibres of the muscular coat. The great inconvenience which will arise from these cysts will be, that the whole of the urine cannot be

discharged at one time. I produce some preparations of cysts of the bladder, that their appearance may be recollected; and that, from our knowing they do sometimes form, we may account for symptoms which otherwise would be inexplicable, not that we have any means of curing them.

I have met with three instances of the bladder being divided into two chambers, communicating by a small opening with each other. Dr. Baillie mentions a case of this kind in his work on Morbid Anatomy, in which the upper chamber was generally much distended with urine, so that a round tumour could easily be distinguished by the touch above the pubes; on the introduction of a catheter into the lower chamber, a few ounces only of urine came away, and the tumour above the pubes remained the same as before. When the patient stood up, a quart of water sometimes passed involuntarily; the tumour very much subsided, and the complaint was relieved for the time: after death, on dissection, the two chambers were found.

I have, in a female, seen a case exactly similar to the above; she was a patient of the late Dr. Clarke's, who frequently introduced an elastic gum catheter through the middle opening, and evacuated the urine contained in both chambers.

In the works of Mr. Pott, a case is mentioned in which a portion of the bladder was lodged in a hernial sac. Other instances of herniæ of the bladder have occurred both under Poupart's liga-

ment and at the abdominal ring, but they are rare; we have no preparations of them in our Museum.

Fungous excrescences occasionally arise from the inner surface of the bladder, and are productive of most distressing symptoms, often very similar to many of those which attend the stone. These excrescences are different in their size, and in the extent of surface which they occupy; sometimes they originate from a single root, and occasionally from several; but they generally consist of a similar loose and fibrous structure: in certain situations, as when immediately behind the neck of the bladder, they will, by blocking up the origin of the urethra, cause a very considerable obstruction to the passage of the urine; and the bladder being irritated and frequently excited by them to stronger action than in a natural state, its muscular coat becomes thickened. These excrescences are sometimes attended with a bloody discharge, and often with a viscid ropy mucus; I have felt them during life on the introduction of a flexible catheter into the bladder, but the sensation, when the instrument touches them, is not distinct like that produced by stone. They sometimes exist without any enlargement of the prostate gland. A well-marked instance of this disease, with the addition of a cyst communicating with the cavity of the bladder, appears in this preparation.

It is the bladder of a person who had been af-

flicted with the disease for more than seven years, and had been for the greater part of that time confined to his bed. The disease during his life, could not be ascertained by any of the medical men whom he had consulted. He had many of the symptoms of stone, and was often sounded, but no stone could be discovered. His urine was in general clear. Mr. Spencer, of Islington, who had attended him, inspected his body on his death, and sent me the bladder. The greater part of the internal surface of the bladder has processes projecting from it, more resembling the vessels of the placenta when unravelled, than any thing else to which they can be compared. These vessels were loaded with blood. A hole is seen near the entrance of one of the ureters, which communicates with an extensive cavity, between the rectum and bladder, which was filled with urine: this hole is not the effect of ulceration, for it is lined by a smooth portion of the internal membrane of the bladder. The cavity was so similar in shape and appearance to the bladder, that it actually was mistaken for such by those who opened the body; and the cavity of the real bladder was mistaken for that of an abscess. A small calculus was found in the urethra where it passed through the prostate gland.

The appearance of the excrescence of the internal membrance of this bladder is very similar, only being more extensive, to one which was preserved in the

collection of Mr. Cruikshank. The person from whom it was taken had symptoms similar to those of stone; a retention of urine came on, a catheter was readily passed to the bladder, but the moment the instrument entered its cavity, the patient gave a shriek as if in excessive pain, and immediately expired. Nothing preternatural was found on inspecting the body, either in the head or the cavities of the trunk, excepting the tumour; the vessels of which were loaded with blood; the instrument might have pressed on it, but had not torn it; for no force had been used. Mr. Cruikshank conceived, that the excessive sensibility of the tumour when touched by the instrument, had produced so much pain as immediately to destroy life.

It is right here to mention, that small irregular processes will sometimes project into the cavity of the bladder, consisting of cellular membrane, intermixed with fat and covered with the inner membrane, otherwise in its natural state. Near the cervix these elongations might be pressed into the urethra, and so obstruct the passage of urine; and in cases where lithotomy is required, they might be productive of much inconvenience by passing between the blades of the forceps employed to extract the stone. These do not admit of being discovered during life.

Scirrhus and cancer sometimes affect the bladder; they seldom, however, begin in that viscus, but

more usually spread to it from other parts in the neighbourhood, which are more liable to assume those states. The bladder, in these cases, before it ulcerates is rendered thick and hard; its substance becomes intersected with white membranous septa, and the other usual appearances of cancer take place. It is painful to the lecturer, when such diseases are mentioned, to add, that all which we have it in our power to accomplish, goes no farther than to alleviate the sufferings of the unfortunate and much afflicted patient. The treatment must therefore depend on the urgency of the symptoms present, and the effect which the various kinds of soothing medicines have upon the particular constitution. Much relief may be afforded to the patient by the proper use of such medicines, although the cure of the disease is beyond all medical or surgical art.

ON DISEASES OF THE PROSTATE GLAND.

In the anatomical lectures of this season, when treating on the prostate gland, I particularly invited the attention of this audience to its relative situation as to the other parts its outer circumference was attached to, or in contact with; and I pointed out in what manner, and to what extent, its substance surrounded the beginning of the urethra. It is evident from the consideration of

these circumstances, that any general swelling of this gland must necessarily have the effect of altering the shape and course of the natural passage for the urine; in some instances, by closing the passage, must produce a retention of urine; and in every instance must occasion more or less difficulty to the passing of the catheter.

Like every other gland, it may swell from phlegmonous inflammation, brought on by some temporary irritating cause. A swelling of this nature may take place in every period of life; and the inflammation may proceed to the formation of an abscess in its substance; the stream of urine will consequently be affected by it; and until the swelling abates, or the abscess bursts, a retention of urine may be produced: but after the evacuation of the matter, the gland may subside to its former healthy size and state.

This affection is not very common; but I have known it in two or three instances to take place soon after the period of puberty; in one of these cases, from a fall; and in the others without any assignable reason. Such swellings are attended with the usual symptoms of inflammation affecting the neck of bladder, but in general without that constant desire to evacuate the urine, which occurs when the inner membrane of the bladder inflames. When the inflammation spreads to the membrane from the gland, this symptom of course takes place;

difficulty of passing the urine comes on, and painful straining in making the attempt. In some instances the rectum sympathizes, and tenesmus is produced.

The phlegmonous inflammation of the prostate gland may readily be distinguished from scrofulous or scirrhous enlargement, by the age and general constitution of the patient, the quickness of its progress, and the acute and throbbing pain felt in the gland. In treating this affection, we have to use those means which are known to lessen inflammatory action. We therefore should bleed from the arm, also bleed by cupping from the loins. We should apply leeches to the perinæum, and above the pubes if the bladder should show any disposition to inflame. The contents of the rectum should be emptied, first by mild aperient medicine, then by glysters. Opiate glysters might be thrown at night into the rectum, and warm emollient fomentations applied to the perinæum and pubes. A bougie may first be introduced; but if the water does not flow when it is withdrawn, the elastic gum catheter should be used sufficiently frequently to prevent the bad effects which would arise from retention.

Suppuration and ulceration of the prostate gland will sometimes take place without considerable enlargement of any part of its substance. A number of ulcerated foramina may be found on each side of the caput gallinaginis, extending into a sinus in the substance of the gland contain-

ing purulent matter; and sometimes forming cells of various sizes communicating with each other. This state of the gland appears to be brought on by the point of a bougie, or small catheter, when unskilfully used, being inserted into some of the natural ducts, and there irritating, so as to bring on ulceration and discharge; particularly when the orifices are so situated that the urine drops into them. If the lacerations made in the gland are so directed in their course, that the urine does not enter them, they may then heal, without the above-named dangerous consequences arising.

When an abscess forms in the prostate gland, it generally bursts into the urethra behind the caput gallinaginis; sometimes, however, before it; but it has in some instances burst in the perinæum, of which last I have known more than one instance. Great care must be used, after the abscess has burst, in introducing the catheter, when such introduction is necessary, as the point of the instrument is very apt to enter the cavity of the abscess. When the abscess bursts into the urethra, pus mixed with mucus is discharged with the urine; and from the urine passing into the abscess, a very acute pain comes on, which usually lasts for some time; a burning kind of pain is often felt at the same time in the glans penis. In cases of this nature, soothing means should be had recourse to, both by the use of internal narcotic medicines, and the injection of glysters into the rectum in which some narcotic

materials have been dissolved. The acrimony of the urine should be lessened by means of the mistura amygdalarum, or of watery mucilaginous fluids frequently taken into the stomach.

The prostate gland is sometimes affected by scrofula. I have seen it enlarged and changed into a white curdly matter precisely the same in quality as that formed in a scrofulous absorbent gland. This swelling is slow in its progress; it is not attended with much pain; it may be felt by a finger introduced into the anus; and its effects on the stream of urine will depend upon the size it enlarges to, and the form it assumes. In treating such enlargement, means must be had recourse to which tend to free the constitution from scrofula. I had the honour of submitting those means to your consideration, in one of the lectures which I delivered last year. Sarsaparilla, cicuta, opium, liquor potassæ, sea-bathing, and electricity, are among those means. Swellings of this nature are usually found in persons not advanced beyond the middle period of life. In more advanced age, a more formidable enlargement of the gland, and often of a scirrhous nature, is apt to take place, and to form one of its most common diseases.

SCIRRHOUS ENLARGEMENT OF THE PROSTATE GLAND.

This enlargement seldom begins until after the middle of life is past, and often increases gradually

but slowly to the close, and is so common, that few people have arrived at a very advanced period of their existence without having been more or less affected by it. It appears, however, to occur most frequently in those persons, who, either from living a life of strict celibacy, have not used the genital organs so much as nature seems to have intended, or who have injured both the genital and the urinary organs by leading a life of excess. Thus structures which are not used, may become diseased; and thus, full living, both in food, wine or spirits, indulging too greatly the venereal passion, in fact, doing any thing which produces too often and too strongly a determination of blood to the urinary and genital parts, so as to excite in them a greater share of action than their natural structure can support, will occasion their blood-vessels to lose their proper tone, and a morbid change to take place. As a confirmation, that not using the secretion of this gland in the way which nature, to a moderate degree, seems to require, may be productive of disease, I shall repeat an observation made by a very eminent physician to the two Hunters, when on his death-bed, he having suffered greatly for many years preceding this from an enlargement of the prostate gland, which ultimately destroyed him. "It is hard," said he, "that I should be punished thus in these parts, with which I have never sinned." It is perhaps here right to add, that this person died a bachelor.

Sir Everard Home conceives, that the slow return of the blood from the neck of the bladder, arising from the disadvantageous situation of the veins respecting the heart, must, by dilating them beyond their usual size, in advanced life, give a tendency to this disease, which will be greatly increased by violent horse exercise, and indulging freely in the pleasures of the table. I have met with several cases which confirm the justness of the observation, so far as the disease happening more frequently to people of the above description.

But many persons have suffered much from the enlargement of the prostate gland, who have lived a moderate and quiet life, without approaching to either of the above-mentioned extremes.

The enlargement takes place slowly at first, it is unattended with pain, and no particular alteration of structure is apparent in the gland when opportunities offer to examine it on death, nor is any discoverable by the examination from the rectum in the living patient. As the disease proceeds, the structure of the whole gland changes, the gland enlarges, sometimes regularly, so as to preserve its shape, to the size of a moderate orange; sometimes very irregularly projecting in a lobulated manner. In this state, when cut into, the substance feels firm, the cut surface is of a whitish brown colour, and the membranous septa extending through it in various directions, are often very strongly marked.

The gland, before the urethra and bladder are opened, in general appears to have enlarged most laterally; a thicker portion of its substance in the natural state is placed on the sides of the urethra than behind; and there is also less resistance from the surrounding parts to the increase of swelling in the lateral direction. It also enlarges by pressing backwards towards the rectum; it in general enlarges least on the anterior part, the connexion it has to the pubes preventing it from passing far forwards; but I have met with instances where the enlargement before the urethra has been considerable. When symptoms occur from which its enlargement may be suspected, a finger introduced carefully into the rectum will enable the surgeon readily to ascertain the extent of the lateral and posterior swelling. In the healthy state of the parts, the finger, when well oiled, and introduced so as to take the sweep of the cavity of the pelvis, which is generally regulated by the anterior concavity of the os sacrum, will pass on in the gut without obstruction from the gland; but when the gland is enlarged so as to press backwards, its projection towards the rectum soon meets the finger, and forms according to its size a greater or lesser impediment to the finger passing on in the gut. The point of the finger, when it is inserted beyond the sphincter muscle, and applied to the anterior part of the cavity of the gut, feels first the bulb of the urethra which is soft, and passing

beyond this, it discovers the harder substance of the prostate gland. If the finger cannot be carried beyond the swelling, we are certain that the gland is much enlarged from the apex to the base; and the extent of its lateral enlargement may be ascertained by passing the finger along its projecting surface from side to side.

The lateral swellings of the gland do not contract and lessen the surface of the urethra contained between them, in the manner it would be lessened by a stricture; on the contrary, the enlargement of the gland increases the length of the surrounded urethra, but at the same time compresses the sides of the canal together, so as to produce an obstruction to the passage of urine; the posterior enlargement allows the urethra to incurvate more backwards, so that it forms a more deep as well as more lengthened cavity, and which therefore will require a longer and more curved instrument to pass through it into the bladder, than would be wanted for a urethra in its natural state; for this and other reasons presently to be given, a flexible catheter must always be preferred in diseases of the prostate gland to an inflexible silver one. By the lateral pressure, the canal of the urethra, instead of being round, is flattened into a narrow groove.

In the progress of the enlargement the two sides do not always swell equally; one often enlarges the most, and often swells more in one particular part

than the other. This produces a lateral bend or obliquity in the passage, which of course will increase the difficulty of passing the urine and of introducing the catheter. I have seen, from the irregularity of the lateral swelling, the passage through the gland bend in succession to both sides. The excellent series of preparations in our Museum afford most instructive instances of these lateral bends of the urethra in passing through the gland. It has been observed, that the left lobe of the gland often increases more rapidly, and to a greater extent, than the right, therefore throwing the lateral bend more frequently towards the right side; the left lobe also frequently projects more than the right towards the cavity of the bladder. Sir Everard Home, who first noticed this circumstance, says, that he is unable to determine whether it arises from any peculiarity in the left lobe, or is only accidental; but it is deserving of notice, that he had, when he published his first volume on the diseases of the prostate gland, never met with the same circumstance in the right lobe. An acquaintance with this fact may be of some use in cases where difficulty occurs in passing the catheter, as it may enable us sometimes to give the proper direction laterally to the point of the instrument. In the second volume, however, which was published in 1818, Sir Everard gives an engraving, where the right lobe of the prostate formed the largest projection towards the cavity of the bladder. He mentions, that in two instances he had seen a

similar enlargement of the right lateral lobe. I have met more than once with this greater enlargement of the right lobe. Sir Everard has very properly observed, that the knowledge of this will induce the surgeon, after trying gently first on the left side, to go immediately to the right, without persevering in farther trials on the left side.

The swelling, however, of the portion of the gland called by Sir Everard Home the middle lobe, deserves most particularly the attention of the surgeon; as this swelling arising in a part behind the origin of the urethra, forming a tumour and projecting over it, and often carrying a fold of the inner membrane of the bladder with it, becomes, on some occasions, a complete valve, being pressed down by the urine behind, when the muscular fibres of the bladder act, so as to completely close the passage, and in such a manner, that the more force the bladder or abdominal muscles exert to expel the urine, the more perfectly is the passage shut up. I have already, in a former Lecture, explained the situation of the third or middle lobe; the terminations of the vesiculæ seminales and vasa deferentia are immediately before it, and bound pretty firmly to it; so that when the gland enlarges, this portion meets with less resistance to its increase towards the cavity of the bladder than in any other direction; and by so projecting, it forms a more powerful impediment to the passing of the urine or introduction of the

catheter than any other part of the gland. Numerous and most interesting specimens of the projection of this lobe are now on the table; each, when contemplated, becomes a volume of instruction to the surgeon. I have placed these before you, but it would occupy too much time, in a limited course of lectures, to name even the most evident morbid changes, perceptible in each preparation, which the gland has undergone; but let me entreat those who have not yet particularly attended to the subject, to study these preparations when at leisure, and in the Museum; and to be assured that by so doing their time will be employed to the advantage of their future patients, and therefore greatly to their own. Many of these specimens have been engraved, and the cases published in the work of John Hunter on the venereal disease, and in Sir Everard Home's Treatise on the Diseases of the Prostate Gland; and, to be viewed with full advantage, these two most useful books should at the same time be consulted. I have already shown a most instructive specimen of the altered state of the urethra, and the valvular projection formed by the third lobe of the gland, which I received, with the history of the case, from Dr. Osborne, and which I have used in my lectures on surgery since the year 1793.

This lobe is rarely found in an enlarged state in persons under fifty years of age. Swell-

ings of the lateral lobes will frequently take place before this period; they are often brought on in consequence of strictures of the urethra, and have disappeared when the strictures were cured. Such swellings may be considered, Sir Everard Home observes, as the consequences of accidental inflammation in the neighbouring membranes extending to this gland, the effects of which subside as readily as in the membranes in which they originated; it becomes necessary, therefore, to distinguish them from the permanent disease now under our consideration.

As it is evident that the enlargement of the prostate gland must occasion a greater force to be used to expel the urine from the bladder, the muscular coat of that organ may be expected to increase in the number and size of the fasciculi of contractile fibres; and we always do find that coat increased very much in thickness from the additional exertion it is obliged to use; the thickness of course depending on the time the disease has lasted, its extent, and the degree of force which has been exerted. I have never met with one instance where the prostate gland had been long, or to any considerable degree enlarged, without this change in the muscular coat having been produced.

The symptoms which generally attend an enlarged prostate gland are similar to those of an irritable bladder. There is a constant heavy dull

pain in the gland, and sometimes sharp lancinating pains darting from it to the urethra, and occasionally to the bladder and ureters. There are frequent calls to void the urine; which is passed with difficulty, only a small quantity being discharged at a time, some always, and often a large quantity, remaining in the bladder. A complete retention of urine may be produced, so that not one drop of urine will pass, although much straining is used. There is sometimes great difficulty in expelling the fæces; and when the stool is sufficiently hard to keep its form, it is always flattened by the projection which the gland makes towards the rectum; even when expelled, there is a feeling of something left in the gut which wants still to come away. In straining to expel the urine and fæces, a quantity of the mucous secretion of the prostate gland is not unfrequently forced out. Most of these symptoms are similar to those produced by stone; when they occur, the gland therefore should be examined by the rectum; and if it is not found to be diseased, a sound should then be introduced and the bladder searched.

The symptoms will of course vary according to the form and place of the projections in regard to the bladder and urethra, and the quantity of inflammation that is produced.

When the middle lobe begins to project towards the cavity of the bladder, it presses on

the internal membrane of that viscus, and sometimes throws it into a fold; and partly from this pressure, and partly from communicating by immediate contact the inflammation which occasioned its own enlargement, the symptoms of an irritable bladder arise; such as the pain in passing the urine, felt more particularly when the last drops are voided, with a desire to void more, although at this early period the bladder may have been completely emptied. Some symptomatic fever also usually attends this state.

As the increase of the third lobe goes on, the projection and inner membrane together, form a most complete and perfect valve, which being open when the bladder first begins to contract, allows a certain quantity of urine to pass; but as the bladder contracts, the valve is gradually pressed downwards and forwards, so as to prevent any more urine from entering the urethra, the rest being left in the bladder behind the projection. The patient feeling relief from some urine having passed, the straining subsides, and more urine entering gradually into the bladder from the kidneys, as it becomes distended the tumour is drawn back, and the orifice into the urethra left open, which thus affords entrance to a certain quantity of urine on the next attempt to evacuate that fluid; but as the tumour in the gland enlarges, the quantity of urine voided at each attempt becomes

smaller, and that which is retained is increased. Some urine is thus always left in the bladder, although the patient may daily continue to pass as much as he usually did before any disease had affected this part. From this circumstance the patient will not believe that his symptoms are kept up by distention of the bladder, conceiving that he has, perhaps immediately before, completely emptied it; and from the same circumstances the medical attendant has very often been deceived, nor has either he or the patient been undeceived until a perfect retention has taken place. This complete retention will occur sooner in some cases than in others, as it does not depend so much on the extent of the enlargement, as on the particular shape and position of the middle lobe in regard to the meatus urinarius internus.

When the gland enlarges, the secretion of its mucus is much increased, some of which is pressed out in straining to pass the urine, and, occasionally, almost in equal quantity with the urine passed: the mucus forms a ropy viscid substance subsiding to the bottom of the chamber-pot. Sir Everard Home has mentioned a decisive proof of this ropy mucus coming from the prostate gland when in an inflamed state, a quantity of it having, in a case related by him, been found, with one extremity floating in the bladder in the dead body, while the other

extremity was discovered to be divided into small filaments, terminating in the orifices of the excretory ducts of the prostate gland at the sides of the caput gallinaginis. This secretion is always the most abundant when the gland is irritated and inflamed. The degree of its tenacity varies; it is most commonly in proportion to the quantity secreted, but not always so. It sometimes is so irritating to the membrane of the urethra, over which it passes, that the membrane appears to be excoriated by it. The urine, when this secretion is abundant, is very offensive to the smell, and readily goes into putrefaction.

As the swelling in the gland increases, the internal membrane of the bladder covering it inflames, and this inflammation soon extends over the whole of its surface: in consequence of this the bladder becomes very irritable, and occasions straining to void the urine as soon as a very small quantity is collected. The inflammation extending to the muscular fibres prevents them from relaxing as they do in health; so that before the bladder contains half of the quantity it commonly did in health, efforts are made to discharge the urine. This also sometimes misleads both the patient and the surgeon, from inducing the belief that the bladder is over-distended when very little urine is contained in its cavity. Small filaments of a

shreddy nature are, in the inflamed state, thrown off from the internal membrane of the bladder, and are seen floating in the urine.

A scirrhous prostate gland is often attended with a stone or stones in the bladder, the composition of which is generally, for the reason already given in a former Lecture, the ammoniaco-magnesian phosphate. The enlarged lobes of the prostate gland will, when accompanied by stone, produce two effects: one will be, to render it impossible for a calculus of any moderate size, which enters the bladder from the ureters, to escape by the urethra; and the other will be, that when the stone is the first disease, the enlargement of the middle lobe of the prostate will lessen the violence of the symptoms, keeping the stone in the back part, and preventing it from coming in contact with the most irritable surface of the bladder, viz. that of its neck. But in some instances the enlargement of the prostate becomes the cause of stone, from the dregs of urine always being detained in the bladder, and allowing the phosphates and mucus to concrete.

When the gland is much enlarged, and the patient is advanced in life, our views will be directed to the only thing we are likely to succeed in effecting, which is, the palliation of the symptoms; and in doing this we certainly have it in our power to render a life, that otherwise would be passed in

misery, comparatively comfortable, by the simple means of using the elastic gum catheter. But early in this affection of the gland, and in younger patients, active means should be adopted to cure the disease if possible, and if not, to suspend or retard its effects. In no case should the gland be irritated, when irritation can be avoided; but that produced from a careful introduction of the catheter cannot be helped. The immediate means must be adapted, of course, to the symptoms present, and which are the most urgent, and to the age and constitution of the patient. In the commencement of the disease, and in the progress of it, when inflammation occurs, blood taken by cupping from the loins will often immediately mitigate the distressing symptoms, so will leeches applied about the perinæum and the verge of the anus. In the beginning also, when inflammation is present, unless there is an absolute retention of urine, no bougies or catheter, either of elastic gum or silver, should be used, until the first irritation has abated. The tepid hip-bath, or occasionally the warm bath, may be employed. Costiveness should be prevented by mild aperient medicines or glysters; but no materials of a drastic nature, likely to irritate the rectum, should be exhibited. At bed-time, some narcotic medicine, such as we find likely to agree best with the patient's particular constitution, may be given, to allay that irritation which almost

constantly is increased at night; the extr. conii, papaveris albi, hyosciami, humuli, or opii, separately, or some of them combined, if it is found that the patient cannot rest without them; but many cases will occur where the patient will pass a better night when they are not used. Dover's powder often gives ease and sleep when other medicines have failed. Injections of the above materials may be thrown into the rectum at bed-time, and be succeeded by a glyster of warm water in the morning, or a bolus made of the proper quantities and proportions of sedative materials may be inserted and left in the rectum.

I have known blisters applied to the perinæum, and removed before the cantharides were absorbed, useful in allaying internal irritation. Setons in the perinæum have been inserted and kept in for weeks, but without any permanent good effect. When the bladder can bear the introduction of the catheter, that instrument should be regularly used.

LECTURE XIII.

CONTINUATION OF THE DISEASES OF THE PROSTATE GLAND, AND ON STRICTURES OF THE URETHRA.

From what has been formerly stated of the structure of the prostate gland, and the alterations produced in the urinary canal by a scirrhous enlargement of its substance, the propriety, indeed I may say the necessity of using the catheter in such disease, must be very apparent, as, by this instrument occasionally emptying the bladder, a constant accumulation of water in its cavity, containing the dregs of the urine, will be prevented. So far as thirty years' experience in the treatment of this complaint allows me to form an opinion, I have no hesitation in saying, that it is only by the catheter any permanent relief will be procured.

It is impossible to settle, by general rules, the number of times the catheter must be introduced in twenty-four hours; that must depend on the quantity of urine secreted, how much of that fluid can without irritation be contained at one time in the bladder, and how far the urethra and

bladder will bear the pressure of the instrument. Were I inclined to relate cases, and were this theatre the proper place for such relation, I could give very many instances, where, from the patient having been taught to introduce the catheter himself, and having persevered in regularly using it, a life of misery has been changed to that of comfortable enjoyment.

I need not tell this audience of the advantage of the elastic gum catheter, in cases of enlarged prostate gland, over the silver. To those who have compared the altered state of the passage with the natural curve, it will be obvious, that in most of these cases, only the elastic catheter can enter the bladder. Those who viewed the preparations which were on the table during our last meeting, with the eyes of anatomists and surgeons, will see the absolute necessity of using no force when the catheter reaches the base of the projecting lobe; they will perceive how much judgment and nicety is required to guide the point of the instrument, so that it may pass gently before, and press back the swelling. They will also see the necessity, when any difficulty occurs previous to the catheter reaching the basis of the third lobe, of occasionally giving its point a direction a little to one side, and if it does not enter in that direction, to try the other. I could detail several cases, and show many instances, where, these circum-

stances not having been attended to, the surgeon has procured an entrance into the bladder by forcing the catheter through part of the substance of the swelling. I have opened two cases where death arose from this injury in a few hours; and, in one of these, the surgeon (who was determined to do that which John Hunter had failed in this case to do, viz. introducing the catheter to the bladder) had, in the course of forty-eight hours, passed the instrument three times through the prostate gland, and each time at a different part.

I have examined other bodies where the catheter has made a false passage through the gland, and been for months and years repeatedly inserted through the artificial channel. We have an instance among the preparations in our Museum in which the catheter had been introduced through a false channel for the long period of five years. It is certain, therefore, that the perforation of the diseased gland does not in every case destroy life; but the chance of its producing very dangerous consequences is such, that we should most carefully, on all occasions, endeavour to prevent its occurrence.

It is obvious, that the length of the catheter, and that its curve, must, in a case of enlarged prostate gland, be greater than the natural state of the urinary passage requires; and also that a full-sized catheter should be preferred to a smaller one. In

cases where the proper curve can be exactly ascertained, and when the passage does not bend to one side, I have occasionally found that a large silver catheter could be inserted more easily into the bladder than one formed of elastic gum; and, in some instances, I have used the silver in preference, under such circumstances.

In many cases it will be necessary to leave a catheter for whole nights, for several days, and even for weeks, in the bladder, removing the instrument only for a short period, that concretions of a calculous nature should not take place on its surface. On some of these occasions, when no difficulty attends the introduction, it may be right, when the catheter is withdrawn, to wait a few hours before it is again inserted, during which time an opportunity may be afforded of observing whether any favourable change as to the natural passing of the urine, has taken place. The catheter can be retained in the bladder by a proper bandage, and having a cork fitted to it, the patient may even attend his common pursuits while wearing it.

A person whose life, from his particular avocations, was one of great anxiety of mind, and also of bodily exertion, had, for many years, suffered most excruciating torments from a diseased prostate gland and irritable bladder. Most of the surgeons of eminence in this country had been consulted on his case, which he considered himself

as hopeless; I saw him a few times, and with great difficulty persuaded him to learn to introduce the elastic gum catheter, and to wear it. I had not heard of him for months, indeed years, when last summer, having met him accidentally at Paris, he appeared in good health, and I found, on my return to London, a letter from him, stating that he now suffered no inconvenience from his bladder, and that he attributed his cure to the catheter, which he still wore without experiencing from it any material inconvenience.

The necessity of using longer catheters than those of the common size will appear from the following instance:—A nobleman, who was a general officer, when attending the late King on some official duty, was obliged to remain several hours on horseback. He had for many years been troubled with an irritable bladder, of which stricture was suspected to be the cause; bougies had frequently been introduced, but never so far as the bladder. A complete retention of urine came on. In the presence of his family physician two bougies of the common size were passed their whole extent, but no urine followed: the case was therefore suspected to be one where no urine was collected in the bladder; but the symptoms continuing, and becoming more urgent, I was requested to see him. The patient was very corpulent, so that no tumour formed by the bladder could be distinctly felt above the pubes on account of the fat

collected there; but, from the pain which pressure produced, I felt convinced that urine was contained in the organ, and on seeing the bougies which had been inserted, and having examined the bladder by the rectum and found it distended, and also the prostate gland enlarged, I was sure, from their length, that they never could have reached the cavity of the bladder. I sent home for an elastic gum catheter, at least three inches longer than the bougies; I inserted it, and immediately drew off more than three pints of water. After this, for many months, until his death, which arose from scirrhus of the rectum as well as of the prostate gland, relief was always afforded him by the use of the elastic gum catheter, and the most distressing symptoms of an incurable complaint were rendered more bearable. This patient afterwards expressed himself convinced that his bladder had not been completely emptied for two or three years previous to this complete retention.

It sometimes happens that one of the lateral lobes of the prostate gland projects backwards towards the rectum, without either of the other lobes having become much enlarged: this will often produce a very painful sensation in the gut, particularly in the act of passing the fæces, which act is often followed by a very distressing and violent tenesmus, and, after the straining has ceased, a painful sensation will continue in the parts for some hours. On introducing the finger

into the rectum, this lateral swelling may be felt, and the part will, in general, have an aching pain produced in it when pressed on. Here all irritation to the gut should be avoided. Glysters of warm water should be thrown into the rectum, so as to clear the gut of fæces; and either glysters, in which some narcotic medicine has been dissolved, or extr. conii, hyosciami, or opii, thrown up at bed-time, or suppositories of the same ingredients, may be inserted, if glysters cannot be retained. The hip-bath may here be used with advantage.

CALCULI OF THE PROSTATE GLAND.

Two different species of concretions have been met with in the prostate gland; one kind having been originally formed elsewhere, but afterwards deposited in the cavities in the gland; and the other formed in some part of its own substance, and peculiar to itself.

The first kind consists of the materials of urinary calculi, and is either of renal or vesical origin. This calculus passes from the bladder, and is detained at first in the part of the urethra which is surrounded by the gland; it there excites inflammation, suppuration, and ulceration; and the last process forms a cavity which receives it nearly in the same manner that a pea is received in the formation of an issue. The cavity enlarges, and

the calculus at last passes from the urethra into a bag, by which it is nearly surrounded; and the urine also entering, from pressure the bag is enlarged, and by a deposition of concreting materials from the urine on the surface of the calculus, the size of that substance is increased. I have met with a urinary calculus, larger than a common-sized olive, in a cavity in the prostate gland, where, from the orifice which first admitted it having contracted, or the size of the calculus having enlarged, the stone could not be pressed back into the urethra, and the whole of the prostate gland had been changed into a capsule surrounding it.

The other species of concretions is peculiar to the prostate gland. These calculi are usually of a size varying from that of a small pin's head to a common-sized garden-pea: they commonly are found either in the enlarged cells, or in the ducts of the gland, and generally are so imbedded by the surrounding substance, as not to be in contact with each other; this is almost always the case when they are small. Their form approaches a little to round, but is very irregular. A considerable number of the larger concretions are sometimes found in one cavity; their shape is then more angular, from their friction against each other. Their colour is sometimes of a yellowish, sometimes of a reddish brown, varying in the degree of tint.

In their chemical composition they differ materially from urinary calculi; but they are occasionally met with, where such calculi exist in the same patient; and, as the symptoms which they produce have often been mistaken for those of stone in the bladder, it is proper that the difference in their composition should be known. To Dr. Wollaston we are indebted for the distinction between them. The calculi of the prostate gland consist of the neutral phosphate of lime not distinctly stratified, but tinged by the secretion of the gland.

Dr. Marcet mentions a case, where the knowledge of the difference in composition between lithic and prostatic calculi, proved of the greatest benefit to the patient; in fact, producing a cure of his disease. A gentleman had passed a number of small brownish concretions, which had been mistaken for calculi of the prostate, and the treatment was for some time conducted upon that supposition; they were found, however, upon being analyzed, to consist of pure lithic acid; and upon an appropriate treatment being adopted, the complaint soon entirely ceased. I have met with fifty or sixty of these concretions of different sizes in one gland, and I occasionally see a patient who has preserved a small box full of those which he has passed at various times for these fifteen years; more than would form four times the size of the gland, are

contained in this box. His kidneys and bladder seem free from lithic concretions. Prostatic calculi are not unfrequently found in cases where the urethra has been long diseased.

The symptoms produced by calculi in the prostate gland, will depend on their size, number, and situation. When small and not projecting, they sometimes have produced so little uneasiness, as not to have been suspected during life: they are generally, however, attended with some difficulty in voiding the urine, and a sensation of uneasiness about the neck of the bladder. This uneasiness is occasionally increased by violent exercise; but so it would be, did it proceed from stone in the bladder. When they project towards the urethra, and produce a difficulty of passing the water, and an instrument is introduced either to search the passages, or the bladder of urine, they will in some instances be found to grate against it, giving that peculiar feel to the surgeon which cannot be mistaken; but they may be pushed back by the instrument into the cavity of the prostate, so as not to be discoverable in several subsequent examinations. They have sometimes accumulated in such numbers, as to have been felt in a cyst through the rectum, and they have even ulcerated their way through the perinæum. A preparation has been added to the collection in Windmill Street, where a large abscess had formed in the

perinæum, and which, when it burst, allowed some prostatic calculi to escape: the substance of the prostate gland is nearly destroyed. Besides the calculi which escaped, many were found in the cavity of the abscess, and are now lying at the bottom of the bottle.

If these calculi are not very troublesome, our best plan will be to leave them alone, and not to irritate the gland by the introduction of the catheter, more frequently than may be necessary to prevent retention of the urine. When very troublesome, and when they can be felt through the rectum, they may be cut out by an incision, as in the old method of cutting for the stone, or the gripe, as it was called; but, what I should conceive to be a safer practice, they may be extracted by an incision made into the gland, from the perinæum.

INFLAMMATION OF THE CAPUT GALLINAGINIS.

A very peculiar and distressing kind of irritation sometimes takes place in the urethra, in the immediate vicinity of the caput gallinaginis; attended with a sensation sometimes of the most tormenting itching, and sometimes with the most wearying pain. Sir Everard Home has given an account of this disease, under the head of inflammation of the verumontanum, in which he has fully

detailed the symptoms, and the practice which has been tried for their removal; and, although it is unfortunate that we at present possess no positive means of effecting an immediate cure, yet much is gained by distinguishing the disease from others for which it has been mistaken, as it has often been rendered worse from the treatment used in consequence of such mistake. From the irritation producing a temporary contraction of the canal between the caput gallinaginis and the orifice of the urethra, the disease has been confounded with stricture; and by the introduction of bougies, the symptoms have always been rendered more violent than before. The symptoms vary according to the peculiarity of the constitution; but they are always increased by sitting or standing, and relieved by lying in a horizontal posture, though they are not removed. It is a disease, in general, of very long duration, but one that seldom or never of itself proves fatal.

It is attended with violent straining after the urine has passed, as if attempting to expel a drop or two more. This brings on an almost insupportable hot, uneasy sensation, about the neck of the bladder; and often occasions the voiding of much glairy mucus, but which is seldom tinged with blood, unless after a bougie has been used.

In this disease, a bougie will sometimes pass into the bladder without difficulty; but the in-

sertion of it is always attended with great pain, when it reaches the caput gallinaginis; and, if the prostate gland is examined by the anus, it does not feel as if it were enlarged.

Many causes have been assigned for the production of this affection. Sir Everard Home says, the most frequent cause from which he has seen it arise, is the use of injections for the cure of gonorrhœa in men advanced in life. I have known it to arise from this cause, in a young person, in whom it lasted several years; and who dying from pulmonary consumption, I had an opportunity of inspecting the appearances of the parts; so that another case of dissection may be added, to that related by Sir Everard Home.

The person I allude to had contracted a gonorrhœa in Newcastle, at the age of eighteen, and wishing to be cured before he came to London, he had applied to a druggist, who gave him a very strong injection of the oxymuriate of mercury. Much inflammation arose in consequence; and on its abatement, the purulent discharge stopped; but the distressing symptoms of this disease immediately came on, and continued with but little variation until his death, which happened about six years afterwards. Every time he passed his urine the pain was considerable; but when the semen was ejected it was excessive, and lasted for many hours. On the urethra and blad-

der being slit open, the caput gallinaginis, and the urethra for some extent on each side, also above and below it, seemed to be a little thickened and highly vascular; the vessels were distinct, filled with blood, and assumed a varicose appearance: this only extended to the sides of the urethra; for the part next the pubes was in a natural state, the unnatural vascular portion terminating by an almost straight line. A small spot or two of abrasion appeared on the caput gallinaginis. The rest of the urethra was perfectly free from disease. The prostate gland was rather larger than usual in so young a person, but not so that its increased size would have been remarked, had not this disease been known to have so long existed. The muscular coat of the bladder was thicker than usual; but otherwise the bladder was free from disease, as were both of the kidneys and their ureters.

I have been consulted in some instances, where a vascular structure, very similar to that which I have now described, has taken place round the external meatus urinarius in females, and which has been attended with the most exquisite sensibility, so that the passage of the urine was always productive of very great pain, and any external pressure could hardly be borne. In two instances the vascular surface was destroyed by the repeated application of lunar caustic, and which procured

much relief; and I believe in both cases the disease is now removed. In a third case, where I was desired by Mr. Clarke to meet him in consultation, he removed the whole of the vascular surface surrounding the meatus urinarius with the knife; and the patient, who was a lady of about twenty years of age, perfectly recovered. The sensibility of the nerves seems in these cases to be augmented in a greater proportion than the vascularity of the part is increased.

In the complaint, as affecting the caput gallinaginis, blisters to the perinæum have been tried; and although they seldom give permanent relief, they sometimes procure a temporary mitigation of the symptoms; but so also do cold applications to the perinæum, and iced water thrown into the rectum. Opiate glysters, and opiate suppositories, will be found useful in temporarily relieving the pain. Sir Everard Home having made repeated trials with various means to remove the symptoms, observes, that he is led to believe no very active treatment should be adopted. He says, "the slighter cases, in young people, by moderation, and avoiding every thing that produced uneasiness, have got well; but in general the parts do not recover themselves." I have known more immediate and permanent relief obtained by the application of the mild mercurial ointment, to an ounce of which a drachm or two of camphor, and the

same quantity of powdered opium, have been added, than by any other means which I have seen tried. A portion of this should be rubbed on the perinæum, and lint, on which some has been spread, left all night on the surface of that part. In two instances I have inserted setons in the perinæum; but in both, the patients suffered so much from the local irritation produced by them, that they would not continue their use. In one of these instances the symptoms were very much abated by the seton, nor have they returned with any thing like their former violence, although the seton has been withdrawn more than a year.

ON STRICTURE OF THE URETHRA.

A stricture of the urethra consists of some morbid alteration of action or of structure, by which a part of the canal of the urethra is rendered narrower than the rest. A stricture may thus form a very simple, or a very complicated disease.

The opinions which have been expressed in various publications on the nature of strictures, and on the treatment best adapted for their removal, have, in many circumstances, been so widely different, that I should have felt reluctant to bring this subject before my present audience, had I not considered that the Professor of Anatomy and

Surgery to this College, cannot be expected to discuss the theoretical opinions of any individual, however ingenious those opinions may be; nor should he enter as a party into any controversy which may have arisen between particular surgeons, who have differed on practical points. The members who compose this audience may, when their time or inclination allows, enter into an investigation of every difference in theory or practice between men eminent in their profession, and carefully weigh their merits and demerits; but in this theatre our opinion must be formed on established facts, and no opinion should be received but as conjectural, unless borne out by a sufficient number of facts which are both pertinent and well authenticated.

Should the Professor of this College indulge in unqualified speculative discussion, the intention of these Lectures might be completely frustrated, and the errors of his judgment might go abroad, not merely as his own, but as sanctioned by the College; by whom, however, he was deputed to explain the nature of the morbid alterations of parts and their treatment, not from fanciful though ingenious conjecture, but from proofs drawn from anatomical investigation, and confirmed by the practical experience of himself and others. On the subject of stricture I shall, therefore, endeavour to avoid controversy, and shall confine myself as much as

possible to what our numerous preparations will, I think, clearly establish.

In the sixth anatomical and physiological Lecture of this season, I gave those proofs which I thought sufficiently demonstrated in what manner the internal membrance of the urethra could be generally or partially contracted in length or in diameter by muscular action. I produced a preparation of the human urethra, in which the packets of fibres running irregularly longitudinally, and connected laterally to each other, were apparent to the naked eye, and were adhering to the outside of the inner secreting membrane of the urethra, and stated, that their appearance and course exactly corresponded to what Mr. Bauer had discovered by the microscope, and of which engravings were published in the last work of Sir Everard Home*. I then gave what to me appeared sufficiently strong proofs of the contractile force of these packets of fibres. When spasmodic strictures are talked of, they therefore mean those produced by a contraction of some of these fibres, remaining in one part, the fibres not relaxing with those of the other parts of the urethra so as to let the urine pass in a full stream. Strictures of this kind depend, therefore, on an alteration of action, not of structure. The muscles

* Vide Plate III. Fig. 1.

which surround the membranous part of the urethra may often produce such strictures; but when they take place anterior to or below the membranous part, they are then dependent on those fibres which adhere to the outer circumference of the internal membrane. The extent of such contractions may vary from the whole of the urethra anterior to the membranous part, to a space less than the tenth of an inch. Muscular contraction ceasing with life, we seldom in the dead body can have an opportunity of seeing the urethra in this state of partial contraction; for, if such did exist at the time of death, stretching the part by the introduction of a bougie, or any other instrument, would dilate the passage, and the contraction of course would not return. In a preparation which I had in my private collection, previous to Dr. Hunter's museum going to Scotland, I however had a specimen of this state of contraction: it was procured by slitting up the urethra carefully without distending the passage. I have hardened it in spirits, and it still shows more than half an inch of the urethra, without any diseased structure in this contracted state. Dr. Baillie has engraved the appearance of it in his valuable work of Morbid Anatomy, and described it as belonging to Dr. Hunter's museum*. Strictures of this kind arise

* Vide Plate III. Fig. 2.

sometimes in irritable habits; they diminish the stream, or may entirely for the time stop the flow of urine; but when once they are overcome by the entrance of a bougie, or surmounted by constitutional means, the urine flows as freely as ever, until the next spasmodic attack. They lay, however, the foundation for the permanent stricture, and often, by producing a muscular contraction round the part affected by it, increase the difficulty of passing the bougie, or of allowing the urine an exit from the bladder. When a spasmodic stricture is once disposed to form, any irritation applied, or any inflammation happening in the urethra, will tend to increase it, and to change it eventually to a more permanent disease.

It is well known that strictures very frequently take place in the urethræ of persons who have resided long in warm countries, and they very possibly may be brought on, from the urethræ of such persons being more constantly stimulated to a strong contraction by the salts of the urine, that fluid not containing enough of the watery part to dilute these salts sufficiently to prevent their too great stimulating power. Some part of the urethra may be more irritable than the rest, or more exposed to the exciting cause; this part may, therefore, be induced to contract more strongly than the rest, and to remain more constantly contracted, relaxing with great difficulty.

This may go on for some time; inflammation may take place in the cellular membrane, the coagulable lymph of the blood may be thrown out, the parts may thicken, the projection towards the centre of the cavity of the urethra may take place, and the spasmodic stricture become a permanent one. For a long time after this period, the contractile power of the fibres not being lost, the spasmodic contraction still continues, and renders the permanent stricture at times more violent; but when the stricture has been of very long duration, it remains more constantly in the same equal state; that is, the flow of urine through it always meets with the same, if not an increased difficulty; as, from the thickening of the parts and the extension of inflammation, perhaps, to the contractile fibres, they may lose that property.

The different degrees of the permanent strictures, and the appearances they assume, will be much better understood by an examination of the specimens before us, than by the most lengthened and accurate description; indeed, the extent and other appearances vary so much, that it rarely happens that two cases exactly alike in every particular are met with by the same surgeon.

Some strictures occupy a very small part of the inner circumference of the urethra; a stricture of this kind appearing like a thin but firm projecting membrane, perforated by a hole of

greater or less capacity, sometimes hardly large enough to admit a bristle, through which the urine passes. The larger circumference of the stricture is generally thicker than the circumference of the part nearest the perforation, but the whole sometimes may be included in the breadth of a middling size thread. Sometimes a thickening of the passage takes place equally all round, and for an uncertain extent, from one fourth of an inch to an inch or more, the canal passing through it in a straight direction. In other instances, the thickening may be irregular, the canal through it may be more contracted in some places than others, and may take a winding or tortuous direction. It occasionally happens, that the whole of the thickened projecting surface is on one side. The thickening is not confined to the part of the surface of the membrane, which forms the inner circumference of the urethra; it also extends, outwards, towards the vascular structure of the corpus spongiosum, by which it is surrounded. The thickened part is always harder and firmer in its consistence than any other part of the urethra. I am now speaking of the strictures themselves, and not of the effect they produce on the parts situated behind them.

The part where strictures most usually begin is where the bulb unites with the membranous part of the urethra; but they may take place in any part

of the canal anterior to the prostate gland; and in some instances, five or six have been found in the same urethra. The bulb is the part the most exposed to irritation; where the membranous part joins the bulb, the canal of the urethra is naturally narrower than elsewhere, and the junction is surrounded by strongly marked muscular fibres; an angle is formed at that part, and the last drops of urine are allowed to accumulate in the sinus of the bulb until they are expelled by the acceleratores urinæ muscles, which nearly cover it: thus the part is exposed longer to the presence of urine, and therefore is more likely to be excited to contraction and occasional inflammation, by any additional acrimony that fluid may happen to possess. But although the bulb is the usual place where strictures first arise, they may originate in any other part of the canal, which, from accidental circumstances, may be more exposed to irritation. It generally happens, when a stricture has taken place at the bulb, and has been of long continuance, that others will be found between such stricture and the orifice of the urethra. This, in all probability, arises from the first stricture producing a greater degree of irritability in the urethra, and also depriving the inner membrane of its natural healthy action; for, by diminishing the size of the stream at the bulb, the remaining part of the urethra cannot be di-

lated by the flow of the urine to its full extent, but must always be in a certain state of contraction; some parts become more so than the rest, and thus three or four additional strictures may be the effect of the one which was first formed. When a stricture has taken place at the bulb, another in time generally forms about two inches more forwards, and often one or two others between this last and the orifice of the urethra. Some of our preparations afford well-marked specimens of these different strictures in the same urethra.

It is impossible in every instance to account for the formation of strictures, although they often may be traced to a distinct cause. They have been very generally supposed to arise, in the greater number of instances, from the effect of venereal gonorrhœa, especially when the inflammation which attends that affection has been suddenly stopped by injections of an astringent quality. The patients themselves, to whom gonorrhœa has occurred, are very apt to believe this; but strictures take place in people who never have had any venereal inflammation, and who never in their lives have used any irritating or astringent injections. Strictures have been met with in children under six years of age; and also in people who have had no sexual connexion. Inflammation in the urethra happening more frequently from gonorrhœa than from any other irritation, so far

only such inflammation may more frequently occasion strictures; but strictures will arise equally from any other irritation, should it be applied, and certainly in themselves are not venereal symptoms.

That irritating injections do often produce stricture, I cannot doubt; although such injections when used, in by far the greater number of cases, would be expelled by the contraction of the urethra, before they could reach the part where the membranous portion joins the bulb, and which is the usual place where strictures first happen. But if produced always by irritating injections, strictures should generally take place within two inches of the glans penis, which is far from being the usual situation of the stricture when one only has formed in the urethra. But strictures do take place, although not so frequently, after claps that have been cured without injections. When a stricture is disposed to form, any inflammation, happening in the urethra, generally tends to increase the disposition. In cases where irritating injections have brought on stricture, the effect usually has been immediate, and the stricture has been situated less than half way between the orifice of the urethra and the bulb, and has usually formed a swelling, attended with inflammation, which could be felt externally through the common integuments; and this happens so frequently in irritable habits, that

it becomes a very important consideration, in what cases injections should be used to cure gonorrhœa, or whether they should be employed at all. Inflammation produced by external violence has also occasioned strictures to form in the urethra.

Any disease beyond the membranous part of the urethra, which, by its effects on the stream of urine, produces a difficulty or irregular action of the parts employed to expel that fluid, may be a cause of stricture: thus stone has sometimes produced stricture in the urethræ of very young persons; so have diseases of the prostate gland in those more advanced in life. Sir Everard Home has, in his last publication, mentioned a case of stricture of three years' duration in a person of twenty years of age, which was brought on by the irritation of passing sand from the kidneys.

One of the most obstinate strictures which I ever attended, was in a person who, when young, had been much addicted to that pernicious practice which procures a frequent erection of the penis and emission of the semen without sexual intercourse, and who had never placed himself in a situation to be infected with gonorrhœa. The penis being long kept in a state of erection and irritation, and the frequent repetition of the action of the ejaculatory muscles being produced, must dispose the parts for those spasmodic contractions which are the harbingers of stricture.

LECTURE XIV.

CONTINUATION OF STRICTURES IN THE URETHRA. ON FISTULÆ IN PERINÆO, AND ON PUNCTURING THE BLADDER.

As the symptoms which denote stricture depend not only on the immediate mechanical obstruction, but also on the effects produced on the parts beyond it, and on the constitution generally, they will in some things vary, both from the extent of the disease, and the peculiar habit of the patient.

Strictures, unless when produced by some active local irritation, are in general slow in forming, and usually have made some considerable progress before the patient attends to his case. In constitutions which are not very irritable, the first effect of stricture is merely a diminution of the stream of urine, which gradually continues to lessen, and, particularly towards the end, becomes more scattered. Sometimes two small streams appear, which cross each other; at other times, the stream is twisted, so as to assume a corkscrew appearance; but as the disease proceeds, the urine is voided with great effort, drop by drop, and every

effort is often attended with much pain. A desire comes on to evacuate the urine frequently, which continuing after the last drops of urine have left the bladder, much straining is produced. As part of the difficulty, at the beginning of the disease, may arise from the action of muscular fibres, when these are not particularly stimulated to contract, the urine will be evacuated with more ease. In summer, it generally happens, that the disease is not so violent as it is in winter; but this is not without exceptions; I have known it the reverse. Sudden changes from hot to cold will produce an increase of the symptoms of stricture; cold often so constringes the part, that a patient, who in a warm room had voided his water with little difficulty, on being suddenly exposed to a cold atmosphere finds that he cannot pass one drop. The stricture will be increased by any excess in eating or drinking, particularly by taking much spirits, wine, or acids, into the stomach.

In the coitus, the stricture will sometimes prevent the semen from passing; the attempt will be attended with sudden and great pain, and when the spasm has gone off, the semen, which had been felt to strike against the stricture, will ooze out. This is more frequently the case when the worst stricture is between the bulb and the orifice of the urethra: it is a painful, and always a most distressing occurrence, and very frequently is suc-

ceeded by a copious discharge of purulent matter, which the patient often mistakes for venereal gonorrhœa, particularly if he had been connected with a suspicious woman. It is, however, easily discriminated from gonorrhœa, by the discharge usually coming on at once, a few hours after the coitus, and being at its first occurrence nearly as great as at any succeeding period, and often subsiding in four or five days, whether any means have been used to remove it, or not. Credit has too often been given for the speedy cure of gonorrhœæ to surgeons, who, by mistaking the case, have used astringent injections: these have stopped the discharge for a time, but eventually have forwarded the progress of the stricture by which the discharge was caused. Patients have frequently, in incipient cases of stricture, been treated for several venereal claps occurring in quick succession; when, had the disease been properly investigated, one only would have been found to have taken place; and, perhaps, not even one.

It often happens, that when purulent matter is discharged from the urethra, the symptoms of stricture are less violent than when no pus is formed; this is not, however, always so. Strictures, when of long continuance, are almost always attended with a gleety discharge, which is increased on violent exercise, or any other excess.

The constitutional effects of stricture are so

numerous, and vary so much, that I shall not attempt to enumerate or describe them; nor is it necessary, as few, if any, are discriminative of stricture, most of them being present in other diseases of the urinary organs. One symptom, however, which occasionally occurs, requires to be noticed. The patient may be attacked with a violent rigor and severe cold fit, attended generally with sickness of the stomach, as if seized with an ague: this shall be succeeded by a hot fit, followed by a very profuse perspiration, which will continue some hours. If the perspiration is copious, there is seldom more than one attack; but when not so, the first fit is usually succeeded by another. These fits do not return, however, at any regular period; and they appear to be brought on, in irritable constitutions, by exposure to cold, by violent exercise, by any excess in food, and sometimes by the first introduction of a bougie.

Other diseases may produce symptoms which resemble those of stricture, as an irritable state of the urethra and bladder, a disease of the prostate gland, ulcers in the urethra and bladder, and also stone. When there is uncertainty respecting the real disease, the point will be ascertained best, by a careful introduction of a moderate-sized bougie.

I have seen but one well-marked instance of caruncles in the urethra, although many of the older surgeons talk of their occurrence as not un-

common; they were described as fleshy excrescences, something like warts, arising from the inner membrane of the urethra, particularly after an ulcer had been supposed to form. John Hunter observes, that in all his examinations of dead bodies he had seen but two, and these were in very old strictures where the urethra had suffered considerably. One of these was preserved in the collection of Dr. William Hunter, and is now at Glasgow; it occurred in a serjeant of Burgoyne's light horse.

The dreadful consequences which have so frequently attended strictures when neglected or improperly treated, have been so amply detailed by Sir Everard Home and others, that I shall refer those of my audience who may require more particular information on these subjects, to those works in which the history of cases is given. In this theatre the allotted time and the nature of the Lectures do not permit of such detail. It is sufficient for me here to observe, that fistula in perinæo is not an uncommon consequence of stricture; that, on some occasions, the bladder has given way from distention; but that, more generally, on distention, the urethra beyond the stricture has burst, and allowed the urine to escape into the surrounding cellular membrane; that communications have sometimes been formed between the bladder and various parts of the intestinal canal; that the

kidney has been affected from their occurrence; that erysipelas, sciatica, and diseases of the testicle have arisen from them; in short, that they have been the foundation of many incurable diseases, as well as of consequences which have immediately destroyed life.

Such consequences of stricture being known, and the means recommended for the treatment of the disease by different authors varying in some essential circumstances, must prove weighty inducements for every student in surgery carefully to investigate the nature, and to inquire upon what principles the different modes of treating strictures have been recommended. These will induce him to be very cautious in the choice and use of those means which he adopts for the cure; and, instead of blindly following one particular mode, will lead him to suit the means to the circumstances of the case and the constitution of the patient.

In the treatment of stricture we may proceed in three ways. 1st, We may, in a gradual manner, dilate the part, and overcome the disposition to contraction; 2dly, we may produce ulceration of the stricture by pressure; 3dly, we may immediately take off the contraction by destroying the part. Stricture being a local disease, our application must be made to the part itself, internal medicines being incapable of affecting it, although

they may be useful in lessening the violence of some symptoms that arise from it. It is not my intention to tire this audience by stating how the different applications for the removal of stricture are to be used; I have here only to bring forward the principles on which they are supposed to act.

The only mode on which we can have any dependence to overcome the contraction gradually and safely, is the use of bougies. Bougies act in two ways; viz. either on the mechanical principle of a wedge, by dilating the parts gradually to their old position; or by their pressure to excite an action in the stricture by which the arteries and absorbent vessels may, by deposition and removal of materials, restore the canal to its healthy and natural size.

Three essential properties are required in the formation and composition of bougies: strength, joined with flexibility, to prevent them from being broken, and to allow them to take the natural direction of the passage; smoothness, to allow of their insertion with the least irritation to the urethra or stricture; and softness, that an impression may be made on them when they have reached, or entered the stricture, so as to convey some information of its extent that may regulate the future practice in the cure. Metallic bougies sometimes irritate, and from their hardness they cannot receive any impression of the extent of the stricture,

nor the form of its surface; but notwithstanding this, they will prove very useful in many cases, where the above information has been obtained by the insertion of the soft bougie.

Bougies should be of all sizes, from the smallest that can pass, to the largest which the urethra will bear. They should be nearly cylindrical in shape, excepting very near the extremity to be inserted, which may taper a very little to a rounded cone; this extremity, however small the bougie may be, should always be round. Whenever a stricture is suspected, a tolerably full-sized bougie should be introduced first; if that does not, after the proper attempt being made, pass the stricture, a smaller should be used, and so on until we find one that will pass to the bladder. When the bougie is withdrawn, the point, and the part of it pressed on by the stricture, should be carefully examined: much information of the nature of the stricture is sometimes acquired by the observation of its impression on the bougie.

It is well known to this audience, that in examining the urethra, a full-sized bougie should be used in preference to a small one: the first will generally pass with more ease than the last if there is no stricture; as a small one, if not introduced by a careful operator, will often have its point entangled in some of the lacunæ of the urethra.

I need not inform this audience that the first

introduction of a bougie will be borne by some patients without much pain or inconvenience; in many it will be attended with severe pain; and in others, though without pain, with much faintness and sometimes sickness: so that it is necessary to guard against these occurrences. When faintness occurs, the bougie should be immediately withdrawn; for, it is apt, if, under such circumstances, it remains inserted, to produce an irritable bladder. The first introduction of a bougie is not unfrequently succeeded by ardor urinæ, but this presently subsides. A discharge of matter is occasionally produced by it, or, if any discharge was present, it may be increased, but is soon discontinued. The glands in the groin will sometimes from a similar cause enlarge, but they will not suppurate. The testicles will also occasionally enlarge; but these swellings, as well as those of the absorbent glands, usually subside in a short period.

After we have passed the first bougie, and informed ourselves of the number, the situation, and extent of the strictures, we may proceed gradually to introduce larger and larger bougies, until one of the full size passes without resistance. The size should be increased according to the ease of passing, and the irritability of the parts: if the parts resist much, and are very irritable, our increase should be by very slow degrees; but where the resistance and irritability are less, we may proceed

faster. Some urethræ will bear four or five bougies of progressively larger sizes, to be introduced in succession in the course of a quarter of an hour. I speak from practical experience, in saying that I have seen this mode of treatment when the urethra would bear it, which, with care in the introduction, it will often safely do, effect a cure in a much shorter time than could have happened by any other method excepting by using the caustic. We should, however, feel our way when we mean to try this mode, and desist immediately if any symptoms of faintness, sickness, or pain in the loins or testicles come on.

Surgeons differ in opinion as to the time bougies should remain inserted in the stricture: speaking from what I have seen, I may venture to assert, that I have, on the whole, known more real good done when they were not permitted to stay in the urethra for more than three or four minutes, at any one time, than I ever have seen effected by their being allowed to remain for hours. The repetition of the introduction must depend on the nature of particular cases; and no rules can be given that would be proper in all. It is better to insert bougies when some urine is contained in the bladder; as the inner membrane of the urethra having not been recently stimulated by the urine passing over it, affords then, in general, less resistance.

The use of bougies should be gradually diminished as to the number and times of introduction,

after a fair-sized bougie has been found to pass without resistance. In introducing small bougies, the lacunæ of the urethra must be remembered, and care should be taken that they are not torn by the points entering them. Bougies, in the hands of surgeons who know the structure of the parts, may be used safely and effectually for the cure of most strictures; and, I think, in common cases of stricture, are to be preferred to every other mode. In using them, it will, indeed, sometimes happen, that after one of a moderate size has passed easily, on the next attempt it shall pass with difficulty, or, perhaps, not at all: in this case we should try a smaller, but not until the irritation produced by the unsuccessful attempt has subsided. It often happens, after waiting a day or two, that one of the largest size will again readily pass on to the bladder.

The contraction in stricture is sometimes so great as to shut up the passage, so that no urine will pass, or will follow even a bougie which has been introduced and withdrawn. Here we should have recourse to the means known to lessen irritation and spasm. Sitting over the steam of warm water, or in the hip-bath, may prove useful. Bleeding from the arm, or extracting blood by cupping from the loins, or by leeches from the perinæum, may be tried. Glysters with opium will often have a good effect. So will blisters applied to

the perinæum, in cases where we can wait for their operation, always taking care, when they are used, not to allow the cantharides to remain too long, so as to be absorbed.

In using bougies, when the stricture cannot be passed, the surgeon must pay great attention to their progress after they have been supposed to enter it; for, if it is found that a bougie has advanced much, and that the patient still can pass no water, it is probable that it is making a false passage, and more particularly so if any force has been used. When a false passage is formed, which adds to the original disease and prevents its cure, such passage should be opened by an incision externally, and means taken at the same time to introduce a canula on by the old passage to the bladder, and to retain it there until the false passage heals. To procure the healing, it may be necessary to lay the false passage open its whole extent. The mode of performing this operation must depend on the circumstances of each case.

The practice of pressing firm bougies or metallic instruments so as to force the stricture, or to produce an ulceration of it, so frequently has been found to form false passages, fistulæ, and gangrene, that I need here make no farther observation on the practice or its consequences. All the advantages that can be gained by pressure, tearing through the stricture, or producing ulceration of it, may be

obtained by a careful and judicious use of the caustic; which will be found, on the whole, a safer application, and will be attended with less inflammation and pain. This may be readily explained, from the effect of caustic being to destroy the life of the part to which it is applied; the inflammation which arises in the neighbouring living part is therefore of a healthy kind; it merely takes place to separate the slough; (we see that even in the tunica conjunctiva of the eye, caustic may be applied without exciting violent inflammation;) whereas the pressure by hard bougies, or metallic sounds, excites inflammation and ulceration in a diseased part.

The cure of strictures by caustic was first proposed by Wiseman; it was improved and revived by John Hunter, and brought into more general use by Sir Everard Home, who, in three volumes, published at different times, in the period of twenty-three years, has fully laid before the public his experience of its use. In his last volume, he states that he continues to prefer the argentum nitratum to any other caustic; he asserts that it has a power of removing spasm, which none of the other caustics are found to possess. In some comparative experiments made by him with the argentum nitratum, and kali purum, on the same patient, he found the use of the kali purum brought on spasm immediately after its application; and from diffusing itself, by going into solution, it produced

inflammation to some extent along the inner membrane of the urethra. From what experience I have had of the kali purum, I conceive it to be inferior to the argentum nitratum, particularly so, as it excites inflammation over a surface of the urethra extending much beyond the stricture.

I may be permitted to add, that having had much experience in the use of caustic for the removal of strictures, I consider it as the safest practice in those cases which will not yield to the introduction of bougies, and which require a portion of the stricture to be destroyed; but the symptoms which sometimes attend its use, and the injury which may be done by its improper application, should confine it to *those* cases; and it should be employed only by those surgeons, whose experience and knowledge would suggest to them the immediate course which ought to be pursued, if any untoward symptom should attend its application. The use of it should never be adopted on slight grounds, even in cases which do not at first yield to bougies. Having stated this, I think it right to add, that some of the dangerous consequences which have been asserted very constantly to attend the use of caustic, have been greatly over-rated. The following cases are illustrations of this.

I applied the argentum nitratum to a stricture which had been of long standing in the urethra of

a physician, who afterwards was jolted all day over the rough pavement in his carriage, and went four miles into the country to sleep: in the evening a hæmorrhage took place, when I was sent for, with the usual entreaty to come immediately, as he was bleeding to death. I found the family in great alarm, for every drop of the blood had been received on linen; and the patient, from various means that had been tried to stop the bleeding, had not been allowed a minute's rest. By keeping him still for ten minutes in a horizontal position, the hæmorrhage stopped, and two days afterwards, the largest-sized bougie passed with ease; and until his death, which happened in Russia, several years afterwards, he had no return of the stricture. If the stricture is as high as the bulb, and hæmorrhage takes place after the use of the caustic, or after the introduction of a bougie, it should be recollected that any pressure made on the perinæum with a view to stop the hæmorrhage, if it cannot be applied to the part, and behind it or nearer to the bladder, will only prevent the blood from escaping by the urethra, and will therefore add to the mischief by forcing the blood back to the cavity of the bladder. Pressure, therefore, should only be used where it can be applied to and beyond the bleeding part.

In the following case, the application of caustic had nearly proved fatal; but in the end, it became

the means of procuring the patient not only relief, but health.

A gentleman, about seventy years of age, whose life had been for many years rendered miserable by a stricture, and whose prostate gland was beginning to enlarge, had the lunar caustic applied to the stricture, by a naval medical officer of the highest rank. Soon afterwards, a complete retention of urine took place; the catheter refused to pass the stricture: the patient became completely insensible, his pulse was failing, and he appeared to be sinking most rapidly to death. I was, at this period, desired to see him, and urged by his nearest relatives to attempt the introduction of the catheter. I fortunately succeeded, and drew off more than a quart of urine; but from the patient's state, little or no hopes of his recovery were entertained. On seeing him in the evening, his senses were restored, and he was in every respect better; but had passed no urine. The urine was again drawn off, and amounted to a quart; he was still better next morning, but it was necessary that the catheter should be again used, and also in the evening of that day. On the morning after this, on withdrawing the catheter, a large slough adhered to it. From this time, he began to pass the urine naturally, but the catheter was introduced every night, until the bladder recovered its tone. It is now four years since the catheter

has been used; during which period, considering his age, he has enjoyed good health. In this case, although the application of the caustic had occasioned the most alarming symptoms, in the result it has been the means of giving the patient a life of ease and comfort.

Before I leave this subject, I shall mention another case, which will show that caustic even being left in the urethra will not always produce alarming symptoms, by destroying too much of the internal membrane.

A gentleman, who resided in Barbadoes, of which island he was a native, suffered so much from a stricture in the urethra, that during the whole period of his passage to England, he had not quitted a chair, that was pierced and prepared to receive his urine, which came drop by drop from the urethra, and with great pain, for more than one hour out of twenty-four; he was in fact obliged to sleep while sitting in this chair. On his arrival in London, the caustic was twice introduced by a surgeon of great eminence; but on the second introduction, it was squeezed from the bougie, and left in the urethra; a fistula in perinæo was the consequence, and the stricture still remained. He quarrelled with the surgeon who first attended him, and placed himself under my care, without telling me what had produced the fistula; but he strongly urged that the caustic should be again

tried. I observed, that he always narrowly watched the caustic bougie, when withdrawn, to examine whether any of the caustic remained in it. I was then in the habit of arming the bougies myself with a small portion of the argentum nitratum. On the seventeenth application, he found the bougie came out without the caustic; he then informed me of what formerly had happened, and gave himself up as lost. Knowing that a very small portion of caustic had been introduced, although not comfortable about the probable event, I did not feel so much alarm. No inconvenience whatever followed the accident: next morning, his water flowed freely; and, four days afterwards, a full-sized bougie went on to the bladder without impediment; the fistula in perinæo soon healed; and, six weeks afterwards, he returned to Barbadoes, where he married, and became the father of four children. He has since called upon me, having made a second voyage to England, and was then perfectly free from his former most distressing complaint.

Several preparations are on the table, showing the state of the urethræ after strictures have been destroyed by caustic; these have been presented to the Museum by Sir Everard Home.

In some very obstinate and complicated cases, where the success of the caustic would be uncertain, and where it would be imprudent and unsafe

to apply it, the stricture may be cut down on; and if the old passage does not admit of being opened, a new one may be formed, and a catheter or canula kept in it, until the external wound has healed. This operation must vary in some particulars in every case; and, to perform it safely and successfully, the operator should be well grounded in anatomical knowledge.

It sometimes has happened, that ulceration has taken place from the pressure of the urine on the side of the stricture next to the bladder: this ulceration has included the stricture; so that it has produced an opening through it, by which the urine has reached the open extremity of the urethra. But more generally, when ulceration takes place, it goes through the coats of the urethra; on some occasions, when attended with the adhesive inflammation, forming an abscess which bursts externally in the perinæum, allowing the matter and urine to escape; or, when not attended with the adhesive inflammation, allowing it to escape into the loose cellular membrane surrounding the penis, often forming a large swelling by distending the skin of that organ, and of the scrotum; and if not immediately evacuated by a free and depending opening, inducing a mortification and sloughing of the skin and cellular membrane belonging to these parts, and then sometimes destroying life.

When the stricture is removed, the opening through which the urine has been discharged will in many instances heal, the constitution having been supported, and proper local applications, such as by moderate pressure would keep the surface of the opening and passage in contact, and prevent the urine constantly flowing through it, having been used. But it often happens, even when the stricture has been removed, that the new passages for the urine do not heal, but become fistulous, and produce fresh inflammations, terminating in abscesses, which sometimes discharge their matter into the old fistulous passage; but which frequently also burst externally, and communicating with the former fistulæ, increase the number of openings through which the urine is discharged. When such abscesses appear, it is right to open them freely as soon as it is ascertained they contain fluid; for, by so doing, we may often prevent a dangerous extension of the disease. Being unsound at the bottom, they do not, however, heal; or should the orifice in the skin heal, it is soon burst open by a fresh accumulation of matter, and becomes truly fistulous. Fistulæ in perinæo may thus vary from a single passage of communication between the bladder or urethra and the skin, having one orifice externally, or may consist of a number of sinuses, communicating with one another, and having one external opening, or per-

haps several, in different parts of the perinæum, scrotum, and penis. Fistulous sinuses in the perinæum may, however, proceed from other causes than stricture, and may communicate with the bladder itself, as well as with the urethra. They have sometimes been produced by calculi ulcerating their way from the bladder, the prostate gland, or urethra. Abscesses forming in the prostate gland, in Cowper's glands, or in the lacunæ of the urethra, will occasionally terminate in fistulæ, through which the urine will pass.

These fistulous openings more rarely take place from a wound merely, than from any of the other causes which have been now named. Thus we find, that when the operation of lithotomy has been performed, although the parts have been considerably bruised by the extraction of the stone, the urine and pus are discharged for a few days through the wound, and then the parts heal without showing any disposition to become fistulous; but if the prostate gland is much diseased, the wound is less inclined to heal: there is here, as in other parts, a backwardness in the constitution to heal over any disease.

It is not unusual for patients who have fistulous orifices in the perinæum, which occasionally heal and break open, to be affected with symptoms similar to those which take place in ague, with this difference, however, that they do not yield to bark

or arsenic; but as soon as the obstruction to the passage of urine has been removed, and the fistulous sores begin to heal, the cold and hot fits cease to take place.

The treatment of fistula in perinæo must depend much on the cause which first produced the disease: this, whatever it is, should, if possible, be removed. When this is done, and there is no stoppage in the urethra between the internal opening of the fistula and the glans penis, the sinus or sinuses should be laid open throughout their whole extent from the surface of the body to the bladder or urethra. No more of the sound part of the urethra should be opened than is absolutely necessary; but, at the same time, the whole of the diseased part should be fully exposed. The operation, of course, must vary in its performance, according to the state of the parts. If we can introduce a staff into the bladder, and a probe through the sinus to the staff, the operation will be easy; but if we cannot make these instruments meet, we must bring them as near each other as possible, and make out the rest with the knife. Unless there is a stricture still remaining, or one which threatens a return after having been once removed, it will seldom be found necessary to keep either a solid or hollow bougie in the urethra until the wound heals. In lithotomy, they are not employed; and when there is no obstruction, they are not wanted

after this operation; on the contrary, by the irritation they produce, they have often been found to retard the cure. Should the urine, however, continue to irritate the wound, the use of the catheter, either occasionally or permanently, according to the nature of the case, should be had recourse to.

When the fistulous passages have been of long continuance, and their inner surfaces and orifices have become callous, they have sometimes been touched with lunar caustic at the time of the operation, with the intention that a sound surface should be produced when the eschars came off; occasionally the callous parts have been removed with the knife. Should either of these modes be thought expedient, while we have the knife in our hands, the last, I think, should be preferred; but in most instances, neither will be necessary, for the callosity generally softens down as healthy suppuration comes on. After the sinuses are laid open, they should be prevented from being partially united, until the surfaces begin to granulate; the union of the granulations should then be hastened from the bottom of the wound by every means in our power.

When fistulæ have proceeded from a stricture, or any other stoppage in the urethra, it is clear that laying open the fistulous sinuses can be of no use, until the obstacle to the free passing of

the urine along the urethra is removed. When that has been accomplished, the operation for the cure is similar to that for other fistulæ, only that the catheter, or hollow bougie, should be used until the parts are healed; otherwise the disposition in the urethra to close the passage may return. Costiveness during the cure should be prevented, and the constitutional treatment adopted which the state of the patient's health seems most to require.

Sir Everard Home, in his last volume, has related two cases, in which he has used the actual cautery for the cure of fistulæ of the urethra, by searing the edge of the fistula. He states, that the actual cautery is safer and more manageable than most others; that the application of it is by no means so painful as that of any of the caustics, and has the advantage of being instantaneous; but for a particular account of the cases, I must refer to his work. My own experience affords no information on this practice.

Some extraordinary cases, however, have occurred, where so much of the urethra has been lost, or the soft parts removed, as to preclude the possibility of healing the fistula by the usual mode of treatment; and sometimes a considerable length, and a large proportion of the circumference of the urethra have been included in the inner aperture of the fistula. In some cases of this kind it is

nearly impossible, even by pins and sutures, to bring the edges of the wound together so that they should unite, the motion of the body drawing the lips of the wound asunder. Mr. Astley Cooper, in a case of this nature, has adopted the plan that in India and in this country has proved successful in the restoration of noses and lips. After paring off the lips of the fistulous sore, he dissected a piece of the loose skin of the scrotum of a sufficient size to fit the wound, leaving it attached only by a narrow slip; he then twisted it so that the raw surface was applied inwardly to the surface of the fistula; and by the use of sutures and bandages these surfaces united and adhered. Granulations arose from the cut surface of the scrotum, which united with each other; and from the great contractility of the skin of that part, the cicatrix has been of a very small size.

CALCULI IN THE URETHRA.

After small renal calculi have passed from the kidneys to the bladder, and from the bladder have entered the urethra, it sometimes has happened that, from the irritation produced, they have been strongly grasped by the muscles of the urethra, and retained in the passage, where they have become imbedded so as not to be capable of being

expelled by the urine. When we have reason to suppose that a stone is retained in the urethra, if it is without the membranous part, it may be sometimes felt through the rectum, and directed outwards by gentle pressure from the fingers; or the forceps invented by John Hunter, contained in a canula, may be introduced, so that it may be taken hold of by the blades; in this case, however, pressure should always be made behind the calculus, so as to prevent it being by the instrument pressed back to the bladder. Sometimes compressing the penis near the orifice of the urethra, and fully distending the canal, by forcing the urine into it from the bladder, has produced room for the calculus to pass. Should this not succeed, it may be cut down on and removed. But in cases where a stricture has taken place in the urethra, and a small calculus is driven against it, it forms a perfect valve, preventing the escape of a drop of urine. In such occurrence, if the retention is complete, the stone must be immediately cut down on and extracted; attention should afterwards be paid to the removal of the stricture, and to the prevention of fistula in perinæo. In cases where the urine passes, and there is no immediate danger from retention, destroying the stricture by caustic has sometimes succeeded in procuring sufficient room for the passage of the stone. In slighter cases, when bougies will pass, the stricture may be

sufficiently dilated by their introduction, to let the calculus pass through; but care should be taken, by making pressure behind the calculus, when bougies are used, to prevent it from being returned to the bladder.

That the urethra will admit of considerable dilatation there can be no doubt; but the length and situation of its course in men preclude the use of those means which can be adapted to dilate the urethra of females, viz. by the introduction of sponge tents. Some excellent cases of substances extracted from the female bladder by such gradual dilatation of the urethra, have been published by my friend and former colleague, Mr. Thomas, in the first volume of the Medico-chirurgical Transactions, and by Mr. Astley Cooper in the eighth volume of the same work.

Calculi retained in the urethra, behind strictures, have sometimes been the cause of the urethra bursting, which has speedily terminated in the patient's death. The following case is an instance of this, and the facts are still seen in the preparation I now exhibit, where the bladder, prostate gland, and penis, have been preserved.

The person to whom these parts belonged had been troubled with a stricture for forty years. In 1792, two years before his death, I was desired to see him for the first time as a patient, in consequence of his having allowed a catgut bougie,

which he had been in the habit of using, to slip into the urethra beyond his reach. I extracted it with the forceps I have lately mentioned, and attended him a few days for his stricture; but as soon as middle-sized bougies would pass, as he could introduce them himself, I discontinued my visits. A day or two before his death I was desired to see him; I found him with a considerable swelling in his scrotum, with a very frequent, small, fluttering pulse, and remarkably furred tongue. He told me that he had not been able to pass the smallest bougie for some days, and that for the three last days he had not evacuated a single drop of urine. I could not introduce any instrument into the bladder, nor could Mr. Cline, whom I immediately requested to meet me in consultation. No tumour could be distinguished above the pubes, nor did the bladder appear distended when felt from the rectum. The urethra had given way. The tumour in the scrotum arose from the extravasated urine. Gangrene having come on, it was too late to save him by the tumour being opened, and in a few hours he was dead. The body was inspected on the ensuing day. The bladder was found to be contracted, and apparently incapable of being dilated so as to contain more than three or four ounces of fluid; its coats were much thickened.

A most extensive ulceration had taken place in the urethra from the caput gallinaginis along the whole of the membranous part; an opening here communicated between the urethra and the prostate gland, which last, instead of being solid, was changed into an extensive cavity, bounded by a firm but thin substance, and in which a small calculus was lodged. Another opening passed from the membranous part of the urethra into the cellular membrane of the penis and scrotum: through this the urine had escaped. Beyond this was a stricture, completely lined for the extent of three quarters of an inch with a solid coating of hard calculous matter, forming a cylindrical tube with a narrow cavity; this coating was cut through with difficulty in slitting open the urethra; another calculus of the shape and size of a small garden-pea had been forced down from the bladder to the upper extremity of this calcareous tube, and had formed a globular valve with it, so as to prevent any pressure from within forcing a drop of urine beyond it. I met with no other preparation showing such morbid appearances.

When no instrument can be passed into the bladder, and the retention of urine is complete, to save life, we are then authorized to puncture that viscus. This may be done above the pubes, from the perinæum, and through the rectum. Each of these operations has had its advocates; but par-

ticular cases may occur where each might have its superior advantages. I do not, however, mean in this place to enter into the comparative advantages or disadvantages of either. I shall, therefore, only add, before any of these operations is done, that the surgeon should seriously weigh within his own mind which is best adapted to the peculiar circumstances of his patient's case.

Some very useful observations on the puncturing of the bladder will be found in John Hunter's work on the venereal disease; and also in Sir Everard Home's various publications, illustrated by cases in which the operation was performed above the pubes and through the rectum.

In a case which came under my own observation, where a complete retention had taken place from an enlarged prostate gland, and which admitted a catheter to be passed as far as that body, it was thought right to puncture the bladder from the perinæum; the patient was placed in the attitude in which the lateral operation of lithotomy is performed, but complained much of the position and restraint. A catheter was passed to the beginning of the prostate gland, and an incision made on the left side of the raphe of the perinæum of about an inch and a half in length, and sufficiently deep to allow the enlarged prostate to be felt. The finger of the operator was then introduced into the rectum, and the situation of the gland and bladder

towards the gut ascertained. Poteau's curved trochar was then introduced into the wound, and conveyed on the left side, but towards the fore part of the enlarged prostate, as near as possible to the bladder; it was then pushed on, and the stilette withdrawn: about a pint and a half of urine followed, and the patient almost immediately fell asleep. The canula was left in the wound for four days, when, from the irritation it produced, it was withdrawn. Some urine having passed by the penis, a flexible gum catheter was introduced into the urethra, and with a little difficulty passed on to the bladder; it was allowed to remain there so long as the patient lived, which was above five days after its introduction, and nine from the first operation. The wound in the perinæum showed no disposition to heal, but otherwise the operation at first promised a favourable result: the patient was, however, too debilitated for any permanent good to be derived from it. On dissection, it was found that the trochar had entered the cavity of the bladder, a little to the fore part and left side of the meatus urinarius; it had passed through a small lateral projection of the left lobe of the gland, but that circumstance did not seem to have had any share in the person's death, as no mark of increased inflammation had taken place round the opening. The great corpulence of the patient, and the pro-

jection of the gland backwards towards the gut, were what determined the place of the puncture, added to the greater safety that it was supposed the patient would derive from the urine passing by the perinæum, should the wound not heal, or should it have been necessary to keep it open.

LECTURE XV.

ON THE DISEASES OF THE TESTICLE. ON IMPOTENCE FROM BODILY DEFECT, AND ALSO FROM IDEAS OF THE MIND. CONCLUSION OF THE THIRD ANNUAL SERIES OF LECTURES.

I HAVE, in a former Lecture, submitted to the consideration of this audience, the most remarkable circumstances which attend the descent of the testicles from the loins to the scrotum. This descent, however, sometimes will not take place, in regard to one or both testicles, until much later than the usual period; in some instances, these important organs do not pass through the external ring, and, in others, they remain within the cavity of the abdomen during life.

Some inconvenience and considerable disadvantage attend those cases where the testicles do not pass the external ring before birth; for, when their descent does take place, after such delay, a portion of intestine or omentum generally descends with them and forms a hernia, to which,

when returned, the usual means of preventing a second protrusion cannot at first be applied.

When the descent has been delayed, or interrupted in its natural progress, it becomes also very uncertain when it will be completed. I have known it take place at different intervals, from a few weeks after birth to the period of puberty. On this subject John Hunter has observed, that it is not easy to ascertain the cause of this failure in the descent of the testicle; but he is inclined to suspect that the fault originates in the testicles themselves; for it is certain, that in cases where one has remained within the abdomen, and the other has descended as usual, the one which descended has been always the largest, and apparently the most perfect. That one which descends afterwards, never reaches so low in the scrotum as the other, and often remains for years immediately on the outside of the ring. What prevents the beginning of the descent of the testicle before birth cannot, however, be positively known; but at the period of birth the testicle has sometimes been found to have been detained within the ring, from the smallness of the opening in the tendon of the external oblique muscle refusing to let it pass through. After birth, the erect position of the body, and the action of the muscles of respiration, may afford mechanical assistance to its descent, when the natural operations of the animal economy

have failed; but from the operation of these causes hernia is as likely to take place, or more so, than the testicle to descend.

It is not improbable, that when the descent has been delayed, the disposition in the peritonæum to unite and close up the passage from the abdomen to the tunica vaginalis is lost; or the union may be prevented from taking place by a portion of intestine or omentum insinuating itself within the passage. It becomes necessary, therefore, in such cases to watch the descent, to endeavour by art to procure that union which the natural powers are either not disposed to accomplish, or are prevented from completing by the protrusion of other parts; but this art should not be employed until the testicle has descended some way below the ring; otherwise, by the means used for the prevention or cure of hernia, we might greatly injure the structure and actions of the testicle.

The testicle often remains for months, indeed I have known it to remain for years, playing about the ring; sometimes appearing as if it would soon come through, and then receding completely within the ring; and when it passes through, it does not descend to the scrotum, but is easily pushed back again, so that there is no space or opportunity for the application of the pad of a truss; a hernia, therefore, cannot be prevented. Some surgeons have advised, under such circumstances, that the

testicle should be pushed as far towards the abdomen as the passage will permit, and that a truss should be applied to prevent either the testicle or the intestine from again descending; but this answers no good purpose, for the testicle is continually getting below the pad, and thus, from the pressure, is constantly exposed to inflammation. I have met with one instance where the testicle, when lodged in the passage between the two rings, suppurated from pressure, in a young man of fifteen years of age, and many shreds of the tubuli testis were discharged with the pus. It is, upon the whole, much better to wait for the gradual descent of the testicle, and not to proceed, as some other surgeons have advised, immediately to the opposite extreme, viz. endeavouring to force it through by jumping or other violent bodily exercise; for then a hernia, and, perhaps, a dangerous one, may take place with or before the descent.

The patient, if his years allow him to understand the danger which is to be avoided, should be cautioned against violent, but should be permitted to use moderate exercise. So soon as the testicle has descended sufficiently far below the ring to admit of the application of the pad of a truss to the passage, that application should be made; but particular attention should be used to prevent the testicle being injured by its pressure. I occasionally see a young person, now under twelve years of

age, in whom one testicle descended about two years ago, and is at present in that state that a truss can be applied to the inguinal passage so as to prevent the intestine from protruding: the intestine, at first, did accompany the testicle. On the other side the testicle has never passed completely through, although it has for the last five years been felt immediately within the ring, and sometimes more than half through that opening.

John Hunter says, that when both testicles remain through life in the belly, he believes they are exceedingly imperfect, and incapable of performing the natural functions of these organs; and this imperfection prevents the disposition for their descent taking place. I know of one case that seems to confirm this remark; but I also am acquainted with another which makes, to a certain degree, against it, although it does not altogether refute it. The first is in a young man of very large fortune, now twenty-five years of age, whose testicles have never descended; he has some beard, and not an unmanly appearance; but although an imprudent, and in some things a dissipated person, he has never shown the least desire for women, or disposition for sexual intercourse. The second is in a person between thirty and forty years of age, who has one testicle forming a tumour within the ring, and the other which descended at puberty lying immediately on the outside of it. He is a married man,

and has children. Before his marriage, he describes himself as having great desire, and not being deficient in the power of performance. He formerly had a venereal gonorrhœa, which was treated by astringent injections; both testicles swelled, and were exceedingly painful; they were mistaken by his medical attendant for buboes, and I was consulted respecting the propriety of opening them as such. When the parts were shown to me, and the nature of the pain or pressure mentioned, I examined the scrotum, and then discovered in what glands the swellings had taken place. In this person one testicle is of the full natural size, and the other also appears to be so, as far as can be judged of by feeling it through the tendon of the external oblique muscle.

ON HYDROCELE.

Hydrocele, or a collection of watery fluid in the cavity of the tunica vaginalis testis, is rather a common disease, and the discrimination and treatment of it is now well understood. Some valuable preparations are preserved in our collection, which show, not only the seat of the disease, but the changes the parts undergo from enlargement and thickening, and also the occasional existence of this with other diseases. Hydrocele is confined to no particular period of life. It often takes place in

young children, and in them most commonly disappears without any operation being necessary for its cure, and, indeed, without any surgical treatment being required, or, at most, merely some lotion that would excite a little the increased action of the absorbents.

Hydrocele may proceed from any cause that would produce dropsy of other circumscribed cavities, but most commonly it follows inflammation. Whatever excites the arteries to throw out more than usual of the lubricating fluid belonging to the surfaces of the cavities, or which prevents the absorbents from removing the proper quantity in the tunica vaginalis testis, may produce this disease. The swelling begins at the lower part of the cavity, and extends towards the ring; it is at first of a pyramidal shape; and it will sometimes so increase in size as to enter the ring; but attention to the feel of the swelling, as well as to the part where it originated, will always readily distinguish it from hernia. I have often found it, however, complicated with hernia, and not only with hernia, but with very numerous and large varicose veins of the chord.

The tumour formed in hydrocele is smooth and equal; and when the tunica vaginalis is not much thickened, the fluctuation of the fluid within it is readily perceptible. The tumour of course does not diminish by compression; and at first, and in

children, upon being properly placed as to the light, it shows a certain degree of transparency. It often increases so as to drag in the skin of the penis. It is, occasionally, blended with a diseased state of the testicle, and particularly in persons advanced in life with a scirrhous state of that organ. The fluid varies in colour, but resembles generally in its properties the serum of the blood. It is usually contained in one cyst; but in cases where repeated partial inflammations have taken place, adhesions have formed in parts, and divided the cavity containing it, into two, three, or more cells. From a partial obliteration of the peritonæum descending from the ring, adhesion of its inner surface having taken place near the ring, and then again near the testicle, leaving the middle space not united, I have known water thrown out in that space, which, from not communicating with the cavity of the tunica vaginalis, has formed a true hydrocele of the chord. The operations for the treatment of this disease are well known.

When it is found that stimulant applications to the scrotum will not excite the absorbents to the removal of the water, a trochar may be employed to let the fluid out, and the cavity may be obliterated by injections thrown in, so as to excite inflammation and union of its surfaces; or it may be laid open by the knife, and obliterated by the

union of the granulations which will arise from its exposed surface. The cavity has sometimes been opened with caustic, and in other instances a seton has been drawn through it.

The surgeon will of course adapt the operation he determines on for the removal of the hydrocele to the age of the patient, and comparative risk and advantages between a palliative and radical cure. In old age, as the secretion of the testicle is not of that importance that it is in youth or in the middle periods of life, the palliative operation, if any operation should be judged necessary, would be that which he should recommend.

INFLAMMATION OF THE TESTICLES.

The testicles, from their external situation, are very likely to be acted on by causes which produce inflammation of their substance, as exposure to violence, &c.; they are also disposed to inflame from irritations applied to other parts, particularly those which affect the urethra, such as astringent injections, bougies, inflammation of the inner membrane of the urethra, or strictures taking place in some part of that canal. The inflammation, however, is generally removed by art before it proceeds to suppuration, and the changes produced by it hardly ever become objects of examination after death.

In cases of venereal gonorrhœa the testicles sometimes inflame, and (although it very rarely indeed happens) they may suppurate; but the matter which is formed in such suppuration has no venereal taint. The swelling does not arise from absorption of matter, for no matter can be conveyed, but through the general circulation, from the urethra to the testicle; but it is a sympathetic action, and may arise from any common irritation of the urethra as well as from a specific one. The testicle, when beginning to swell, becomes tender to the touch; at first it is of a soft pulpy consistence, which soon increases to a hard and painful tumour. The lower part of the epididymis, in general, forms the hardest part of the swelling, and is the longest in subsiding. The vas deferens often partakes of the inflammation, its coats become considerably thickened, and the rest of the spermatic chord is also frequently affected. In these swellings the veins of the spermatic chord have, on some occasions, become varicose, but this is rather unusual.

The testicle is well supplied with nerves from the same plexuses which send branches to the vital viscera. It seems by nature to be considered one of the most important organs of an animal body, and actually is so, as the continuation of our species depends on its healthy action: we therefore cannot be surprised to find, that any derange-

ment of it produces many sympathetic effects on parts which are not in its immediate vicinity. Thus, a pain in the small of the back generally attends all inflammations of the testicle, with a sense of weakness in the loins and pelvis: the course of its nerves from the inferior mesenteric plexus will account for this. Sickness almost constantly attends it, which frequently proceeds to vomiting; the powers of digestion are weakened, which often produces a troublesome flatulence; colicky pains are often felt in the bowels, and the whole of the primæ viæ is often in some degree deranged.

In inflammations of the testicle, which take place in cases where there has been irritation in the urethra, there seems to be, what has been called, a translation of the irritation from the urethra to the testicle; for, when it swells, the pain in voiding the urine has ceased, and the discharge from the urethra has been suspended, and has not returned until the swelling of the testicle began to subside. But sometimes both the pain in voiding urine, and the discharge from the urethra, not only continue, but increase when the testicle swells. The swelling of the testicles has been accounted for by irritation of the mouths of the vasa deferentia, communicated to them from the internal membrane of the urethra, and continued along the coats of these vessels; but this swelling

often takes place when the inflammation and irritation do not pass more than an inch and a half inwards from the orifice of the urethra, and, almost always, only one testicle swells at the same time.

The stoppage of the discharge from the urethra is frequently followed by a strangury; but strangury often will take place, whether the testicle swells or not, when there is inflammation in the urethra.

The swelling of the testicle does not always come on when the inflammation in the urethra is at the height, but more generally when it has begun to abate, and sometimes after it has entirely ceased.

When swelled testicle takes place in gonorrhœa, many have supposed that the swelling is of a specific venereal nature; it does not, however, appear to be so, but to be exactly of the same nature that any other local irritation in the urethra would produce. It usually takes place quickly, and is violent, but hardly ever suppurates. When the testicles swell from injuries inflicted on their own substance, the swellings are more permanent and more inclined to suppurate, as the real disease exists in the part itself.

When the testicle swells, the part should be immediately suspended, but not pressed on; and the patient should be as much as is possible confined to the horizontal position. The means of lessen-

ing inflammatory action should be quickly and actively used, such as local and general bleeding, purging and fomentation: the last will always answer better than cold applications, where there is much tension. Cupping from the loins is particularly useful. When the inflammation is very violent, the pulse is often small before bleeding, but will rise and become full after some blood has been removed; this also takes place in the inflammation of the vital viscera; and, when it does happen, we are encouraged to go on with the evacuation. All irritation to the urethra should, as far as is possible, be prevented; and should the discharge again appear, it should rather be encouraged, by fomentations to the penis, than repelled by cold applications or restringent injections. When the inflammatory symptoms have been removed, should the swelling (which is sometimes the case) appear likely to become indolent, bleeding should on no account be used, as it will tend, by further weakening the parts, to increase the indolence.

As a great sympathy is always found to exist between the testicle and the stomach, emetics have been by some practitioners recommended, and certainly will often be found useful in hastening the removal of the swelling if given at the time when the inflammatory symptoms have begun to abate; they will then sometimes produce the

almost immediate disappearance of the tumour, probably by exciting increased action in the absorbents; but if given in the height of the inflammatory action, they will often so much add to it as to procure its termination in suppuration. In the inflammatory stage much good will, however, generally arise from medicines which produce nausea without vomiting. Costiveness should of course be prevented. Opium is very useful in lessening irritation of these parts, and may be given in rather full doses both by the mouth and in the form of glysters.

Surgeons have been divided in opinion as to the propriety of employing cold applications or warm fomentations to the scrotum. If the tension is not great, the tumour not indolent, and the irritation in the urethra (if the swelling of the testicle arose from that cause) having lessened, cold sedative applications to the scrotum may be proper and useful; but if there is much pain with tension in the part, the warm emollient applications answer best in the removal of such symptoms, and consequently in the cure of the inflammatory action. Mercury is not necessary in the treatment of those swellings of the testicle which take place in gonorrhœa, at least so far as regards the testicle itself. By the above-named plan being pursued, such swellings will very rarely suppurate;

but, should they do so, they must be treated like other abscesses.

When the swelling begins to abate, the tumour in the body of the testicle becomes soft first, and then gradually lessens. The epididymis subsides the last: that part will often remain hard for months; and not unfrequently years will elapse before it returns to its natural size and softness; indeed it sometimes remains hard through life. This, however, does not seem to affect the general health of the patient, as it seldom happens that the secretion of semen is interrupted by such hardness. Stimulating applications to the scrotum near the epididymis will now and then prove serviceable in removing the hardness, and therefore may be tried; but often they will not be found to have any sensible effect in procuring its diminution.

SCROFULOUS TESTICLE.

The testicle is not so commonly affected with scrofula as many other glands; but it is sometimes wholly converted into a truly scrofulous mass, similar to the white curdy substance met with in diseased absorbent glands. At other times scrofulous inflammation takes place in spots, where this substance is deposited and mixed occasionally with pus. In scrofulous affections the testicle is enlarged, but the progress of the enlargement is

slow, and attended with but little pain: such enlargement often occurs and continues a long time, before the general health of the patient seems to suffer from it.

The scrofulous enlargement of the testicle will sometimes yield to the plan of treatment which is found to remove similar affections of other glands. In the Lectures of last season, I had the honour to name to the audience the principles on which the treatment of scrofulous swellings was recommended. This disease in the testicle will often cease at puberty; but both before and after puberty, it will sometimes terminate in suppuration; in other instances it will continue for life, without producing much bodily uneasiness to the patient. Sea-bathing is useful in swellings which are truly scrofulous.

The testicle sometimes becomes much enlarged, and converted into a pulpy uniform substance, in which its natural structure is entirely lost. This state of the gland, before the testicle has been removed, has been mistaken for scirrhus, but it is very different from that disease. The testicle is usually much larger than in scirrhus, it is also softer, and, when cut into, the membranous septa peculiar to scirrhus are not found. The disease rather appears to be a modification of the scrofulous than of the scirrhous action. But both of these affections may require removal by the

knife, and when there is any probability of the case being of a scirrhous nature, and the chord not diseased, such removal should be recommended. The extirpation of a scrofulous testicle will be attended with the most probable chance of success, because the disease does not return in the part from which the gland was removed. The most distinguishing marks between scrofula and scirrhus of the testicle are, the more regular shape and feel of the first, the want of the sharp lancinating pains shooting up the chord, and no swelling of the neighbouring absorbent glands usually attending it, even when it has become an open sore; whereas, when a scirrhous testicle becomes an open cancer, the absorbents and their glands are sure to participate of the disease.

SCIRRHOUS TESTICLE.

In scirrhus of the testicle, the disease sometimes appears as a mere simple enlargement and induration of the body of the testicle, without pain, and producing no inconvenience but that which arises from weight; and in this state it may remain for years: if extirpated and cut into, it will be found to be changed into a hard mass, more or less intersected with white membranous septa. In other instances, it soon becomes unequal and knotty on its surface, and acute lancinating pains

dart upwards from it: when laid open, cells of an irregular shape and size are found in it, containing a sanious fluid, and often being bounded by a cartilaginous substance. Sometimes a sanious fluid will be found in the thickened vaginal coat, which may give, when it first accumulates, the feel of a hydrocele; indeed, a scirrhous testicle is sometimes combined with hydrocele. In the progress of the disease, the epididymis and the spermatic chord become affected, so does the skin of the scrotum, which at last gives way, the whole forming a foul deep ulcer, with thickened and ragged edges, and sometimes throwing out a vascular and painful fungus. When the skin is affected, the absorbent glands in the groin begin immediately to enlarge; the patient becomes sallow, emaciated, and is worn out with the constant irritation and pain.

If the chord can be cut through in a part free from disease, to save the patient's life, the testicle must be parted with; but the operation for its removal should not be recommended, unless we are sure the whole can be extirpated without the knife coming into contact with an actually diseased part; for, if the operation cannot be performed, so that the knife shall divide none but the healthy parts surrounding the scirrhus, the disease will probably return. Notwithstanding this, in certain cases, some months of comfort may be given to a patient

by the removal of the testicle, who may, the chances of the return of the disease having been explained to him, choose to submit to the operation under less favourable circumstances.

FUNGUS HÆMATODES OF THE TESTICLE.

The disease described by Mr. Hey, of Leeds, under the above name, occasionally takes place in the testicles and scrotum. From the greater vascularity and consequent hæmorrhage that attends it, it has usually been considered as, and called, a soft bleeding cancer. Like cancer, it requires removal as soon as its nature is known; for it generally spreads rapidly, and is quickly communicated to the surrounding parts. A very good specimen of the disease, as affecting the testicle, is now before us, and the difference in appearance between it and cancer is manifest; but each goes on to destroy, so that early removal is to be recommended in both. In my friend Mr. Abernethy's publication on the Classification of Tumours, a clear and accurate account is given of this disease, under the head of Medullary Sarcoma. This affection is not confined to the testicle, but arises also in various other parts. The cases which Mr. Abernethy has published show the uncommon facility with which the disease is propagated along the absorbing vessels; and, as it spreads

both towards and from the heart, confirm the opinion that it extends itself by imparting irritation to the vessels, as well as, perhaps, by furnishing a matter which, if imbibed, may communicate the same irritation.

I have met with instances of the testicles being converted into masses of cartilage, and also of bone; but I know no means of altering the disposition of these parts to such morbid changes of structure.

ON IMPOTENCY.

Among the causes of impotency, one has been found from malformation of the epididymis: instead of passing on to the vas deferens, that tube has terminated in a cul de sac. I have preserved an epididymis of this kind in the collection in Windmill Street. In Dr. Hunter's Museum, and in our own Museum, similar malformations have also been preserved. John Hunter has published an engraving of this deficiency of natural structure in his Observations on the Animal Œconomy.

Dr. Baillie, in his Morbid Anatomy, has mentioned that he has known one case, in a person of middle age, where each of the testicles was not larger than the extremity of the finger of an adult; and this state of the testicles was attended with the total want of the natural propensities. I was

some years ago consulted by a gentleman, on the point of marriage, respecting the propriety of his entering that state, as his penis and testicles very little exceeded in size those of a youth of eight years of age. He was then six-and-twenty, but never had felt the desire for sexual intercourse until he became acquainted with his intended wife; since that period he had experienced repeated erections, attended with nocturnal emissions. He married, became the father of a family; and these parts, which at six-and-twenty years of age were so much smaller than usual, at twenty-eight had increased nearly to the usual size of those of an adult man. I mention this, I believe very singular case, as it will admit of question whether the parts alluded to became properly formed as to size, and possessed of the power of secretion, in consequence of being, although so late in life, influenced by the passions excited by attachment to a particular female; or whether the enlargement and proper action of the parts beginning, occasioned such passion first to exist. In the above case, the probability, I think, is in favour of the former supposition.

The testicles, like other parts of the body, may be shrunk or altered in structure, so as to become useless, either by immediate compression on their substance, or on the spermatic chords. Many instances of this kind of wasting of parts have been

met with. It is not usual, however, for any distinct structures of the body to disappear entirely, although from disuse, pressure, or other causes, they may much decrease in size. The thymus gland, which diminishes more than any other part, even in very old persons allows of some imperfect remains of its former existence to be found. But the testicles, enlarged from inflammation, have afterwards not only been reduced below their usual size, but have disappeared, so that no vestige whatever of their former existence has remained. John Hunter, in his Treatise on the Venereal Disease, has given an account of three cases in which this absorption of the whole testicle took place. I have never met with an instance of this kind. When such loss of one testicle occurs, the natural desires and powers are preserved; but when both testicles are lost, both desire and power must cease.

The disposition in the veins of the spermatic chord to become varicose, and the treatment which such affection requires, I have already mentioned in the first annual series of Lectures which I delivered in this theatre, among the diseases of blood-vessels. The testicle and its chord are liable also to other morbid alterations of structure, which cannot, however, be included in the present series of Lectures.

The vesiculæ seminales in the dead body have been found much thickened in their coats, and

adhering to other parts from the effect of inflammation. In some very few instances, abscesses have formed in their cavities, partial adhesion to confine the pus having taken place: they have also been found filled with scrofulous matter. They have, on some occasions, been discovered not to enter the urethra, but to terminate, after having been joined by the vasa deferentia, in imperforated pouches, or cul de sacs, producing complete impotence from such malformation. A vesicula seminalis of one side has been wanting; but the extremity of the corresponding vas deferens has become enlarged and tortuous. I have seen two cases of this kind.

Cowper's glands have, on some occasions, been known to inflame and form abscesses; but disease arising originally in them is far from being common. In dissections of these parts, particularly in elderly bodies, there is often much difficulty in distinguishing Cowper's glands from the condensed cellular substance which surrounds them.

Ulcers of the urethra, unless those which are brought on by violence, very rarely occur: I have, however, seen two or three instances, where several of the orifices of the lacunæ had gone into ulceration: they were in children under six years of age, whose bodies showed, in various places, marks of having been strongly affected with scrofula. When a chancre is met with in the urethra,

it will be found to have spread there from the glans penis.

Instances of malformation in the opening of the urethra are not very uncommon. Many diseased appearances will occasionally take place on the penis, which are the effect of specific diseases, and which, therefore, I do not include in the present series of Lectures. I shall here say nothing as to phymosis and paraphymosis: these may be the effects either of specific or common inflammation.

Before I conclude this sketch of the diseases affecting the male urinary and genital organs, I beg leave to call the attention of my audience to a subject which often is productive of more real distress to the mind of the patient than could be occasioned to the body by any active disease: I mean the supposition, that he is incapable of fulfilling the first great command, "Be fruitful, and multiply, and replenish the earth."

A person alarmed at the idea of impotency is most anxious to know if his suspicions are founded; but he dreads to enter on a proper inquiry, lest he should find them fully confirmed. He feels most reluctant to communicate such suspicions even to those medical friends, whose honour, in all other things, he would perfectly depend on, and whose professional talents he knew, and most highly estimated; from the fear, that his loss of manhood

would occur to their minds whenever he met them, or their presence would produce the recollection of it to his own.

This drives him to consult the writings of empirical authors. In some of these, and often with the appearance of much candour, he finds many of the symptoms which first alarmed him detailed, but mentioned only as precursors to others of a more terrible nature. His mind is absorbed in his own sufferings; this prevents him from perceiving in such descriptions that fear is intended to predominate, but that a distant hope is to be inspired that the case is not yet desperate. Instances of success, most speciously adapted to draw the frightened and interested reader into the toils, are then related; and either directly or indirectly, a cure, by means known only to the authors, is promised to those who personally consult them. In an evil hour, the reader becomes their patient: he does consult, and employs them, until he is sometimes drained of his last guinea; and is then left by them with a ruined constitution, and a mind bordering upon absolute insanity. If his circumstances should place him beyond the first of those misfortunes, the two last are almost sure to await him.

Some, with their eyes opened to the ignorance of such shameless impostors, cling still to the hope, that in their particular instances the pro-

mises of certain cure may be fulfilled; in fact, they dread to state their cases to other persons, from the additional fear, that their folly would be severely censured in having employed the first. When such patients do apply to honourable medical practitioners, it should always be remembered by those to whom the application is made, that they have to "minister to a mind diseased;" the complaints submitted to their consideration, however unfounded or light in reality, must not be heard with impatience, or treated with levity. I have known the commission of suicide the consequence of such injudicious treatment. It is the duty of a medical man to reason with a patient who will hear reason, and to demand confidence when the patient's mind is not open to conviction. Few people will be found so obstinate, as not to listen at last, to what will relieve them from misery and despondency, although at first they would rather receive and believe the unqualified promises of an ignorant quack, than the well considered and founded arguments of a regularly educated and experienced physician or surgeon.

There are some real causes of impotence, which arise from morbid action and alteration of structure. I have already mentioned instances of these; but impotence often depends on the mind of the patient.

When the parts of generation have been frequently affected by disease, they may become weakened either partially or generally. In perfect coition, the immediate and the secondary organs of generation should always act in consent with each other; but when weakened, they do not always do this. The penis sometimes acts without the testicle, and becomes erected when there is no desire, and no semen to be evacuated. When this erection takes place during an inflammatory state of the urethra or penis, it requires to be treated with cold applications, perhaps with the solutions of lead externally, and also with opium; the last may be given internally. When it arises without inflammation, it may be treated with bark, steel, camphor, electricity, the cold bath, and other tonics.

But it also sometimes happens, that the testicles shall secrete semen too quickly, and an evacuation of that fluid shall immediately take place without any erection of the penis, or perhaps a vrey imperfect one, and this without desire, or with it in a very limited degree. The patient shall sometimes be in that state, that ideas when awake, and dreams when asleep, will produce an evacuation of semen frequently in a very short space of time; indeed, the testicles will sometimes become so irritable, that any motion, such as walking, riding, or even the linen rubbing against

the glans penis, will produce an evacuation of imperfectly formed semen; and this so often, that it shall at last take place without the constitution being sensible of it, or the usual spasm being felt. This state requires the use of tonic medicines, and sea-bathing. Opium at night, with camphor rubbed upon the perinæum, is often useful; and the patient's mind should be strongly impressed that by this treatment his disease will admit of cure.

In respect to impotence produced by the mind, the observations and reasoning of John Hunter on this point are so excellent and so conclusive, that they should be carefully studied, and perfectly understood, by every member of our profession. For reasons which cannot but be obvious to the whole of my audience, the closet must be much better adapted to the study and comprehension of this subject than a public theatre. John Hunter's observations, to which I refer you, will be found from the 201st to the 208th page of his Treatise on the Venereal Disease. It should always be remembered, that the whole of the means of cure, either of real or imaginary complaints, are not confined to the exhibition of medicines, or external applications, or the performance of operations; and that we should endeavour to know, and use all the means which our

reason and experience may convince us are adapted to the patient's case. In the truly distressed state of the person's mind, from supposed impotency, a few minutes should be devoted to give the patient a true view of his situation, and to explain to him the real cause of failure, by proving to him that the perfect accordance of the mind and the body are necessary to the act, and that his very desires, doubts, and apprehensions are the causes of his failure. We may be certain, that more favourable results will attend such friendly and confidential communications, than any medicine, or any other medical treatment, could effect.

In concluding the Surgical Lectures of the present season, I may be permitted to remind my audience, that the Lecturer in this theatre is placed in a very distinct situation from an author who volunteers a dissertation on a particular subject, on which he professes to give information unknown before. My well-informed and much-respected colleague has lately observed to you, that no Professor could be supposed annually to supply suffi-

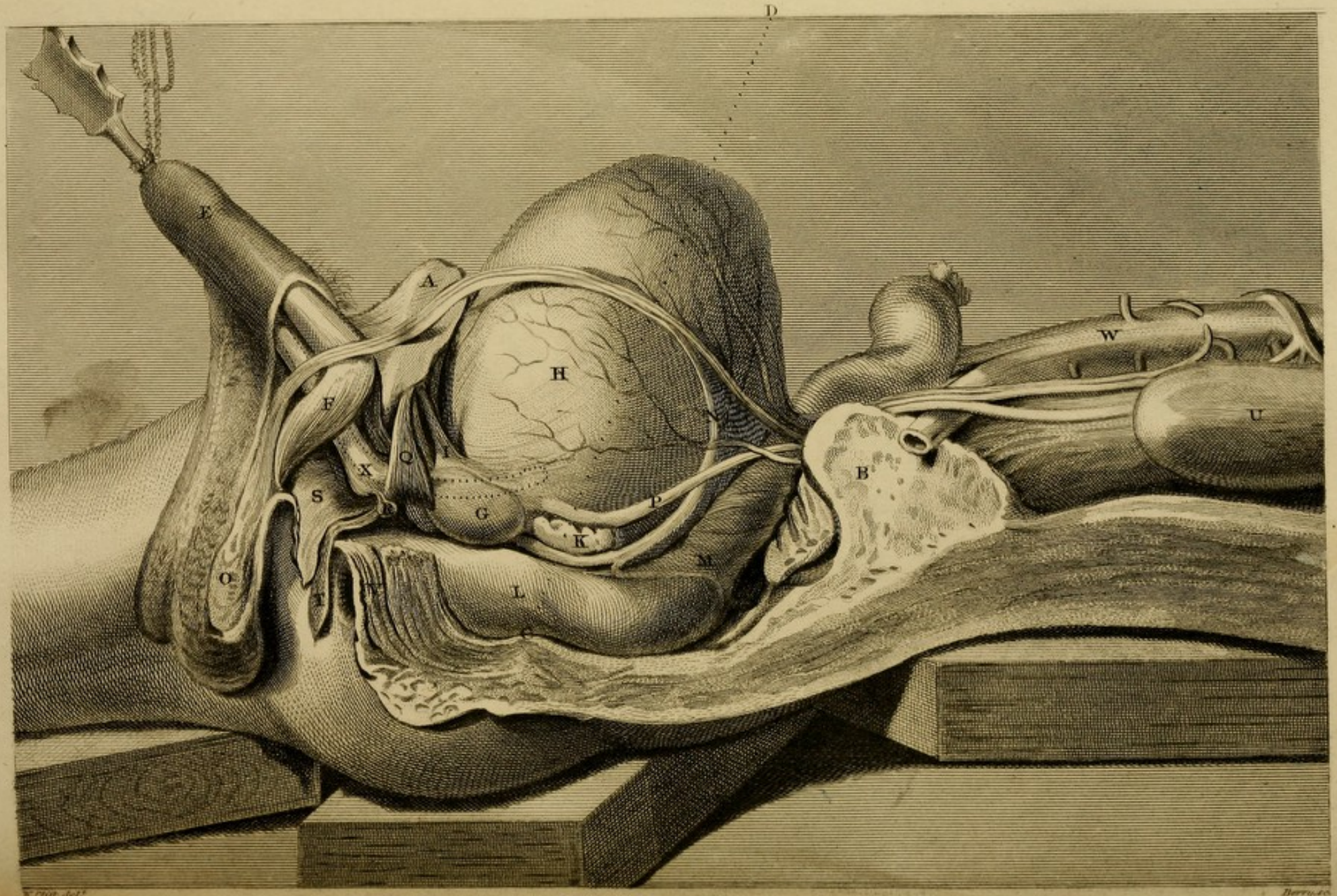
cient new matter to fill up fifteen Lectures; and I have formerly stated, that my conception of the duties of the Professor is, that he should collect information from all channels on those subjects on which he proposes to treat; and that he should communicate such information in the most concise, best arranged, and clearest manner he can to his audience.

The nature of calculous concretions has been lately much attended to; and the specimens in our Museum have often been referred to in various publications. I considered it this year as a part of my duty to bring these specimens publicly before you. For much of the information which I have attempted to deliver, particularly in what regards the chemical properties of such concretions, I have been indebted to the labours of those meritorious authors, to whose works I have repeatedly referred. In mentioning the discoveries of such authors, or in reasoning on such discoveries, I have altered as little as circumstances would permit, the very language which they have themselves used: I now publicly state this, that I may be exonerated from any supposed wish to appropriate to myself their just claims to honourable distinction and well-deserved fame.

In concluding the forty-fifth Lecture which I have delivered in this theatre, I beg to offer my

sincere thanks to you, Sir*, and this most respectable audience, for the attention with which I have been honoured in my attempts to fulfil those duties which have been assigned me by the College.

* Sir William Blizard, who was then in the Master's chair.



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EXPLANATION

OF

PLATE I.

A Side View of the Pelvis.

A. The Symphysis of the Pubes.

B. The Os Sacrum where it forms the Joint with the Os Ilium.

C. The Apex of the Os Coccygis.

D. A dotted Line drawn through the Axis of the Cavity of the Pelvis, showing the Obliquity of the Cavity in the erect Position of the Body, the line in such position approaching nearer to a horizontal than a perpendicular direction.

E. The Penis, having a Staff introduced along the Urethra to the Bladder.

F. The left Crus of the Penis, detached from the left Ilium and Pubes, and turned to one Side.

G. The prostate Gland; the dotted Lines marking the Course of the Urethra through it.

H. The Bladder, partially distended.

I. The Ligamentum inferius Vesicæ, or tendinous Attachment of the Bladder to the Pubes.

K. The left Vesicula seminalis.

L. The Rectum.

M. The Peritonæum: the Reflexion of that Membrane from the Bladder to the Rectum is seen.

N. The left Vas deferens.

O. The Testicle in the Scrotum.

P. The Ureter.

Q. The Compressores Urethræ Muscles surrounding and attaching the membranous Portion of the Urethra to the Symphysis of the Pubes. The introduction of the staff has thrown these muscles on the stretch.—Vide Lecture VI. p. 167.

R. Cowper's Glands.

S. The Accelerator Urinæ Muscle detached from the Bulb of the Urethra.

T. The transversalis Perinæi Muscle detached from the Ischium.

V. The Sphincter Ani Muscle, and Part of the Levator Ani.

U. The left Kidney.

W. The Aorta.

X. The Bulb of the Urethra. The dotted lines continued through the membranous portion of the urethra and prostate gland, mark the passage of the staff.

Z. The spermatic Artery and Vein.

PLATE II.

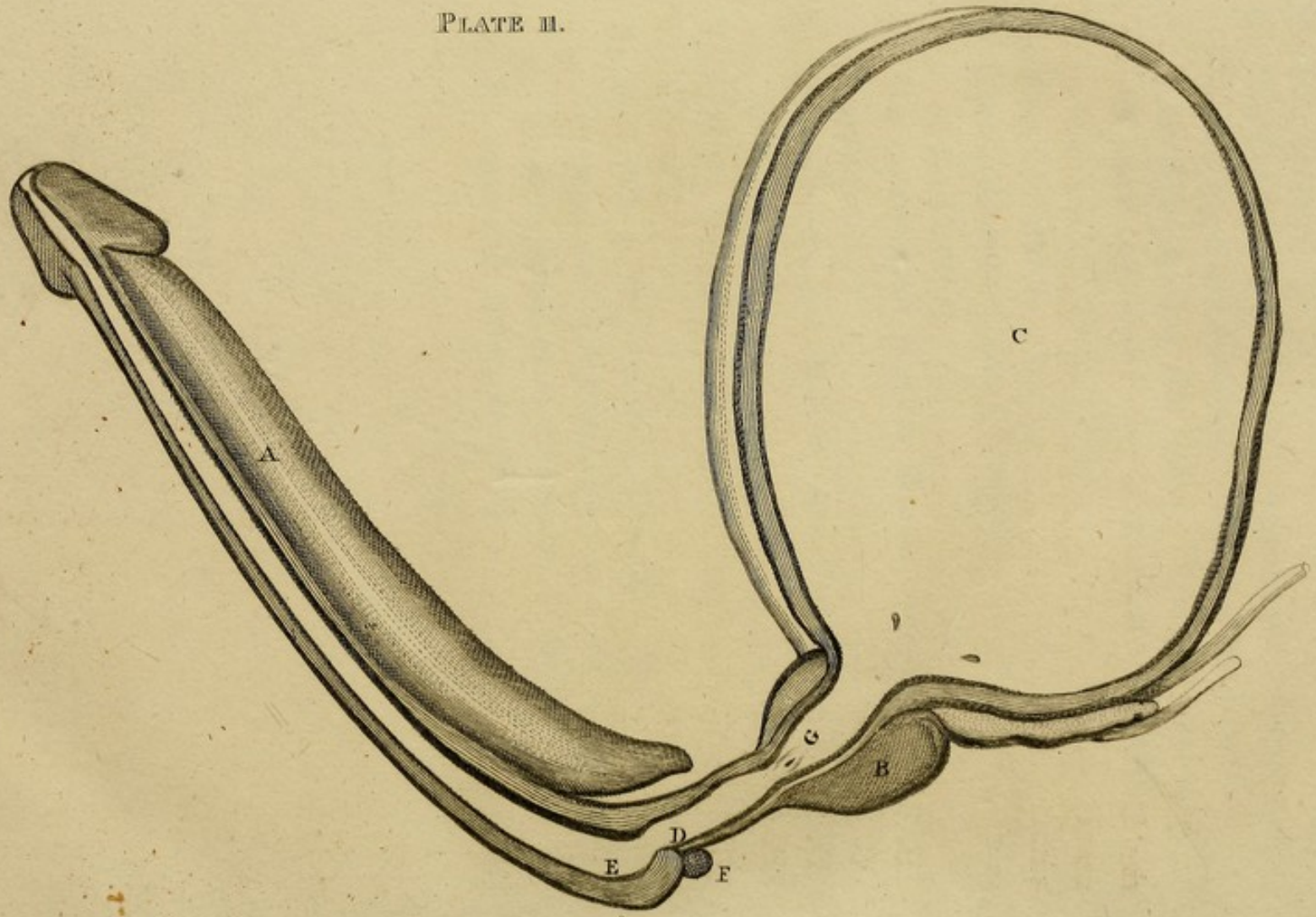

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PLATE II.

The intention of this Sketch is to show the Course of the Urethra, and to mark the variations in the size of the canal in different parts of its course. The engraving is rather less than one half of the natural size of the parts in an adult. It is referred to in Lecture IV. p. 145.

A. The Penis.
B. The prostate Gland.
C. The Bladder.
D. The membranous Portion of the Urethra.
E. The Sinus of the Bulb of the Urethra.
F. Cowper's Gland.
G. The Caput Gallinaginis.

PLATE III.

Fig. 1.

Represents the Penis of a healthy young Man who was executed for Murder: it shows the muscular Fibres adhering to the outer Circumference of the inner Membrane of the Urethra formed into Packets.—Vide Lecture IV. p. 149.

A. The Urethra slit open.

B. Packets of muscular Fibres.

C. The Lacunæ of the Urethra.

Fig. 2.

The partial Contraction of the inner Membrane of the Urethra forming a spasmodic Stricture. The two dotted lines A and B mark the extent of the stricture. — Vide Lecture XI. p. 364.

THE END.

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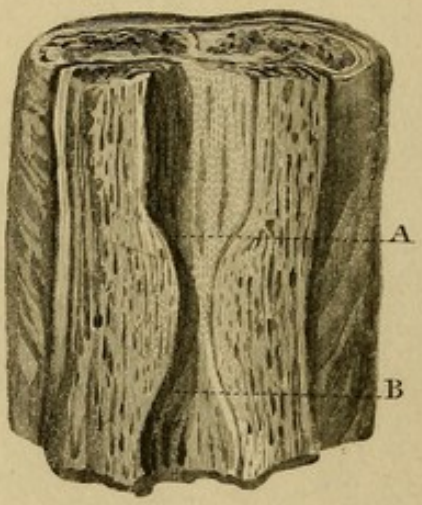
PLATE III.

Fig: 1.

Fig: 2.



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